Gender, Statistical Anxiety, and Supplemental Instruction

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ABSTRACT

Supplemental Instruction (SI) programs, which have been used in colleges and universities since the 1970's, are viewed as a cost-effective method of delivering peer-assisted instruction to students in courses that traditionally experience high failure and drop rates. In a previous analysis of students in an introductory business statistics class at a mid-sized university in the Southwest, it was found that SI was very important in a student's grade determination, especially in view of the fact that the course is designed as blended learning meeting one time per week. The analysis also seemed to indicate that there may well be significant differences as between men and women in terms of the effect of SI attendance on grade determination. The present paper investigates the differences between males and females in the course, and concludes that, while both men and women suffer from a fear of statistics (and mathematical courses in general) upon entering the course, their reactions to the anxiety are very different. While men appear to be better prepared than women when beginning the course, at the end of the semester, there is no significant difference in final grades. Several possible reasons for this are given, and the results may hold important lessons for encouraging greater participation of females in STEM activities from an early age.

INTRODUCTION

In a previous paper (Kennelly and Szal, 2016), an attempt was made to assess the effect of attendance at Supplemental Instruction sessions. In the context of that paper, Supplemental Instruction was taken to mean class sessions given by students (Supplemental Instruction leaders) who had been chosen on the basis of their highly successful completion of that or similar courses. The course to be analyzed in this paper meets once a week and is organized around a blended/flipped learning model. Attendance by current students at SI sessions is voluntary, although highly recommended in view of only one class meeting per week of a blended learning class. To encourage attendance, some professors offer extra-credit for the sessions attended. SI should be viewed as a nontraditional form of tutoring that focuses on collaborative group study and interaction designed to assist students in successful completion of "traditionally difficult" courses. SI is especially suited for courses with a relatively high proportion of students that drop, withdraw, or fail (approximately 30%) since it provides a trained, highly successful peer to assist the current students.

There has been a previous attempt, albeit some time ago, to analyze the effects of supplemental instruction at the same university as this study. An analysis conducted on 39 sections of a statistics course (albeit non-blended learning versions) from Fall 1998 to Spring 2001 revealed a relatively high attrition rate (defining attrition as a D, F, or Withdrawal) ranging between 13% and 63%, with a mean of 31% (Ng and Pinto 2003). Thus, students in the business statistics classes seem to be likely candidates for peer-assisted SI.

Several other studies have identified student anxiety toward statistics classes as a cause of the relatively high withdrawal and failure rate (Onwuegbuzie, 2004). Their anxiety led some students to experience fear of tests, attendance at class meetings, and asking for help from the instructor, as well as task aversion and severe fear of failure (Onwuegbuzie, 2004). Peer-assisted supplemental instruction can help to overcome some of these problems. An important consideration is that students' knowledge is enhanced by interactions with more competent peers who are at a level of understanding beyond that of the current students themselves (Miller and Oldfield, 2005). Statistical anxiety is experienced by as many as 80% of students in statistics courses (Onwuegbuzie and Wilson, 2003, Williams 2010), and is at least partly responsible for the procrastination of students enrolling in required statistics courses (Onwuegbuzie, 1997). This anxiety can affect students‟ performance in statistics classes, and cause feelings of inadequacy and low self-confidence for statistics-related activities (Blalock, 1987; Dillon, 1982). Statistics anxiety has been linked to students performance in statistics and research courses (Lalonde and Gardner, 1993; Onwuegbuzie and Seaman, 1995, Zanakis and Valenza, 1997), and has been recognized as a deterrent to students retention and graduation (Onwuegbuzie, 1997).

It was observed in the previous paper (Kennelly and Szal, 2016), that there appeared to be significant differences in the effect on grades as between males and females in the statistics course that was analyzed. The current paper attempts to investigate the differences in the effects of SI on males and females and relate this to the differing reaction of males and females to statistical anxiety. Some possible explanations for the sources of the anxiety and differing responses of males and females are offered.

Before proceeding, it will be useful to specify why SI is an almost essential tool in the context of blended learning classes. Blended learning is a teaching methodology that combines face-to-face classroom meetings with computer-mediated activities. A blended learning strategy potentially can create a more integrated approach to education for students. Many terms can be used interchangeably to describe blended learning: "blended," "hybrid," "flipped," and "mixed-mode". The introductory business statistics course in the present analysis was taught using a blended learning and flipped approach. In the blended learning statistics class being analyzed, much of the work normally covered in traditional in-class lectures is done by the students on their own outside of class. Normal homework assignments, applications, and issues that are unclear to the students are discussed in the one in-class

session held with students each week, and they are reviewed in the SI sessions with students by the SI leader.

As is the case in all SI-assisted courses, student instructors were involved in helping the students in the class. Student instructors take on a much more significant role in a blended learning course. They provide the bridge between class activities, deeper understanding of the materials, and grades. They can help to overcome the anxiety and fear associated with asking the professor for assistance in the course. Attendance data for previous classes in statistics at this mid-sized university in the Southwest indicate that students tend to utilize their student instructors more often and more effectively in a blended learning environment than in statistics class offered in a more traditional fashion.

The data used for this analysis were drawn from a course entitled "Introduction to Business Statistics." The course was offered in the Spring 2017 semester, and it was organized as a blended learning/flipped class. It is a required course for all students majoring in business in the College of Business at this mid-sized university in the Southwest, and, as mentioned, it has a relatively high attrition and failure rate. The great majority of students in this course are in their sophomore year. Students are required to pass this course with a grade of at least a "C" to apply to the College's Business Professional Program (BPP) at the end of their sophomore year.

The students met with the professor once a week for a 75-minute lecture session. They were expected to complete reading assignments and online pre- and post-lecture quizzes. The students were strongly encouraged to attend the SI sessions that were offered by the student instructors during four different one-hour time slots during the week. As an additional incentive, they received a one-quarter point in extra-credit for attendance at a session with a maximum of five points added to their overall point total for the course at the completion of the semester. That is, if the students attended 20 or more sessions, they could receive 5 extra -credit points. The extra-credit points are added to the students' overall point total for the course, implying that a student can obtain greater than 100 percent in the course. The analysis in this paper is based upon the performance of 91 students who attended at least one SI session.

Supplemental Instruction

Supplemental Instruction (SI) can take various forms and titles. In North America it often is referred to as SI, in Australasia, it is referred to as the Peer Assisted Study Sessions, and in the United Kingdom, it called Peer Assisted Learning (Dawson and Van Der Meer 2014). It is not equivalent to what is termed Teaching Assistance. Student instructors do not undertake teaching in the traditional meaning of covering new concepts. Instead, they review activities undertaken in class meetings with the professor and, in the case of a statistics class, clarify how problems are solved and results interpreted. This is particularly important in the case of a blended learning course in which class meetings are held once a week or in reduced numbers. The SI leaders provide a bridge between the activities in the limited time available in class and question-and-answer sessions. Further, SI sessions provide a vehicle for students to ask the professor additional questions and to raise concerns. In a survey of 286 respondents conducted by Longfellow et al. (2008), 15% of the students felt they had more opportunity with student instructors and indicated they were more comfortable asking questions in the SI session than in in-person lectures with the professor.

Very positive results of the SI program at the University of North Carolina at Charlotte were also documented (Congos and Schoeps 1993). Student grades were found to be significantly higher for SI attendees as compared to non-attendees. Congos and Schopes (1993) described three basic modes of operation for SI sessions:

a. Reviewing and completing notes from lecture sessions;
b. Problem-solving for possible examination questions; and
c. Reviewing test questions from previous exams.

The authors suggest that the role of the professor in the three modes of operation should remain small. Regular encouragement to attend SI sessions is important, and consideration can be given to awarding extra-credit for the attendance. Through four optional 60-minute SI sessions per week, students can be provided with course-specific learning and study strategies, note taking and test taking skills, as well as the opportunity for a structured study time with peers.

The U.S. Department of Education (Dawson, et. al., 2014) has identified three potential benefits of SI programs. These are:

- Students participating in these sessions will earn a higher final grade;
- Students will experience higher success and confidence and, thus, lower attrition; and
- Students who participate will demonstrate higher retention rates at the institution than those who don't attend SI sessions.

Numerous studies have found evidence supporting these claims. In a study conducted by the University of Missouri – Kansas City (UMKC) team encompassing 1,477 SI supported courses at 49 higher education institutions with an undisclosed number of participants, students who participated in SI sessions were found to have an average course grade of 2.39 as compared to 2.09 for students who did not participate, and the attrition rate (defined as average percent receiving a D, W, or F) was 23 percent for those participating in SI as compared to 38 percent for those who did not participate (Martin and Arendale 1992). Numerous subsequent studies have been conducted which have reported similar findings, supporting the claim that students who attend SI sessions receive

higher mean course grades than those who do not, and they have lower drop rates, and higher mean retention rates in the school (Arendale 1997) (Kenney and Kallison 1994) (Hensen and Shelley 2003). Another analysis (Bowles 2008) concluded that, everything else held constant, those who attended SI sessions had increased on-time graduation by approximately 11%. This could imply that attendance and use of SI sessions carry over to improve student performance in other classes (Malm, et. al., 2012). A systematic review of literature published from 2001 through 2010 concerning the effectiveness of SI programs concluded that all available literature supported the Department of Education claims. (Dawson, et. al., 2014). And, SI has been found to improve student performance for those who may have performed poorly in pre-college or university classes (Ning and Downing 2010).

The current study differs from previous SI studies since it is based on a blended learning course, with an emphasis on revealing the quantifiable effectiveness of each SI session. Unlike most previous work, this analysis uses multiple regression techniques to determine the effectiveness of the SI program while looking at other factors that contribute to the final course grades. This technique illustrates the potential benefits that each SI session attended may have on a student's final course grade. Our research revealed that only one other study (Kenney 1989), done at The University of Texas at Austin, used multiple regression analysis with two different control groups (one in which SI attendance was mandatory and one in which SI sessions were not offered). When controlling for previous GPA, those who did not attend the SI sessions had an average course grade of 2.51 while those who were required to attend had an average course grade of 2.95 (Kenney 1989). This tends to indicate that there is a direct relationship between course grade and attendance at SI sessions.

Other studies used Chi-square analysis (Fayowski and MacMillan 2008; Hensen and Shelley 2003). These studies also concluded that SI programs have a positive impact on students' course grades. These researchers reported that students who attended the sessions reported significantly higher pass rates at the $p < .05$ level (Peterfreund, et al. 2008). While these studies concluded that SI programs are effective, only limited information has been provided about the type of data used to reach their conclusions. Further, these previous studies have been criticized because they often did not deal with variation in the number of SI visits and they used high school performance or SAT/ACT test scores as measures of preparedness for learning (McCarthy, Smuts, and Cosser 1997). The present study uses the actual number of SI visits during the semester and student cumulative GPA as explanatory variables for student performance.

In general, SI programs can be justified on four grounds: behavioral, pedagogical, economic, and political (Goldschmid and Goldschmid, 1976; Hill and Helburn 1981). First, SI has been reported to foster a number of behavioral changes and development in both the student instructors and students (Collier 1980; Hill and Helburn 1981). These include accelerated maturity, reduced student anxiety, increased learning, as well as the promotion of teamwork, leadership, empathy, and responsibility (Hill and Helburn 1981, 150). Second, SI is often associated with instructional (or pedagogical) benefits, notably through applied individual and personal active learning strategies as opposed to passive ones. Here, SI may serve to motivate participation in learning outside the classroom and reduce inhibitions emanating from the absence of personal responsibility in the learning process (Cornwall 1980). Third, apart from these benefits, SI can be justified on the basis of economic considerations. SI can help reduce high student/teacher ratios in a cost-effective manner (Goodlad and Hirst 1989; Malm, et. al., 2012). SI combined with a blended learning approach in which classes meet once a week can result in significant cost savings for schools by reducing space requirements and increasing student intake per class. However, these cost savings can be somewhat offset by the need for larger and better-equipped classrooms and student instructor selection and training. Finally, the concept of SI has been justified on the grounds of empowering students and changing relationships that exist both within the professional teaching staff community and between professors and supplemental instructors (Hill and Helburn 1981, 152).

Gender and Statistical Anxiety

Statistical literacy in the present day and age has become virtually a necessity making statistics courses mandatory for university students. Unfortunately, empirical evidence suggests that most university students do not understand why statistics courses are necessary for business disciplines and the social sciences A great deal of research has been done recently on statistical anxiety and on gender differences in the reactions to it.

Statistical anxiety has been identified (Chew & Dillon 2014) as a key impediment to student success. Nervousness and negative feelings that arise when confronting quantitative information in their daily lives may block students' ability to learn the subject. Factors that might affect statistics anxiety were studied as part of a sample of 970 students taking an introductory statistics class at The Ohio State University in Spring 2014. Anxiety was measured using the Statistics Anxiety Measure (Earp, 2007) and examined for its relationship with gender, course performance, and Student Attitudes Towards Statistics. Female students, students who went on to do poorly in the class, and students with negative attitudes towards statistics tended to have greater anxiety in the SAM pre-test. These factors were similarly associated with the post-course anxiety levels, except that the effect of course performance naturally grew stronger (Chew and Dillon, 2014).

Of interest to this paper is the finding that females tend to suffer greater anxiety than males in statistics classes. Are there particular reasons for this? There is a growing body of research that indicates that females, from a very early age, tend to be discouraged from taking math-based courses, and more generally, STEM-type courses. Research has found that there is a gender imbalance in STEM courses with females being underrepresented (Leslie, Cimplan, Meyer, and Freeland, 2016). Surveys revealed that some fields are believed to require attributes such as brilliance and genius, whereas other fields are believed to require more empathy or hard work. In fields where people thought that raw talent was required, academic departments had lower percentages of women. The authors hypothesized that across the academic spectrum, and starting from a very early age, women are

underrepresented in courses that educators and practitioners believe require raw, innate talent as a requirement for success, because women are stereotyped as not possessing such talent. The perception of women that they may not be suited to STEM subjects and courses may lead them to have a very different reaction to a math-based course such as statistics. While the current paper cannot claim to provide a definitive answer to these questions, the analysis will attempt to add to the understanding of gender differences and statistical anxiety.

Context

The particular model of SI utilized in this study was developed at the University of Missouri, Kansas City (UMKC), as early as 1973, to provide targeted assistance to learning in high-risk courses rather than high-risk students (Arendale 1997). In the UMKC model, the SI sessions are facilitated by academically successful undergraduate business student instructors. The student instructors who offer Supplemental Instruction are peer-tutors who have previously excelled in the course and have received training so that they can guide collaborative group study sessions. Student instructors attend most assigned lectures, take thorough notes, and participate in the course in the same fashion as other students. They plan and conduct four 60-minute study sessions each week at fixed times. They use a variety of teaching and learning methods within these sessions to demonstrate effective study strategies that a student can apply to any class. These study strategies thus provide an opportunity for students to learn *how* to learn while learning *what* to learn.

In contrast to other forms of teaching assistance and regular tutoring, SI is a non-remedial, proactive, voluntary opportunity for all students to improve their understanding of course materials by directly assisting in the development of their study skills. The success of any SI program relies heavily on the quality of its student instructors (Congos and Schoeps 1993). Student instructors who get along well with the students are better able to achieve positive results such as higher final grades for the assisted students. Thus, student instructor selection and training are important to the success of the students whom they attempt to assist.

The SI program at this mid-sized university in the Southwest is widely used to support courses that are historically recognized as difficult for the majority of students. While the statistics course in the College of Business is recognized as one of those courses, the SI program is also used to support courses in accounting, economics, finance, health sciences, psychology, biology, chemistry, engineering, astronomy, physics, and mathematics. The program has been in operation at the university for well over a decade. It began initially to cater to introductory science courses, and it has expanded to support additional lower-division courses as the benefits were recognized. Attendance at SI sessions in the statistics course of this study is voluntary, and a small amount of extra-credit is given toward a student's final grade for the number of sessions attended during the semester.

THE DATA

A blended learning course requires a strong online learning tool, since much of the work done by the students is outside of the class meetings. For this course, an online textbook and assignment system dealing specifically with business statistics was utilized. It needs to be stressed that, by-and-large, the theory of statistics is the same no matter what the field of specialization and application. The difference occurs primarily in the types of applications. For example, hypothesis testing can be applied to pre-testing a new drug in the pharmaceutical industry or to quality control on an assembly line. The former can be labeled medical research whereas the latter is business research. Yet both use essentially the same techniques.

From the course offered in the Spring of 2017, several important variables were available to gauge the effect of each on student performance. These variables include:

a. **Student Grade Point Average upon entering the course.** From university records, it is possible to obtain the cumulative grade point average for each student at the time of entering the course. The assumption made in including this variable is that GPA is a measure of ability. On the other hand, it needs to be kept in mind that these students, for the most part, are sophomores so that the cumulative GPA of each student is based on a relatively small number of required courses. The value of GPA varies between 1 and 4.

a. **Gender**. Male or female.

b. **Time spent on online assignments**. The online system used in the course offers summary slides of textbook chapters, practice problems, pre-lecture and post-lecture quizzes, and exams. Statistics are available from the instructor's grade book for the amount of time students have logged into their account for each of the activities. To keep the analysis uncomplicated and to avoid value judgments concerning the importance of various activities, the total number of hours for all activities has been used in the analyses. No bounds apply to this variable.

c. **Engagement in the Course**. A student's grade for Engagement is based on attendance, correct responses by clicker to questions posed during the lectures, and the number of times the student accessed the textbook.. Generally speaking, a semester encompasses 15 weekly lectures with, on average, 3 questions per lecture to be answered anonymously by clicker. For purposes of the present analyses, each student's overall point total has been converted to a percentage.

d. **Number of SI sessions attended during the semester**. SI leaders are required to hold 4 one-hour sessions per week. Attendance by students is optional, and they can attend more than one session per week. Extra credit for attendance at SI

sessions is given. A student receives 0.25 of a point for each session attended up to a maximum of 5 points. This means that extra-credit is given for up to 20 SI visits during the semester, and this is the upper limit of this variable. A student's semester total is added to their overall point total for the course after all other components are taken into account.

e. **Semester Point Total**. A student's final grade in the course is based upon the weighted total of course elements used for grading. Each element is converted to a percentage of the possible points, and the components are weighted in the following way:

TABLE 1
GRADING COMPONENTS

2 Mid-Term Exams (10% each)	20%
Homework Quizzes	30%
Team Project	20%
Final exam	20%
Course Engagement	10%
Attendance at SI Sessions (0.25 points per sessions)	Max 5 points

It needs to be kept in mind that a student's total score for the course can exceed 100 percent. With the exceptions of the Team Project and Class Participation, students can potentially obtain more than 100 points for the other components of their grade. This extra credit is earned more for attitude and effort in the class than for ability.

f. **Sample Size**. In total there were 133 students in 2 sections of the course in the spring semester of 2017. Of these, 91 attended at least one student instructor session and 42 did not attend any. The motivation for not attending sessions differs as between

TABLE 2.
SUMMARY OF STUDENTS ATTENDING AND NOT ATTENDING BY GENDER (STANDARD DEVIATIONS IN PARENTHESES)

Variable	All Students			Males		Females	
	All	Attending	Not Attending	Attending	Not Attending	Attending	Not Attending
Number	133	91	42	56	28	35	14
GPA	2.99 (0.59)	3.13 (0.55)	2.70 (0.58)	3.02 (0.59)	2.50 (0.52)	3.30 (0.44)	3.06 (0.82)
Online Time (hrs.)	15.02 (11.44)	16.27 (13.34)	12.69 (11.04)	14.64 (9.75)	10.32 (8.22)	16.40 (13.74)	17.43 (14.40)
Engagement (%)	67.22 (19.03)	69.60 (16.36)	62.06 (23.23)	69.05 (16.72)	59.52 (25.12)	10.48 (15.95)	67.14 (18.71)
SI Visits	6.20 (7.13)	9.07 (6.96)	0	8.66 ((6.86)	0	9.71 (7.14)	0
Final Exam (%)	65.91 (28.65)	70.98 (28.25)	54.94 (26.65)	69.41 (27.96)	52.02 (26.79)	73.49 (28.95)	60.78 (26036)
Total Points (%)	77.24 (16.77)	81.76 (13.97)	67.97 (15.12)	80.70 (14.57)	64.37 (15.84)	83.45 (13.02)	73.66 (11.78)

[a] Significantly different. The p-Value is 3.84E-07.
[b] Significantly different. The p-Value is 1.01E-05.
[c] Significantly different. The p-Value is 0.0148.

students, e.g., timing conflicts, the feeling that the sessions are not necessary to succeed in the class, work commitments, etc. The non-attendees are excluded from the regression analyses done later in the paper. To have included non-attendees in this analysis would have biased the results by the inclusion of too many zeros for the SI Attendance variable for a variety of reasons not related to the overall analysis.

Table 2 summarizes descriptive statistics for the students in the statistics course during the spring 201 semester.

There are several noteworthy facts that emerge from the above table. The differences that emerge both from those who attend SI sessions and as between men and women are significant. The points below summarize the salient features:

1. The composition of the class was 63% males and 37% females. Two-thirds of all students attended at least one SI session;
2. Within the groups of males and females, 67% of males and 71% of females attended at least one SI session;
3. Females in the course, whether they eventually attend or do not attend SI sessions, begin with a significantly higher GPA;
4. Those students who attend SI sessions also spend more time on online assignments, attend class more regularly, and respond correctly more often than students who do not attend the sessions;
5. Students who attend SI sessions have significantly higher grades on the final exam;
6. Students who attend SI sessions have significantly higher total points, and therefore final grades, for the semester;
7. Females, both those who attend and those who do not, have higher total points for the semester than males; and
8. The total semester points for males and females that attend SI sessions are not significantly different (the p-Value=0.365 for a 2-tail test).

REGRESSION ANALYSIS

In an attempt to more thoroughly investigate the apparent differences between males and females, regression analyses were undertaken using ordinary least squares (OLS). A couple of factors need to be kept in mind when interpreting the results of these results. First, students that did not attend any SI session are eliminated from the analysis. Including them would lead to too many zeros in the data, and this would bias the results. Secondly, because the sample sizes are relatively small (56 males and 35 females who attended at least one SI session), the number of independent variables that can be included in the equations must be limited. With these provisos in mind, the model tested for both males and females is the following:

CP = f (GPA, HT, P, SI)

Where:

CP = Total points for the semester;

GPA = Grade Point Average;

HT = Time spent on online assignments in hours;

P = Class participation during weekly lectures.

SI = number of SI sessions attended;

The above model is estimated separately for males and females. The OLS estimator is consistent when the regressors are exogenous and there is no multicollinearity, and they are optimal in the class of linear unbiased estimators when

TABLE 3
MALE REGRESSION RESULTS

OLS Regression Table	Coefficient	Standard Error	t-Value	p-Value	VIF
Constant	15.80				
GPA	13.887	2.240	6.199	9.99E-08	1.274
Time Online (HT)	0.195	0.130	1.495	.1411	1.367
Engagement (P)	0.227	0.072	3.141	0.003	1.025
SI Attendance (SI)	0.515	0.166	3.092	0.003	1.152
R^2/Adjusted R^2	0.694/0.670				
F-ratio	28.97			1.40E-12	

Table 4. Female Regression Results

OLS Regression Table	Coefficient	Standard Error	t-Value	p-Value	VIF
Constant	3.678				
GPA	18.577	3.022	6.147	9.24E-07	1.062
Time Online (HT)	0.150	0.093	1.617	0.116	1.140
Engagement (P)	0.140	0.082	1.719	0.096	1.054
SI Attendance (SI)	0.602	0.177	3.391	0.002	1.108
R^2/Adjusted R^2	0.635/0.613				
F-ratio	28.89			3.48E-08	

the errors are homoscedastic and serially uncorrelated. Under these conditions, the method of OLS provides minimum-variance mean-unbiased estimation when the errors have finite variances.

The results of the regression are presented in tables 3 and 4
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The comparison of the results for males and females indicate significant differences in the approaches of males and females in the course:

1. The values of the intercepts in the equations indicate that males are better prepared when beginning the course. The value of the intercept for the male equation is about 4 times as great as that for females;
2. Conversely, GPA plays a greater role in the performance of females than males. Both GPA coefficients are highly significant. The not surprising conclusion is that students with higher GPA's perform better in the statistics class;
3. Time spent on assignments online does not appear to have a highly significant effect on a student's performance both for males and females. This tends to reinforce the finding from the information presented in Table 2 that, on average, students only spend about an hour a week on homework assignments, and they do not access the textbook with any regularity;
4. Engagement, which includes class attendance and clicker responses to questions, is highly significant in the determination of grades for males, but much less so for females. The coefficient for females is significantly different from zero at the 90% level of confidence; and
5. Finally, we arrive at SI attendance. It is highly significant for both males and females in the determination of their grades. In fact, excluding the constants for the intercepts and GPA's, attendance at an SI session adds more to a student's grade than any other component of the equation.

There is an explanation for the importance of attendance at SI sessions for both males and females. It was pointed out earlier that available information indicates that, on average, students do not spend a great deal of time in preparation for class meetings. Generally, then, class presentations are often a student's first detailed exposure to course materials. In addition, class presentations must concentrate a lot of attention on the theory underlying statistical operations. Supplemental Instruction leaders do not teach, but rather they concentrate their attention on the application of the concepts covered in class. Much more time is spent on problem solutions than on the underlying theory. Aside from the application of the concepts, the SI sessions act as a reinforcement of what the students had first come into contact with during the class meetings. For all these reasons, SI sessions are very important, and they play an even more critical role in the case of a blended learning class in which the number of class meetings is limited.

The last column in the regression tables presents Variance Inflation Factors (VIF). The VIF's are summary measures of multicollinearity in the data. A rule of thumb is that a VIF must be less than 5 to indicate the absence of multicollinearity. All of the coefficients in the VIF columns are small indicating the absence of multicollinearity.

The VIF's in the regression tables are a type of summary measure. It is also useful to assess the correlation between specific variables used in the equations. The Tables below present the Correlation Matrices for the variables used in the equations for males and females. The only problematic figures in the tables concern the correlation between GPA and Time Online for males, but we do not consider this to be serious. It might be expected that time spent on assignments is positively correlated with GPA. Students with higher GPA's spend more time studying. It is surprising that this is not the case for females. The other noteworthy result is the negative correlation between Engagement and Time Online for females. While the coefficient is small, it tends to indicate that females may substitute (to a small extent) online assignment completion for class attendance.

SI ATTENDANCE AND FINAL GRADES

The course Introduction to Business Statistics has been designed so that no one element of the course can be devastating to

TABLE 5
CORRELATION MATRIX FOR MALES

	GPA	*Time Online*	*Engagement*	*SI Attendance*
GPA	1.000			
Time Online	.456	1.000		
Engagement	.340	.232	1.000	
SI Attendance	.116	.075	.137	1.000

TABLE 6
CORRELATION MATRIX FOR FEMALES

	GPA	*Time Online*	*Engagement*	*SI Attendance*
GPA	1.000			
Time Online	.225	1.000		
Engagement	.247	-.032	1.000	
SI Attendance	.144	.018	.204	1.000

a student's grade. In addition, several of the components of a student's grade include the ability to earn extra credit for extra effort or for taking part in activities that are not a strict college requirement for the course. The bottom line for most students is class points and their grade. This paper has attempted to demonstrate how important SI sessions are to student grades. To summarize that demonstration, the following table presents information on the relationship between final grades and SI attendance.

TABLE 7
SI ATTENDANCE AND FINAL GRADES

Grade	**Attended SI Session(s)**		**Did Not Attend SI Session**	
	Males	**Females**	**Males**	**Females**
A	**16**	**13**	**0**	**1**
B	**17**	**10**	**4**	**2**
C	**18**	**9**	**12**	**9**
D	**3**	**3**	**7**	**1**
F	**2**	**0**	**5**	**1**
Total	**56**	**35**	**28**	**14**

While the relationship between SI attendance and final grades seems clear, it must be borne in mind that a student's final grade depends on many factors, e.g., having taken a statistics course in high school, having a penchant for math-based courses, etc. Attending SI sessions also may be due to many factors, e.g., more highly motivated students, a higher level of anxiety, attending with friends, etc. As students must be aware (at some point during the semester) that there are significant benefits to attending SI sessions, why don't they do so? At least 4 reasons come to mind:

a. Students feel they can do well without SI attendance; It should be noted that 7 students received an "A" or a "B" without attending SI sessions;
b. SI attendance is voluntary and some students "just want to get by with a C". Twenty-one students obtained a passing grade of "C" without attending SI sessions;
c. Students have conflicts with the fixed time slots of SI sessions. This is perhaps the most serious concern. By their nature, SI sessions must have fixed times due to classroom assignments and SI leaders' schedules of classes. Attendance at SI sessions for the leaders of other professors is possible, but that may not result in the optimum solution. While course content is to some extent standardized through a "Master Syllabus" for the course, professor presentations and course schedules are not.
d. Some students just don't care about their grade.

Whatever the reason, it would seem to be an important step forward to determine the reasons why some students choose not to attend and the ways in which they could be encouraged to do so. This is particularly important in the context of blended learning courses.

CONCLUSIONS AND FUTURE DIRECTIONS

The aim of this paper was to determine whether there is a significant difference in the effect of attendance at SI sessions for males and females in a statistics course. The addition per SI session attended to total course points is more than twice as much as the completion of homework assignments and participation in class activities for both males and females, and the effect on the grades of females is significantly larger than for males. It was pointed out earlier that SI takes on added importance in the context of a course designed using blended learning techniques. SI leaders, in principle, do not undertake teaching, but rather more of a review of the materials covered in the one class meeting with the professor per week. In addition, they also spend more time demonstrating the application of the statistical techniques covered in the formal class meeting. Thus, the SI sessions provide a review and reinforcement of the class activities. As such, they inevitably provide the link between theory and practice. As a consequence, it is not surprising to find that, on the course evaluations, many students express the feeling that they could not have gotten through the course without the help and support of the SI leader.

The results of the analyses performed in the paper have pointed up several other important differences between males and females in the course. These are:

a) As pointed out in the previous paragraph, SI attendance is very important in the determination of both male and female grades;
b) SI attendance has a significantly larger effect on the grades of females;
c) Males appear to be better prepared, as compared to females, at the outset of the class as witnessed by a much larger intercept term in the regressions;
d) Females have a higher GPA at the outset of the class;
e) There is no significant difference in the grades of males and females at the completion of the course; and
f) The results tend to lead to the conclusion that males and females have different strategies in their approaches to succeeding in the course.

Most studies on students taking statistics or mathematics courses have pointed out that there is significant anxiety on the part of the students when beginning the course. The reaction to this anxiety appears to be very different for males and females, however. There are 2 somewhat diametrically opposed ways by which the students attempt to overcome the anxiety; avoidance and working harder. The data available for this study do not allow a definitive conclusion on the strategies of males and females, but what can be gleaned from the results is that for some reason, females seem to get more out of the course than males. Grade differences are large at the outset of the course, as witnessed by the intercept terms in the regressions, but these grade differences narrow over the span of the semester. There is no noticeable or significant difference in the final grades of males and females. One can think of at least 3 possible explanations for the convergence of grades:

1. The initial anxiety results in females working harder to succeed in the class;
2. The method of instruction used in the course appeals more to females than to males; and
3. The gender of the SI leader (in the present case female) results in women taking greater advantage of the SI sessions.

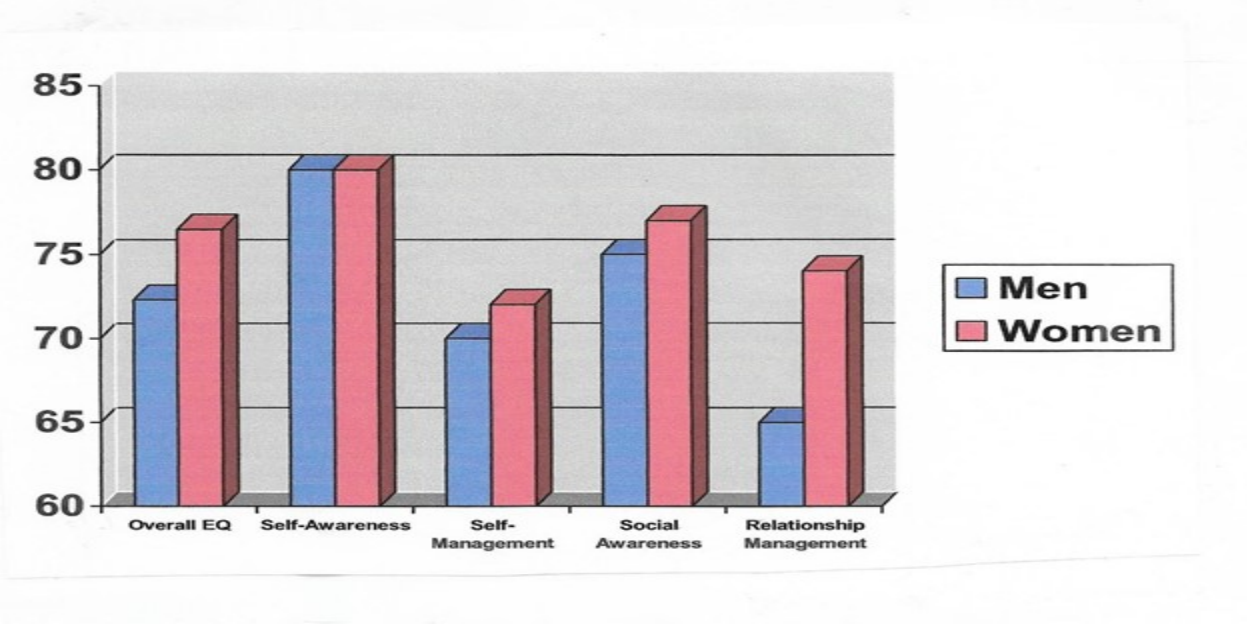
The data indicate that males tend to spend more time online and engage more in class activities than females. Conversely, females tend to obtain greater usefulness from SI sessions relative to males.

It is totally unproductive and quite parochial to talk about whether males or females are smarter. Most studies on the subject of IQ arrive at the conclusion that there is no significant difference between the scores of men and women. A great deal more attention has been paid to the differences in Emotional Intelligence. In simple terms, emotional intelligence (sometimes called "EQ") is the ability to use emotions effectively and productively. A general finding of educational psychologists has been that females tend to maintain a consistently high standard in the classroom, and they evaluate their own performance more critically than males (Dwyer and Johnson, 1997). One might then conclude that females are more self-confident about academic abilities and self-esteem. This is not the case. The stereotyping of females from an early age leads them to believe they cannot be "brilliant" and to be overly critical of their academic performance. Psychologists refer to this as the "Imposter Syndrome". Despite evidence of their competence, success is dismissed as luck, timing, or deceiving others into thinking they are more intelligent and competent than they believe themselves to be. The cultural messages given to young females leads them to believe that yes, I work hard, yes, I get good grades, but I am not naturally smart. As a consequence, women shy away from courses in engineering, mathematics, and physics.

We arrive back to the discussion of Emotional Intelligence (EQ). Almost all research over decades has come to the conclusion that males and females have the same average IQ. Things are not so equal when it comes to EQ. Research conducted in the 1990's by TalentSmart provided a credible link between emotional responses and actions. This, in turn, can be the key to success in their education. On the basis of results from different regions of the world, females have been found to score higher than men in three of four emotional intelligence skills, namely, self-management, social awareness, and relationship management. They were rated as equal to men in the category of self-awareness. The following figure from a white paper report by TellSmart (Su and Bradberry, 2004) depicts the results of the survey and research.

We arrive at a paradox facing professors teaching highly technical and/or mathematical subjects; females may obtain straight A's but feel unprepared and highly anxious when taking a course whereas males may barely be getting B's but feel they are brilliant and it is the professor's fault if they do not perform well. This is referred to by psychologists as the cognitive bias called

EMOTIONAL INTELLIGENCE (EQ) AND GENDER (2004)



Source: Su and Bradberry, 2004

"Illusory Superiority" which means males may overestimate their abilities.The reaction of each group is different. Females tend to apply themselves more to the task at hand whereas males become less motivated to study unless the course contents interest them. What seems to be required in each case is a reality check. Females need encouragement concerning their competence and males need to be made to realize that they are not as intellectually superior as they may think. In both cases, the answer is to challenge the students with the materials in the course.

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