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Learning styles and performance in principles of economics: does the gender gap exist?

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Abstract

Do male students in principles of economics courses outperform female students? The economic education literature is replete with studies suggesting that male performance – as measured by final course grades or grades on standardized tests – exceeds female performance. Recent studies, however, indicate a narrowing of this gender gap when additional attributes such as personality traits, expectations, and/or motivation are included in the traditional education production function. Using a sample of students from principles of economics courses taught at Mount Royal University in Calgary, Alberta, this study investigates the relationship between gender and performance accounting for several different measures of abilities and attributes. Adopting the VARK (visual, aural, reading/writing, and kinesthetic) inventory as a representation of student learning styles, we find a reversal of the gender gap; female students outperform male students.

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1. Introduction

Determinants of student success in principles of economics courses are frequently classified under two major categories: abilities and attributes. Abilities, for example, include such measures as high school GPA and levels of math skills whereas attributes include race, gender, and levels of motivation, among others.

Over the years, as different authors develop different models and econometric methodologies, one line of inquiry persists; identifying the source, magnitude, and reasons for differences in performances between male and female students. Conventional wisdom, with corroboration from earlier empirical studies (Bolch and Fels 1974, Siegfried and Fels 1979, and Anderson *et al.* 1994), identifies the existence of a gender gap whereby men outperform women in principles of economics courses. The rationales for the gender gap include sociological and cultural factors (MacDowell *et al*. 1977, and Siegfried 1979), student-specific attributes (Sherman 1971, and Waber 1976) as well as discipline-specific characteristics (Ferber *et al*. 1983, Lumsden and Scott 1987, Walstad and Robson 1997, Dynan and Rouse 1997, and Jensen and Owen 2000, 2001).

Subsequent studies in the 1980s and 1990s replicate the existence of a gender gap in favour of males (Heath 1989, Anderson *et al*. 1994) and corroborate the results across different nations (U.K. – Lumsden and Scott 1987, Singapore – Tay 1994, and Canada – Robb and Robb 1999). At this stage, a number of researchers examine the role of innate attributes and abilities such as motivation, expectations, personality traits, and learning styles as potential determinants of performance in principles of economics courses.

Johnson *et al*. (2014) argue that a number of the traditional explanations for the gender gap no longer exist and suggest a re-evaluation of the gender gap in economics, particularly given the gains by women in the science, technology, engineering, and mathematical (STEM) fields. Indeed, over the past decade, there are studies which show that the gap is statistically insignificant when controlled for certain factors such as expectations (Ballard and Johnson 2005), personality types (Borg and Stranahan 2002, Opstad and Fallan 2010), and learning styles (Boatman *et al*. 2008, Leung *et al.* 2014).

In addition to acknowledging that some of the underlying reasons for the gender gap are no longer significant, our motivation for exploring this issue arises from anecdotal evidence over the past decade; namely that women account for a larger portion of students in first-year principles of economics courses and appear, on average, to be outperforming their male colleagues. Our descriptive statistics indicate that, on average, women receive higher grades in these courses compared to men. Even simple regression analysis, accounting only for high school mathematics grades, substantiate this new finding.

Using the VARK (visual, aural, reading/writing, and kinesthetic) inventory as a representation of students' learning styles and accounting for traditional attributes and abilities such as high school grades in different subjects, age, motivation, and paid working hours per week, we find additional evidence to support these initial findings; namely, that the gender gap is *reversed*.

2. Data and methodology

The data for this study comes from a sample of 217 students enrolled during the 2015 winter semester in both Principles of Microeconomics (7 sections) and Principles of Macroeconomics (11 sections) at Mount Royal University (MRU) in Calgary, Canada. Each section is capped at 35 students and consists of the traditional three-hour per week lecture format. Of note, all instructors teaching first-year economics courses at MRU use a combination of (i) multiple-choice questions, (ii) mathematical and/or graphical questions, and (iii) theory and/or application (i.e., written) questions on all tests – including the final exam.

During the fourth week of the semester, students who volunteered to participate were asked to fill out a questionnaire consisting of two parts. The first part contained six questions identifying both abilities and attributes: age, gender, high school grades in mathematics (Math 30) and language/arts (LA 30), the number of hours of paid work, and their level of interest in the course. The second part of the questionnaire identifies the student's VARK-based preferred style of learning as developed by Fleming and Mills (1992) and comprises sixteen multiple choice questions. Each question has four potential answers; individual answers imply a specific preference for one of the four learning styles. Participants, however, are asked to choose *all* answers that apply to them and not to be restricted to one answer per question. By instructing students to choose all relevant answers for each question, we are able to identify students who have bimodal or multimodal learning styles. As a result, therefore, the raw scores for each of the learning styles (i.e., V, A, R, and K) can range from 0 to 16 for each participant.

Final grades – measured as a percentage – are used to identify students' performances in these courses. With the exception of those students who participated but later withdrew from the course, all grades are recorded including those students who failed.

Table I below provides the descriptive statistics of all the variables – with the exception of the level of interest – regardless of gender.

Table I

Descriptive Statistics – All Participants

	Age	Math 30	LA30	Hours of work	V	A	R	K	Grade (%)
Mean	20.6	77.98	77.20	11.45	5.01	5.65	5.94	6.29	70.19
Minimum	17	52	60	0	0	0	0	0	25.4
Maximum	41	98	97	50	14	13	14	16	98.6
# of students	212	204	208	217	217	217	217	217	215 (2W's)

While there is a considerable variance in the age of the students, the average age of 20.6 years for first-year principles of economics courses reflects MRU's historical trend of attracting "older"

students (relative to primarily research-orientated, post-secondary institutions). The average high school grades in mathematics and language/arts are in the high 70s and students work, on average, over 11 hours per week.[1] When we examine the raw VARK scores, we observe that participants are more likely to indicate a preference for the kinesthetic learning style (mean = 6.29) and least likely to show a preference for the visual learning style (mean = 5.01). But clearly, there does not appear to be any significant differences between the four learning styles.

Tables II and III below report the summary statistics of all the variables along the lines of gender; again, with the exception of the level of interest. Of the 217 participants, however, 39 did not provide a gender; consequently the sample size is reduced to 90 males and 88 females.

Table II

Descriptive Statistics – Males Only

	Age	Math30	LA30	Hours of work	V	A	R	K	Grade (%)
Mean	21.0	77.94	77.62	12.44	5.14	5.72	5.51	6.77	70.21
Minimum	17	60	60	0	0	0	1	2	29.9
Maximum	35	98	97	50	14	13	14	16	98.1
# of students	86	84	87	90	90	90	90	90	89 (1W)

Table III

Descriptive Statistics – Females Only

	Age	Math30	LA30	Hours of work	V	A	R	K	Grade (%)
Mean	20.5	77.14	77.69	11.62	5.26	6.05	6.88	5.92	72.58
Minimum	17	52	60	0	0	1	0	0	25.4
Maximum	41	95	95	40	12	13	14	13	98.3
# of students	88	81	82	88	88	88	88	88	87 (1W)

In terms of similarities across gender, we see that age as well as average high school grades in mathematics and language/arts are remarkably similar. The absence of a clear male superiority in

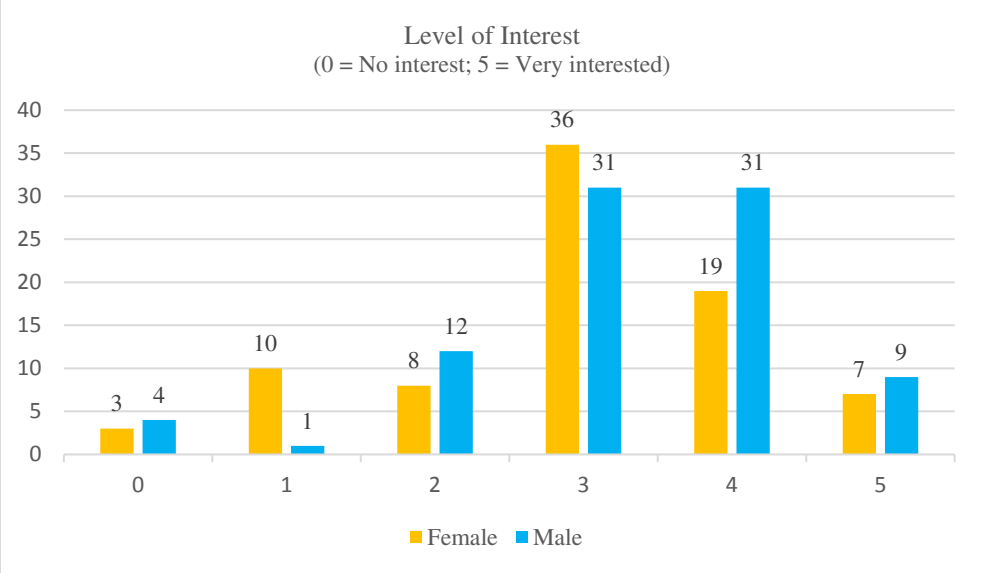
[1] Self-reporting by students, without official verification, raises concerns about reliability of the data. Verifying self-reporting data can be a time-consuming and costly endeavor. In some cases, post-secondary ethics boards may refuse, in the name of confidentiality, to permit verification. There are a number of studies, however, (Arnold and Rowaan 2014, Arnold and Straten 2012, Ballard and Johnson 2004), that use official data to verify whether students' self-reported information is reliable. These studies find that (i) administrative records and student-reported data are similar, or (ii) the difference is negligible in terms of statistical significance.

high school mathematics grades reflects recent studies in this area (Else-Quest *et al*. 2010) and supports the evidence that this explanation for the traditional gender gap in economics is questionable (Johnson *et al*. 2014).

There is a small difference in the weekly hours worked with males working slightly more than females. In terms of the learning styles, both males and females are least likely to show a preference for the visual learning style. As in the overall descriptive statistics, males are more likely to show a preference for kinesthetic learning; females, however, are more likely on average to indicate a preference for the read/write learning style. Most importantly, we observe a difference in the performance of males versus females (i.e., a gender gap). On average, females receive a final grade almost 2.5% greater than males. This observation is counter to the traditional gender gap reported in the literature whereby males typically outperform females. In the next section, we empirically estimate this gap to verify both the size of the gap as well as its statistical significance.

We design a "level of interest" variable as a proxy for motivational determinants. Students assign their level of interest by selecting an integer value from 0 (no interest; i.e., a required course in the program) to 5 (very interested). Since a mathematical mean of this variable would not necessarily provide a meaningful observation, we sum the number of participants selecting each of the individual integers along the lines of gender; the results are depicted in Figure 1.

Figure 1



Based on the results of Figure 1, we see that roughly 25% of females (21/83) indicate that they have no interest or little interest (values 0,1,2) in the principles of economics course whereas 31% (26/83) state they are interested or very interested (values 4,5). Males, however, have a much more skewed distribution; 19% (17/88) have no interest or little interest but 45% (40/88) indicate a higher level of interest.

We summarize the average gender differences and similarities of these descriptive statistics in the following manner:

(i) males and females are roughly the same age and have identical high school grades in mathematics and language/arts,
(ii) males indicate a preference for kinesthetic learning styles whereas females prefer read/write learning styles,
(iii) males indicate a greater level of interest in principles of economics courses, and
(iv) females receive higher final grades than males (a "reverse" gender gap).

From this summary, we see that points (iii) and (iv) appear contradictory: if the level of interest is a measure of motivation, shouldn't higher-motivated students receive, on average, higher grades? We discuss this situation in more detail in the next section once we estimate the value and significance of the level of interest as an independent variable.

3. Empirical results

The descriptive statistics in the previous section indicate that, on average, females score higher grades on principles of economics courses than their male counterparts. In this section, we use OLS regression analysis to quantify the relationship between gender and performance.

One of the interesting results from the descriptive statistics is the remarkable similarity in the average grade for high school mathematics: 77.94% for males versus 77.14% for females. Statistically significant differences in mathematical ability in favour of males is a typical explanation for the traditional gender gap in principles of economics courses. Since our descriptive statistics contradict this assumption of male superiority in mathematics, we explore a simple OLS regression of the form:

$$\text{Grade} = f(\text{Gender}, \text{Math30}) \quad (1)$$

The dependent variable (Grade) is the student's final grade (measured as a percentage) in either the principles of microeconomics or principles of macroeconomics course. The results of this regression are presented in Table IV under the column listed as Preliminary (Gender and Math only). The gender coefficient of 4.52 is statistically significant at a 5% level of significance. After accounting for high school math grades only, on average, women outperform men in principles of economics courses by 4.5%. Without controlling for learning styles (or other abilities and attributes), this preliminary regression indicates a *reversal* of the traditional gender gap favouring men.

Recognizing that determinants of student performance in introductory economics courses include a variety of abilities and attributes, we estimate a standard education production function of the form:

$$\text{Grade} = f(\text{Age}, \text{Gender}, \text{Math30}, \text{LA30}, \text{Hours worked}, \text{Level of Interest}, \text{V}, \text{A}, \text{R}, \text{K}) \quad (2)$$

Following Fleming's (1995) rationale, a strong preference for a particular learning style is identified by a raw score on that learning style which is *at least four points higher* than a raw score of *any* other learning style. As such, the raw scores for V, A, R, and K are recoded in a binary form; a value of 1 indicates a strong preference for a specific learning style, otherwise the value is

0. The regression results from the complete sample are summarized in Table 4 under the columns Model 1 and Model 2.

Table IV
OLS Regression Results

Independent Variable	Preliminary (Gender and Math only)		Model 1 (All variables)		Model 2 (Exclude Level of Interest)	
	Coefficient (std err.)	t- statistic	Coefficient (std err.)	t- statistic	Coefficient (std err.)	t- statistic
Age			0.44 (0.27)	1.64	0.48 (0.27)	1.79*
Gender	4.52 (2.04)	2.21**	3.90 (1.95)	2.00**	3.95 (1.99)	1.98**
Math30	0.38 (0.10)	3.90***	0.31 (0.10)	3.24***	0.31 (0.10)	3.13***
LA30			0.34 (0.15)	2.23**	0.40 (0.15)	2.64***
Hours worked			-0.11 (0.08)	-1.29	-0.12 (0.08)	-1.48
Level of Interest			0.55 (0.81)	0.67		
Visual (V)			6.50 (2.34)	2.78***	6.76 (2.34)	2.88***
Aural (A)			2.54 (2.24)	1.13	2.08 (2.23)	0.93
Read/write (R)			-0.96 (2.43)	-0.39	-1.20 (2.37)	-0.51
Kinesthetic (K)			1.31 (2.24)	0.59	1.83 (2.17)	0.84
Constant	39.89 (7.64)	5.22***	8.43 (12.17)	0.69	5.07 (12.30)	0.41
Adjusted R^2	0.0933		0.1751		0.1926	
Number of observations	163		154		159	

Significance Level: *p < .10; **p < .05; ***p < .01
Gender: female = 1

From Table IV, we notice that for the initial regression containing all the independent variables (Model 1), the gender coefficient of 3.9 is statistically significant at a 5-percent level; females have a 4% higher average than males. High school grades in both mathematics and language/arts have coefficients equal to 0.3 and are also statistically significant at a 1-percent and 5-percent level, respectively. The hours worked has the anticipated negative effect on performance but is not significantly different from zero. Of the four VARK learning styles, only the visual (V) learning style is statistically significant. For those students who have a visual preference, their average grade is roughly 6.5% greater than other students. It is not surprising that visual learners excel in

the principles of economics courses since there is a strong emphasis in the presentation (and assessment) of visual materials such as graphs and tables.

Finally, we see that the coefficient for the "level of interest" is not statistically significant. The inclusion of the level of interest was to capture, albeit in an indirect form, motivational aspects contributing to performance. It is possible that this variable is not a particularly good proxy for measuring students' motivation. Moreover, we noted in the data and methodology section that while males self-reported the higher average level of interest, their grades were lower than females. So, it's equally possible that level of interest – as indicated by the regression results – has no explanatory effect on performance. But, we also note that the coefficient for "age" is on the cusp of being statistically significant (t-statistic = 1.64). For a variety of reasons, older, more mature students, frequently have a greater motivation to succeed at post-secondary institutions. With this in mind, we remove the level of interest as an explanatory variable for motivation and run a secondary OLS regression (Model 2).

With Model 2, we see a duplication of the results derived from the first regression but with a slightly higher fit as measured by the adjusted R^2. Gender, high school math grades, and the visual learning style (V) all remain statistically significant at the same level of significance while the statistical significance for the high school language/arts grade improves to a 1-percent level. In addition, age now becomes a statistically significant variable at the 10-percent level.

For our purposes, the empirical results indicate a robustness (and relatively stable value) of the reverse gender gap to different empirical specifications. On average, female students outperform male students in principles of economics courses by 4%.

4. Conclusions

Earlier literature on the gender gap in economics, particularly for principles courses, suggests that male performance – as measured by final course grades or grades on standardized tests – exceeds female performance. The rationales for the gender gap include sociological and cultural factors, student-specific attributes, as well as discipline-specific characteristics. Johnson *et al*. (2014) argue that many of the explanations for the gender gap no longer exist (e.g., female inferiority in mathematics) and suggest a re-evaluation of the gender gap in economics, particularly given the gains by women in the science, technology, engineering, and mathematical (STEM) fields. Indeed, recent studies indicate a narrowing of this gender gap when additional attributes such as personality traits, expectations, and/or motivation are included in the traditional education production function.

In this paper, we quantify the gender gap using a sample of students registered in both principles of microeconomics and principles of macroeconomics courses. Our descriptive statistics indicate that, on average, women receive higher grades in these courses compared to men. Preliminary regression analysis suggests that one of the primary reasons for the gender gap in favour of men – high school mathematics grades – no longer applies. In addition to traditional attributes and abilities (gender, high school grades in mathematics and language/arts, age, motivation, and paid working hours per week), we implement the VARK (visual, aural, reading/writing, and kinesthetic) inventory as a representation of students' learning styles. The results from the

regression analysis show that the gender coefficient is statistically significant, however, the gender gap is *reversed*: females on average have a 4% higher final grade than males.

This gender gap reversal is a new and important contribution to the literature. Can these results be replicated at other institutions across Canada or are these results, in some fashion, unique to the institution of Mount Royal University? There are three important characteristics or limitations of our study that may prevent duplication of our results across other institutions: class size, types of assessment, and instructor gender.

Mount Royal University is a primarily undergraduate liberal arts institution with small class sizes. Each section in the introductory economics courses, for example, is capped at a maximum of 35 students. Small class sizes are conducive to stronger relationships between instructors and their students. As mentioned in the data and methodology section, all instructors at Mount Royal use a combination of multiple choice, mathematical and/or graphical questions, as well as theory and/or application (i.e., written) questions on all tests – including the final exam. By providing a variety of assessment methodologies, students have the opportunity to express their knowledge in a manner that best suits their learning abilities.[2] Finally, and perhaps most importantly, Mount Royal has a significant portion of women instructors teaching the principles of economics courses. In this study, roughly half of the female students had a female instructor. As role models and mentors, there are studies suggesting that matching instructor and student gender can be a significant performance factor (McCarty *et al*. 2006).

Why do female students outperform male students? Is this the beginning of a new gender pattern? Does the gender or the preferred learning style of the instructor have a statistically significant influence on students' performance? These questions are suggested future research topics in this area. In the meantime, however, more empirical studies – across institutions and nations – are required to verify whether the reversal of the gender gap in principles of economics courses is a statistically significant trend.

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[2] There are studies suggesting that women do not perform as well as men on multiple-choice only exams (Lumsden and Scott 1987, Chulkov 2008, and Emerson *et al*. 2012)

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