READING SCORES AND GENDER

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Abstract

This research investigated fourth-grade reading scores and gender. The study used data from a population of 156,590 fourth graders taking the 2011 NAEP reading test to determine variables and factors affecting reading scores on the general student, male, and female populations. Variables were chosen based on the literature and researcher's preference. These variables included economic status, race, school variables, student variables, and teacher variables. Using principal component factor analyses orthogonal factors were derived from Varimax factor loading. Correlations and multiple regression analyses were performed on all variables and factors using standardized and unstandardized data. Split data for male and female students were analyzed. Significant results ($p < .001$) were found for most items and most factors indicating that females did significantly better on the fourth-grade reading test than males. Furthermore, the research indicated that home resources, outside school reading experiences, liking to read, and economic status probably had the greatest influence on fourth-grade reading scores.

Introduction

Despite increasing expenditures for education in the United States, reading scores have continued to be a source of concern for American educators. In a greater sense reading measures the literacy of students and in an increasingly technological society, industries demand a literate workforce. Male employment domination has slowly eroded. Females in the United States are going to institutions of higher education at a greater rate than male students. According to the (United States Bureau of Census, 2013) male students admitted to higher education are now in the minority.

Table 1
School Enrollment by Sex and Level: 1970 to 2009 (in millions)[a]

	All Levels			Elementary			High School			College	
Year	Total	Male	Fem	Total	Male	Fem	Total	Male	Fem	Total	Male	Fem
1970	60.4	31.4	28.9	37.1	19.0	18.1	14.7	7.4	7.3	7.4	4.4	3.0
1980	58.6	29.6	29.1	30.6	15.8	14.9	14.6	7.3	7.3	11.4	5.4	6.0
1985	59.8	30.0	29.7	30.7	15.7	15.0	14.1	7.2	6.9	12.5	5.9	6.6
1990	63.0	31.5	31.5	33.2	17.1	16.0	12.8	6.5	6.4	13.6	6.2	7.4
1992	64.6	32.2	32.3	34.3	17.7	16.6	13.3	6.8	6.5	14.0	6.2	7.8
1993	65.4	32.9	32.5	34.8	17.9	16.9	13.6	7.0	6.6	13.9	6.3	7.6
1994	69.3	34.6	34.6	35.4	18.2	17.2	14.6	7.4	7.2	15.0	6.8	8.2
1995	69.8	35.0	34.8	35.7	18.3	17.4	15.0	7.7	7.3	14.7	6.7	8.0
1996	70.3	35.1	35.2	35.5	18.3	17.3	15.3	7.9	7.4	15.2	6.8	8.4
1997	72.0	35.9	36.2	36.3	18.7	17.6	15.8	8.0	7.7	15.4	6.8	8.6
1998	72.1	36.0	36.1	36.4	18.7	17.7	15.6	7.9	7.6	15.5	6.9	8.6
1999	72.4	36.3	36.1	36.7	18.8	17.9	15.9	8.2	7.7	15.2	7.0	8.2
2000	72.2	35.8	36.4	36.7	18.9	17.9	15.8	8.1	7.7	15.3	6.7	8.6
2001	73.1	36.3	36.9	36.9	19.0	17.9	16.1	8.2	7.8	15.9	6.9	9.0
2002	74.0	36.8	37.3	36.7	18.9	17.8	16.4	8.3	8.0	16.5	7.2	9.3
2003	74.9	37.3	37.6	36.3	18.7	17.6	17.1	8.6	8.4	16.6	7.3	9.3
2004	75.5	37.4	38.0	36.5	19.0	17.6	16.8	8.4	8.4	17.4	7.6	9.8
2005	75.8	37.4	38.4	36.4	18.6	17.7	17.4	8.9	8.5	17.5	7.5	9.9
2006	75.2	37.2	38.0	36.1	18.5	17.6	17.1	8.8	8.4	17.2	7.5	9.7
2007	76.0	37.6	38.4	36.3	18.6	17.7	17.1	8.8	8.3	18.0	7.8	10.1
2008	76.3	37.8	38.6	36.4	18.6	17.7	16.8	8.5	8.2	18.6	8.3	10.3
2009	77.3	38.0	39.3	32.2	16.5	15.7	16.4	8.4	8.1	19.8	8.6	11.1

[a] Source: U.S. Census Bureau.

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　　　　By analyzing this table, gender enrollment trends appear. For example, in 1970, there were 60,400,000 students enrolled in U.S. schools, of which 31,400,000 were male and 28,900,000 were female. For the same year, approximately 19,000,000 males and 18,100,000 females were enrolled in elementary school, 7,400,000 males and 7,300,000 females were enrolled in high school, and 4,400,000 males and 3,000,000 females were enrolled in college. There were 1,400,000 more males going to college than females. By 1980, there was a marked change. With a total school enrollment of 58,600,000, there were 29,600,000 males and 29,100,000 females, of which 15,800,000 males and 14,900,000 females were enrolled in elementary school, 7,300,000 males and 7,300,000 females were enrolled in high school, and 5,400,000 males and 6,000,000 females were enrolled in college. In 1980, the table showed that there were more female students enrolled in college than males. By 1990, out of a total enrollment population of 63,000,000 there were 31,500,000 males and 31,500,000 females. Elementary school enrollment included 17,100,000 males and 16,000,000 females, and high school enrollment included 6,500,000 males and 6,400,000 females. However, college enrollment showed 6,200,000 males and 7,400,000 females. In 20 years, the college gender enrollment majority

switched from over one million male students to over one million female students. By the millennium, the gap continued. Out of a total school population of 72,200,000, with 35,800,000 males and 36,400,000 females, the elementary school enrollment was 18,900,000 males and 17,900,000 females. For high school, the enrollment showed 8,100,000 males and 7,700,000 females. Only the college enrollment had the male population trailing, with 6,700,000 males to 8,600,000 females, a difference of 1,900,000. The table showed the gap widening until by 2009, the last year posted, out of a total population of 77,300,000 enrolled students, 38,000,000 male and 39,300,000 female, there were the following results. In elementary school, there were 16,500,000 males and 15,700,000 females. In high school, there were 8,400,000 males and 8,100,000 females, but in college, there were 8,600,000 males and 11,100,000 females, a difference of 2,500,000. Having a gender gap this large indicated a need to research and explain the reasons for males not enrolling in higher education at the same rate as females. This was especially true since most of the high paying employment requires at least a bachelor's degree or beyond. With 2,500,000 fewer males enrolled in college, the probability that male students will find high paying, highly skilled jobs will diminish.

Reading as a Barometer

Literacy can be measured through standardized reading scores. In the United States the National Assessment of Educational Progress (NAEP) administers standardized examinations throughout the United States every two years to fourth, eighth, and twelfth grade students in reading, mathematics, and other subjects (NAEP, 2014). Along with testing, NAEP conducts educational surveys for students, teachers, and administrators. The data is used for research in order to improve the quality of education in the United States. The data surveys include many variables such as race, ethnicity, gender, economics, teacher background, teacher methods, student background, student resources, parent background, size of school, and location of school in terms of city, suburban and rural.

NAEP Reading Scores and Gender

Table 2 illustrates the average fourth grade reading results for NAEP since 1992 (NAEP, 2014).

Table 2
Average Scale Scores for NAEP Fourth-Grade Reading by Gender[a]

Year	Jurisdiction	Male	Female	Gap
2011	National	218	225	7
2009	National	218	224	6
2007	National	218	224	6
2005	National	216	222	6
2003	National	215	222	7
2002	National	215	222	7
2000	National	208	219	11
2000[1]	National	212	222	10
1998	National	212	217	5
1998[1]	National	214	220	6
1994[1]	National	209	220	11
1992[1]	National	213	221	8

[1] Accommodations were not permitted for this assessment.

It appears that female students on average scored approximately seven points better than male students on the fourth-grade reading portion of the test for the past two decades. This is despite the fact that most of the students participating in the NAEP fourth grade reading examinations were from coeducational public elementary schools. This paper investigates the reason/reasons why the reading gap exists and suggests possible solutions to narrow the gap.

Literature Review
Studies concerning the effects different items had on reading performance were based on empirical data and theory. Research on reading is diverse and bountiful. It can be classified into three basic areas: reading strategies, school variables, and individual student differences.

Reading strategies and results vary based on the type of student and the grade level. However, most research in this area has limited sample populations with or without control groups. Some of the prior research pertaining to reading improvement on the elementary school level is summarized below.

Reading should be taught using the thought process as well as comprehension (Applegate & Applegate, 2011). Another group of researchers (Ritter, Park, Saxon, & Colson, 2013), found that the phonologically based reading program resulted in significantly better reading achievement scores than the control group. In a recent action research study (Fisher & Frey, 2012), the authors concluded that boys could be motivated to read by selecting books and materials that interest them.

In another study measuring the effectiveness of a first-grade and second-grade one-to-one reading tutoring program (Chang, 2011), early intervention significantly improved the Development Reading Assessment

scores for first-grade male students. In a study investigating peer-assisted learning for the ELL populations in grades 3 through 6 (Sáenz, Fuchs, & Fuchs, 2005), PALS was found to be an effective tool to help students read. Students were paired by English reading level with bright students helping learning disabled students. In a study investigating the effectiveness minimally trained college student tutors had on first- and second-grade reading underachievers (Fitzgerald, 2001), there were significant average gains for those students receiving a full term of one-to one tutoring. The gender gap has been also observed in Europe. A study was performed with data from 21 European countries (Helbig, 2012). The study compared male results with male and female teachers. The research showed no difference in reading or math scores, dispelling the assertion that the reason for the gap was the primacy of female teachers in elementary schools. Sadowski (2010) found the gender gap as reported in the NAEP results favored girls in every grade level for basic, proficient, and advanced students throughout the country, but gaps in racial and ethnic groups were larger, leading to the implication that the effect size for gender may be less than for other factors. A study measuring the effect parent support had on motivating students to read (Klauda & Wigfield, 2012) concluded that mothers had the greatest motivational influence on fourth- and fifth-grade students followed by father's support and friends' support. Girls were more influenced by their friends than boys, and girls tended to discuss narrative stories that they read, while boys tended to read magazines and newspapers rather than books. From the review of the literature, there existed a need to conduct a large scale research analyses to determine which variables and factors influenced fourth-grade reading scores the most, thus corrective measures could be implemented to narrow the reading gap between male and female students.

Design
      According to the literature, differences among reading scores stem from a variety of causes. In order to investigate possible reasons for the differences in fourth-grade reading scores between male and female students, probable variables were selected. For this study the NAEP 2011 fourth-grade reading test and surveys were used based on correcting the reading imbalance at an early age, the large and diverse sample size and the availability of student, teacher, and school questionnaire data. Only complete data was included for the sample fourth- grade population resulting in a population size consisting of (n = 156,590) scores of which males were (n = 78,174) and females were (n = 78,416). See Figure 1.

Figure 1. *General Sample Populations by Gender*

Using principal component factor analyses with varimax rotation 35 survey items were reduced to 12 factors. These factors were named based on their major loadings. See Table 3.

Table 3 *Composition of Factors*

Code	Factor #	Items
LIKE	1	Read for fun on own
		Reading is favorite subject
		Talk with friends about what you read
		Talk about studies at home.
THINK	2	Emphasis on integrate/interpret when reading text
		Emphasis on critique/evaluate when reading text
		Taught about fiction this year
TALK	3	Class discussion about something class has read
		Explain story in own words
		Work in groups to talk about something read
		Write about what you read
		Read aloud
OUTSD	4	Use school/public library for project/hw info
		Use school/public library for info own use
		Do reading at after-school or tutoring program
TBCKGRD	5	Highest academic degree
		Grad major/minor education w/elementary
MOTV	6	Read silently
		Read a book you chose yourself
HOMERES	7	Books in home
		Computer in home
		Magazines in home
		Pages read in school and for homework
CPTR	8	Computers available to teacher/studs for reading/lang arts
		Students use computer to build and practice vocab
STRATEGY	9	Time per week on language arts
		Students read books of own choosing

		Students write about what they read
		Students do group activity/project
RINSTR	10	Part reading instr.: Work in a reading workbook
		Part reading instr.: Students understand new words
TEXPER	11	Undergrad major/minor education w/elementary
		How many years as an elementary or secondary teacher
		Type of teaching certificate
EFFORT	12	Effort on this reading test
		Importance of success on this reading test

All factors were tested for collinearity and were found to be orthogonal. Multiple regression analyses were performed to discover which factors had the most influence on reading scores   The 12 factors, economics, and five races (White, Asian, black, American Indian, and Pacific Islander) were tested for regression residuals and the ratios between the regression equations and the residuals were statistically significant (p < .001) for all three groups. See Table 4.

Table 4 *ANOVA All Students and Gender All Factors Standardized Scores*

Model	Gender	Sum of Squares	df	Mean Square	F	Sig.
Regression	All	50382.105	19	2651.690	3909.116	.000
Residual		106206.90	156570	.678		
Total		156589.00	156589			
Regression	Male	25688.790	18	1427.155	1988.717	.000
Residual		56086.069	78155	.718		
Total		81774.859	78173			
Regression	Female	23512.114	18	1306.229	2049.471	.000
Residual		49966.252	78397	.637		
Total		73478.366	78415			

Results and Analyses:
The results of the multiple regression analyses showed only four factors that significantly (estimates > .1) impacted reading scores. See figure 2.
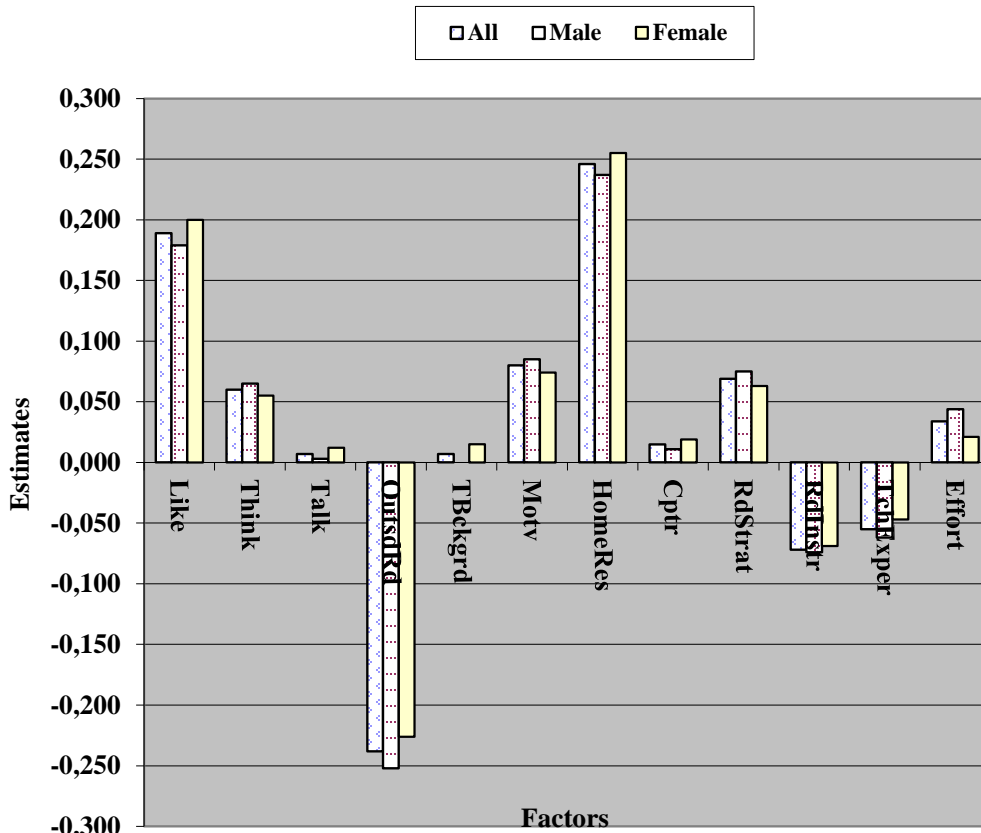
Figure 2: Factor Standard Estimates for All, Male, and Female Fourth-Grade Reading Scores

The strongest indicator of reading scores was home resources which included books, computers, and magazines in the home, and pages read in school and for homework. Outside reading experiences including after-school tutoring and use of library services for school and personal use showed a strong second factor. The negative influence to reading scores were probably due to the fact that non-readers avail themselves of tutoring and library services more than the reading population. Economics (based on the National Free Lunch Program) scored third and liking to read scored fourth. Factors that did not influence reading scores enough to be used as an indicator were thinking, talking, teacher background, student motivation, use of computers, reading strategies, reading instruction, teacher experience and student effort had on the reading scores. The data indicated that reading scores were influenced the most by home materials such as books in the home, liking to read on their own, and the utilization of one-to-one tutoring. These factors were significant at the (p < .001). See results on Table 5.

Table 5
Factor Regressions with Standardized Scores (All Students)

Parameter Name	Estimate	Standard E	z Score	p >|z|
Constant	.022	.006	3.601	0
zGender	.056	.004	14.662	0
zSocioEconomics	.190	.005	34.773	0
zWhite	.071	.006	11.011	0
zBlack	-.029	.007	-4.357	0
zAsian	.074	.006	13.137	0
zAmerican Indian	.006	.005	1.329	.184
zPacific Islander	-.023	.005	-4.747	0
zFactor 1 (LIKE)	.189	.005	38.975	0
zFactor 2 (THINK)	.060	.005	11.236	0
zFactor 3 (TALK)	.007	.004	1.795	.073
zFactor 4 (OUTSD)	-.238	.004	-54.446	0
zFactor 5 (BCKGRD)	.007	.005	1.351	.177
zFactor 6 (MOTV)	.080	.004	18.414	0
zFactor 7 (HMERES)	.246	.005	52.31	0
zFactor 8 (CPTR)	.015	.006	2.73	.006
zFactor 9 (STRAT)	.069	.006	11.93	0
zFactor 10 (INST)	-.072	.006	-11.725	0
zFactor 11 (TEXP)	-.055	.005	-10.971	0
zFactor 12 (EFFORT)	.034	.004	8.451	0

Root Mean Square Error   .817
Observations: 156590
Strata Variable: Jackknife variance stratum
Cluster variable: Jackknife variance unit
Weight variable: Student weight (unadjusted) – Unpoststratified
Adjusted Wald Test: $F(19, 106) = 926.704$
$p(F > f) = 0$
Dependent Variable: Zscore: Plausible NAEP reading value #1
R-Square = 0.322

Figure 3 includes those factors that influenced fourth-grade reading scores the most (Beta > .1). Upon comparing the three factors for males versus females, the following results were obtained. Female students reading scores are influences more by liking to read than male students. Female students utilizing library services and tutoring obtain less negative scores than male students. Female students obtain better reading scores using resources at home than male students. In other words, for the factors that influence fourth-grade reading scores the most, females relate to these factors more than males.
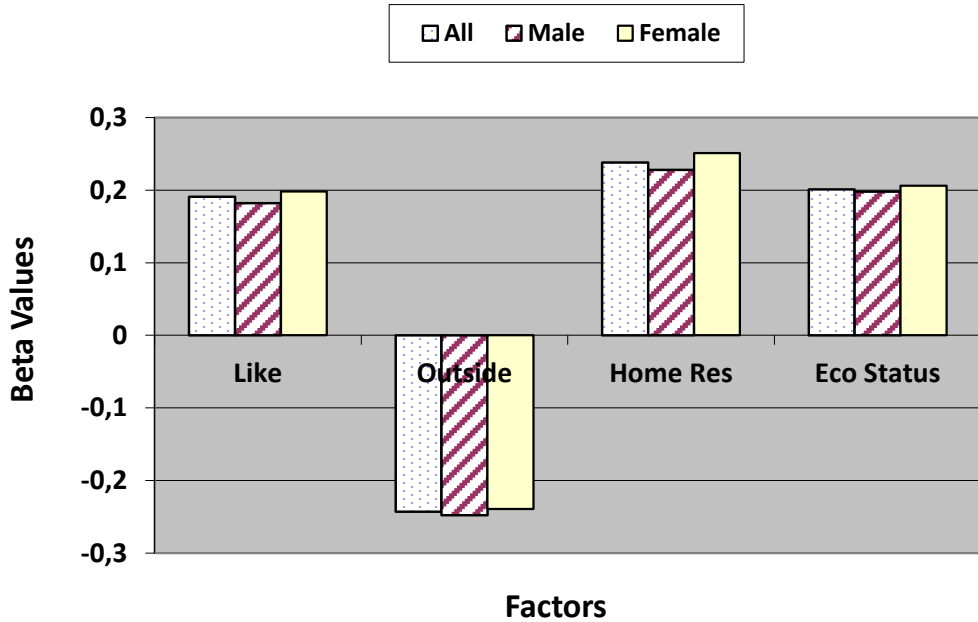
Figure 3: Standardized Factors with Beta > 0.1

Forming multiple regression analyses equations

Using the factors that influence reading scores the most (beta > 0.1) and eliminating the other factors as too weak to have significant influence on the reading scores, multiple regression equations were obtained for all students, male students and female students only.

$$y_{all} = .201x_1 + .191x_2 - .243x_3 + .238x_4$$

$$y_{male} = .198x_1 + .179x_2 - .248x_3 + .228x_4$$

$$y_{female} = .206x_1 + .198x_2 - .239x_3 + .251x_4$$

Where: x_1 = economic status

x_2 = Like to read factor

x_3 = Outside reading experience factor

x_4 = Reading resources found in home factor

Substituting for one standard deviation above the mean we obtain:

$$y_{all} = .387$$

$$y_{male} = .357$$

$$y_{female} = .416$$

At one standard deviation the difference between female and male standardized reading scores are:

$$diff = y_{male} - y_{female}$$

$$diff = .357 - .416$$

$$diff = -.059$$

This accounts for the reading gap between male and female fourth grade students. The results were consistent with NAEP postings on the Internet.

Conclusion

To summarize, multiple regression was conducted to determine the best linear combination of factors to predict fourth-grade reading achievement test scores. This combination significantly predicted reading achievement $F_{(19, 156570)} = 3909.116$, $p < .001$ with economics, liking to read, outside reading experiences, and home resources having the most influence on the grades. The adjusted R Square indicated that this accounted for approximately 32% of the variance in reading that was explained in this model. This was considered a moderate effect based on the size of the sample and the diversity of the population. For the male population $F_{(18, 78155)} = 1988.717$, $p < .001$ adjusted R Square $= .314$ and for the female population $F_{(18, 78397)} = 2049.471$, $p < .001$ adjusted R Square $= .320$. When comparing the four factors that predict reading the most, male regression coefficients were all less than the female regression coefficients, indicating that female students were affected more by the factors that influence reading scores the most than male students. These formulas probably point to the reasons why female students score higher on the fourth-grade reading test than male students and indicate probable areas of exploration to eliminate the gap.

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