Sex Differences in Attributional Style, Self-Efficacy, and Academic Achievement in Mathematics

by

Jennifer Elizabeth Victoria Lloyd

B.Sc., University of Victoria, 1998

A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of

MASTER OF ARTS

in the Department of Educational Psychology and Leadership Studies.

We accept this thesis as conforming to the required standard.

[redacted]

Dr. John Walsh, Supervisor
(Department of Educational Psychology and Leadership Studies)

[redacted]

Dr. John Anderson, Departmental Member
(Department of Educational Psychology and Leadership Studies)

[redacted]

Dr. Leslee Francis-Pelton, Outside Member
(Department of Curriculum and Instruction)

[redacted]

Dr. Nancy Galambos, External Examiner
(Department of Psychology)

Supervisor: Dr. John Walsh

ABSTRACT

The purpose of the current study was to provide a further test of the claim that sex differences in mathematics achievement are due to boys' and girls' differing achievement-related beliefs (Stipek & Gralinksi, 1991). 161 students participated in the study (62 fourth-graders, 99 seventh-graders). Boys' and girls' mathematics report card grades, achievement on the 2001 Foundation Skills Assessment Numeracy subtest, performance attributions, and perceptions of self-efficacy were compared. Results revealed that girls' report card grades were significantly higher than those of boys, whereas boys' and girls' achievement on the 2001 Foundation Skills Assessment did not differ significantly. While results show relative gains for girls in attributional thinking, girls were significantly more apt to display underconfidence relative to their actual mathematics achievement and to attribute mathematics failure to a lack of teachers' help than were boys. Suggestions for future research are presented.

Examiners:

[redacted]

Dr. John Walsh, Supervisor
(Department of Educational Psychology and Leadership Studies)

[redacted]

Dr. John Anderson, Departmental Member
(Department of Educational Psychology and Leadership Studies)

[redacted]

Dr. Leslee Francis-Pelton, Outside Member
(Department of Curriculum and Instruction)

[redacted]

Dr. Nancy Galambos, External Examiner
(Department of Psychology)

Table of Contents

List of Tables

Acknowledgements

This thesis represents the efforts of many special people. I would first like to extend my gratitude to John Walsh for his friendly guidance, for being so generous with his time, and for being an overall terrific supervisor. Thanks also to the other members of my thesis committee - John Anderson, Leslee Francis-Pelton, and Nancy Galambos - for their friendly input and assistance.

I would like to recognise various teachers and principals in the participating school district that kindly allowed me into their classrooms in order to conduct my research: Sharon Anderson, Doug Archibald, Paul Bendall, Jim Cambridge, Daphne Churchill, Martin Conder, Pat Cownden, Tom Cullen, Deanna Craddock, Paul Drummond, Bob Ennis, Jim Gauley, Darlene Hagel, Bob Hatcher, Duane Kinshella, George Kruse, Carole Mackenzie, Annette McKellar, Freda Morgan, Shirley Myers, Leon Politano, John Rizzuti, Linda Turnbull, Joan Vivian, and Gary Wong.

Special thanks to the students for their interest and enthusiasm. Extra special thanks to David Drummond, district superintendent, and to Janice Fougler, his secretary, whose patience and kindness were ever-present, despite my many phone calls and emails.

Thank you to Manizheh Shehni for her helpful suggestions and for assisting me with pilot testing, and to Stephanie Versteege for kindly helping me to prepare for my defense. Thanks also to my team of undergraduate volunteers, Jackie Barone, Kate Blackmore, Marttine Doyle, Erin Favell, Corrine Lowen, Lindsay Mathieson, and Kristin Smirfitt, for their first-rate assistance.

I would also like to extend my gratitude to various former and present employees of the Ministry of Education's Student Assessment and Program Evaluation (SAPE) and

Data Management and Student Certification (DMSC) Branches for their time and efforts: Baljinder Bains, Tom Bennett, Jim Gaskill, Dean Goodman, Nita Lalli, Colleen Turner, and especially Pat McCrea and Caroline Ponsford.

Finally, I would like to express my gratitude to my parents, Janet and Kelvin Lloyd, for a lifetime of love and encouragement and for always believing in me. Thanks also to Chris Scott for his love and friendship. I love you all very much.

Veni, vidi, vici!

- J.L.

Sex Differences in Attributional Style, Self-Efficacy, and Academic Achievement in Mathematics

CHAPTER 1

Introduction

Sex differences in academic achievement have been the subject of extensive investigation over the past two decades (Fan & Chen, 1997; Kianian, 1996). In the past, research has shown that boys' achievement in mathematics surpasses that of girls. The typical explanation given for such achievement differences is that there are sex differences in achievement-related beliefs (Stipek & Gralinski, 1991) and that, more specifically, boys and girls tend to make different inferences about the causes of their performance and to hold different perceptions of their academic abilities.

The inferences people make about the causes of their successes and failures are called attributions. Generally, people ascribe the causes of their academic performance to either internal factors (e.g., ability, effort, traits, and dispositions) or external factors (e.g., luck, task ease, and help from teacher). Whether one attributes the causes of behaviour to internal or external factors is referred to as one's "locus of causality" (Weiner, 1986). According to Basow and Medcalf (1988), whether students ascribe their performance to internal or external factors affects their self-esteem, expectancies for success, and task achievement.

An attributional pattern in which a person ascribes his or her successes to internal factors and failures to external factors has long been thought to be beneficial academically and important in explaining success (Schunk & Gunn, 1986). Murray and Warden (1991) stated that if a student has the ability to perform a task, "an attributional

pattern in which he or she internalizes success and externalizes failure is adaptive and constructive" (p. 25). According to Glasgow, Dornbusch, Troyer, and Steinberg (1997), a functional attributional style is one in which students make ability or effort attributions for task successes and make effort attributions following task failures. Conversely, they defined a dysfunctional attributional style as one in which students "make external attributions for either task success or failure, or attributions to low ability following failure" (p. 510). Furthermore, Weiner (1979) reported that if a student perceives that success is caused by ability, then competence and confidence is experienced. It is worth noting that although ability and effort are both internal attributions, it is preferable for an individual to attribute success to ability rather than to effort. This is because ability attributions lead to higher motivation, self-efficacy, and skill development than do effort attributions (Schunk & Gunn, 1986). Conversely, it is generally agreed that it is preferable for students to attribute failure to lack of effort rather than to a lack of ability (Graham, 1991).

Research shows that girls tend to attribute their academic successes to external factors and effort (e.g., Lightbody, Siann, Stocks, & Walsh, 1996) and their failures to their own lack of ability. Thus, females tend to take personal responsibility for their failures, but not for their successes (Li & Adamson, 1995). Conversely, boys tend to ascribe the causes of their mathematics successes to internal factors and their mathematics failures to external factors. Girls' self-defeating attributions and boys' self-enhancing attributions for academic performance have been thought to explain girls' traditionally poorer mathematics achievement compared to that of boys.

Sex differences in academic achievement have also been related to boys' and girls' differing perceptions of their ability. According to Bandura's (1986) social cognitive theory, self-efficacy beliefs play a central role in promoting human motivation and action. Self-efficacy refers to judgements persons make about their ability to perform behaviours at a certain level (Schunk, 1984). The perceptions students hold about themselves and about their academic competence help determine what they do with the knowledge and skills they possess (Pajares & Valiante, 1999), and are shown to influence their choice of activities, effort expended, task persistence, and task accomplishments (Schunk & Gunn, 1986). Self-efficacy beliefs are powerful enough that it is possible for students who have similar ability but different perceptions of self-efficacy to demonstrate different academic attainments (Pajares & Valiante, 1999). Individuals interpret the results of their experiences and, consequently, "the influence of powerful determinants of academic performances – such as knowledge, skill, or the results of prior attainments – on subsequent performance is mediated by the beliefs that result from such interpretations" (Pajares, 1996b, p. 325). Pajares (1996a) argues that enhanced feelings of self-efficacy encourage feelings of serenity in approaching difficult tasks and activities, whereas low feelings of efficacy may lead individuals to believe tasks are tougher than they really are, and stress and depression may result. As such, he claims that self-efficacy beliefs "are strong determinants and predictors of the level of accomplishment that individuals finally attain" (p. 545). A large quantity of research has found differences in males' and females' perceptions of their mathematics self-efficacy, and that these different perceptions relate to girls' relatively lower mathematics

performance (e.g., Junge & Dretzke, 1995) and lower participation rates in mathematics-related careers (Eccles, 1987; Eccles, 1994; Otto, 1991).

The current study is precipitated by recent findings that show a closing of the mathematics achievement gap between the sexes (e.g., Marsh & Yeung, 1998). Contrary to prior research, a growing number of studies show that girls' achievement in mathematics meets or exceeds that of boys (e.g., Brandon, Newton, & Hammond, 1987). For example, British Columbia's Ministry of Education (2000) found negligible sex differences in fourth-, seventh-, and tenth-grade students' performance on the 2000 Foundation Skills Assessment Numeracy subtest.

The purpose of the current study is to provide a further test of previous researchers' claims that sex differences in academic achievement are due to boys' and girls' differing perceptions of self-efficacy and performance attributions. If achievement differences are in fact due to students' self-efficacy and attributions, then one would expect that boys' and girls' self-beliefs are the same when their academic achievement is also the same. Therefore, this study will help determine if the recent academic gains made by girls in mathematics have been met with heightened feelings of self-efficacy and more self-enhancing performance attributions. If the results show that girls' academic gains have not produced commensurate gains in achievement-related beliefs, then it is unlikely that the achievement gains will increase girls' participation in advanced mathematics courses or mathematically-oriented careers (Pajares, 1996b).

CHAPTER 2

Review of the Literature

In this chapter, a review of related literature is presented. First, past and recent studies of sex differences in mathematics achievement are discussed. Second, literature exploring the general relationship among students' attributions and their academic achievement is examined. Third, studies concerning sex differences in students' attributional patterns are presented. Fourth, the relationship between students' self-efficacy and academic achievement is discussed. Finally, research focussed on sex differences in students' perceptions of mathematics self-efficacy is offered.

Sex Differences in Mathematics Achievement

Prior research findings. As mentioned at the outset, prior research on mathematics achievement has shown large and consistent differences in the academic performance of boys and girls in favour of the former. In their landmark work, Maccoby and Jacklin (1974) explored the similarities and the differences between the sexes in various areas of psychological functioning. Their aim was to determine which sex differences have solid bases rooted in fact and which do not (Maccoby & Jacklin, 1974). As part of this research, the authors investigated the specific intellectual abilities of the sexes. While they found no evidence of sex differences in quantitative abilities during the preschool and early school years, they did conclude that, when sex differences exist during adolescence, they typically favour boys. Furthermore, the authors argued that after the ages of 9 to 13 years, boys' quantitative abilities surpass that of girls. It should be noted, however, that Maccoby and Jacklin cautioned that there can be "great variation in the degree of male advantage" (Maccoby & Jacklin, 1974, p. 85).

In a more recent study, Bradberry (1989) investigated sex differences in mathematics achievement because of his "great concern that girls are underparticipating and underachieving in external mathematics examinations within a system of education with so-called 'equal opportunities'" (p. 313). As such, he compared students' scores on a 1986 mathematics assessment test to the similar scores of students assessed over a decade earlier. The results revealed that boys' scores were significantly higher than those of girls. He concluded that, despite actions to achieve sex equality in the schools, the achievement gap between boys and girls had persisted over a thirteen year period, and that girls continued to struggle particularly in areas of scale or ratio concepts, spatial problems, space-time relationships, and probability - as they had in the study conducted a decade earlier. Bradberry suggested further that teachers need to be more aware of sex differences in achievement in general and, more specifically, that educators attempt to teach mathematics lessons in an "unbiased manner".

Various researchers have found that sex differences in mathematics achievement persist across grades. For example, Randhawa and Hunt (1987) examined sex differences in the standardised achievement scores and mathematics skills of fourth-, seventh-, and tenth-grade students, and found that boys generally outperformed girls in quantitative tasks. Wentzel (1988) explored sex differences in the mathematics and English performance of students as they progressed from Grade 6 to Grade 12 . She predicted that girls' mathematics and English achievement test scores would decline through the years. Conversely, she predicted that boys' performance in both subjects would remain stable. The results supported her hypotheses. Randhawa's (1991) research, in part, involved investigating the presence of sex differences in mathematics achievement in a

sample of approximately 10,000 fourth-, seventh-, and tenth-grade students, from 1978 to 1985. In that time, the mathematics achievement of fourth-grade girls improved. Seventh-grade girls' achievement advantage in the first year of the study decreased significantly by the study's conclusion. Tenth-grade boys outperformed females - a trend that persisted through the seven years of this study.

Recent research findings. A number of studies conducted within the last decade report that the mathematics achievement gap between the sexes has closed. Aksu (1997), for example, sought to determine how students comprehend the meaning of fractions, and how they perform computations and word problems with fractions. Turkish students were administered fractions tests that had a concept component, an operations component, and a problem-solving component. Aksu investigated the relationship between sex and fractions performance, and detected no statistically significant relationship. In an Australian study, Marsh and Yeung (1998) investigated the school grades, standardised test scores, academic self-concept, affect, and coursework selection of nearly 25,000 students over three waves of data collection. Data were first collected in 1988, and the second and third waves of data collection occurred two and four years later, respectively. All students were in the eighth grade at the time of the first data collection. The results, in part, revealed that girls' mathematics scores were higher than those of boys, although it should be noted that girls exhibited relatively lower mathematics self-concepts. These data also showed gains for girls in achievement and coursework selection for mathematics over the waves of the study.

Various researchers have performed meta-analyses in order to summarise and compare the mathematical achievement of boys and girls. Hyde, Fennema, and Lamon

(1990), for example, conducted a meta-analysis of 100 studies that dealt with sex differences in mathematics performance. Numerous findings stemmed from the research: (a) there was only a nominal achievement gap and this gap tended to decline over school years; (b) sex differences were smallest and actually favoured females in samples of the general population, grew larger with increasingly selective samples, and were largest for highly selective samples (e.g., students with exceptional mathematical precocity) and samples of gifted students (Hyde, Fennema, & Lamon, 1990); (c) girls outperformed boys in the areas of computation in elementary school and middle school; (d) despite this fact, there were no sex differences in problem solving until high school and college, where males began to show higher performance; and (e) sex differences in achievement had declined over the years. Overall, the researchers (1990) found little empirical support for Maccoby and Jacklin's (1974) global conclusions that boys' mathematical abilities tend to surpass that of girls. They did suggest, however, that future research examine females' lower performance in problem solving. Friedman (1989) also performed a meta-analysis of studies conducted between 1974 and 1987 on sex differences in mathematics performance. The results showed that the mathematics achievement gap between the sexes had decreased during the period of the review.

Recent studies involve an examination of sex differences in mathematics achievement across ages. Feingold's (1993) research involved a comparison of performance trends in achievement, by age, on the Wechsler Intelligence Scales (1949-1981) and the California Achievement Tests (1956-1985). He found that childhood sex differences were small or non-existent in the Wechsler and CAT norms from 1949-1985. Over time, the achievement gap narrowed over the years among adolescents. In

adulthood, however, sex differences emerged on the Wechsler scales. Similarly, Skaalvik and Rankin (1994) examined whether there were sex differences in sixth- and ninth-grade Norwegian students' mathematics achievement. The results did not reveal any significant sex differences in achievement. It should be noted that boys' mathematics self-concept and self-perceived skill was higher than that of girls. One component of Hall, Davis, Bolen, and Chia's (1999) research involved an examination of sex differences in the mathematics performance of fifth- and eighth-grade students. Mathematics performance was assessed by scores on the math-concepts and math-computation sections of the California Achievement Test. The authors discovered no significant sex differences in performance. It is noteworthy that the authors wondered if their lack of significant sex differences may be a result of their assessment of only fifth- and eighth-grade students. They implied that sex differences in achievement may exist among students in higher grades. Tartre and Fennema's (1995) research involved the investigation of mathematics achievement of boys and girls progressing from Grade 6 to Grade 12. Despite their discovery that students stereotyped mathematics as a male domain, no sex differences in spatial, verbal, or mathematics skills were found. Results of British Columbia's 2000 Foundation Skills Assessment revealed that fourth-, seventh-, and tenth-grade girls' numeracy achievement did not differ significantly from that of boys (Ministry of Education, 2000).

A number of researchers have discovered, despite the closing of the traditional achievement gap between the sexes, girls continue to enrol in fewer mathematics courses. Hyde (1993) reported there are no sex differences in mathematics "except in problem solving beginning in high school, and the issue there may be not lack of ability but failure

to continue to take mathematics courses" (p. 247). As such, she suggested that, rather than conduct further research on students' abilities, future research should focus on the issue of sex differences in course taking. Callas (1993) sought to ascertain how the overall mathematics achievement of females at a particular college and the proportion of female students enrolled in mathematics classes changed over time. Records of students' achievement in elementary algebra, college algebra, precalculus and calculus in 1970, 1975, 1980, 1985, and 1990 were collected. The results showed that females' achievement generally surpassed that of males. Callas also discovered that, although the proportion of females attending the college had increased over time, the percentage of females enrolled in precalculus and calculus in the last fifteen years of the study had decreased and remained significantly below the proportion of females enrolled at the college (Callas, 1993).

Increasingly, researchers are discovering that girls' mathematics achievement not only meets that of boys, but that girls' achievement may even exceed that of boys. Bulcock, Whitt, and Beebe (1991) found that tenth-grade females outperformed boys in every school subject except for physics. Kianian (1996) investigated sex differences in college students' performance of a general mathematics course that included such topics as introductory algebra, intermediate algebra, college algebra, principles of statistics, and finite mathematics. The researcher collected the general mathematics course grades for students over a four-year period, and found that females' mean semester grades were slightly higher than males in every subject except for finite mathematics (although these differences were not statistically significant).

Brandon, Newton, and Hammond's (1987) research stemmed from a number of studies (e.g., Brenner, 1984a; Brenner, 1985b; as cited in Brandon, Newton, & Hammond, 1987) that have shown sex differences in the mathematics achievement of Hawaiian students. Their objectives were (a) to determine if there were sex differences in the mathematics achievement of fourth-, sixth, eighth-, and tenth-grade Hawaiian students of Caucasian, Filipino, Hawaiian, and Japanese ethnicity; (b) to provide further information about the differential performance of boys and girls on a variety of mathematical tasks; (c) to further investigate sex differences in the mathematics achievement of gifted students; (d) to explore the effect of sociocultural variables on sex differences in mathematics achievement; and (e) to present various consequences of the sex differences in mathematics. Their results revealed that (a) girls outperformed boys in 76 of the 80 comparisons made between the sexes; (b) boys' highest achievement was found in the area of mathematics reasoning, whereas girls' highest scores were found in computation problems; (c) gifted girls' achievement surpassed that of gifted boys; (d) sex differences in mathematics achievement were smallest among Caucasian students; and (e) sex differences in the mathematics achievement of grade-school students may lead to similar differences in adulthood, which can, in turn, result in sex differences in the mathematics training and career choices of Hawaiian boys.

In summary, research has traditionally demonstrated a mathematics achievement gap between the sexes in favour of boys. Recent studies indicate that this gap has now closed and may, in fact, favour girls. In the next section, the relationship between students' attributions and their academic achievement is explored.

Attributions and Academic Achievement

As mentioned at the outset, sex differences in academic performance have been ascribed to boys' and girls' differing achievement-related beliefs. Attributions, or the inferences one makes about the causes of one's successes and failures, are examples of such achievement-related beliefs (Graham, 1991; Weiner, 1986).

A large quantity of attribution research involves an examination of the relationship between students' attributions and their achievement in mathematics and in the language arts. For example, one of Georgiou's (1999) objectives was to measure the achievement attributions in mathematics and the languages of sixth-grade students. More specifically, he sought to determine if children's achievement attributions were related to their academic achievement. It was found that children's attributions of achievement to effort, to ability, and to other internal factors were related positively to academic achievement. Conversely, attributions to luck and to external factors were related negatively to achievement. Georgiou also found that females attributed their achievement to effort more than males did. As well, low-achieving students tended to attribute their performance to external factors, whereas high-achievers tended to ascribe their performance to effort and other internal attributions. Schunk and Gunn (1986) investigated how task strategies and success attributions during mathematics training affect students' feelings of self-efficacy and skills. Participants were children who lacked division skills and, as such, were given assistance in solving problems. Children who attributed their problem-solving success to ability also showed enhanced feelings of self-efficacy. These feelings of self-efficacy, in turn, promoted children's mathematics achievement. Shell, Colvin, and Bruning (1995) explored grade- and achievement-level differences in fourth-, seventh-, and tenth-grade students' control-related beliefs and

relations between students' beliefs and their reading and writing achievement. They found that students' beliefs significantly predicted their achievement. In particular, when compared to low achievers, high achievers showed higher self-efficacy and made fewer attributions to luck, task ease, and help from the teacher in explaining their success.

Some researchers have compared students' attributions to their academic achievement in other domains, as well. Glasgow, Dornbusch, Troyer, and Steinburg (1997) examined the relationship among students' attributional styles and their classroom engagement, homework, and academic achievement in a variety of subjects. They found that students who had dysfunctional attributional styles (i.e., where students make external attributions for task success or failure, or attributions to low ability for failure) were associated with reductions in all three educational outcomes (i.e., classroom engagement, homework, and academic achievement). Sweeney, Moreland, and Gruber (1982) investigated sex differences in attributions for success or failure in a psychology course. They hypothesised that female participants would make more external attributions for their performance. The results revealed that successful participants, regardless of sex, made internal attributions regarding their performance, and were pleased with their performance. It is worth noting that, contrary to traditional attribution research, unsuccessful females ascribed their performance to external causes and unsuccessful males made internal performance attributions.

In summary, research has been presented that demonstrates that students' attributional styles relate to their academic achievement. More specifically, an attributional style in which students ascribe their success to internal factors and failures to external factors is shown to be beneficial academically and important in explaining

success. In the next section of this paper, literature focussed on sex differences in attributions is explored.

Sex Differences in Attributions

Research shows that girls tend to attribute their mathematics successes to external factors and effort and their mathematics failures to their own lack of ability. Thus, females tend to take personal responsibility for their failures, but not for their successes (Li & Adamson, 1995). Conversely, boys tend to ascribe the causes of their mathematics successes to internal factors and their mathematics failures to external factors. Girls' self-defeating attributions for their performance in mathematics have been thought to explain their traditionally poorer mathematics achievement compared to that of boys.

Typically, researchers have studied sex differences in attributions within the domains of mathematics or English. For example, Leung, Maehr, and Harnisch (1996) examined the relationship between secondary school students' sex and their motivational orientations for the language arts. Their findings revealed that girls attributed their failure in coursework to a lack of ability and to a lack of effort more than boys did. It should be noted that girls tended to attribute their successes to internal factors, as well. These findings imply that girls seem to have a "stronger sense of personal responsibility for school achievement" (p. 27).

Hackett and Campbell (1987) investigated the consequences of participants' success or failure at completing anagrams - a task the researchers believed to be sex-neutral. They found that students' self-efficacy and task interest declined as a result of task failure. Furthermore, self-efficacy ratings increased as a result of success. While there were no significant sex differences in students' self-efficacy, females who

experienced success attributed their performance to luck significantly more than males did. Similarly, females who experienced failure were significantly more likely than males to ascribe the cause of their failure to inability.

Some researchers have investigated sex differences in attributions in other academic domains, as well. Beyer (1998/1999) studied the causal attributions and the emotions for imagined success and failure on examinations of college students. The researcher asked students to imagine receiving either an A or an F in any course they required for their college graduation. Beyer asked students to report the causes for their imagined grades and to describe the emotions they felt after success or failure. It was found that male students ascribed their success to ability more frequently than females did. Conversely, female students believed studying and paying attention were important reasons for their success. Male students tended to blame failure on a lack of studying and low interest, whereas female students were more likely than males to blame their failure on a lack of ability. Beyer also found that females felt happier than did males for their success, but felt more like a failure than did males after imagining academic failure. Ryckman and Peckham (1987) investigated sex differences in students' attributions for success and failure across various subject areas. In the area of language arts, both boys and girls tended to display functional attributional patterns. In mathematics and science, however, girls displayed a more learned-helpless pattern of attributions. According to the authors, a learned-helpless attributional pattern is one in which an individual ascribes success to unstable factors (e.g., effort) and failure to stable factors (e.g., ability). Lightbody, Siann, Stocks, and Walsh (1996) studied students' enjoyment of school, enjoyment of various subjects, and the attributions they made for academic success.

Girls tended to enjoy school more, liked friends, teachers, the languages, history, drama and music more than boys did, whereas boys liked sports, school clubs, science, informational technology, and craft and design technology more than girls did. As well, girls tended to attribute their academic success more to hard work and how much teachers liked them, while boys tended to attribute their success to cleverness, talent and luck. It is worth noting, however, that differences in attributions for academic success varied more with age than with sex.

Chandler, Shama, and Wolf (1983) examined participants' attributions for success and failure in both achievement and affiliation domains across cultures. Their goal was to evaluate whether sex differences in attributions are linked with participants' cultures. As such, participants from India, Japan, South Africa, Yugoslavia, and the United States took part in the study. Males' and females' attributions to ability, effort, task, and luck, and overall "internality" were compared. "Students' overall internality was obtained by summing the attributions for ability and effort (both internal) and subtracting those for task and luck (both external)" (Chandler, Shama, & Wolf, 1983, p.247). They discovered significant differences between males and females regardless of their nationality for achievement attributions to task and for the internal/external dimension. It is noteworthy to state that the attributions to ability, effort, and luck did not differ significantly between the sexes.

A great deal of research has focussed specifically on the relationship between students' sex and their attributions for their mathematics performance. Stipek and Gralinski (1991), for example, investigated sex differences in students' achievement-related beliefs and emotional responses to success and failure on a mathematics

examination. The researchers had several hypotheses, which included four pertaining to attributions: (a) girls, as compared to boys, would ascribe success less to high ability and would ascribe failure more to low ability; (b) ability attributions for success would be associated with greater pride, higher expectations for future mathematics performance, and an increased desire to seek out future mathematics achievement opportunities; (c) ability attributions for failure would be associated with increased shame and a greater desire to avoid future mathematics achievement opportunities; and (d) external attributions would diminish pride in success and shame in failure. Each of the participants was asked to join one of two groups: the "poor outcome" group (those who believed they had done poorly on the examination) or the "good outcome" group (those who believed they had done well). More girls than boys placed themselves in the "poor outcome" group, although the sex difference was not significant. There was a strong association between students' subjective and objective marks. The "poor outcome" group earned a C-/D+ average on the examination, whereas the "good outcome" group earned a B+ average. The authors determined that boys attributed good outcomes to ability significantly more than girls, and girls attributed poor outcomes more to a lack of ability than boys did. In other words, girls' achievement-related beliefs were generally more negative than those of boys. As well, ability attributions for success were significantly associated with desires to seek out future achievement opportunities in mathematics. The more "students attributed poor outcomes to low ability, the more likely they were to avoid mathematics in the future" (Stipek & Gralinski, 1991, p. 366). It should be noted that girls were also more likely than boys to report less pride in their

successes and were less likely than boys to believe that mathematics success could be achieved through effort.

Campbell and Hackett (1986) also investigated sex differences in mathematics performance attributions by assigning randomly college students to either a success or a failure condition and having students attempt a series of easy or difficult mathematics tasks. Women in the success condition rated being lucky as the cause of their performance significantly more than did men. It is noteworthy to mention that women in the failure condition were significantly more dissatisfied than men with their performance. Petiprin and Johnson (1990) sought to determine "the differential effects of item difficulty on subsequent performance" (p. 46) in mathematics. Participants were divided into two groups, and were asked to complete sequential number completion tests. The first group initially received more difficult questions, whereas the second group initially received easier questions. The methodology was designed to minimise the extraneous effects of previous mathematics experience (Petiprin & Johnson, 1990). Both groups' tests shared a similar question, which served as the standard criterion measure. The effect of attributional style on subsequent performance was also measured. The results showed that men and subjects with self-serving attributional styles scored higher on the criterion measure, compared to females and those with self-defeating attributional styles. An individual with a self-serving attributional style is one who tends to attribute positive events to internal factors and negative events to external factors. Conversely, an individual who possesses a self-defeating attributional style is one who tends to ascribe positive events to external factors and negative events to internal factors.

One component of Stipek's (1984) research was centred on examining sex differences in children's attributions for achievement on a mathematics test. The fifth- and sixth-grade participants completed pretest scales designed to measure students' self-perceptions of competence in mathematics and their performance expectations on the test. The mathematics test was then administered, marked, and returned to the students. Posttest scales were subsequently completed and were designed to assess students' actual performance on the test, students' opinions of their performance, attributions for the cause of their achievement, and future performance expectations. Stipek found that, compared to girls, boys perceived themselves to be more competent in mathematics and they also achieved higher grades on the examination. In addition, boys ascribed success more to ability than did girls and boys were less likely to attribute failure on the test to lack of ability and more likely to attribute success to ability than were females.

A small number of studies have discussed the effects of attributional retraining on students' achievement levels. According to Okolo, Bahr, and Gardner (1995), these retraining programs can promote more functional attributional styles among students by teaching them to attribute their successes to their efforts and to their abilities and their failures to a lack of effort and to a lack of effective learning strategies. Schunk (1984) designed two experiments to determine how different attributional feedback (i.e., attributing students' performance either to ability or to effort) influenced students' motivation attributions for success and subsequent mathematics achievement. Students lacking subtraction skills participated in both experiments, and they received tutelage and solved problems over a series of four sessions. Both experiments had the same framework: one group received ability feedback from the experimenter for success during

all four sessions (e.g., "you're good at this"); the second group received effort feedback for success during all four sessions (e.g., "you've been working hard"); the third group initially received ability feedback, and subsequently received effort feedback; and the fourth group was given effort feedback in the first half, followed by ability feedback in the second half. Both experiments' findings showed that students who initially received ability feedback (ability-ability, and ability-effort) adopted more internal attributions for their achievement, developed higher task self-efficacy, and finished the sessions with better subtraction skills, compared to students who had received effort feedback first (effort-effort, and effort-ability). Schunk postulated that attributing children's early successes to ability was more effective than initial attributions of effort for the following reason:

> As children solve problems during training, they perceive that they are becoming more competent and begin to develop a sense of efficacy for continued success. Because early successes constitute a prominent cue for forming ability attributions, telling them early in the course of skill development that ability is responsible for their successes supports these self-perceptions (p. 1166).

Schunk's findings suggest that attributional retraining can have direct effects on boys' and girls' achievement levels.

Heller and Ziegler (1996) also investigated the effect of attributional retraining on sex differences in mathematics and the sciences. According to the researchers, women "underestimate their own talents in mathematics and the sciences and [attribute] their successes and failures in such a way as to further inhibit motivation" (Heller & Ziegler,

1996, p. 200). University statistics students and high school students enrolled in mathematics participated in a two-phase attributional retraining program. The researchers' goal was to "provide gifted female students with realistic knowledge about their own ability and knowledge about [mathematics and science]" (Heller & Ziegler, 1996, p. 200). At the beginning of their school term, university students enrolled in statistics were given a pretest designed to measure attributional style, general and mathematics self- concept, and statistics interest and anxiety. The pretest results revealed that female students attributed failure to internal, stable factors (e.g., lack of skill) significantly more than males in a control group. As well, females had higher anxiety levels and lower expectations in statistics. The experimenters then delivered the attribution retraining program, which included a combination of written and verbal commenting techniques. Subsequent to the implementation of the program, the students were given a posttest. The results showed that the retraining program proved to be especially successful. Prior to the program, approximately half of the female students attributed their failure to internal, stable causes. At the completion of the program, none of the students attributed their failure to internal factors. These findings are positive because, according to Stipek (1984):

> an ability attribution for failure is the most debilitating where future achievement behaviors are concerned. If failure is attributed to a stable factor, the child is not likely to look forward to future successes. Since ability is [out] of the control of the individual, there is little that he or she can do to achieve success in the future (p. 970).

Heller and Ziegler then applied a similar program to female high school students enrolled in mathematics courses. Following the program, girls increasingly attributed their mathematics success to internal, stable causes (e.g., high ability). Also, they showed a decline in attributing success to luck and task ease. According to Heller and Ziegler, attribution retraining in both cohorts of students resulted in "impressive improvements in self-related cognitions and in [mathematics] achievement" (p. 207).

Some researchers believe that the male-female attribution dichotomy is exacerbated by the North American culture. More specifically, some research suggests that one's social milieu may affect one's use of attributions (Siann, Lightbody, Stocks, & Walsh, 1996). For instance, Campbell (1991) investigated the academic self-concepts, achievement, and attributional style of male and female Asian-American and Caucasian high school students who had won prestigious scholarships. These awards were given to students who ranked among the top technical students in the United States. Campbell decided to compare Asian-Americans to Caucasians because the former group of students had "been receiving a disproportionate number of awards in [the] competition" (Campbell, 1991, p. 252). He postulated that Asian-American families socialise their children differently than Caucasian families. Thus, Asian-American students were particularly successful in scholarly competitions. Campbell had three main objectives. First, he wanted to examine how Asian-Americans and Caucasians differed in terms of attributions and technical self-concept. Second, he sought to compare the attributions and self-concept of males and females of each ethnic group. Finally, he sought to determine if Asian-American females display certain characteristics that would explain their greater competition in technical fields. Campbell found that not only did Caucasian females

score lower on self-concept scales and express more dysfunctional attributions for their performance in technical areas, but also their achievement in technical sections of the Scholastic Aptitude Test (SAT) was lower than that of Asian students.

In summary, research has been presented that suggests that girls' and boys' attributions for their academic performance differ. More specifically, research shows girls tend to attribute their academic successes to external factors and effort and their failures to their own lack of ability. In the next section of this paper, literature focussed on the relationship between students' self-efficacy and academic achievement is discussed.

Self-Efficacy and Academic Achievement

As mentioned at the outset, a second achievement-related belief thought to affect boys' and girls' academic achievement is termed self-efficacy. Self-efficacy refers to judgements one makes about one's ability to perform tasks at a certain level (Schunk, 1984). Self-efficacy has been shown to influence students' "choice of activities, effort expended, persistence, and task accomplishments" (Schunk & Gunn, 1986, p. 238).

Various researchers have investigated the relationship between students' attributions and their achievement in a variety of subject matter domains. Williams (1994) investigated the sex-related differences in the relationship between self-efficacy and academic performance on a national assessment test of mathematics, English, reading, and science skills. Prior to students' participation in the assessment, participants rated their self-efficacy for their performance in each of the four components. She found that students who reported higher self-efficacy tended to perform at higher levels, particularly in mathematics, than those who reported lower levels of self-efficacy.

Hackett, Betz, Casas, and Rocha-Singh (1992) sought to determine how self-efficacy, professional interests, outcome expectations, personal support, and academic ability relate to the academic achievement of college students enrolled in engineering or the sciences. It was found that self-efficacy, together with other academic and support variables, was the best predictor of academic achievement. A large portion of Shell, Colvin, and Bruning's (1995) research was devoted to examining the grade-level difference in fourth-, seventh-, and tenth-grade students' perceived self-efficacy and their English achievement levels. Statistical analyses of their results showed a link between students' beliefs and achievement in both reading and writing. The researchers also found that higher reading and writing achievement was related to higher self-efficacy in both tasks. It should be noted that they also found that reading and writing self-efficacy was significantly higher at each successive grade level. This finding may imply that one's developmental stage affects feelings of self-efficacy. Pajares and Valiante (1999) sought to determine the degree to which students' perceptions of writing self-efficacy, writing self-concept, writing apprehension, prior writing achievement, sex, and grades could predict competence in writing. They were particularly interested in whether or not self-efficacy alone could reliably predict writing achievement. Their results revealed that writing self-efficacy was the only motivation construct to predict students' writing competence. It is worth mentioning that girls outperformed boys, but there were no sex differences in writing self-efficacy. Jinks and Morgan (1999) explored children's perceptions of self-efficacy and their self-reported academic achievement in reading, mathematics, science, and social studies. The researchers asked students for the grades they received in each subject on their latest report card, and compared those grades to

students' responses on a self-efficacy questionnaire. The results revealed that students who reported higher self-efficacy in each subject also tended to report higher grades.

Hackett, Betz, O'Halloran, and Romac (1990) studied the effects of verbal and mathematics success and failure on students' self-efficacy and task interest. Participants were divided randomly into verbal or mathematics success or failure conditions in which students were asked to solve easy or difficult anagrams or number series tasks. They discovered that students' task performance in either subject significantly affected their feelings of self-efficacy and task interest. Students' success experiences resulted in enhanced feelings of self-efficacy and task interest, whereas failure experiences resulted in decreases in self-efficacy and task interest.

A large number of related studies involve an examination of the relationship between students' attributions and their achievement in mathematics. Lopez, Lent, Brown, and Gore (1997) obtained information on the objective mathematics ability, perceived sources of efficacy, outcome expectations, course-specific self-efficacy, interest in mathematics and science activities, and mathematics achievement of high school geometry and algebra students. They found that self-efficacy and outcome expectations predicted interest in mathematics and that self-efficacy partially mediated the effect of ability on students' academic achievement. Their results support the link between mathematics achievement and self-efficacy. According to the researchers, "self-efficacy percepts are important in complex task performance" (Lopez, Lent, Brown, & Gore, 1997, p. 50). Hackett and Betz (1989) explored the relationship between college students' mathematics achievement and mathematics self-efficacy, attitudes towards mathematics, and the students' choice of mathematics-related degree programs. They

found a correlation between students' mathematics achievement and their perceived self-efficacy, mathematics attitudes, and their masculine sex-role orientation. Lent, Lopez, and Bieschke (1993) investigated the relationship between prior mathematics achievement, mathematics self-efficacy, outcome expectations, and students' interests in an attempt to predict students' performance in mathematics-related college courses. They found that participants' mathematics self-efficacy related positively to their interest in mathematics and science, to their selection of science-based degree programs and career choices, and to their performance in mathematics. Matsui, Matsui, and Ohnishi (1990) sought to determine the mechanisms underlying mathematics self-efficacy in Japanese college students. They found that students with high levels of performance accomplishment (i.e., many successful experiences in mathematics) also had higher levels of mathematics self-efficacy than students with low performance accomplishments. They also found that males' mathematics self-efficacy was significantly higher than that of females. As mentioned in a previous section, Campbell and Hackett (1986) randomly assigned college students to either a success or a failure condition and had students attempt a series of easy or difficult mathematics tasks. They found that self-efficacy changed as a result of task success and failure. More specifically, participants' feelings of self-efficacy varied according to their experiencing task success or failure. As well, participants' ratings of self-efficacy declined as a result of the failure experience and increased as a result of the success experience. Schunk and Cox (1986) investigated how disabled students' verbalisation during subtraction influenced their self-efficacy and skill performance. Students were divided into three groups: (a) those who verbalised continuously while solving problems; (b) those who verbalised during first half of the

study and did not verbalise in the second half; and (c) those who did not verbalise. Their findings demonstrated that students who continuously verbalised had higher self-efficacy and better performance than students in other conditions.

A great deal of the research focussed specifically on students' perceptions of mathematics self-efficacy has been undertaken by Frank Pajares and his colleagues. For example, Pajares and Miller (1995) investigated the relationship between students' solution of mathematics problems and three types of mathematics self-efficacy: (a) confidence to solve the mathematics problems they would be later asked to answer; (b) confidence to succeed in mathematics-related courses; and (c) confidence to perform mathematics-related tasks. The authors hypothesised that students' confidence to solve the mathematics problems was a better predictor of mathematics performance than the other types of self-efficacy, and the results supported this hypothesis. Pajares and Miller concluded by stating that, because of the task-specificity of self-efficacy perceptions, self-efficacy scales should be created around the criterial task being assessed. Pajares (1996b) examined the role that gifted students' self-efficacy plays in their mathematical problem solving. He found that students' self-efficacy beliefs made an independent contribution to the prediction of their problem-solving performance, even after controlling for the effects of mathematics anxiety, cognitive ability, prior mathematics achievement, and sex. Pajares and Graham (1999) sought to determine the influence of various motivation variables on mathematics performance and to explore whether the influence of such variables change during the first year of middle school. They discovered that students' task-specific self-efficacy was the only motivation variable to predict academic performance. It is worth mentioning that gifted students' perceptions of

their ability were more accurate than those of the regular students and that gifted students' perceived self-efficacy demonstrated less overconfidence than the perceptions of regular education students. Pajares and Kranzler (1995) investigated the effect of mathematics self-efficacy and general mental ability on the mathematics performance of students in grades 9 to 12. The results demonstrate that students' perceptions of self-efficacy had strong direct effects on their performance. As well, students' ability had a strong direct effect on their perceptions of self-efficacy, which mediated the indirect effect of ability and level on performance.

In summary, research has been presented that illustrates the positive relationship between students' feelings of self-efficacy and their academic achievement. In the next section of this paper, literature focussed on sex differences in mathematics self-efficacy is discussed.

Sex Differences in Mathematics Self-Efficacy

Research shows sex differences in students' perceptions of mathematics self-efficacy. More specifically, literature indicates that girls tend to have lower self-efficacy than boys in mathematics, which, in turn, negatively affects their achievement in mathematics. Malpass, O'Neil, and Hocevar (1999) investigated the effects of sex, self-efficacy, learning goal orientation, self-regulation, and worry on mathematics achievement in a sample of gifted high school students. Their results showed that self-efficacy was positively related to achievement and that males had higher perceptions of mathematics self-efficacy than did females. Junge and Dretzke (1995) investigated the relationship between gifted students' self-efficacy and their mathematics behaviours. They determined that boys generally had more enhanced perceptions of self-efficacy

expectations than did girls. It is worth noting that girls' confidence was weakest in mathematics-related college coursework and was strongest in traditionally female tasks. Pajares and Miller (1994) investigated the role of self-efficacy in mathematical problem solving. Their results revealed that mathematics self-efficacy was more predictive of problem solving than was mathematics self-concept, perceived usefulness of mathematics, prior experience with mathematics, or students' sex. Self-efficacy also mediated the effect of sex and prior experience on self-concept, perceived usefulness, and problem solving. Sex and prior experience influenced self-concept, perceived usefulness, and problem solving largely through the mediational role of self-efficacy. Men demonstrated higher performance, self-efficacy, and self-concept and lower anxiety, but these differences were due largely to the influence of self-efficacy, for sex had a direct effect only on self-efficacy and a prior experience variable. One component of Lent, Lopez, and Bieschke's (1991) research involved an exploration of the relationship between four sources of efficacy information (personal performance accomplishments, vicarious learning, social persuasion, and emotional arousal) and perceptions of mathematics self-efficacy. The researchers discovered that the sources of efficacy information predicted significantly and helped explain sex differences in mathematics self-efficacy.

Some researchers have studied sex differences in the mathematics self-efficacy perceptions of students from varied cultural backgrounds. For example, Sayers' (1994) research on mathematics education in Zambia revealed that boys consistently outperformed girls on a mathematics test administered to students graduating from high school. Moreover, he found that boys had better attitudes toward, and confidence in,

mathematics; girls, however, seemed to be less confident, to be more nervous, to enjoy mathematics less and to see less use for their mathematics when compared with boys (Sayers, 1994). Sayers concluded that students' attitudes and perceived self-efficacy affect mathematics performance. Randhawa (1994) studied the mathematics self-efficacy, attitudes, and achievement of twelfth-grade students in Canada and West Australia. His results uncovered that boys tended to be more confident than girls in their mathematics ability, that boys felt more comfortable applying mathematics knowledge to their daily lives, and that boys' academic achievement surpassed that of girls.

In summary, research has been presented that suggests sex differences in students' perceptions of self-efficacy. More specifically, studies have found that males tend to have higher feelings of self-efficacy than do girls, which may explain girls' traditionally lower mathematics performance in comparison to that of boys.

Research Questions

The purpose of the current study was to determine whether there were sex differences in fourth- and seventh-grade students' (a) Foundation Skills Assessment Numeracy subtest scores; (b) mathematics report card grades; (c) attributions for mathematics success and failure; and (d) mathematics self-efficacy.

Given the growing body of literature that shows a closing of the mathematics achievement gap between the sexes (e.g., Ministry of Education, 2000), it was predicted that girls' mathematics achievement would meet that of boys. As mentioned in the previous chapter, mathematics achievement differences between the sexes have been ascribed to sex differences in students' self-efficacy and attributions. Therefore, one would expect that boys' and girls' achievement-related beliefs are the same when their

academic achievement is also the same. As such, given the researcher's prediction that boys' and girls' mathematics achievement would not differ significantly, she did not expect to find significant sex differences in students' achievement-related beliefs.

CHAPTER 3

Method

Participants

One hundred sixty-one students participated in the study: 62 fourth-graders (37 male, 25 female) and 99 seventh-graders (43 male, 56 female). The mean age of fourth-grade participants was 9.32 years ($SD = 0.50$, range 8 to 10 years), and seventh graders' mean age was 12.27 years ($SD = 0.45$, range 12 to 13 years). Fourth-grade students were drawn from five public elementary schools and seventh-grade students were drawn from two public middle schools in suburban Victoria, British Columbia, Canada.

According to a 1996 Statistics Canada Census of the district's (province's) residents, (a) 92% (76.5%) selected English as their first language and (b) 4.8% (5.1%) were Aboriginal. A 1995 Canada Labour Force Survey showed that (a) residents' median family annual income was $52,262 ($49,207); (b) 9.7% (15.2%) of residents had a mean annual income of less than $20,000; and (c) 71% (66.4%) of residents were in the labour force (Ministry of Education, n.d.).

Instruments

Two measures of mathematics achievement were used in this study: students' Foundation Skills Assessment 2001 Numeracy subtest standardised scores and students' spring 2001 mathematics report card grades.

Foundation Skills Assessment (FSA). The Ministry of Education's Foundation Skills Assessment is a three-part annual assessment test designed to measure the reading comprehension, writing, and numeracy skills of fourth-, seventh-, and tenth-grade students throughout British Columbia. The Reading Comprehension subtest is divided

into two parts, both of which are comprised of various multiple-choice and open-ended questions. Students are given a maximum of 45 minutes to write each section. The Writing subtest is divided into two parts. The first is comprised of a short essay question, which students must complete within 30 minutes. The second part is comprised of a long essay question, which students must complete within 60 minutes. Similar to the Reading Comprehension subtest, the Numeracy subtest is divided into two parts, both of which are comprised of various multiple-choice and open-ended questions. Students are given a maximum of 45 minutes to complete each part. In total, students require 270 minutes (4.5 hours) to complete the entire FSA (Ministry of Education, 2001c). It is worth noting that the fourth- and seventh-grade versions of the 2001 FSA Numeracy subtest both contained 32 multiple-choice questions and four open-ended questions worth four points each.

The 2001 FSA was administered in public and funded independent schools across the province from April 23 to May 4. Teachers are required to administer the FSA to their students according to one of two sequences of administration laid out by the Ministry of Education: the first and preferred sequence requires that teachers administer the FSA over six consecutive days, while the second sequence requires that teachers administer the FSA over three consecutive days (Ministry of Education, 2001c; Ministry of Education, 2001d). These sequences are detailed in Tables 1 and 2, respectively.

Table 1

Preferred Sequence of FSA Administration

Day	Subtest
1	Reading 1
2	Writing 1
3	Reading 2
4	Writing 2
5	Numeracy 1
6	Numeracy 2

Table 2

Alternative Sequence of FSA Administration

	Subtest	
Day	Morning	Afternoon
1	Reading 1	Writing1
2	Reading 2	Writing 2
3	Numeracy 1	Numeracy 2

Most students with special needs, most English as a Second Language, Programme Francophone and French Immersion students participate. A student may be excused from participating in the FSA by his or her district superintendent or school principal if (a) the student is on an excused absence from school; (b) the student is an English as a Second Language student who knows too little English to respond meaningfully; or (c) the student has special needs and is on a modified school program (Ministry of Education, 2001a).

The FSA relates to what students learn in the classrooms in two important ways. First, the FSA measures:

> critical skills that are part of the provincial curriculum. FSA represents broad skills that all students are expected to master. FSA only addresses skills that can be tested in a limited amount of time, using a pen and paper format. FSA does not measure specific subject knowledge or many of the more complex, integrated areas of learning (Ministry of Education, 2001e, p. 34).

Second, the FSA tests are designed to measure cumulative learning. This means that when fourth-graders complete the assessment, they are expected to implement skills they have gained from kindergarten to the spring of Grade 4. Similarly, when seventh-grade students complete their version of the FSA, they are expected to use skills gained from kindergarten to Grade 7 (Ministry of Education, 2001e).

As mentioned previously, the researcher was interested only in participants' Numeracy subtest performance. Numeracy refers to the "combination of mathematical knowledge, problem solving and communication skills required by all persons to function

within our technological world. Numeracy "is more than knowing about numbers and number operations" (Ministry of Education, 2001e, p. 41).

The Ministry of Education and the school districts use FSA results to: (a) report the results of student performance in various areas of the curriculum; (b) assist in curriculum improvement; (c) facilitate discussions on student learning; and (d) examine the performance of various student populations to determine if any require special attention. Schools use FSA data primarily to assist in the creation and modification of various school growth plans (e.g., plans for academic improvement). The FSA data also complement other available achievement information, such as report cards and other assessment activities (Ministry of Education, 2001e). It should be mentioned that FSA results do not count towards students' report card marks.

The Ministry of Education provided the researcher with students' individual FSA Numeracy subtest standardised scores, rather than their raw scores. In standardising 2001 results, the Ministry of Education pooled 2000 and 2001 Numeracy subtest raw scores for all participants in the province, and scaled them so their mean is 500 and their standard deviation is 100.

Mathematics report card grades. The second measure of achievement in this study is students' spring 2001 mathematics report card grades. These report card grades reflect teachers' assessments of students' performance of the Ministry of Education's Grade 4 or Grade 7 mathematics curriculum. Teachers and school secretaries provided the researcher with each student's grade. For easier analysis, the researcher requested grades in percentage form. The Ministry of Education's descriptions of each report card achievement level are presented in Table 3.

Table 3

Description of Report Card Achievement Levels

Achievement levels	Letter grade	Description
86-100%	A	Excellent
73-85%	B	Very good
67-72%	C+	Good
60-66%	C	Satisfactory
50-59%	C-	Minimally acceptable
0-49%	F	Below minimally acceptable

Two instruments were designed to assess students' achievement-related beliefs: an attribution scale and a self-efficacy scale.

Attribution scale. The attribution scale, based on the work of Stipek (1993), was designed to measure students' attributions for their performance in mathematics. The researcher administered the same scale to fourth- and seventh-graders. The first half of the scale required that students look over a list of six attributions commonly given by students in explaining their academic success: three internal attributions ("I studied hard", "I studied the right things", and "I am smart") and three external attributions ("the teacher explained things well", "someone helped me", and "the work was easy"). Students then indicated the degree to which each attribution explained their mathematics success using a five-point Likert scale (1 = "this is not why I did well", 3 = "this is kind of why I did well", and 5 = "this is the most important reason why I did well").

The second half of the scale required that students look over a list of six additional attributions commonly given by students in explaining their poor academic performance: three internal attributions ("I didn't study enough", "I studied the wrong things", and "I don't think I am smart"), and three external attributions ("the teacher explained things poorly", "no one helped me", and "the work was hard"). Students then indicated the degree to which each attribution explained their mathematics failure using a five-point Likert scale (1 = "this is not why I did poorly", 3 = "this is kind of why I did poorly", and 5 = "this is the most important reason why I did poorly").

Regardless of their actual academic achievement, students completed both halves of the attribution scale. As such, before beginning the success portion of the scale, each student was asked to imagine he or she had just received any individually-pleasing mark

in mathematics and to respond to the related questions under that pretence. Conversely, before beginning the failure portion of the scale, each student was asked to imagine he or she had just received any individually-disappointing mark in mathematics and to respond to the related questions under that pretence.

Self-efficacy scale. The researcher designed two versions of the self-efficacy scale – one for fourth-graders and one for seventh-graders – according to specifications laid out by Bandura (2001). The Grade 4 scale included a booklet of nine numeracy test items equivalent in form and difficulty to items on the fourth-grade version of the 2001 FSA (see Appendix I). The Grade 7 scale included a booklet of nine test items similar to those found on the seventh-grade version of the FSA (see Appendix J). The test items included in both versions of the scales were drawn directly from the Ministry of Education's web site (see Appendix O), which contains sample FSA numeracy items for parents, students, and teachers to review. Students in both grades received an answer sheet (see Appendix H) on which to report their perceived confidence according to each of the test items in their respective booklets.

The proportions of self-efficacy scale questions devoted to each of the four FSA numeracy categories (numbers, patterns and relationships, shape and space, and statistics and probability) were commensurate with the proportions of questions used on the 2001 FSA. This parity was achieved by designing the self-efficacy scales according to the Ministry of Education's Table of Numeracy Specifications (Ministry of Education, 2001b), a document that details the proportion of test questions devoted to each numeracy category on the 2001 FSA (see Appendix K). The Table of Specifications also contains a description of each of the four categories of numeracy. Table 4 details the percentage

(and number) of self-efficacy scale items and 2001 FSA test items devoted to each numeracy category.

It is worth mentioning that the FSA items included in the self-efficacy scales were not included on the 2001 FSA. As well, because the Ministry of Education does not provide external researchers with information about the numeracy category to which each sample FSA test item belongs, the researcher was required to determine the number and proportion of test items to include in the self-efficacy scales. By comparing each test item to the description of each numeracy category provided in the Table of Specifications, the researcher was able to determine the numeracy category to which each test item belonged. As a result, the proportions of self-efficacy scale test items devoted to each of the four FSA numeracy categories were commensurate with the proportions of questions used on the 2001 FSA.

Table 4

Percentage (and Number) of FSA and Self-Efficacy Scale Items Devoted to Each Numeracy Category

	2001 FSA		Self-efficacy scale	
Category	Grade 4	Grade 7	Grade 4	Grade 7
Numbers	35 – 45	35 – 45	33 (3)	44 (4)
Statistics and probability	10 – 20	10 – 20	22 (2)	22 (2)
Shape and space	20 – 30	20 – 30	33 (3)	22 (2)
Patterns and relationships	15 – 25	15 – 25	11 (1)	11 (1)

Note. Information about the exact number of 2001 FSA questions devoted to each numeracy category was not available to the researcher.

Self-efficacy judgements are task-specific. As such, a self-efficacy scale must assess the same skills called for in the performance task with which the scale is to be compared (Bandura, 1986). Furthermore, self-efficacy scales specifically designed around the criterial task being assessed and to the domain of functioning being analysed increase prediction (Pajares & Miller, 1995). Marsh, Roche, Pajares, and Miller (1997) reported similar sentiments. It is for the aforementioned reasons that the researcher had students report their feelings of self-efficacy according to items similar in form and difficulty to questions on the 2001 FSA.

Pajares and Kranzler also cautioned that self-efficacy scales must be administered as closely as possible in time to the performance task with which the scale's responses will be compared. As such, the researcher administered the scales approximately one to two weeks before the administration of the 2001 FSA and as close as possible to the release of spring report card grades.

Procedure

Prior to data collection, the researcher received approval to conduct research using human participants from the University of Victoria's Human Research Ethics Committee. The researcher also obtained permission to conduct research in the schools from the district superintendent's office. As well, the researcher completed a Ministry of Education Research Agreement and obtained permission to access 2001 FSA data. The Ethics Committee Certificate of Approval, the district letter of permission, and the Ministry of Education letter of permission are appended (see Appendices A, B, and C, respectively).

Pilot testing. To ensure the procedure would be clear for students, particularly for the fourth-graders, and to ensure that students would understand the researcher's instructions, pilot testing was conducted with six fourth-grade students who attended a public school located in the district. This school, however, was not one of those from which final participants were drawn.

The researcher rehearsed the procedure with each of the six students individually so each student could make comments and ask questions as necessary, and so the researcher could gauge if the directions permitted each student to respond to the scales with sufficient understanding. The researcher also asked the students to talk their way through the entire procedure in their own words. When students responded to various scale items, she asked students to explain their rationale in making their selections. As a result of pilot testing, the researcher was satisfied the procedure would be adequate for the actual participants. Report card grades and FSA scores were not obtained for pilot students.

Consent. The researcher visited participants' classes to deliver a small presentation detailing major aspects of the study (see Appendix D). At the end of her presentation, she handed students packages that included the following three items: (a) an information letter for parents/guardians, (b) an information letter for students, and (c) a consent form for students and parents/guardians to sign (see Appendix E). The researcher asked that students take the package home for their parents/guardians to review with them and sign, and to return have the signed consent letters to their respective teachers within two weeks after the forms were distributed.

Administration of scales. Once the permission forms had been obtained and the participants determined - approximately two weeks after the researcher's initial visit to each classroom - she returned to each class and administered the attribution and self-efficacy scales. Approximately 25 minutes were required for students to complete both scales. The administration of the scales occurred in April, 2001.

For the success portion of the attribution scale, the researcher asked students to cover everything on the page, using a blank piece of paper, except for the list of six success attributions. Students were told that the list contained reasons some students provide for doing well in mathematics, and were asked to look over the list of reasons thoroughly. The researcher then asked students to cover everything except for the first attribution and its corresponding Likert scale and to indicate the degree to which that particular reason explained their success in mathematics. Once students had finished responding, the researcher instructed students to slide their blank pieces of paper down to the second attribution and its corresponding Likert scale. Students then indicated the degree to which the second reason explained their mathematics success. These steps continued for each of the six listed attributions.

Once students had completed rating each attribution, the researcher asked students to look over their responses. In this instance, the researcher was mainly interested in the primary attributions students give for their success in mathematics. As such, she asked that if students rated two reasons as the most important reason for their success (e.g., both rated as fives) that they choose which of the two reasons was more important in explaining their success, and to re-rate the other. This step ensured that only one success attribution was rated as most important in explaining their successful performance.

Similar steps were taken for the failure portion of the attribution scale. To help students better understand the procedure, the researcher duplicated both halves of the scale on poster paper and provided students with step-by-step instructions and examples prior to and during students' participation.

In order to complete the self-efficacy scale, each student was given a booklet containing an answer sheet and nine sample FSA questions. Students were given instructions not to open the question booklets until instructed to do so. Once each student had the appropriate materials, the researcher directed students to open the question booklet to only the first page, which contained the first sample FSA question. The researcher asked students to refrain from attempting to answer the question. Using a stopwatch, the researcher measured a 20-second period during which students were asked to read over the first question and to judge how confident they were that, if asked to complete that particular question, they could determine the correct answer. Once the time had elapsed, students were asked to place the open question booklet face down and to rate their perceived confidence to complete successfully that particular question according to the seven-point scale on the answer sheet (1 = "not confident at all", 3 = "not too confident", 5 = "pretty confident", and 7 = "very confident").

Once the researcher determined that all of the class' participants had rated their perceived confidence to answer correctly the first question, she instructed students to turn over their answer sheet, and their question booklet to the next page. Once the 20-second period had elapsed, students rated their confidence to correctly answer the second question. The process continued for each of the scale's nine questions.

The researcher chose 20 seconds as the duration of viewing time per question because, during pilot testing, it proved to be enough time for students to thoroughly read each question, yet too little time for students to attempt calculating answers. The researcher did not want students to attempt answers, despite the knowledge that perceptions of ability are formed as individuals attempt and complete tasks, because people are more influenced by how they interpret their experience, than by their actual achievement (Bandura, 1986).

As mentioned previously, the researcher had students keep their question booklets turned over while they rated their confidence and had students turn over their answer sheets while they read each question. These actions were taken because, during pilot testing, the researcher noticed that students' first reaction to being given the question booklets was to leaf through the nine questions. By requiring that students open and close the question booklet according to her directions, the researcher could ensure that students looked at a given question for only the maximum allotted time. The researcher instructed students to turn over their answer sheets while reading each scale item to prevent students from changing their confidence ratings for earlier questions.

Collection of mathematics grades and FSA scores. The researcher collected students' individual spring 2001 mathematics report card grades from teachers and school secretaries at the time of the administration of the self-efficacy and attribution scales. The Ministry of Education made FSA student-level results available in November, 2001. At this time, the researcher obtained participants' Numeracy subtest standardised scores from the Ministry.

CHAPTER 4

Results

This chapter is divided into two major sections. In the first section, various data anomalies are discussed, the creation of two special motivation indices are explained, Cronbach internal measures of consistency are reported, means and standard deviations for the achievement variables (FSA scores and report card grades) and the motivation variables (success attributions, failure attributions, total self-efficacy, and relative self-efficacy) are presented for all participants. Finally, intercorrelations between various achievement and motivation variables for all participants, between sexes, and between grade-levels are reported, respectively.

In the second section of this chapter, results of two multivariate analyses of variance, of various 2 x 2 analyses of variance, and of various independent t-tests are presented.

Preliminary Analyses

Data anomalies. Certain values were either missing from or excluded from analyses for a variety of reasons. First, two participants' FSA scores were not in the Ministry of Education's FSA database, indicating that the students either missed class during the days of the Numeracy subtest administration or moved out of province prior to the administration of the FSA. Second, one male seventh-grader earned an FSA score of over 1000 (the province-wide mean was 500). Third, since the calculation of students' relative self-efficacy was partially contingent upon the FSA scores, the three students missing FSA scores were also missing relative self-efficacy scores. Fourth, one student failed to indicate how important task difficulty was in explaining poor performance.

Finally, two male seventh-graders' and one male fourth-grader's report card grades were well below the grades of their colleagues (report card achievement levels were equal to or less than 20%), and were removed as extreme variables.

Special motivation indices. The researcher calculated each student's total self-efficacy and relative self-efficacy prior to statistical analyses. A student's total self-efficacy represents the sum of his or her confidence ratings for each of the self-efficacy scale items. As mentioned in a previous chapter, students rated their self-efficacy from one ("not confident at all") to seven ("very confident") for each of the nine scale items; therefore, it was possible for students' total self-efficacy scores to range from nine to sixty-three.

A number of researchers suggest that boys tend to display overconfidence relative to their actual academic achievement, while girls tend to display relative underconfidence (e.g., Hackett & Betz, 1989). To determine the degree to which the participants held efficacy perceptions incongruent with their academic achievement, the researcher calculated an index of relative efficacy for each of the students. First, each student's total self-efficacy score was standardised (Z_{SE}) by subtracting the mean total self-efficacy of all participants in his or her grade ($\overline{X}$) from his or her individual total self-efficacy score (X_i). The difference was then divided by the standard deviation of the total self-efficacy scores of all participants in his or her grade (SD). These steps are illustrated in Equation 1.

$$Z_{SE} = (X_i - \overline{X}) / SD \qquad (1)$$

Second, each student's FSA score was standardised (Z_{FSA}) by subtracting the mean FSA score of all participants in his or her grade ($\overline{X}$) from his or her individual FSA score (X_i). The difference was then divided by the standard deviation of the FSA scores of all participants in his or her grade (SD). Please refer to Equation 2 for an illustration of these steps.

$$Z_{FSA} = (X_i - \overline{X}) / SD \tag{2}$$

Finally, as illustrated in Equation 3, each student's relative self-efficacy (Z_{REL}) was calculated by subtracting his or her standardised FSA score (Z_{FSA}) from his or her standardised total self-efficacy (Z_{SE}).

$$Z_{REL} = Z_{SE} - Z_{FSA} \tag{3}$$

The rationale underlying the creation of the relative self-efficacy index was that: (a) students whose standardised total self-efficacy values were high but whose standardised FSA scores were low would yield positive relative efficacy values, thus implying that the students' self-efficacy was unrealistically high given their actual academic achievement; (b) students whose standardised total self-efficacy values were low but whose standardised FSA scores were high would yield negative relative efficacy values, thus implying that the students' self-efficacy was unrealistically low given their actual academic achievement; and (c) students whose standardised total self-efficacy and standardised FSA scores were both high or whose standardised total self-efficacy and

standardised FSA scores were both low would yield near-zero relative efficacy values, thus implying that the students' self-efficacy was commensurate with their actual academic achievement.

Each fourth-grade participant wrote the same version of the FSA as all other fourth-graders in the province; similarly, each seventh-grader wrote the same version of the FSA as all other seventh-graders in the province. As such, the researcher calculated students' relative self-efficacy on the basis of FSA scores rather than report card grades because the former was a more objective measure of students' achievement than the latter.

Reliabilities. Cronbach internal consistency coefficients of .77 and .85 were calculated for the fourth- and seventh-grade versions of the self-efficacy scale, respectively. With permission from the Ministry of Education, the researcher also obtained the internal consistency coefficients for the fourth- and seventh-grade versions of the 2001 FSA Numeracy subtests. They were .85 and .86, respectively. Because students' performance attributions were analysed item-by-item, an overall measure of reliability was not calculated for the attribution scale.

Means and standard deviations. Tables 5 and 6 present the means and standard deviations for both achievement variables (FSA scores and report card grades) and all motivation variables (success attributions, failure attributions, total self-efficacy, and relative self-efficacy) for the entire sample, respectively.

Table 5

Means and Standard Deviations of All Students' Achievement Variables

Variable	*M*	*SD*	*N*
Report card grades	76.71	15.20	158
FSA scores	503.56	84.08	158

Table 6

Means and Standard Deviations of All Students' Motivation Variables

Variable	*M*	*SD*	*N*
Attributions for success			
Effort	3.15	1.44	161
Strategy	3.10	1.30	161
Ability	3.72	1.23	161
Teacher's help	3.47	1.44	161
Help from others	2.48	1.34	161
Task ease	3.41	1.33	161
Attributions for failure			
Lack of effort	2.87	1.45	161
Lack of strategy	2.35	1.44	161
Lack of ability	1.87	1.37	161
Lack of teacher's help	2.53	1.53	161
Lack of help from others	2.18	1.35	161
Task difficulty	2.84	1.41	160
Total self-efficacy	52.98	8.14	161
Relative self-efficacy	0.01	1.14	158

Note. The higher an attribution's mean, the more important the attribution was in explaining students' success or failure.

Correlative findings. In this section, various Pearson product moment correlation coefficients are reported. Table 7 presents the intercorrelations between all participants' sex, grade level, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for all participants. Tables 8 and 9 present the intercorrelations between female and male participants' grade level, FSA scores, report card grades, total self-efficacy, and relative self-efficacy, respectively. Tables 10 and 11 present the intercorrelations between fourth- and seventh-graders' sex, FSA scores, report card grades, total self-efficacy, and relative self-efficacy, respectively. The researcher also examined the intercorrelations between all twelve attribution variables; for the sake of brevity, however, individual correlation coefficients related to students' attributions are not reported here.

An examination of the intercorrelations between students' sex, grade level, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for the entire sample (see Table 7) revealed significant positive relationships between students' FSA scores and report card grades ($r = .590, p < .01$), FSA scores and total self-efficacy ($r = .358, p < .01$), and between report card grades and total self-efficacy ($r = .328, p < .01$). As well, there was a positive relationship between students' sex and their relative self-efficacy ($r = .157, p < .05$). As girls and boys were coded 0 and 1, respectively, this finding implies that males display more confidence relative to their actual academic achievement than do females.

Conversely, there was a negative correlation between students' sex and report card grades ($r = -.217, p < .01$). This finding lends more support to the notion that report card grades tend to favour females. There were also significant negative relationships

between students' relative self-efficacy and FSA scores ($r = -.569, p < .01$) and between students' relative self-efficacy and report card grades ($r = -.236, p < .01$).

It may also be worth noting the near-zero relationship between students' grade level and relative self-efficacy ($r = -.009, p > .05$). This finding suggests that students' perceptions of self-efficacy relative to their actual academic achievement may remain relatively stable from grades four to seven. Please refer to Appendix L for the intercorrelations between all students' individual attributions, FSA scores, and report card grades.

Table 7

Intercorrelations Between All Students' Sex, Grade Level, FSA Scores, Report Card Grades, Total Self-Efficacy, and Relative Self-Efficacy

Variable	1	2	3	4	5	6
1. Sex	--					
2. Grade level	-.158 *	--				
3. FSA scores	-.087	-.120	--			
4. Report card grades	-.217 **	.028	.590 **	--		
5. Total self-efficacy	.087	-.152	.358 **	.328 **	--	
6. Relative self-efficacy	.157 *	-.009	-.569 **	-.236 **	.563 **	--

Note 1. For the sex variable, girls were coded 0, boys 1.

Note 2. * $p < .05$, ** $p < .01$

The researcher then examined the intercorrelations between females' grade level, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for the entire sample (see Table 8). Once again, the matrix revealed positive relationships between students' FSA scores and report card grades ($r = .556, p < .01$), FSA scores and total self-efficacy ($r = .409, p < .01$), and between report card grades and total self-efficacy ($r = .232, p < .05$).

Again, there were significant negative relationships between students' relative self-efficacy and FSA scores ($r = -.532, p < .01$) and between students' relative self-efficacy and report card grades ($r = -.288, p < .01$). Although both were not significant, there were negative relationships between students' grade level and total self-efficacy ($r = -.208, p > .05$) and between students' grade level and FSA score ($r = -.184, p > .05$). These findings imply that females in higher grades have lower scores for total self-efficacy and poorer academic achievement. Please refer to Appendix M for the intercorrelations between females' individual attributions, FSA scores, and report card grades.

Table 8

Intercorrelations Between Females' Grade Level, FSA Scores, Report Card Grades, Total Self-Efficacy, and Relative Self-Efficacy

Variable	1	2	3	4	5
1. Grade level	--				
2. FSA scores	-.184	--			
3. Report card grades	-.039	.556 **	--		
4. Total self-efficacy	-.208	.409 **	.232 *	--	
5. Relative self-efficacy	.005	-.532 **	-.288 **	.554 **	--

Note. * $p < .05$, ** $p < .01$

The researcher then examined the intercorrelations between males' grade level, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for the entire sample (see Table 9). As in the previous instances, the matrix revealed positive relationships between students' FSA scores and report card grades ($r = .631, p < .01$), between FSA scores and total self-efficacy ($r = .325, p < .01$), and between report card grades and total self-efficacy ($r = .475, p < .01$).

Once again, there were significant negative relationships between students' relative self-efficacy and FSA scores ($r = -.598, p < .01$) and between students' relative self-efficacy and report card grades ($r = -.153, p > .05$), although the correlation was not significant. Although both were not significant, there were also negative relationships between students' grade level and total self-efficacy ($r = -.075, p > .05$) and between students' grade level and FSA score ($r = -.091, p > .05$). Similar to the findings for the females, it may be that males' total self-efficacy and academic achievement worsen over time. Please refer to Appendix N for the intercorrelations between males' individual attributions, FSA scores, and report card grades.

Table 9

Intercorrelations Between Males' Grade Level, FSA Scores, Report Card Grades, Total Self-Efficacy, and Relative Self-Efficacy

Variable	1	2	3	4	5
1. Grade level	--				
2. FSA scores	-.091	--			
3. Report card grades	.016	.631 **	--		
4. Total self-efficacy	-.075	.325 **	.475 **	--	
5. Relative self-efficacy	.029	-.598 **	-.153	.563 **	--

Note. * $p < .05$, ** $p < .01$

The researcher then examined the intercorrelations between fourth-graders' sex, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for the entire sample (see Table 10). Once again, the matrix revealed positive relationships between students' FSA scores and report card grades ($r = .735, p < .01$), FSA scores and total self-efficacy ($r = .445, p < .01$), and between report card grades and total self-efficacy ($r = .548, p < .01$).

Again, there were significant negative relationships between students' relative self-efficacy and FSA scores ($r = -.529, p < .01$), between students' sex and report card grades ($r = -.239, p > .05$), and between students' relative self-efficacy and report card grades ($r = -.181, p > .05$), although it should be noted that the latter two relationships were not significant.

Table 10

Intercorrelations Between Fourth-Graders' Sex, FSA Scores, Report Card Grades, Total Self-Efficacy, and Relative Self-Efficacy

Variable	1	2	3	4	5
1. Sex	--				
2. FSA scores	-.180	--			
3. Report card grades	-.239	.735 **	--		
4. Total self-efficacy	-.034	.445 **	.548 **	--	
5. Relative self-efficacy	.155	-.529 **	-.181	.524 **	--

Note 1. For the sex variable, girls were coded 0, boys 1.

Note 2. * $p < .05$, ** $p < .01$

Finally, the researcher examined the intercorrelations between seventh-graders' sex, FSA scores, report card grades, total self-efficacy, and relative self-efficacy for the entire sample (see Table 11). Once again, the matrix revealed positive relationships between students' FSA scores and report card grades ($r = .511, p < .01$), FSA scores and total self-efficacy ($r = .288, p < .01$), and between report card grades and total self-efficacy ($r = .202, p < .01$).

Again, there were significant negative relationships between students' relative self-efficacy and FSA scores ($r = -.599, p < .01$), between students' sex and report card grades ($r = -.201, p < .05$), and between students' relative self-efficacy and report card grades ($r = -.269, p < .01$).

Table 11

Intercorrelations Between Seventh-Graders' Sex, FSA Scores, Report Card Grades, Total Self-Efficacy, and Relative Self-Efficacy

Variable	1	2	3	4	5
1. Sex	--				
2. FSA scores	-.066	--			
3. Report card grades	-.201 *	.511 **	--		
4. Total self-efficacy	.123	.288 **	.202 *	--	
5. Relative self-efficacy	.159	-.599 **	-.269 **	.595 **	--

Note 1. For the sex variable, girls were coded 0, boys 1.

Note 2. * $p < .05$, ** $p < .01$

Main Analyses

Two multivariate analyses of variance were computed for the purpose of determining if there were grade-level differences in the combination of students' motivation variables (success attributions, failure attributions, total self-efficacy, and relative self-efficacy) or their combined achievement variables (report card grades and FSA scores), respectively. Because the sample size was relatively small, the researcher posited that in the instance a MANOVA failed to reveal a significant main effect of students' grade level on a given set of measures, then the grade levels could be collapsed and independent t-tests could be performed to determine if the sexes differed on the related individual measures. The researcher suspected that collapsing the grades and grouping participants by their sex only (rather than both sex and grade level) would be advantageous in that the size of the groups would be larger, in turn, increasing statistical power in subsequent analyses. An alpha level of .05 was used for all statistical tests.

As mentioned previously, the researcher examined the intercorrelations between all 14 motivation variables and between both achievement variables for the entire sample, respectively. According to Tabachnick and Fidell (1996), MANOVAs work best with moderately-correlated dependent variables, and are "less attractive if correlations among the [dependent variables] are very high or very low" (p. 406). Pearson product moment correlation coefficients were examined for each attribution with the other motivation variables and moderate correlations were found.

Motivation variables. The first multivariate analysis of variance was performed on the motivation variables: all six success attributions (effort, strategy, ability, teacher's help, help from others, and task ease, respectively), all six failure attributions (lack of

effort, lack of strategy, lack of ability, lack of teacher's help, no help from others, and task difficulty, respectively), total self-efficacy, and relative self-efficacy. The independent variable was students' grade level (4 or 7). The results of the MANOVA revealed that the combined dependent variables were significantly related to students' grade level, Wilks' $\lambda = .795$, $F(14, 142) = 2.61$, $p < .01$.

According to Tabachnick and Fidell (1996), Wilks' Lambda represents the variance not accounted for by a linear combination of variables. For each statistically significant effect, the proportion of variance accounted for by the given combination of variables (η^2) is determined by subtracting the Wilks' Lambda value from one. This process is illustrated in Equation 4.

$$\eta^2 = 1 - \lambda \tag{4}$$

Thus, it was determined that 20.5% of the composite variable's variability could be attributed to students' grade level.

Subsequent univariate F-tests conducted on each of the 14 motivation variables suggested that there was a significant main effect of students' grade level on the composite variable on the basis of three particular variables: students attributions of effort for success ($F(1, 155) = 10.62$, $p = .001$), attributions of teachers' help for success ($F(1, 155) = 9.12$, $p < .005$), and total self-efficacy ($F(1, 155) = 4.01$, $p < .05$). Each of the other motivation variables failed to result in a significant univariate F score, implying that the main effect of students' grade level on the composite motivation variable did not result from any of the variables. Since the univariate F-tests suggested that students'

effort attributions for success, attributions of teachers' help for success, and total self-efficacy were significantly related to their grade level, the researcher did not collapse grade levels as planned at the outset. Rather, she performed three 2 x 2 (sex x grade level) analyses of variance for students' effort attributions for success, attributions of teachers' help for success, and total self-efficacy, respectively, to investigate the effect of both students' grade level and sex on each variable. Results of the ANOVAs showed that there was no significant main effect of gender on any variable, nor was there a significant sex x grade interaction in any instance. There was, however, a significant main effect of grade level on students' effort attributions for success and attributions of teachers' help for success, respectively, $F(1, 157) = 11.46, p = .001$, $F(1, 157) = 9.97, p < .01$. Although results of the univariate F-test suggested that the main effect of grade level on the composite motivation variable was related to students' total self-efficacy, the ANOVA results indicated that there was no significant effect of students' grade level, $F(1, 157) = 3.43, p = .066$. These results, however, should be interpreted with caution; since students' grade levels could not be collapsed in three instances, students were grouped by both sex and grade level, and a by-product of such grouping was relatively small sample sizes.

The researcher then calculated the Cohen's *d* effect size for each significant finding by subtracting the mean of one group ($\overline{X}_1$) from that of the other group ($\overline{X}_2$) and dividing the difference by the pooled standard deviation (SD_p). Thus, the effect sizes for effort attributions for success and for attributions of teachers' help for success were 0.52 and 0.53, respectively. According to Cohen (1988), these values represent medium effect sizes. Please refer to Equation 5 for an illustration of these steps.

$$d = (\overline{X}_1 - \overline{X}_2) / SD_p \quad (5)$$

As mentioned previously, univariate F-tests suggested that the main effect of students' grade level on the composite motivation variable was in all likelihood not due to 11 of the 14 motivation variables: four success attributions (strategy, ability, help from others, and task ease), all six failure attributions (lack of effort, lack of strategy, lack of teachers' help, no help from others, and task difficulty), and relative self-efficacy. As such, the researcher collapsed the grade levels and a series of independent samples t-tests were conducted to determine if the sexes differed on each measure, respectively. Results revealed that the sexes differed significantly on only two measures: attributing failure to a lack of teachers' help ($t(159) = 3.05, p < .01$) and relative self-efficacy ($t(156) = -1.98, p < .05$). Using the steps illustrated in Equation 5, the effect sizes were calculated to be 0.47 for attributing failure to a lack of teachers' help and 0.31 for relative self-efficacy. According to Cohen (1988), these values represent medium and small/medium effect sizes, respectively. Please refer to Tables 12 to 15 for the means and standard deviations of the motivation variables for female participants, male participants, fourth-graders, and seventh-graders, respectively.

Table 12

Means and Standard Deviations of Females' Motivation Variables

Variable	*M*	*SD*	*n*
Attributions for success			
Effort	3.20	1.36	81
Strategy	3.30	1.27	81
Ability	3.80	1.12	81
Teacher's help	3.32	1.47	81
Help from others	2.63	1.26	81
Task ease	3.43	1.22	81
Attributions for failure			
Lack of effort	3.02	1.40	81
Lack of strategy	2.31	1.34	81
Lack of ability	1.89	1.33	81
Lack of teacher's help	2.89	1.57	81
Lack of help from others	2.15	1.17	81
Task difficulty	2.81	1.33	81
Total self-efficacy	52.28	8.34	81
Relative self-efficacy	-0.17	1.10	81

Note. The higher an attribution's mean, the more important the attribution was in explaining students' success or failure.

Table 13

Means and Standard Deviations of Males' Motivation Variables

Variable	*M*	*SD*	*n*
Attributions for success			
Effort	3.10	1.51	80
Strategy	2.90	1.32	80
Ability	3.64	1.34	80
Teacher's help	3.63	1.40	80
Help from others	2.33	1.41	80
Task ease	3.38	1.43	80
Attributions for failure			
Lack of effort	2.71	1.50	80
Lack of strategy	2.39	1.54	80
Lack of ability	1.86	1.41	80
Lack of teacher's help	2.17	1.41	80
Lack of help from others	2.21	1.51	80
Task difficulty	2.87	1.50	79
Total self-efficacy	53.69	7.94	80
Relative self-efficacy	0.19	1.15	77

Note. The higher an attribution's mean, the more important the attribution was in explaining students' success or failure.

Table 14

Means and Standard Deviations of Fourth-Graders' Motivation Variables

Variable	*M*	*SD*	*n*
Attributions for success			
Effort	3.61	1.45	62
Strategy	3.39	1.32	62
Ability	3.82	1.36	62
Teacher's help	3.94	1.27	62
Help from others	2.36	1.46	62
Task ease	3.43	1.41	62
Attributions for failure			
Lack of effort	2.72	1.51	62
Lack of strategy	2.22	1.48	62
Lack of ability	1.98	1.55	62
Lack of teacher's help	2.35	1.51	62
Lack of help from others	2.31	1.56	62
Task difficulty	2.85	1.61	61
Total self-efficacy	54.54	7.89	62
Relative self-efficacy	0.00	1.05	61

Note. The higher an attribution's mean, the more important the attribution was in explaining students' success or failure.

Table 15

Means and Standard Deviations of Seventh-Graders' Motivation Variables

Variable	*M*	*SD*	*n*
Attributions for success			
Effort	2.86	1.36	99
Strategy	2.92	1.27	99
Ability	3.66	1.14	99
Teacher's help	3.18	1.47	99
Help from others	2.56	1.26	99
Task ease	3.39	1.28	99
Attributions for failure			
Lack of effort	2.96	1.42	99
Lack of strategy	2.43	1.42	99
Lack of ability	1.81	1.24	99
Lack of teacher's help	2.65	1.55	99
Lack of help from others	2.10	1.19	99
Task difficulty	2.84	1.28	99
Total self-efficacy	52.00	8.18	99
Relative self-efficacy	0.00	1.19	97

Note. The higher an attribution's mean, the more important the attribution was in explaining students' success or failure.

Achievement variables. The second multivariate analysis of variance was performed on the two achievement dependent variables: FSA scores and report card grades. Once again, the researcher sought to determine if there were grade-level differences in the students' combined achievement measures in order to make the decision whether or not grade levels could be collapsed. As such, the independent variable was once again students' grade level. The results suggested that there was no significant main effect of students' grade level on the composite achievement variable, Wilks' $\lambda = .972$, $F(2, 152) = 2.21$, $p > .05$. This finding implies that students' academic achievement is not related significantly to their grade level.

Consequently, the researcher collapsed the grades and conducted two independent samples t-tests to determine whether the sexes differed significantly in terms of FSA scores and report card grades, respectively. Results of the first t-test showed that boys' and girls' FSA performance was essentially the same ($t(156) = 1.09$, $p > .05$). Results of the second t-test, however, revealed that girls' report card grades were significantly higher than those of boys ($t(156) = 2.78$, $p < .01$). Using the steps illustrated in Equation 5, the effect size was calculated to be 0.43. According to Cohen (1988), this value represents a moderately small effect size. Please refer to Tables 16 to 19 for the means and standard deviations of both achievement variables for female participants, male participants, fourth-graders, and seventh-graders, respectively.

Table 16

Means and Standard Deviations of Females' Achievement Variables

Variable	*M*	*SD*	*n*
Report card grades	79.92	13.07	81
FSA scores	510.64	84.24	81

Table 17

Means and Standard Deviations of Males' Achievement Variables

Variable	*M*	*SD*	*n*
Report card grades	73.34	16.58	77
FSA scores	496.12	83.82	77

Table 18

Means and Standard Deviations of Fourth-Graders' Achievement Variables

Variable	*M*	*SD*	*n*
Report card grades	76.18	15.85	61
FSA scores	516.28	81.36	61

Table 19

Means and Standard Deviations of Seventh-Graders' Achievement Variables

Variable	*M*	*SD*	*n*
Report card grades	77.05	14.86	97
FSA scores	495.57	85.19	97

CHAPTER 5

Discussion

A number of studies show that boys' mathematics achievement has traditionally surpassed that of girls (e.g., Maccoby & Jacklin, 1974). The typical explanation given to explain the mathematics achievement gap between the sexes is that boys' and girls' achievement-related beliefs differ significantly (Stipek & Gralinski, 1991). In particular, these achievement differences have been ascribed to boys' and girls' differing performance attributions and perceptions of self-efficacy. In conducting the current study, the researcher sought to conduct a further test of various researchers' claims that sex differences in academic achievement are due to boys' and girls' differing achievement-related beliefs. The researcher conceived that, if achievement differences are in fact due to students' self-efficacy and attributions, then boys' and girls' achievement-beliefs should be the same when their academic achievement is also the same. Therefore, this study was designed to determine if the recent academic gains made by girls in mathematics have been met with heightened feelings of self-efficacy and more self-enhancing performance attributions. To this end, fourth- and seventh-grade students were surveyed about their mathematics success attributions, failure attributions, and perceptions of self-efficacy. In addition, participants' mathematics report card grades and scores on the Numeracy subtest of the 2001 Foundation Skills Assessment were collected.

As mentioned in a previous chapter, due to the relatively small sample size, the researcher had hoped to be able to collapse students' grade levels and to group students by their sex alone, rather than by their sex and grade level. A number of variables were

unaffected by students' grade level and, in those instances, the grades were collapsed and independent samples t-tests were performed. Various analyses, however, indicated that a number of variables were related significantly to students' grade level. In those instances, 2 x 2 (grade x sex) analyses of variance were performed.

In this chapter, the researcher presents a review of the results as they pertain to the objectives of the study. Second, the limitations of the current study are discussed and suggestions for future research are offered. Finally, the researcher presents her conclusions.

Achievement Findings

Girls' scores on the Numeracy subtest of the 2001 FSA were on average fourteen points higher than those of boys. Subsequent analyses, however, revealed that this gap between the sexes was not significant. This finding is consistent with those of previous studies (e.g., Hall, Davis, Bolen, and Chia, 1999).

Recent studies have shown that the mathematics achievement of girls meets or exceeds that of boys (e.g., Ministry of Education, 2000). Data collected from the participants of the current study indicated that girls' mean report card grade was over four percentage points higher than that of boys. Subsequent analyses of students' report card grades indicated that girls' achievement was significantly higher than that of boys.

Attributions for Mathematics Success

Students were asked to rate how important each of six attributions was in explaining their mathematics success: effort, strategy, ability, teachers' help, help from others, and task ease, respectively. Traditionally, research has shown that girls tend to ascribe the cause of their success to external factors (e.g., help from teachers) and effort,

whereas boys tend to ascribe their success to internal factors (e.g., ability). Attributing success to external factors has long been thought to relate to lower academic achievement, greater feelings of helplessness, and more self-deprecating perceptions of self-efficacy (Stipek, 1984).

Analyses of students' effort attributions for success did not verify the findings of traditional studies that report that girls tend to attribute their academic success to effort significantly more than boys do. Rather, boys and girls were equally likely to attribute their success to effort. While the sexes did not differ in their effort attributions, the researcher did discover that students' effort attributions were related significantly to their grade level. The results indicated that fourth-graders tended to ascribe the cause of their success to effort more than seventh-graders. One potential explanation for this finding is that younger children tend to view effort and ability as being equal, whereas older children tend to view effort and ability as being inversely related. Consequently, younger children tend to ascribe the cause of their success to effort (Stipek, 1993, as cited in Shell, Colvin, & Bruning, 1995).

The researcher expected that boys would attribute their success to strategy significantly more than girls would. Results revealed that boys did in fact attribute their success to strategy more than girls did, but this difference was not significant.

As a result of the large quantity of research that suggests that boys tend to ascribe the cause of their success to ability more than girls do, the researcher anticipated that the sexes would differ significantly in their ability attributions for success. Results did not substantiate this expectation. Rather, boys' and girls' ability attributions for success were approximately the same. It is noteworthy to mention that, on average, ability was the

attribution that both boys and girls rated as most important in explaining their success. Since ability attributions for success have been linked with higher academic achievement and enhanced perceptions of self-efficacy, this finding challenges Stipek and Gralinski's (1991) claim that girls' attributional patterns are more self-defeating than those of boys.

Analysis of students' attributions of help from teachers for their success revealed that the sexes did not differ significantly on this measure. While students' sex did not have an impact on the importance they gave this attribution in explaining their success, students' grade level did. More specifically, fourth-graders were significantly more likely than seventh-graders to attribute their success to help from their teachers. A possible explanation for this finding is that fourth-graders may tend to be less autonomous and to rely on their teachers more than their older counterparts, resulting in fourth-graders' attributing their success to their teachers' help more than seventh-graders. Future research should investigate this issue to a fuller extent.

The researcher then compared boys' and girls' use of the "help from others" attribution in explaining their academic success. Results revealed that boys and girls did not differ significantly on this measure.

As mentioned in the second chapter, a great deal of research reports that girls tend to ascribe the cause of their academic success to task ease or luck considerably more than boys do. Contrary to these studies' findings, results of the current study indicated that boys and girls did not differ significantly in their attributing success to task ease.

Attributions for Mathematics Failure

Students were also asked to rate how important each of six common attributions were in explaining their mathematics failure: lack of effort, lack of strategy, lack of

ability, lack of teachers' help, no help from others, and task difficulty, respectively. Traditionally, research has shown that girls tend to ascribe the cause of their failure to a lack of ability, whereas boys tend to ascribe their success to external factors (e.g., no help from teachers) and a lack of effort. Attributing failure to a lack of ability has long been thought to relate to lower academic achievement, greater feelings of helplessness, and more self-deprecating perceptions of self-efficacy (Stipek, 1984). In the next section of this chapter, each failure attribution is discussed individually.

Consistent with the findings of various studies discussed in a previous chapter, the researcher expected boys to attribute their failure to a lack of effort significantly more than girls would. Results did not meet this expectation. Rather, the importance both boys and girls gave a lack of effort in explaining their failure in mathematics was approximately the same. It should be noted that effort was the attribution that girls, on average, reported as being most important in explaining their academic failure.

The researcher then compared boys' and girls' use of the "lack of strategy" attribution in explaining their academic failure. Results revealed that boys and girls did not differ significantly on this measure.

A wealth of literature reports that girls tend to ascribe the cause of their failure to within-person factors, like a lack of ability. Attributing failure to a lack of ability has long been thought to be harmful to students' sense of efficacy, task persistence, and academic achievement (Stipek, 1984). As a result, the researcher expected that girls would attribute their failure to a lack of ability significantly more than boys would. Results revealed that the importance boys and girls gave a lack of ability in explaining their academic failure did not differ significantly.

The researcher then compared boys' and girls' use of the "lack of teachers' help" attribution in explaining their academic failure. Results revealed that girls were more apt to attribute their failure to a lack of teachers' help than were boys.

Next, the researcher compared the sexes' use of the "lack of help from others" attribution in explaining their academic failure. Results revealed that boys and girls did not differ significantly on this measure.

Analysis of the "task difficulty" attribution indicated that there was no significant difference in boys' and girls' use of this attribution in explaining their academic failure. It should be noted that task difficulty was, on average, the attribution that boys regarded as being most important in explaining their academic failure.

Mathematics Self-Efficacy

A large volume of studies (e.g., Randhawa, 1994) indicates that traditionally girls have held more self-defeating perceptions of mathematics self-efficacy than have boys. Girls' relatively lower perceptions of self-efficacy, despite recent findings that girls' mathematics achievement surpasses that of boys, have been thought to explain the relatively small number of females enrolled in college- and university-level mathematics courses and in mathematics-related careers (Pajares, 1996b). In the current study, the researcher examined participants' total self-efficacy and their self-efficacy relative to their academic achievement.

Results of the motivation MANOVA suggested that there was a significant main effect of students' grade level on the basis of their total self-efficacy. As a result, the grade levels were not collapsed, and a 2 x 2 (grade x sex) ANOVA was performed. Analyses determined that boys' and girls' total self-efficacy did not differ significantly.

Fourth-graders, however, tended to be more efficacious than seventh-graders. The latter findings have been observed elsewhere (Paris & Oka, 1986, as cited in Shell, Colvin, & Bruning, 1995).

A number of researchers have suggested that boys tend to display overconfidence relative to their actual academic achievement, while girls tend to display relative underconfidence (e.g., Hackett & Betz, 1989). As such, in addition to examining students' total self-efficacy, the researcher calculated an index of relative efficacy for each of the participants. Doing so allowed the researcher to determine the degree to which participants held efficacy perceptions incongruent with their academic achievement. Similar to the findings of Hackett and Betz (1989), results revealed that girls tended to be underconfident relative to their actual academic achievement and that boys tended to be relatively overconfident. This finding suggests that, despite the current study's results that demonstrate relative gains for girls in terms of their attributional thinking and despite the finding that girls' academic achievement meets or exceeds that of boys, girls are still underconfident of their abilities in comparison to boys.

As mentioned in the previous chapter, the researcher noted that the relationship between students' relative self-efficacy and their FSA scores was negative for the entire sample, between sexes, and between grade levels, respectively. These findings imply that academic achievement may be affected negatively when students are either underconfident or overconfident of their abilities.

Future Research

Researchers interested in replicating or modifying the current study should address various limitations. First, only fourth- and seventh-graders participated in the

study; the FSA, however, is administered to tenth-graders, as well. A number of studies have demonstrated that sex differences in students' achievement-related beliefs undergo developmental change from elementary to secondary school (Shell, Colvin, & Bruning, 1995), and are most pronounced during late adolescence. Having only fourth- and seventh-graders in the study may explain why there were relatively few significant differences between girls' and boys' achievement-related beliefs. As a result, researchers should consider including tenth-grade students in their studies to investigate to a fuller extent the degree to which students' academic achievement and achievement-related beliefs change - or remain stable - over time.

A second limitation pertains to the administration of the self-efficacy scale. As mentioned in an earlier chapter, the researcher asked students to report their perceived confidence according to various sample FSA questions typed in individual paper booklets. Various attempts were made to ensure that children looked at each FSA question for no more than twenty seconds. For example, the researcher (a) used a stopwatch to monitor accurately students' viewing time per question, (b) required that students close the booklets after each twenty-second viewing time, and (c) had children re-open question booklets when instructed by the researcher. While the researcher was satisfied that these steps ensured a standard administration of the scale from classroom to classroom, it may be worthwhile to place sample FSA questions one by one on an overhead projector. Doing so would ensure that children are looking at each question for only the allotted time. Not all classrooms included in the study were equipped with overhead projects or otherwise this step would have been taken by the researcher. By default, the individual booklets containing the sample FSA questions were created.

A third limitation of the current study pertains to the attribution scale. The scale required that students indicate the degree to which each of six attributions was important in explaining their academic successes or failures, respectively. Although the scale was comprised of some of the most common attributions given by children in explaining their academic performance, it is possible that the particular attribution a student rated as being "most important" on the scale may not have been indeed his of her true and dominant attribution. For example, one participant informed the researcher that his dominant reason for failure in mathematics was that he tended to rush and make "stupid mistakes". For this reason, researchers should consider including a greater variety of attributions on the scale.

Furthermore, consistent with the stance taken by many attribution researchers, the researcher of the current study classified each attribution as being either internal or external. According to Weiner (1983), however, attributions may vary according to three "dimensions of causality": locus, stability, and controllability. Locus refers to whether the location of the cause is within the person (internal) or outside the individual (external). The locus dimension is the one in which each attribution was viewed. Stability refers to "the temporal nature of a cause" (Weiner, 1983, p. 531) and, more specifically, whether the cause of a behaviour is viewed to be relatively enduring or variable across situations or from moment to moment (Weiner, 1983). Using this definition, attributing mathematics failure to a lack of ability could be considered an example of a stable attribution, as an individual's abilities tend to remain constant over time. Conversely, attributing mathematics success to effort could be considered an example of an unstable attribution, as an individual's efforts tend to vary from situation

to situation. Finally, controllability refers to whether or not an individual can exert choices over a cause. For example, attributing mathematics success to effort could be an example of a controllable cause, in that an individual decides to focus efforts on achieving a task. Conversely, uncontrollability may be illustrated by students' attributing their failure to a lack of ability in that it can be argued that a student has little if any control of his or her aptitude. It is important to note that each of the attributions that appeared on the scale has aspects of all three dimensions.

Ultimately, the classification of students' attributions on the basis of their locus of causality alone provides only limited information about the attributional patterns of girls and boys, and implies that the internal-external dimension is the most important dimension in understanding students' achievement-related beliefs. Future studies should compare students on the basis of all three of Weiner's dimensions.

A fifth limitation pertains to the format of the numeracy questions included in the 2001 FSA. As the sample FSA items in Appendices I and J illustrate, numeracy questions included in the assessment are typically posed with a great deal of accompanying text. According to Maccoby and Jacklin (1974), when mathematics-related questions are posed in such a manner, it may be that the test is assessing verbal skills, rather than mathematical skills exclusively. This may have a negative impact on the performance of boys, whose reading and writing achievement has typically been surpassed by that of girls (Wentzel, 1988). Future research should examine this issue more closely.

Conclusions

Overall, results of the current study are promising in terms of girls' mathematics performance for several reasons. First, results confirmed that girls' achievement in mathematics meets or exceeds that of boys. Second, it seems that there have been relative gains for girls in terms of their attributional thinking. More specifically, it appears that girls' success and failure attributions tended to be more self-enhancing than reported in traditional attribution research. Boys' success and failure attributions were also relatively self-enhancing. These results seem to challenge those of previous studies that claim that girls espouse more self-defeating attributional styles than boys. According to Hill and Augoustinos (1997), less emphasis should be placed on such studies because they are based on research conducted twenty years ago. Since that time, they argue, girls' achievement-related beliefs have changed dramatically. Results of the current study seem to support this view.

Despite gains for girls in terms of their attributional styles, educators, parents, and researchers alike should be concerned about the finding that girls tend to be underconfident of their mathematics ability relative to their actual achievement, while boys tend toward overconfidence. According to Shell, Colvin, and Bruning (1995), perceptions of ability become more accurate with students' increasing age, so it may be that the relative efficacy findings are related significantly to the age of the children. Nonetheless, for girls' and boys' academic potentials to be maximised, it is imperative that students' achievement-related beliefs are commensurate with their actual academic achievement. Future studies should investigate the specific reasons underlying girls'

underconfidence and boys' overconfidence relative to their actual mathematics achievement.

References

Aksu, M. (1997). Student performance in dealing with fractions. *Journal of Educational Research, 90*(6), 375-380.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (2001). *Guide for constructing self-efficacy scales (Revised).* Available from Frank Pajares, Emory University.

Basow, S.A., & Medcalf, K. (1988). Academic achievement and attributions among college students: Effects of gender and sex typing. *Sex Roles, 19*(9/10), 555-567.

Beyer, S. (1998/1999). Gender differences in causal attributions by college students of performance on course examinations. *Current Psychology: Developmental, Learning, Personality, Social, 17*(4), 346-358.

Bradberry, J.S. (1989). Gender differences in mathematical attainment at 16+. *Educational Studies, 15*(3), 301-314.

Brandon, P.R., Newton, B.J., Hammond, O.W. (1987). Children's mathematics achievement in Hawaii: Sex differences favoring girls. *American Educational Research Journal, 24*(3), 437-461.

Bulcock, J.W., Whitt, M.E., & Beebe, M.J. (1991). Gender differences, student well-being, and high school achievement. *The Alberta Journal of Educational Research, 37*(3), 209-224.

Callas, D. (1993). Differences in mathematics achievement between males and females. *Community College Review, 21*(3), 62-67. Retrieved January 27, 2002, from the EBSCOhost database.

Campbell, J.R. (1991). The roots of gender inequity in technical areas. *Journal of Research in Science Teaching, 28*(3), 251-264.

Campbell, N.K., & Hackett, G. (1986). The effects of mathematics task performance on math self-efficacy and task interest. *Journal of Vocational Behavior, 28,* 149-162.

Chandler, T.A., Shama, D.D., & Wolf, F.M. (1983). Gender differences in achievement and affiliation attributions: A five-nation study. *Journal of Cross-Cultural Psychology, 14*(2), 241-256.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum, Associates.

Eccles, J.S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11,* 135-172.

Eccles, J.S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly, 18,* 585-609.

Fan, X., & Chen, M. (1997). Gender differences in mathematics achievement: Findings from the National Education Longitudinal Study of 1988. *Journal of Experimental Education, 65*(3), 229-242.

Feingold, A. (1993). Cognitive gender differences: A developmental perspective. *Sex Roles, 29*(1/2), 91-112.

Friedman, L. (1989). Mathematics and the gender gap: A meta-analysis of recent studies on sex differences in mathematical tasks. *Review of Educational Research, 59*(2), 185-213.

Georgiou, S.N. (1999). Achievement attributions of sixth grade children and their parents. *Educational Psychology, 19*(4), 399-412.

Glasgow, K.L., Dornbusch, S.M., Troyer, L., & Steinberg, L. (1997). Parenting styles, adolescents' attributions, and educational outcomes in nine heterogeneous high schools. *Child Development, 68*(3), 507-529.

Graham, S. (1991). A review of attribution theory in achievement contexts. *Educational Psychology Review, 3*(1), 5-39.

Hackett, G., & Betz, N.E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education, 20*(3), 261-273.

Hackett, G., Betz, N.E., Casas, J.M., & Rocha-Singh, I.A. (1992). Gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering. *Journal of Counseling Psychology, 39*(4), 527-538.

Hackett, G., Betz, N.E., O'Halloran, M.S., & Romac, D.S. (1990). Effects of verbal and mathematics task performance on task and career self-efficacy and interest. *Journal of Counseling Psychology, 37*(2), 169-177.

Hackett, G., & Campbell, N.K. (1987). Task self-efficacy and task interest as a function of performance on a gender neutral task. *Journal of Vocational Behavior, 30,* 203-215.

Hall, C.W., Davis, N.R., Bolen, L.M., & Chia, R. (1999). Gender and racial differences in mathematical performance. *Journal of Social Psychology, 139*(6), 677-689.

Heller, K.A., & Ziegler, A. (1996). Gender differences in mathematics and the sciences: Can attributional retraining improve the performance of gifted females? *Gifted Child Quarterly, 40*(4), 200-210.

Hill, M.E., & Augoustinos, M. (1997). Re-examining gender bias in achievement attributions. *Australian Journal of Psychology, 49*(2), 85-90.

Hyde, J.S. (1993). Gender differences in mathematics ability, anxiety, and attitudes: What do meta-analyses tell us? In L.A. Penner, G.M. Batsche, H.M. Knoff, & D.L. Nelson (Eds.), *The challenge in mathematics and science education: Psychology's response* (pp. 237-249). Washington, DC: American Psychological Association.

Hyde, J.S., Fennema, E., & Lamon, S.J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin, 107*(2), 139-155.

Jinks, J., & Morgan, V. (1999). Children's perceived academic self-efficacy: An inventory scale. *Clearing House, 72*(4), 224-230. Retrieved February 10, 2002, from the EBSCOhost database.

Junge, M.E., & Dretzke, B.J. (1995). Mathematical self-efficacy gender differences in gifted/talented adolescents. *Gifted Child Quarterly, 39*(1), 22-28.

Kianian, A.M. (1996). Gender and mathematics achievement parity: Evidence from post-secondary education. *Education, 116*(4), 586-591.

Lent R.W., Lopez, F.G., & Bieschke, K.J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology, 38*(4), 424-430.

Lent, R.W., Lopez, F.G., & Bieschke, K.J. (1993). Predicting mathematics-related choice and success behaviors: Test of an expanded social cognitive model. *Journal of Vocational Behavior, 42,* 223-236.

Leung, J.J., Maehr, M.L., & Harnisch, D.L. (1996). Some gender differences in academic motivational orientations among secondary school students. *Educational Research Quarterly, 20*(2), 17-32.

Li, A.K.F., & Adamson, G. (1995). Motivational patterns related to gifted students' learning of mathematics, science, and English: An examination of gender differences. *Journal for the Education of the Gifted, 18*(3), 284-297.

Lightbody, P., Siann, G., Stocks, R., & Walsh, D. (1996). Motivation and attribution at secondary school: The role of gender. *Educational Studies, 22*(1), 13-25.

Lopez, F.G., Lent, R.W., Brown, S.D., & Gore, P.A, Jr. (1997). Role of social-cognitive expectations in high school students' mathematics-related interest and performance. *Journal of Counseling Psychology, 44*(1), 44-52.

Maccoby, E.E., & Jacklin, C.N. (1974). *The psychology of sex differences.* Stanford, CA: Stanford University Press.

Malpass, J.R., O'Neil, H.F., Jr., & Hocevar, D. (1999). Self-regulation, goal orientation, self-efficacy, worry, and high-stakes math achievement for mathematically gifted high school students. *Roeper Review, 21*(4), 281-288.

Marsh, H.W., Roche, L.A., Pajares, F., & Miller, D. (1997). Item-specific efficacy judgments in mathematical problem solving: The downside of standing too close to trees in a forest. *Contemporary Educational Psychology, 22,* 363-377.

Marsh, H.W., & Yeung, A.S. (1998). Longitudinal structural equation models of academic self-concept and achievement: Gender differences in the development of math and English constructs. *American Educational Research Journal, 35*(14), 705-738.

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior, 37,* 225-238.

Ministry of Education. (n.d.). *District information profile for school year 1999/2000: School District 62.* Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/statistics/sdprofiles/062.pdf

Ministry of Education. (2000). *British Columbia Foundation Skills Assessment 2000: Highlights*. Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/00_highlights.pdf

Ministry of Education. (2001a). *Foundation Skills Assessment: Information for students, parents and guardians*. Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/en_brochure.pdf

Ministry of Education. (2001b). *FSA 2001 Numeracy Specifications.* Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/numeracy_specs.pdf

Ministry of Education. (2001c). *2001 Foundation Skills Assessment: Instructions for teachers/invigilators*. Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/teacher_guide.pdf

Ministry of Education. (2001d). *2001 Foundation Skills Assessment: Instructions for school/district administrators*. Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/admin_guide.pdf

Ministry of Education. (2001e). *Interpreting and communicating British Columbia Foundation Skills Assessment results 2001*. Retrieved November 24, 2001, from http://www.bced.gov.bc.ca/assessment/fsa/01interpret.pdf

Murray, C.B., & Warden, M.R. (1991). Implications of self-handicapping strategies for academic achievement: A reconceptualization. *The Journal of Social Psychology, 132*(1), 23-37.

Okolo, C.M., Bahr, C.M., & Gardner, J.E. (1995). Increasing achievement motivation of elementary school students with mild disabilities. *Intervention in School and Clinic, 30*(5), 279-286, 312.

Otto, P.B. (1991). One science, one sex? *School Science and Mathematics, 91,* 367-372.

Pajares, F. (1996a). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*(4), 543-578.

Pajares, F. (1996b). Self-efficacy beliefs and mathematical problem-solving of gifted students. *Contemporary Educational Psychology, 21,* 325-344.

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology, 24,* 124-139.

Pajares, F., & Kranzler, J. (1995). Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemporary Educational Psychology, 20,* 426-443.

Pajares, F., & Miller, M.D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology, 86*(2), 193-203.

Pajares, F., & Miller, M.D. (1995). Mathematics self-efficacy and mathematics performances: The need for specificity of assessment. *Journal of Counseling Psychology, 42*(2), 190-198.

Pajares, F., & Valiante, G. (1999). Grade level and gender differences in the writing self-beliefs of middle school students. *Contemporary Educational Psychology, 24,* 390-405.

Petiprin, G.L., & Johnson, M.E. (1990). Effects of gender, attributional style, and item difficulty on academic performance. *The Journal of Psychology, 125*(1), 45-50.

Randhawa, B.S. (1991). Gender differences in academic achievement: A closer look at mathematics. *The Alberta Journal of Educational Research, 37*(3), 241-257.

Randhawa, B.S. (1994). Self-efficacy in mathematics, attitudes, and achievement of boys and girls from restricted samples in two countries. *Perceptual and Motor Skills, 79,* 1011-1018.

Randhawa, B.S., & Hunt, D. (1987). Sex and rural-urban differences in standardized achievement scores and mathematics subskills. *Canadian Journal of Education, 12*(1), 137-151.

Ryckman, D.B., & Peckham, P. (1987). Gender differences in attributions for success and failure situations across subject areas. *Journal of Educational Research, 81*(2), 120-125.

Sayers, R. (1994). Gender differences in mathematics education in Zambia. *Educational Studies in Mathematics, 26,* 389-403.

Schunk, D.H. (1984). Sequential attributional feedback and children's achievement behaviors. *Journal of Educational Psychology, 76*(6), 1159-1169.

Schunk, D.H., & Cox, P.D. (1986). Strategy training and attributional feedback with learning disabled students. *Journal of Educational Psychology, 78*(3), 201-209.

Schunk, D.H., & Gunn, T.P. (1986). Self-efficacy and skill development: Influence of task strategies and attributions. *Journal of Educational Research, 79*(4), 238-244.

Shell, D.F., Colvin, C., & Bruning, R.H. (1995). Self-efficacy, attribution, and outcome expectancy mechanisms in reading and writing achievement: Grade-level and achievement-level differences. *Journal of Educational Psychology, 87*(3), 386-398.

Siann, G., Lightbody, P., Stocks, R., & Walsh, D. (1996). Motivation and attribution at secondary school: The role of ethnic group and gender. *Gender and Education, 8,* 261-274.

Skaalvik, E.M., & Rankin, R.J. (1994). Gender differences in mathematics and verbal achievement, self-perception and motivation. *British Journal of Educational Psychology, 64*(3), 419-428.

Stipek, D.J. (1984). Sex differences in children's attributions for success and failure on math and spelling tests. *Sex Roles, 11*(11/12), 969-981.

Stipek, D.J. (1993). *Motivation to learn: From theory to practice* (2nd ed.). Needham Heights, MA: Allyn and Bacon.

Stipek, D.J., & Gralinski, J.H. (1991). Gender differences in children's achievement-related beliefs and emotional responses to success and failure in mathematics. *Journal of Educational Psychology, 83*(3), 361-371.

Sweeney, P.D., Moreland, R.L., & Gruber, K.L. (1982). Gender differences in performance attributions: Students' explanations for personal success or failure. *Sex Roles, 8*(4), 359-373.

Tabachnick, B.G., & Fidell, L.S. (1996). *Using multivariate statistics* (3rd ed.). New York: Harper Collins College Publishers.

Tartre, L.A., & Fennema, E. (1995). Mathematics achievement and gender: A longitudinal study of selected cognitive and affective variables grades 6-12. *Educational Studies in Mathematics, 28*(3), 199-217.

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, 71*(1), 3-25.

Weiner, B. (1983). Some methodological pitfalls in attributional research. *Journal of Educational Psychology, 75*(4), 530-543.

Weiner, B. (1986). *An attributional theory of motivation and emotion.* New York: Springer-Verlag.

Wentzel, K.R. (1988). Gender differences in math and English achievement: A longitudinal study. *Sex Roles, 18*(11/12), 691-699.

Williams, J.E. (1994). Gender differences in high school students' efficacy-expectation/performance discrepancies across four subject matter domains. *Psychology in the Schools, 31*(3), 232-237.

Appendix A

Certificate of Approval from Human Research Ethics Committee

University of Victoria
Human Research Ethics Committee

CERTIFICATE OF APPROVAL

PRINCIPAL INVESTIGATOR	DEPARTMENT/SCHOOL	SUPERVISOR
Jennifer E.V. Lloyd **Graduate Student**	**EPLS**	**Dr. John Walsh**

CO-INVESTIGATOR(S):

TITLE: **The Effect of Gender on Attributional Style, Perceived Self-Efficacy, and Academic Achievement in Mathematics**

PROJECT NO.	START DATE	END DATE	APPROVAL
041-01	**3/15/2001**	**3/14/2002**	**3/15/2001**

CERTIFICATION

This is to certify that the University of Victoria Ethics Review Committee on Research and Other Activities Involving Human Subjects has examined the research proposal and concludes that, in all respects, the proposed research meets appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Subjects.

[redacted]

J. Howard Brunt,
Associate Vice-President, Research

This Certificate of Approval is valid for the above term provided there is no change in the procedures. Extensions/minor amendments may be granted upon receipt of "Request for Continuing Review or Amendment of an Approved Project" form.

OFFICE OF VICE PRESIDENT RESEARCH
Room 424, Business & Economics Building
P.O. Box 1700
Victoria, BC V8W 2Y2

Tel: (250) 472-4362
Fax: (250) 721-8960
E-mail: ovprre@uvic.ca

Lloyd, Jennifer E.
041-01

Appendix B

Letter of Permission from the District

(Janice Foulger is the secretary for the district superintendent, David Drummond)

From:	Janice Foulger
To:	jevlloyd@hotmail.com
Subject:	Permission granted to conduct study
Date:	Fri, 03 Nov 2000 09:44:33

Hi Jennifer,

Dave has spoken to the principals of the schools that will be participating in your study. He has given his ok for you to carry on with your project. Good luck and don't forget to send us a copy of your completed study.

Cheers,

Janice

Appendix C

Letter of Permission from Ministry of Education

I accept that the expiry date for access to the records in Part C is the date as listed by the Ministry of Education below.

I agree that I am bound by the terms and conditions contained in this agreement.

Signed at **Victoria** on this **21st day of September, 2001**.

[redacted] [redacted]

Name and Position of Witness

Dr. John Walsh, Associate Professor
c/o University of Victoria
Department of Educational Psychology and Leadership Studies
P.O. Box 3010
Victoria, BC
V8W 3N4
(250) 721-7791
walshj@uvvm.uvic.ca

Part E – Approval of Terms and condition (to be competed by the Ministry of Education)

The Ministry of Education approves the terms and conditions of this agreement under which the Ministry of Education grants access to the researcher.

The expiry date for access to the records listed in Part C is:

2003/11/01
(Year/Month/Day)

[redacted]

Position: A/Director Date: October 23/01

Appendix D

Presentation to Students

Hi everybody,

My name is Jennifer Lloyd, and I am a student at the University of Victoria. I am working on my Master's of Arts degree in Educational Psychology. I am here today to talk to you a little bit about some research that I am doing. I'd also like to know if you could help me with my research. Before I tell you more, though, I would like you to know that your participation in this project is completely voluntary. So, if you don't want to participate, you don't have to.

I am interested in how students' feelings and thoughts about mathematics affect their achievement in mathematics. So, I've designed a research project around my interest. If you decide to help me, I am going to compare your feelings about mathematics to your report card grades in mathematics (that is the grades given by your teachers) and to your scores on the Foundation Skills Assessment, which is the big test you'll all be writing in May. You may know that the Foundation Skills Assessment is a test that all students in grades 4, 7, and 10 complete, and it helps to evaluate students' reading, writing, and mathematics skills.

If you decide to help me, I'm going to ask that you fill out two short questionnaires about your feelings toward math. As well, if you decide to participate, I'll have to get your permission to get your mathematics grades (both the report card grades and your score on the FSA). All of the information I get from you will be confidential, which means that only my research supervisor, Ministry of Education personnel, and I will see it. No one else will be able to see the information you give me. I'm going to use this information in my school project, but remember that your name will kept private.

I have some handouts for you today. Please take them home and have your parents or guardians look read them with you. To participate, I must have you and your parents or guardians sign a permission form. This permission form has to be returned to your teacher by next week, [date].

Does anyone have any questions?

Appendix E

Consent Package

Dear Parents/Guardians:

Your child is being invited to participate in a study entitled "Feelings About Mathematics" that is being conducted by me, Jennifer Lloyd. I am a graduate student in the department of Educational Psychology at the University of Victoria and you may contact me if you have further questions by emailing me at jevlloyd@hotmail.com or calling me, through my supervisor, at (250) 721-7791.

As a graduate student, this research is part of the requirements for a Master's of Arts degree and it is being conducted under the supervision of Dr. John Walsh, Associate Professor, in the University of Victoria's department of Educational Psychology. You may contact my supervisor at the above phone number.

The purpose of this research project is to investigate the relationship between students' achievement in mathematics and their feelings and thoughts about mathematics. Research of this type is important because helps us better understand the relationship between students' self-perceptions and their academic achievement.

Your child is being asked to participate in this study because the study will be conducted with students in Grades 4 and 7, in your child's district.

If your child agrees to voluntarily participate in this research, your child's participation will include: (a) filling out a scale about students' perceived reasons for their mathematics performance. In other words, students will be asked to report whether they believe their mathematics success or failure is due to internal reasons (e.g., skill, ability, effort) or external reasons (e.g., teacher, luck, help from others); (b) filling out a scale about students' perceived level of competence or skill in mathematics; (c) providing consent for me to obtain their spring report card grades; and (d) providing consent for me to obtain their Foundation Skills Assessment (FSA) scores. The FSA is a test that the Ministry of Education requires grades 4, 7, and 10 students to write in May, 2001.

Participation in this study may cause an inconvenience to your child because twenty-five minutes of class time will be required to administer the scales. There are no known or anticipated risks to you by participating in this research.

The potential benefit of your child's participation to the state of knowledge includes a better understanding of the relationship between students' self-perceptions and their academic achievement.

Your child's participation in this research must be completely voluntary. If your child decides to participate, he or she may withdraw at any time without any consequences or any explanation. If your child does withdraw from the study, his or her data will be included in the study only if your child and you agree to it. If your child participates in this study, that participation will not reflect positively on the grades or services students receive. In other words, there are no rewards for students who choose to participate. Conversely, students who choose not to participate will not experience any punishment, nor will their lack of participation reflect negatively on the grades or services they receive.

To make sure that your child continues to consent to participate in this research, I will periodically remind participants of the terms of their participation during the course of data collection. In other words, I will remind them that their participation is completely voluntary and that they are free to terminate their participation at any time.

In terms of protecting your child's anonymity, students' mathematics grades and scale responses will be seen only by my thesis supervisor and me. As well, individuals' names will not be included in any presentation or paper that results from this research. Rather, students will be identified by numbers only.

Your child's confidentiality and the confidentiality of the data will be protected by keeping all scales, documents, disks, and transcripts in a locked filing cabinet. As well, all data will be available only to my supervisor and me.

I hope to use the results of this study in three ways: 1) in my thesis; 2) in a publication my supervisor and I intend to create from this study; and 3) in a presentation I will do for the Ministry of Education and the district after the conclusion of the study.

The data from this study will be destroyed in November, 2001, by shredding paper records and electronically deleting computer files.

In addition to being able to contact my supervisor and me at the above phone number, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Associate Vice President Research at the University of Victoria (250) 721-7968.

Your signature on the last page of this booklet indicates that you understand the above conditions of your child's participation in this study and that you have had the opportunity to have your questions answered by me.

Dear Students:

You are invited to participate in a study that is being done by me, Jennifer Lloyd. I am a graduate student in the department of Educational Psychology at the University of Victoria and you may call me (through my supervisor) at (250) 721-7791 or email me at

jevlloyd@hotmail.com if you have any questions. I am doing this study so I can earn a Master's of Arts degree. Dr. John Walsh is my supervisor and he works in the University of Victoria's department of Educational Psychology.

With this project, I want to look at the relationship between students' achievement in mathematics and their feelings and thoughts about mathematics. This study is important because it looks at the relationship between students' feelings and thoughts about mathematics and their mathematics achievement.

You are being asked to participate in this study because the study will be conducted with students in Grades 4 and 7, in your district.

If you choose to volunteer to help me with this research, I will ask you to: (a) fill out a survey about whether you believe your mathematics success or failure is due to reasons inside of you (e.g., skill, ability, effort) or outside of you (e.g., teacher, luck, help from others); (b) fill out a scale about what you think your skill level in mathematics is; (c) give me permission to get your spring report card grades from your school; (d) give me permission to get your Foundation Skills Assessment (FSA) scores. The FSA is a test that the Ministry of Education requires you to write in May, 2001.

If you decide to help me, I'd like you to know that twenty-five minutes of class time will be required to have you fill out the surveys. No danger or harm will come to you if you decide to help me.

Your participation in this research must be completely voluntary, which means that if you don't want to participate, you don't have to. If you decide to participate, you can stop your participation at any time without any consequences or any explanation. If you do withdraw from the study, your information will be included in the study only if you and your parent/guardian agree to it. To make sure that you continue to want to help me with this research, I will remind you and your classmates that your participation is completely voluntary and that you are free to stop your participation at any time. If you choose to help me with this study, your participation will not result in higher grades or better services from the school. If you choose not to participate, there will be no punishment, and your lack of participation will not mean lower grades or services you receive.

I will keep your names, your math scores, and your survey answers private, and only my supervisor and I will see all information. As well, your name will not be included in any presentation or paper that results from this research. Rather, I will make up a number to identify you.

Your privacy and the privacy of the information I collect will be protected by keeping all information in a locked filing cabinet. As well, all data will be available only to my supervisor and me.

I hope to use the results of this study in three ways: 1) in my school project; 2) in an article my supervisor and I will write about this study; and 3) in a presentation I will do for the Ministry of Education and the district after this study ends.

The data from this study will be destroyed in November, 2001, by shredding paper records and electronically deleting computer files.

In addition to being able to contact my supervisor and me at the above phone number, your parent or guardian and you may make sure my study has been approved by the university, or make any comments, by contacting the Associate Vice President Research at the University of Victoria (250) 721-7968.

Students & Parents/Guardians:

Your signature on the last page of this booklet tells me that you understand the study, that you know the conditions about your participation in this study, and that you have had the opportunity to have your questions answered by me.

Please complete the parent/guardian consent section of this form and have your child complete the student consent section and return them (attached) to [the school's main office or the student's teacher] by [insert date here], even if you do not wish your child to participate in this study and/or your child does not want to participate. Thank you, Jennifer Lloyd

---------- ✂ ----------

Parents/Guardians:

I do / do not (circle one) give permission for _____ (student's full name) to participate in the "Feelings About Mathematics" project as described in the attached letter.

Parent's/Guardian's Name (please print) _____

Parent's/Guardian's Signature _____

Date _____

Name of school _____

Students:

I do / do not (circle one) agree to join the "Feelings About Mathematics" project as described in the attached letter.

Student's Name (please print) _____

Student's Signature _____

Appendix F

Cover Sheet of Scales

Last name: _____

First & middle names: _____

Birth date: Year: _____ Month: _____ Day: _____

School: _____

Teacher's name: _____

Today's date: _____

Sex (please circle one): Female Male

What grade are you in? _____

STUDENTS – PLEASE DO NOT FILL OUT THIS SECTION

Spring 2001 Math Report Card Grade _____

PEN: _____

Appendix G

Attribution Scale

Question 1: When I do well in math, it is usually because:

	Reason:	This is not why I did well.		This is kind of why I did well.		This is the most important reason why I did well.	Rank:
Row A	**I studied hard.**	1	2	3	4	5	
Row B	**I studied the right things.**	1	2	3	4	5	
Row C	**I am smart.**	1	2	3	4	5	
Row D	**The teacher explained things well.**	1	2	3	4	5	
Row E	**Someone helped me.**	1	2	3	4	5	
Row F	**The work was easy.**	1	2	3	4	5	

Question 2: When I do poorly in math, it is usually because:

	Reason:	This is not why I did poorly.		This is kind of why I did poorly.		This is the most important reason why I did poorly.	Rank:
Row A	**I didn't study enough.**	1	2	3	4	5	
Row B	**I studied the wrong things.**	1	2	3	4	5	
Row C	**I don't think I'm smart.**	1	2	3	4	5	
Row D	**The teacher explained things poorly.**	1	2	3	4	5	
Row E	**No one helped me.**	1	2	3	4	5	
Row F	**The work was hard.**	1	2	3	4	5	

Appendix H

Self-Efficacy Scale

How confident are you that you could correctly do **Question 1**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 2**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 3**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 4**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 5**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

How confident are you that you could correctly do **Question 6**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 7**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

How confident are you that you could correctly do **Question 8**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

---

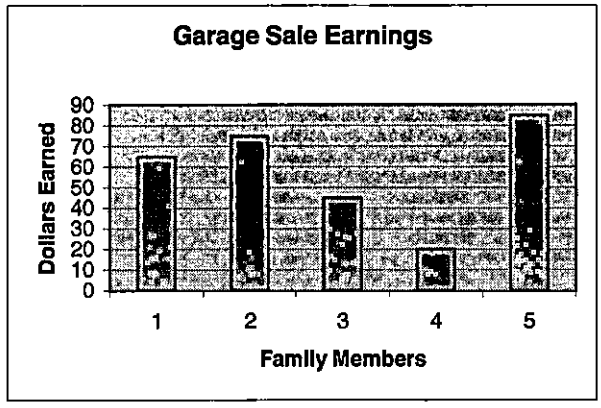
How confident are you that you could correctly do **Question 9**?

1	2	3	4	5	6	7
Not confident at all		Not too confident		Pretty confident		Very confident

Appendix I

Sample FSA Numeracy Items Included in Grade 4 Self-Efficacy Scale

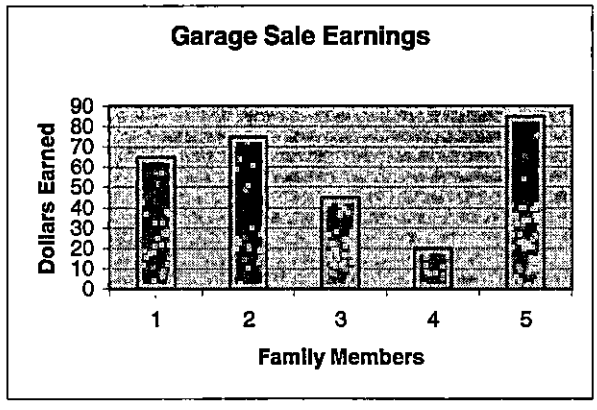
Question 1



About how much money did Family Member 1 earn at the garage sale?

A	$60.00	C	$70.00
B	$65.00	D	$75.00

Question 2



About how much money did Family Members 3, 4, and 5 earn together?

A	$85.00	C	$130.00
B	$105.00	D	$150.00

Question 3

Bradley Evans has 100 pencils to sell. He bundles them into groups of 5. How many bundles will he have?

A	5	C	20
B	10	D	95

Question 4

The front faces of Jessica's puzzle boxes have these shapes:

2 boxes look like this 

3 boxes look like this 

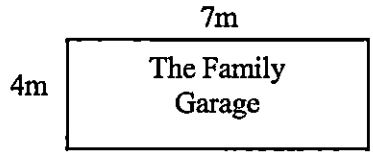
8 boxes look like this 

5 boxes look like this 

What is the most common shape of the front faces of the puzzle boxes?

A	a circle	C	a triangle
B	a square	D	a rectangle

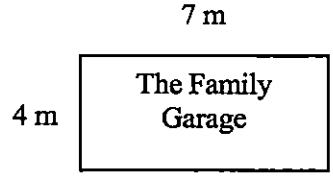
Question 5



What is the area of the garage?

A	$11m^2$	C	$28m^2$
B	$22m^2$	D	$56m^2$

Question 6



What is the perimeter of the family garage?

A	11m	C	28m
B	22m	D	56m

Question 7

What is the shape of the family garage?

A	square	C	rectangle
B	triangle	D	trapezoid

Question 8

Mrs. Evans sells 3 of her 10 cookbooks. What fraction of the cookbooks does she have left?

A	1/2	C	3/10
B	3/5	D	7/10

Question 9

The garage sale will start at 9:00am and finish five and a half hours later. At what time will it finish?

A	14:00	C	14:50
B	14:30	D	15:00

Appendix J

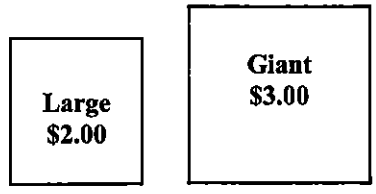
Sample FSA Numeracy Items Included in Grade 7 Self-Efficacy Scale

Question 1

One group of students decided to rent a popcorn machine to sell popcorn. For each batch of popcorn, they require 200 g of kernels, 40 g of butter, and 6 mL of salt. What is the ratio of butter to kernels?

A	1 to 5	C	6 to 200
B	40 to 6	D	200 to 4

Question 2



Popcorn is sold in two sizes. The students' popcorn sales were $51.00. They sold 20 bags in all. How many giant bags were sold?

A	6	C	11
B	9	D	20

Question 3

The expenses for the popcorn sales were:

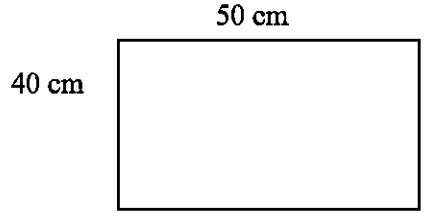
Machine Rental	$10.00
Popcorn	$ 4.75
Butter	$ 2.49
Salt	$ 1.65
Bags	$?

The total sales were $61.00 and the profit was $39.61. What was the cost of the bags?

A	$0.25	C	$2.50
B	$1.49	D	$4.25

Question 4

A rectangular quilt was raffled off. When folded in half, and then in half again, the quilt had the dimensions below.



When unfolded, what could be the dimensions of the quilt?

A	120cm x 150xm	C	40cm x 100cm
B	50cm x 80cm	D	80cm x 100cm

Question 5

A group of students decided to sell candy bars.

- The group sold 8 boxes of candy bars.
- The group paid $7.00 for each box of 12 candy bars.
- The group sold each candy bar for $0.75.

How much profit did they make on 8 boxes of candy bars?

A	$ 2.00	C	$16.00
B	$ 8.00	D	$24.00

Question 6

Another group of students decided to work at a hamburger concession during a ball tournament. The concession requires 3 students per shift. Shifts are one and a half hours long. How many students are needed to run the concession from 09:30 to 18:30 if each student works only one shift?

A	6	C	15
B	9	D	18

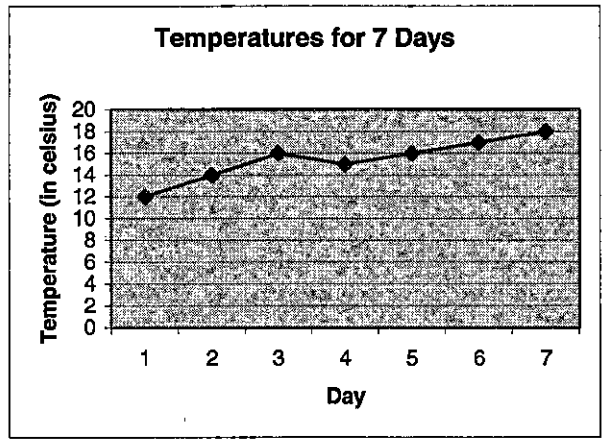
Question 7

Barbecues are needed to cook the hamburgers at the concession. One barbecue will cook 18 hamburgers in 12 minutes. They want to cook 350 hamburgers in one hour. How many barbecues will be needed?

Barbecues	*Hamburgers*	*Time*
1	18	12 minutes
?	350	1 hour

A 3
B 4
C 7
D 10

Question 8



To the nearest tenth of a degree, what was the mean temperature for the Days 1-7?

A 14.5 degrees
B 15.0 degrees
C 15.4 degrees
D 16.0 degrees

Question 9

On the day of the ball tournament, the weather report stated there was a 40% probability of rain. What was the chance of rain?

A highly unlikely
B unlikely
C likely
D highly likely

Appendix K

Ministry of Education's 2001 FSA Numeracy Table of Specifications

Numeracy can be defined as the combination of mathematical knowledge, problem solving, and communication skills required by all persons to function successfully within our technological world. Numeracy is more than knowing about numbers and number operations.

	Mathematical Knowledge	Percentage
Grade 4	**Number** • Students apply their number sense to solve problems using whole numbers from 0 to 10 000, proper fractions, and decimal fractions to 100ths • They use the four basic arithmetic operations in whole number contexts and the addition and subtraction of decimals.	35 - 45
	Patterns and Relationships • Students investigate, establish and present rules for numerical and non-numerical patterns.	15 - 25
	Shape and Space • Students estimate, measure and compare quantities, including money and time, using decimal numbers and standard units. • They describe, classify and relate three-dimensional objects and two-dimensional shapes. • They use numbers and directional words to describe the relative positions of objects.	20 - 30
	Statistics and Probability • Students collect, assess, validate and graph data. • They conduct simple probability experiments to explain outcomes.	10 - 20
Grade 7	**Number** • Students solve problems involving numbers including decimal fractions and integers. • They use ratios, rates, percentages and decimal numbers in various contexts.	35 – 45
	Patterns and Relationships • Students use expressions containing variables to make predictions. • They use variables and equations to express and summarize relationships.	15 – 25
	Shape and Space • Students solve problems involving the properties of circles and their relationships to angles and time zones. • They solve problems involving perimeter, area, surface area, volume and angle measurement. • They link angle measurements to the properties of parallel lines. • They analyze patterns and designs using congruence, symmetry, translation, rotation and reflection.	20 – 30
	Statistics and Probability • Students analyze data using measures of variability and central tendency. • They solve problems using probability.	10 - 20

Appendix L

Intercorrelations between All Students' Individual Attributions, FSA Scores, and Report Card Grades

Variable	1	2	3	4	5	6	7
Attributions for success							
1. Effort	--						
2. Strategy	.629**	--					
3. Ability	-.107	.041	--				
4. Teacher's help	.186*	.281**	-.020	--			
5. Help from others	.201*	.208**	-.068	.030	--		
6. Task ease	-.181*	-.121	.103	-.019	.036	--	
Attributions for failure							
7. Lack of effort	.310**	.211**	-.301**	.069	.164*	-.172*	--
8. Lack of strategy	.215**	.241**	-.277**	-.068	.193*	-.042	.492**
9. Lack of ability	-.049	-.073	-.334**	.024	.171*	-.165*	.217**
10. Lack of teacher's help	-.055	-.030	.073	-.439**	.117	.054	.061
11.Lack of help from others	.138	.161*	-.113	.107	.249**	.130	.265**
12. Task difficulty	.018	.021	-.262**	.023	.146	-.043	.299**
Achievement variables							
13. FSA scores	-.197*	-.144	.371**	.118	-.244**	.058	-.246**
14. Report card grades	-.043	.022	.389**	.090	-.210**	-.034	-.217**

Note. * $p < .05$, ** $p < .01$

Variable	8	9	10	11	12	13	14
Attributions for success							
1. Effort							
2. Strategy							
3. Ability							
4. Teacher's help							
5. Help from others							
6. Task ease							
Attributions for failure							
7. Lack of effort							
8. Lack of strategy	--						
9. Lack of ability	.264**	--					
10. Lack of teacher's help	.165*	.094	--				
11.Lack of help from others	.261**	.179*	.232**	--			
12. Task difficulty	.327**	.189*	.143	.292**	--		
Achievement variables							
13. FSA scores	-.272**	-.175*	-.073	-.096	-.108	--	
14. Report card grades	-.278**	-.279**	-.152	-.254**	-.195*	.590**	--

Note. * $p < .05$, ** $p < .01$

Appendix M

Intercorrelations between Females' Individual Attributions, FSA Scores, and Report Card Grades

Variable	1	2	3	4	5	6	7
Attributions for success							
1. Effort	--						
2. Strategy	.702**	--					
3. Ability	-.051	.087	--				
4. Teacher's help	.080	.236*	.085	--			
5. Help from others	.065	.054	-.014	.085	--		
6. Task ease	-.179	-.091	.174	-.002	.048	--	
Attributions for failure							
7. Lack of effort	.345**	.292**	-.252*	.203	.133	-.306**	--
8. Lack of strategy	.357**	.321**	-.116	-.013	.299**	-.174	.524**
9. Lack of ability	-.008	.005	-.379**	.222*	.251*	-.154	.217
10. Lack of teacher's help	-.199	-.190	.058	-.432**	-.021	.038	-.078
11.Lack of help from others	.200	.121	-.034	.066	.105	.120	.288**
12. Task difficulty	-.028	-.093	-.305**	-.027	.063	-.042	.318**
Achievement variables							
13. FSA scores	-.218	-.156	.362**	.175	-.200	.121	-.121
14. Report card grades	.041	.123	.336**	.223*	-.195	.026	.042

Note. * $p < .05$, ** $p < .01$

Variable	8	9	10	11	12	13	14
Attributions for success							
1. Effort							
2. Strategy							
3. Ability							
4. Teacher's help							
5. Help from others							
6. Task ease							
Attributions for failure							
7. Lack of effort							
8. Lack of strategy	--						
9. Lack of ability	.181	--					
10. Lack of teacher's help	.022	-.036	--				
11.Lack of help from others	.313**	.202	.300**	--			
12. Task difficulty	.257*	.206	.121	.090	--		
Achievement variables							
13. FSA scores	-.317**	-.273*	.003	.023	-.069	--	
14. Report card grades	-.161	-.407**	-.212	-.069	-.164	.556**	--

Note. * $p < .05$, ** $p < .01$

Appendix N

Intercorrelations between Males' Individual Attributions, FSA Scores, and Report Card Grades

Variable	1	2	3	4	5	6	7
Attributions for success							
1. Effort	--						
2. Strategy	.570**	--					
3. Ability	-.154	-.013	--				
4. Teacher's help	.299**	.371**	-.103	--			
5. Help from others	.307**	.317**	-.123	.003	--		
6. Task ease	-.184	-.154	.050	-.032	.023	--	
Attributions for failure							
7. Lack of effort	.277*	.113	-.357**	-.038	.170	-.069	--
8. Lack of strategy	.105	.188	-.393**	-.127	.118	.059	.478**
9. Lack of ability	-.085	-.151	-.302**	-.172	.102	-.175	.218
10. Lack of teacher's help	.072	.064	.064	-.425**	.211	.063	.156
11.Lack of help from others	.096	.202	-.163	.140	.359**	.138	.257*
12. Task difficulty	.057	.130	-.228*	.068	.219	-.042	.291**
Achievement variables							
13. FSA scores	-.184	-.161	.377**	.077	-.310**	-.005	-.396**
14. Report card grades	-.117	-.120	.422**	.026	-.281*	-.086	-.469**

Note. * $p < .05$, ** $p < .01$

Variable	8	9	10	11	12	13	14
Attributions for success							
1. Effort							
2. Strategy							
3. Ability							
4. Teacher's help							
5. Help from others							
6. Task ease							
Attributions for failure							
7. Lack of effort							
8. Lack of strategy	--						
9. Lack of ability	.334**	--					
10. Lack of teacher's help	.331**	.233*	--				
11.Lack of help from others	.225*	.164	.203	--			
12. Task difficulty	.382**	.175	.185	.436**	--		
Achievement variables							
13. FSA scores	-.229*	-.081	-.209	-.194	-.141	--	
14. Report card grades	-.367**	-.198	-.236*	-.370**	-.229*	.631**	--

Note. * $p < .05$, ** $p < .01$

Appendix O

Contact Information

Information current as of February, 2002.

Please direct questions or comments about this thesis to:

Jennifer E.V. Lloyd
Email: jevlloyd@hotmail.com

For further information about the Foundation Skills Assessment, please contact:

Student Assessment and Program Evaluation Branch
Ministry of Education
PO Box 9143 Stn Prov Govt
Victoria, BC, V8W 9H1, Canada
Phone: (250) 356-5348
Fax: (250) 387-3682
Email: EDUC.SAPE@gems3.gov.bc.ca
http://www.bced.gov.bc.ca/assessment/fsa

Please refer to the following web site for sample FSA items:

http://www.bced.gov.bc.ca/assessment/fsa/sample_tests.htm

VITA

Surname: Lloyd Given Names: Jennifer Elizabeth Victoria

Place of Birth: Vancouver, British Columbia, Canada

Educational Institutions Attended:

University of Victoria	1999-2002
University of Victoria	1994-1998

Degrees Awarded:

B.Sc.	University of Victoria	1998

UNIVERSITY OF VICTORIA PARTIAL COPYRIGHT LICENSE

I hereby grant the right to lend my thesis to users of the University of Victoria Library, and to make single copies only for such users or in response to a request from the Library of any other university, or similar institution, on its behalf or for one of its users. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by me or by a member of the University designated by me. It is understood that copying or publication of this thesis for financial gain by the University of Victoria shall not be allowed without my written permission.

Title of Thesis:

Sex Differences in Attributional Style, Self-Efficacy, and Academic Achievement in Mathematics

Author: 

Jennifer E.V. Lloyd

April 30, 2002