Improving exam performance in an undergraduate statistics course for at-risk students through peer tutoring

Milushka Elbulok-Charcape, Evan Grandoit, Lorin Berman, Joshua Fogel, Lauren Fink & Laura Rabin

Peer tutoring is an effective method of improving undergraduate students' academic performance, especially for those at-risk for poor grades. Peer tutoring has seldom been explored in undergraduate statistics, a difficult but required course for many college majors. The current study investigated the benefits of peer tutoring for 180 demographically-diverse undergraduate students enrolled in an introductory psychology statistics course at an urban public university. We investigated the predictive value of attendance at peer tutoring sessions for in-class examination performance. We also studied the role of help-seeking and self-efficacy. Results indicated that peer tutoring attendance was associated with higher grades for in-class examination among at-risk students. Help-seeking and self-efficacy were not associated with in-class examination scores. Peer tutors can help at-risk students increase scores in statistics courses. Departments offering undergraduate introductory statistics courses should allocate resources to allow for funding of peer tutoring programs.
Keywords: *peer tutoring; undergraduate students; psychology; introductory statistics; self-efficacy; help-seeking.*

INTRODUCTORY STATISTICS is a foundational course required for undergraduate degrees in psychology, the social and health sciences, education, and business, and it also serves as a pre-requisite for many graduate programmes (Barron & Apple, 2014; Blumberg, 2001; Stoloff et al., 2010). From 2003 to 2013, the number of undergraduate students completing statistics degrees grew by 140 per cent (Carver et al., 2016). Moreover, students earning bachelor's degrees in statistics increased more than any other Science, Technology, Engineering, and Mathematics (STEM) field from 2010 to 2013 (Wasserstein, 2015). Projections suggest that the demand for data science jobs will exponentially increase in the next decade (De Veaux et al., 2017). As enrollment numbers increase, improved statistical instruction and novel educational methods and approaches would benefit students and instructors alike.

Despite upward enrollment trends, undergraduates encounter academic and non-cognitive challenges while undertaking statistics courses (Evans, 2007; Leavy et al., 2013; McGrath, 2014). The course has an abstract and complex nature typically not found in other social science courses (Schacht & Aspelmeier, 2005) and requires mathematical computation (Prabhakar, 2008). Statistics can raise fears about mathematical abilities (Baloğlu, 2004) and demands basic mathematical background knowledge/skills (Carpenter & Kirk, 2017) not yet mastered by some students (Fonteyne et al., 2015; Rabin et al., 2018). Some students believe that statistics courses require special talents such as a deeper understanding of concepts that 'typical' students do not have or cannot develop (Tomasetto et al., 2009). Also, some students find that grasping statistical jargon may simply be difficult (Dunn et al., 2016).

Student demographic characteristics and their relationship to statistics performance have not been systematically investigated. However, much research has been devoted to studying the relationship between women and underperformance in STEM. Reasons for findings related to underperformance of women in STEM majors include: lower academic self-efficacy (a person's beliefs in their own abilities; Bandura, 1986), stereotype threat, and lack of role models (Appel, Kronberger & Aronson, 2011; Herrmann et al., 2016; Stout, et al., 2011). Other studies that have explored self-perceptions have found that women hold more negative perceptions about statistics (Cendales, Trujillo, & Barbosa, 2013) and mathematics, despite comparable academic performance in these disciplines (Jacobs, 2005). Research on the relationship between sex and statistics course performance, including a meta-analysis (Schram, 1996), have yielded mixed or inconclusive results (Lalonde & Gardner, 1993; Lester, 2016; Sibulkin & Butler, 2008; Voyer & Voyer, 2014). Performance in statistics has also been examined with race/ethnicity, where in an introductory statistics course there was a greater discrepancy between expected and actual grades for Latino and Black students as compared to their Asian counterparts (van Es & Weaver, 2018).

Psychological variables have also been explored in relation to course performance. Increased student help-seeking behaviour corresponds to better performance in STEM courses (Horowitz, Rabin & Brodale, 2013; Karabenick, 2003; Sun, Xie & Anderman, 2018; Szu et al., 2011). Additionally, negative help-seeking behaviour has been associated with predictors of lower statistics performance (Onwuegbuzie, 1999; Rodarte-Luna & Sherry, 2008). To our knowledge, the relationship between statistics performance and help-seeking orientation has not been investigated. Self-efficacy, on the other hand, has been found to positively relate to course achievement in statistics (Finney & Schraw, 2003) and overall academic performance (Pajares, 1996). Lastly, other student attitudes and perceptions (Garfield & Ben-Zvi, 2007), statistics anxiety (Bourne, 2018; Chiou, Wang & Lee, 2014; Onwuegbuzie & Wilson, 2003; Sandoz, Butcher & Protti, 2017), inconsistent motivation (Acee & Weinstein, 2010; Ejei et al., 2011; Gelman & Nolan, 2017), persistent unfavorable views of the course (Chiesi & Primi, 2010), and ambivalent or negative attitudes (Walker & Brakke, 2017) can make learning statistics difficult.

Teaching undergraduate statistics can also be challenging because traditional pedagogical techniques (e.g., lecture) focus on calculations, procedures, and formulas (Hassad, 2009), and may appear to be removed from real-life applications (Garfield et al., 2002). Numerous strategies have been employed to improve achievement in statistics courses and raise student morale. These include active learning (Harlow, Burkholder, & Morrow, 2002; Macher et al., 2012; Onwuegbuzie & Wilson, 2003; Vandiver & Walsh, 2010), co-operative learning conditions (Miller, Oldfield & Bulmer, 2004), flipped classrooms (Cilli-Turner, 2015; Peterson, 2016), gamification (Hazan et al., 2018; Smith, 2017), and game-based learning (Boyle, 2014). Although variable levels of success have been associated with these methods and techniques, universities have had to contend with factors such as reduced financial resources (Carmody, & Wood, 2009) and classroom time constraints, limiting the opportunity for implementation. As a result, institutions of higher learning have sought to utilise time, cost effective, and sustainable ways to assist students in introductory statistics courses.

Peer tutoring, i.e., academic assistance from non-professional individuals (Falchikov, 2003; Topping, 1996) of equal standing (Forman & Cazden, 1985), is an appealing solution to the aforementioned challenges in teaching statistics. Peer tutoring is an active learning method that is low cost (Topping, 1996) and requires minimal instructor involvement. Peer tutoring improves undergraduate students' academic performance (Cantinotti et al., 2017; Harlow et al., 2002; Helman & Horswill, 2002; Laher et al., 2007; Miller et al., 2004), statistical conceptual knowledge (Budé et al., 2011), self-concept (Leung et al., 2005) and satisfaction (Stone et al., 2012). Interventions similar to peer tutoring (e.g., learning communities, peer learning groups, co-operative learning, peer assessments) have yielded similar positive results (Carlson et al., 2016; Curran et al., 2013; Sun et al., 2015).

The use of peer tutoring specifically to improve performance in statistics courses has been investigated in a few previous studies. One study found that when undergraduate students in a research design and statistics course utilised peer tutoring, along with other active learning techniques, they performed significantly better on a statistics examination as compared to students who did not utilise those active learning strategies (Helman & Horswill, 2002). Another study reviewed university data after years of implementing a peer tutoring system, in which senior undergraduates instructed freshmen on research design and statistics (Laher et al., 2007). Both students and tutors reported that the programme had a positive influence on their knowledge and teaching development. A relationship between students who attended more peer tutoring sessions and higher statistics course final grades was also found (Laher et al., 2007). Similarly, other studies have reported a positive impact of undergraduate student participation in collaborative learning, a component of peer tutoring, on statistics course performance (Carlson et al., 2016; Curran et al., 2013).

Studies have reported a positive relationship between peer-assisted study sessions (PASS) attendance and course grades for undergraduate science students in statistics courses (Miller et al., 2004). PASS, a form of collaborative learning that targets students in first year courses (Miller et al., 2004), allows peer facilitators to redirect questions back to student attendees to encourage group discussion, to guide students to find answers themselves, and to promote self-regulated learning (i.e., monitoring and controlling of one's own learning processes through a recursive, adaptive, and dynamic cycle (Butler & Winne, 1995; Zimmerman, 1990). Another study examined the relationship between PASS attendance and undergraduate student performance in a business statistics course (Dancer et al., 2015). Students who attended PASS more frequently earned higher statistics grades and this pattern was more pronounced for low-performing students. Lastly, research on the perceived benefits of collaborative learning for undergraduate and graduate psychology students in a statistics course found that low-performing students reported valuing peer tutoring more as compared to high-performing students (Cantinotti et al., 2017). However, this study did not measure how attending peer tutoring sessions affected course performance.

Although the current project did not utilise PASS, we utilised peer tutoring, a similar form of collaborative learning that is low cost, to help undergraduate psychology students learn statistics at a well-adapted pace and improve the exam performance of low-performing students. We studied the association of attendance at peer tutoring with multiple grade outcomes throughout the semester for subgroups of those at-risk for poor grades and those not at-risk for poor grades. Although there is research that attendance at peer tutoring sessions is positively associated with higher statistics course final grades (Laher et al., 2007), to our knowledge, this has not been studied with the subgroup of undergraduate students at-risk for poor statistics grades. Furthermore, the positive association of attendance at peer tutoring sessions with grades has only been done with a one-time grade outcome (Helman & Horswill, 2002; Laher et al., 2007) and not with the impact at multiple grading times during the semester.

To our knowledge, the current study on peer tutoring is the first to adjust not only for demographics, but also for the potentially relevant covariate of help-seeking orientation, a variable previously found to positively impact STEM courses and statistics performance, and self-efficacy, a variable previously found to positively impact statistics achievement and overall academic performance. One research question is that academically at-risk students would derive more benefit from attending peer tutoring sessions than those students not academically at risk. A second research question is that psychological variables of help-seeking and self-efficacy would each be beneficial for exam performance. We hypothesised that: (1) Peer tutoring sessions attended would be positively associated with exam performance with an increased benefit with number of tutoring sessions attended among academically at-risk students while no such pattern of increased benefit with number of tutoring sessions attended would occur for those students not academically at risk; (2) Student help-seeking scores would be positively associated with exam performance; and (3) Student self-efficacy scores would be positively associated with exam performance.

Method

Participants

Participants were undergraduate students enrolled in a psychology statistics course offered over a 15-week semester at an urban public college that is part of a large public university system in the north-east United States. We pooled data from two consecutive semesters taught by the same instructor that used the same textbook and course materials. During the first week of class, enrolled students were invited to participate in a study that aimed to improve student performance in undergraduate statistics. Participation was voluntary, and students were not compensated for their participation nor penalised for non-participation. Participants provided informed consent. The study was ethically conducted and received Institutional Review Board approval. The response rate was 95 per cent, calculated from the 201 students approached, with 10 declining. Over three quarters of the sample was female (N=145, 80.6 per cent). More than one third of students were in their third year of college (N=67, 37.2 per cent). Year in school categories were equally represented in the sample. Due to privacy concerns, we did not ask participants to report their age in years, however, most students were of typical college age (i.e., 18–24 years). We excluded 11 participants from the analyses because they did not take Exam 3, which resulted in a sample of 180 participants.

Procedure

Participation entailed completion of a questionnaire, developed as part of a research study, during the first week of the semester and completion of course requirements (discussed below). Each week, the instructor presented two 75-minute lectures and a graduate student instructor taught a weekly 120-minute lab section. Students were assigned to one of several lab sections based on their registration preferences. In addition, two undergraduate peer tutors, provided weekly tutoring sessions that students voluntarily attended with the goal of reinforcing statistical concepts taught during lecture. During the first week of the semester, the undergraduate peer tutors were introduced to the students and they provided information about the voluntary peer tutoring sessions. Also, their contact information and weekly hours were printed on the syllabus distributed on the first day of class. Peer tutors were undergraduate students who had previously earned a grade of A or A+ in psychology statistics, were familiar with the course as taught by the designated instructor, and had informally tutored other students when they undertook the course.

Peer tutoring sessions were available four days per week for a total of four hours per week (tutoring was increased to six to eight hours each week prior to an exam). Also, students were encouraged to set up individual conferences, if listed times were inconvenient for them. Tutoring sessions focused on students' specific questions (e.g., students asked to review particular problems from the homework or concepts from class or the textbook). In some cases, students asked peer tutors to explain the information presented in the lecture in simpler terms. In these cases, the tutor used the same lecture slides as the course instructor and explained the material to students at an adjusted pace.

Attendance at peer-tutoring sessions was recorded for each student via an attendance sheet. To maintain confidentiality, students' names were maintained separate from attendance records and questionnaires, and not linked to any student data.

Questionnaire Measures

Demographic variables collected were gender (men, women), race/ethnicity (White, non-White), and year in school (first/second, third, fourth/postgraduate). As there were small sample sizes in some of the year school categories, categories were combined. Peer tutoring variables were 0, 1, and 2 or more sessions. Psychological variables were one question that measured participants' self-efficacy (I am quite capable of mastering the material in this class). Possible responses were: strongly agree, somewhat agree, somewhat disagree, strongly disagree. Responses of strongly agree and somewhat agree were classified as high self-efficacy (coded as 1), and responses of somewhat disagree and strongly disagree were classified as low self-efficacy (coded as 0). A second question measured help-seeking behaviour (if you do not understand something in class or got stuck when working on problems outside of class, how likely are you to ask a friend or classmate for assistance?). Possible responses were: very likely, somewhat likely, somewhat unlikely, never would. Responses of very likely and somewhat likely were classified as high help-seeking behaviour (coded as 1), and responses of somewhat unlikely and never would were classified as low help-seeking behaviour (coded as 0). The self-efficacy and help-seeking behaviour questions were each one item rather than numerous questions in order to minimise participant response burden from having to answer too many questions.

Exams

There were three non-cumulative in-class exams, each covering approximately one third of the course material. Scores were the percent correct out of a possible 100 points. The first exam consisted of multiple-choice questions and covered descriptive statistics, mean, variance, standard deviation, *z* scores, correlation, prediction, the normal curve, sampling, and basic probability theory. The second exam consisted of multiple-choice questions, one short answer, and one problem that required carrying out hypothesis testing by hand. This exam covered basic principles of hypothesis testing, decision errors, effect size, power, *z* tests, and *t* tests for a single sample and dependent means. The third exam consisted of multiple-choice questions and problems that required carrying out hypothesis testing by hand (students had the option of completing one or two problems). This exam covered: *t* test for independent means, analysis of variance, chi square tests, strategies for non-normal populations, and an overview of advanced statistical procedures (e.g., multiple regression, multivariate analyses, reliability, causal modeling). Exams were graded objectively, and while partial credit was awarded for the hypothesis testing problems, point values were assigned using a detailed scoring rubric with pre-determined values for all portions of the response.

Statistical Analysis

Descriptive statistics of mean and standard deviation were used to describe the continuous variables and frequency and percentage to describe the categorical variables. Inferential statistics for the categorical variables used either the Pearson chi-square test or the Fisher's exact test when cell size had fewer than five cases. Multivariate linear regression analyses were performed for each of the exam scores. Predictor variables for the multivariate linear regression analyses were demographics (sex, race/ethnicity, college year), number of peer tutoring sessions attended per exam period, and psychological variables (help-seeking,

Table 1: Descriptive Statistics of Sample.

Variable	Frequency	Percentage	Mean	SD
Sex (women)	145	80.6		
Race/ethnicity (non-White)	89	49.4		
College year				
First & Second	54	30.0		
Third	67	37.2		
Fourth & Post-graduate	59	32.8		
Tutoring Session for Exam 1 (number)				
0	150	83.3		
1	17	9.4		
2 or more	13	7.2		
Tutoring Session for Exam 2 (number)				
0	146	81.1		
1	12	6.7		
2 or more	22	12.2		
Tutoring Session for Exam 3 (number)				
0	131	72.8		
1	29	16.1		
2 or more	20	11.1		
Ask friend or classmate for assistance (help-seeking)	162	90.0		
Capable of mastering class material (self-efficacy)	170	94.4		
Exam 1			81.7	13.15
Exam 2			72.9	15.26
Exam 3			71.4	16.12

Note: SD=standard deviation

self-efficacy). Additionally, a predictor variable of previous exam performance was added for analyses of the later exams. Separate outcome variables were performance on each in-class exam of Exam 1, Exam 2 and Exam 3. These analyses were repeated among those with good or better scores of 80 or higher on the prior in-class examination and also those at-risk with scores of less than 80 on the prior in-class examination. IBM SPSS Statistics version 22 was used for all analyses. All *p*-values were two-sided.

Results

Table 1 contains students' basic demographics, student scores in help-seeking and self-efficacy peer tutoring attendance, and scores earned on Exams 1, 2 and 3. Over one-third of the students (39 per cent, N=71) were identified as 'at-risk,' with a score lower than 80 on the first in-class examination. Attendance at tutoring sessions (for either one or multiple sessions) was less than 10 per cent for Exam 1 and slightly over 10 per cent for Exams 2 and 3. The mean score for Exam 1 was over 80 and over 70 for Exams 2 and

Table 2: Linear Regression Analyses for Predictors of Exam 1 Score.

Variable	β (*N*=180)	SE
Sex (women)	−2.08	2.40
Race/ethnicity (non-White)	−6.27	2.04**
College year		
First & Second	reference	
Third	−5.41	2.43*
Fourth & Postgraduate	−2.31	2.55
Tutoring Session for Exam 1 (number)		
0	reference	
1	−2.00	3.23
2 or more	−5.53	3.71
Ask friend or classmate for assistance (help-seeking)	−4.36	3.10
Capable of mastering class material (self-efficacy)	5.47	4.11
Intercept	90.64	7.01***

Note: β=unstandardised beta, SE=standard error **p*<0.05, ***p*<0.01, ****p*<0.001

Table 3: Linear Regression Analyses for Predictors of Exam 2 Score.

Variable	All β (*N*=180)	SE	Exam 1 <80 β (*N*=71)	SE	Exam 1 ≥80 β (*N*=109)	SE
Sex (women)	4.81	1.96*	7.16	3.63	4.65	2.29*
Race/ethnicity (non-White)	0.24	1.68	2.70	3.00	-0.68	2.02
College year						
First & Second	reference		reference		reference	
Third	−2.46	1.98	−2.27	4.08	−1.70	2.22
Fourth & Postgraduate	−2.50	2.08	−3.11	4.07	−2.09	2.48
Tutoring Session for Exam 2 (number)						
0	reference		reference		reference	
1	2.50	3.06	1.75	5.20	4.03	3.75
2 or more	2.25	2.35	7.90	3.74*	−3.94	3.03
Ask friend or classmate for assistance						
(help-seeking)	1.97	2.54	7.48	5.29	0.60	2.81
Capable of mastering class material						
(self-efficacy)	−3.56	3.37	−2.51	4.76	−5.98	4.94
Exam 1 score	0.87	0.06***	0.77	0.13***	1.28	0.19***
Intercept	−4.27	8.05	−9.57	13.74	−36.95	18.84#

Note: β=unstandardised beta, SE=standard error **p*<0.05, ***p*<0.01, ****p*<0.001

3. The majority of students were classified as having high help-seeking behaviour (*N*=162, 90.0 per cent) and high self-efficacy (*N*=170, 94.4 per cent).

For Exam 1, contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict Exam 1 score. Non-White students were associated with lower performance than White students on Exam 1 (β=–6.27, SE=2.04, $p<0.01$). Also, students in their third year were associated with lower scores on Exam 1 as compared to first/second year students (β=–5.41, SE=2.43, $p<0.05$). No other variables were found to predict Exam 1 score (see Table 2). For Exam 2, when analysing the entire sample, contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict Exam 2 score. There were significant positive associations for women (β=4.81, SE=1.96, $p<0.05$) and Exam 1 score (β=0.87, SE=0.06, $p<0.001$). Neither tutoring sessions nor the rest of the variables were found to be associated with Exam 2 scores for the entire sample (see Table 3). For Exam 3, when analysing the entire sample, contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict Exam 3 score. There was a significant positive association for Exam 2 score (β=0.81, SE=0.05, $p<0.001$), attending one tutoring session (β=5.28, SE=2.08, $p<0.05$), and attending two or more tutoring sessions (β=6.78, SE=2.41, $p<0.01$). There was also a significant negative association for women (β=–4.69, SE=1.92, $p<0.05$) (see Table 4).

For at-risk students (those who earned lower than 80 on Exam 1), consistent with hypothesis 1, attending 2 or more tutoring sessions (β=7.90, SE=3.74, p<0.05) as well as Exam 1 score (β=0.77, SE=0.13, p<0.001) predicted higher Exam 2 grades. Also, sex

Table 4: Linear Regression Analyses for Predictors of Exam 3 Score.

Variable	All β (*N*=180)	SE	Exam 2 <80 β (*N*=180)	SE	Exam 2 ≥80 β (*N*=72)	SE
Sex (women)	–4.69	1.92*	–6.57	2.67*	–0.21	2.23
Race/ethnicity (non-White)	–1.09	1.62	–1.18	2.29	–0.35	1.94
College year						
First & Second	reference		reference		reference	
Third	–0.15	1.94	–1.90	2.95	2.66	2.01
Fourth & Post-graduate	–0.55	2.04	–1.45	3.03	1.91	2.31
Tutoring Session for Exam 3 (number)						
0	reference		reference		reference	
1	5.28	2.08*	9.35	3.16**	1.89	2.11
2 or more	6.78	2.41**	10.75	3.11**	–2.66	3.47
Ask friend or classmate for assistance (help-seeking)	3.95	2.48	5.46	3.75	2.20	2.64
Capable of mastering class material (self-efficacy)	5.57	3.27	4.73	4.41	6.17	4.08
Exam 2 score	0.81	0.05***	0.63	0.10***	0.76	0.16***
Intercept	11.28	6.77	24.37	9.89*	9.49	15.03

Note: β=unstandardised beta, SE=standard error *$p<0.05$, **$p<0.01$, ***$p<0.001$

(women) approached significance (p=0.054) for an association with higher Exam 2 scores. Contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict Exam 2 score. For students who earned equal to or higher than 80 on Exam 1, women (β=4.65, SE=2.29, p<0.05) and higher Exam 1 score (β=1.28, SE=0.19, p<0.001) were each statistically significantly associated with higher exam 2 scores. For the students who earned equal to or higher than 80 on Exam 1, neither the tutoring nor other variables were statistically significantly associated with Exam 2 scores. Contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict Exam 2 score (see Table 3). In the Pearson chi-square analysis comparing those scoring <80 or ≥80 on Exam 1 and number of tutoring session categories for Exam 2, there were no significant differences (p=0.54) between the <80 and ≥80 Exam 1 score groups. In preparation for Exam 2, out of the total students in the at-risk group, 55 (77.5 per cent) attended no tutoring sessions, five (7.0 per cent) attended one tutoring session, and 11 (15.5 per cent) attended two or more tutoring sessions. Out of the total students in the not at-risk group, 91 (83.5 per cent) attended no tutoring sessions, seven (6.4 per cent) attended one tutoring session, and 11 (10.1 per cent) attended two or more tutoring sessions.

For at-risk students (those who earned lower than a score of 80 on Exam 2), consistent with hypothesis 1, attending one tutoring sessions (β=9.35, SE=3.16, p<0.01), attending two or more tutoring sessions (β=10.75, SE=3.11, p<0.01), and higher Exam 2 scores (β=0.63, SE=0.10, p<0.001) were each statistically significantly associated with higher Exam 3 scores. Sex (women) was associated with earning a lower score on Exam 3 for the at-risk students (β=–4.69, SE=1.92, p<0.05). Neither self-efficacy nor help-seeking were found to predict Exam 3 score. None of the other variables were associated with Exam 3 scores. For students who earned equal to 80 or higher score on Exam 2, higher Exam 2 scores were statistically significantly associated with higher Exam 3 scores (β=0.76, SE=0.16, p<0.001). Neither self-efficacy nor help-seeking were found to predict Exam 3 score. None of the tutoring or other variables were statistically significantly associated with Exam 3 scores (see Table 4). In the Fisher's exact test analysis comparing those scoring <80 or ≥80 on Exam 2 and number of tutoring session categories for Exam 3, there were no significant differences (p=0.14) between the <80 and >80 Exam 2 score groups. In preparation for Exam 3, out of the total students in the at-risk group, 76 (70.4 per cent) attended no tutoring sessions, 16 (14.8 per cent) attended one tutoring session, and another 16 (14.8 per cent) attended two or more tutoring sessions. Out of the total students in the not at-risk group, 55 (76.4 per cent) attended no tutoring sessions, 13 (18.1 per cent) attended one tutoring session, and 4 (5.6 per cent) attended two or more tutoring sessions.

Discussion

We assessed the benefits of attending peer-tutoring sessions for examination performance in an undergraduate psychology statistics course. Although peer tutoring was available to all students, we hypothesised in hypothesis 1 that at-risk students would be positively associated with exam performance with an increased benefit with number of tutoring sessions attended. Study results supported this hypothesis, as linear regression analyses showed that at-risk students were significantly associated with higher scores on subsequent exams after attending peer tutoring sessions while this same pattern did not occur among those students not at-risk. Contrary to hypotheses 2 and 3, neither self-efficacy nor help-seeking were found to predict any of the exam scores. For at-risk students only, attending two or more tutoring sessions was associated with a higher Exam 2 score. This is an interesting finding and suggests that those at risk for poor outcomes (based on early class performance) should be identified and encouraged to seek tutoring prior to the middle of the semester when the material usually gets more intense. For Exam 3, when analysing the entire sample, there was a significant positive association of attending two or more tutoring sessions with a higher Exam 3 score. However, this finding is better understood when separately analysing the risk groups, with results showing that this pattern is being driven by the at-risk group. For at-risk students only, attending one and also two or more tutoring sessions were each associated with higher Exam 3 scores. For not at-risk students, there was no association of tutoring with Exam 3 score. Also, we found no significant differences for tutoring attendance between the at-risk group and the not at-risk group. Essentially, greater levels of tutoring attendance that occurred in the at-risk group did not drive the significant association with increased Exam 3 score. However, the dose effect of peer tutoring for this course should be further investigated given the overwhelmingly low levels of student attendance at tutoring sessions.

Overall, the relationship between attendance at peer tutoring sessions and higher score on subsequent exams only occurred for the at-risk group. This finding is encouraging for institutions dealing with chronic underperformance in specific courses because it suggests that those most in need can benefit from an intervention such as peer tutoring. As to why peer tutoring is associated with higher scores for those at risk, a possibility is that weaker students require and benefit from the one-on-one assistance in statistics classes, where difficult material can be reviewed at a slow pace and in a manner that is more digestible and understandable. It is also possible that peer tutors give encouragement, support, or advice that leads to more effective learning and studying. The inclusion of peers has been discussed in literature pertaining to statistics instruction which shows that peer collaboration allows students to discuss course material and apply what they learn concretely (Garfield & Everson, 2009). This may be the reason for our finding for the at-risk group of the positive association of peer tutoring with exam performance.

Another study finding was that attendance at tutoring sessions (for either one or multiple sessions) was less than 10 per cent for Exam 1 and slightly over 10 per cent for Exams 2 and 3. Despite a high percentage of students scoring high on the help-seeking item, peer tutoring attendance was low which may have affected the analysis. Although peer tutoring attendance increased gradually as the semester progressed, this resource was clearly underutilised. Reasons for this have been explored in the literature (George et al., 2015) and include anxiety (Bervell & Umar, 2018) inaccurate appraisal of peer tutoring value (Berghmans et al., 2014), negative interactions between peer tutors and students (Colvin, 2007), and intra-personal challenges (Topping, 2015). In the present study, underutilisation at the beginning of the semester may be due to the nature of the content covered in the first few weeks (mostly descriptive statistics, which could be perceived as easy). As the semester progressed, the material became increasingly more difficult and students' scores on exams declined– but those who were not attending from the beginning may have found it difficult to initiate attending tutoring sessions (given issues of scheduling, etc.). Also, students may have erroneously believed that only academically weak students seek tutoring. Another possibility is that students inaccurately estimated their academic performance and decided that they did not need tutoring. To counter this trend, instructors should encourage students to attend tutoring sessions, include a class component that requires attendance at a minimum of one session, emphasize the effectiveness of peer tutoring, and frame peer tutoring as a resource rather than a last resort. Furthermore, an intervention focusing on self-reflection could also help students accurately estimate and thus improve their academic performance.

For the whole sample, neither help-seeking nor self-efficacy was associated with exam performance. A possible explanation is that the one-item questions utilised were not robust or specific enough to distinguish those high and low in these constructs. Future research would benefit from utilising lengthier measures. It is also possible that social desirability played a role; students may have expressed agreement to these statements because they appear to be positive study behaviours/habits (in our study more than 90 per cent of students were classified as having high help-seeking behaviour and self-efficacy). Also, neither non-White race/ethnicity nor third year in school, the two variables that predicted a lower score on Exam 1, were related to performance on Exams 2 or 3. More research might be needed to elucidate the relation between these student characteristics and performance in statistics courses – the pattern of results suggests that they may exert an impact at the beginning of the course, as students are just getting used to the material, level of difficulty, etc.

For the whole sample, non-White race/ethnicity and year in school (students in their third year) were associated with lower Exam 1 score. The relationship between third year class standing and lower performance might be due to these students being enrolled primarily in major-specific courses, which may be more time-intensive and challenging, leaving less time to devote to statistics. Also, students who opt to take the statistics course later in their college career may be less confident in their ability and/or weaker students overall. Indeed, delaying statistics is a commonly reported issue for psychology majors (Onwuegbuzie & Wilson, 2003), and might lead to lower exam performance. The observed lower performance of non-White students could be due to reasons explored in the literature in terms of underperformance of underrepresented groups (Appel et al., 2011; Herrmann et al., 2016; Stout et al., 2011).

For the whole sample, higher Exam 1 score was associated with higher Exam 2 score, and a similar pattern emerged for Exam 3, where earning a higher Exam 2 score was associated with a higher Exam 3 score. The finding that previous course performance predicts future course performance is not surprising (Geiser & Santelices, 2007). Academically strong students earn higher grades as they tend to employ self-regulated behaviours (e.g., planning, organising, strategy knowledge and use) from the beginning of the semester (DiFrancesca et al., 2016). Also, in the whole sample, being female was associated with earning a higher score on Exam 2 and a lower score on Exam 3. The lack of a clear pattern for sex is consistent with the overall literature on sex differences in statistics courses (Lalonde & Gardner, 1993; Lester, 2016; Schram, 1996; Sibulkin & Butler, 2008; Voyer & Voyer, 2014). This topic would benefit from additional research.

Limitations and Future Research

This study has some limitations. There was no matched control group and future research would benefit from randomly assigning students to active and control groups. Peer tutors' availability was limited (i.e., sessions were limited to a four-hour block over the span of two days, two hours each day), which may have contributed to low attendance. Also, tutors were not formally recruited or trained. Lastly, we assessed self-efficacy and help-seeking using only one question and decided against including other known psychological predictors of statistics performance (e.g., anxiety) to reduce participant burden. Future research could include questions on self-efficacy and help-seeking that use lengthier and validated measures. Future research should study the underlying beneficial components of peer-tutoring for at-risk students. Additionally, research should explore barriers to attendance at peer tutoring sessions. At-risk students may be resistant or hesitant to attend peer tutoring due to a fear of being judged, shame/stigma, math anxiety, low self-efficacy, or erroneous perceptions or expectations about peer tutoring (Hodges & White, 2001; Wright, 2003). Interventions aimed at reducing these barriers should be implemented.

In conclusion, we found that peer tutors can help at-risk students with increased scores in a statistics class. The positive impact for the at-risk group was observed even when attendance was limited to just one session. Peer tutoring that is more rigorous in terms of frequency, duration, or structure could possibly yield even stronger findings and should be investigated. We recommend that given the relative low cost for peer tutoring that departments teaching undergraduate introductory statistics courses should allocate resources to allow for peer tutoring programs.

Authors

Milushka Elbulok-Charcape, The Graduate Center of CUNY,
Evan Grandoit, Northwestern University,
Lorin Berman, Nassau University Medical Center,
Joshua Fogel, Brooklyn College of CUNY,
Lauren Fink, SUNY Downstate Medical Center,
Laura Rabin, Brooklyn College and The Graduate Center of CUNY

Corresponding authors

Milushka Elbulok-Charcape
Email: MCharcape@gc.cuny.edu
Address: 365 5th Avenue, New York, 10016
Tel: 212.817.1810

Laura Rabin, Ph.D.
Email: LRabin@brooklyn.cuny.edu
Address: 2900 Bedford Avenue, Brooklyn, NY, 11210
Psychology Department
Tel: 718.951.5000 (x6012)

References

Acee, T.W. & Weinstein, C.E. (2010). Effects a value-reappraisal intervention statistics students' motivation and performance. *The Journal of Experimental Education, 78*(4), 487–512. doi:10.1090/00220970903352753

Appel, M., Kronberger, N. & Aronson, J. (2011). Stereotype threat impairs ability building: Effects on test preparation among women in science and technology. *European Journal of Social Psychology, 41*, 904–913. doi:10.1002/ejsp.835

Baloğlu, M. (2004). Statistics anxiety and mathematics anxiety: Some interesting differences I. *Educational Research Quarterly, 27*(3), 38–48.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359–373.

Barron, K.E. & Apple, K.J. (2014). Debating curricular strategies for teaching statistics and research methods: What does the current evidence suggest? *Teaching of Psychology, 41*, 187–194.

Berghmans, I., Michiels, L. Salmon, S. et al. (2014). Directive versus facilitative peer tutoring? A view on students' appraisal, reported learning gains and experiences within two differently-tutored learning environments. *Learning Environments Research, 17*(3), 437-459.

Bervell, B. & Umar, I.N. (2018). Blended learning or face-to-face? Does Tutor anxiety prevent the adoption of Learning Management Systems for distance education in Ghana?. *Open Learning: The Journal of Open, Distance and e-Learning*, 1–19.

Blumberg, C.J. (2001). *Is there life after introductory statistics?* Paper presented at the 53rd session of the International Statistical Institute. Retrieved 1 November 2018 from: https://iase-web.org/documents/papers/isi53/961.pdf.

Bourne, V.J. (2018). Exploring statistics anxiety: Contrasting mathematical, academic performance and trait psychological predictors. *Psychology Teaching Review, 24*(1), 35–43.

Boyle, E.A., MacArthur, E.W., Connolly, T.M. et al. (2014). A literature review of games, animations and simulations to teach research methods and statistics. *Computers and Education, 74*, 1–14.

Budé, L., van de Wiel, M.W., Imbos, T. & Berger, M.P. (2011). The effect of directive tutor guidance on students' conceptual understanding of statistics in problem-based learning. *British Journal of Educational Psychology, 81*(2), 309–324.

Butler, D.L. & Winne, P.H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of educational research, 65*(3), 245–281.

Cantinotti, M., Désormeaux-Moreau, M. & Balbinotti, M. (2017). Mapping psychology students' perspective on group peer-tutoring in statistics. *Mentoring & Tutoring: Partnership in Learning, 25*(4), 466–484.

Carlson, K., Celotta, D.T., Curran, E. et al. (2016). Assessing the impact of a multi-disciplinary peer-led-team learning programme on undergraduate STEM education. *Journal of University Teaching & Learning Practice, 13*(1), 1–21.

Carmody, G. & Wood, L. (2009). Peer tutoring in mathematics for university students. *Mathematics and Computer Education, 43*, 18–28.

Carpenter, T.P. & Kirk, R.E. (2017). Are psychology students getting worse at math?: Trends in the math skills of psychology statistics students across 21 years. *Educational Studies, 43*(3), 282–295. doi:10.1080/03055698.2016.1277132

Carver, R., Everson, M., Gabrosek, J. et al. (2016). *Guidelines for assessment and instruction in statistics education: College report.* Boston, MA: American Statistical Association.

Cendales, B., Trujillo, E.V. & Barbosa, C. (2013). Factores psicológicos asociados al desempeño académico en los cursos universitarios de estadística: Diferencias por sexo y área de titulación. *Avances en Psicología Latinoamericana, 31*(2), 363–375.

Chiesi, F. & Primi, C. (2010). Cognitive and non-cognitive factors related to students' statistics achievement. *Statistics Education Research Journal, 9*(1), 6–26.

Chiou, C.C., Wang, Y.M. & Lee, L.T. (2014). Reducing statistics anxiety and enhancing statistics learning achievement: Effectiveness of a one-minute strategy. *Psychological Reports, 115*(1), 297–310.

Cilli-Turner, E. (2015). Measuring learning outcomes and attitudes in a flipped introductory statistics course. *PRIMUS, 25*(9-10), 833–846. doi:10.1080/10511970.2015.1046004

Colvin, J.W. (2007). Peer tutoring and social dynamics in higher education. *Mentoring & Tutoring, 15*(2), 165–181.

Curran, E., Carlson, K. & Celotta, D.T. (2013). Changing attitudes and facilitating understanding in the undergraduate statistics classroom: A collaborative learning approach. *Journal of the Scholarship of Teaching and Learning, 13*(2), 49–71.

Dancer, D., Morrison, K. & Tarr, G. (2015). Measuring the effects of peer learning on students' academic achievement in first-year business statistics. *Studies in Higher Education, 40*(10), 1808-1828. doi:10.1080/03075079.2014.916671

De Veaux, R.D., Agarwal, M., Averett, M. et al. (2017). Curriculum guidelines for undergraduate programmes in data science. *The Annual Review of Statistics and its Application, 4*, 15–30. doi:10.1146/annurev-statistics-060116-053930

DiFrancesca, D., Nietfeld, J.L. & Cao, L. (2016). A comparison of high and low achieving students on self-regulated learning variables. *Learning and Individual Differences, 45*, 228–236.

Dunn, P.K., Carey, M.D., Richardson, A.M. & McDonald, C. (2016). Learning the language of statistics: Challenges and teaching approaches. *Statistics Education Research Journal, 15*(1), 8–27.

Ejei, J., Weisani, M., Siadat, S. & Khezriazar, H. (2011). The role of academic motivation and learning strategies in statistics anxiety: Testing a causal model. *Journal of Psychology, 15*, 110–128.

Evans, B. (2007) Student attitudes, conceptions, and achievement in introductory undergraduate college statistics. *The Mathematics Educator, 17*(2), 24–30.

Falchikov, N. (2003). What is peer tutoring? In Falchikov, N. (Ed.), *Learning together: Peer tutoring in higher education* (pp.7–66). New York: RoutledgeFalmer.

Finney, S.J. & Schraw, G. (2003). Self-efficacy beliefs in college statistics courses. *Contemporary Educational Psychology, 28*(2), 161–186.

Fonteyne, L., Fruyt, F.D., Dewulf, N. et al. (2015). Basic mathematics test predicts statistics achievement and overall first year academic success. *European Journal of Psychology of Education, 30*(1), 95–118.

Forman, E.A. & Cazden, C.B. (1985). Exploring Vygotskian perspectives in education: The cognitive value of peer interaction. In Wertsch, J.V. (Ed.), *Culture, communication, and cognition: Vygotskian perspectives* (pp. 323-347). New York: Cambridge University Press.

Garfield, J. & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International Statistical Review, 75*(3), 372–396. doi:10.1111/j.1751-5823.2007.00029.x

Garfield, J. & Everson, M. (2009). Preparing teachers of statistics: A graduate course for future teachers. *Journal of Statistics Education, 17*(2).

Garfield, J., Hogg, B., Schau. C. & Whittinghill, D. (2002). First courses in statistical science: The status of educational reform efforts. *Journal of Statistics Education, 10*(2). doi:10.1080/10691898.2002.11910665

Geiser, S. & Santelices, M.V. (2007). *Validity of high-school grades in predicting student success beyond the freshman year: High-school record vs. standardized tests as indicators of four-year college outcomes.*

Gelman, A. & Nolan, D. (2017). *Teaching statistics: A bag of tricks.* New York: Oxford University Press.

George, M., Khazanov, L. & McCarthy, C. (2015). Peer coaching of at-risk students in a remedial mathematics course. *Community College Journal of Research and Practice, 39*(11), 1022–1038.

Harlow, L.L, Burkholder, G.L. & Morrow, J.A. (2002). Evaluating attitudes, skill, and performance in a learning-enhanced quantitative methods course: A structural modeling approach. *Structural Equation Modeling, 9*(3), 413–430.

Hassad, R.A. (2009). Reform-oriented teaching of introductory statistics in the health, social and behavioural sciences: Historical context and rationale. *International Journal of Human and Social Sciences, 4*(2), 132–137.

Hazan, B., Zhang, W., Olcum, E. et al. (2018). Gamification of an undergraduate psychology statistics lab: Benefits to perceived competence. *Statistics Education Research Journal.*

Helman, S. & Horswill, M.S. (2002). Does the introduction of non-traditional teaching techniques improve psychology undergraduates' performance in statistics? *Psychology Learning & Teaching, 2*(1), 12–16.

Herrmann, S.D., Adelman, R.M., Bodford, J.E. et al. (2016). The effects of a female role model on academic performance and persistence of women in STEM courses. *Basic and Applied Social Psychology, 38*(5), 258–268. doi: 10.1080/01973533.2016.1209757

Hodges, R. & White, W.G. Jr. (2001). Encouraging high-risk student participation in tutoring and supplemental instruction. *Journal of Developmental Education, 24*(3), 2–11.

Horowitz, G., Rabin, L. & Brodale, D.L. (2013). Improving student performance in organic chemistry: Help seeking behaviours and prior chemistry aptitude. *Journal of the Scholarship of Teaching and Learning, 13*(3), 120–133.

Jacobs, J.E. (2005). Twenty-five years of research on gender and ethnic differences in math and science career choices: What have we learned? *New Directions for Child and Adolescent Development, 110,* 85–94.

Karabenick, S.A. (2003). Seeking help in large college classes: A person-centred approach. *Contemporary Educational Psychology, 28*(1), 37–58.

Laher, S., Israel, N. & Pitman, M. (2007). Teaching research and statistics at undergraduate level: The RDA tutorial programme. *South African Journal of Psychology, 37*(2), 368–374.

Lalonde, R.N. & Gardner, R.C. (1993). Statistics as a second language? A model for predicting performance in psychology students. *Canadian Journal of Behavioural Science, 25*, 108–125.

Leavy, A.M., Hannigan, A. & Fitzmaurice, O. (2013). If you're doubting yourself then, what's the fun in that? An exploration of why prospective secondary mathematics teachers perceive statistics as difficult. *Journal of Statistics Education, 21*(3). doi:10.1080/10691898.2013.11889684

Lester, D. (2016). Predicting success in psychological statistics courses. *Psychological Reports, 118*(3), 772–777.

Leung, C.K.C., Marsh, H.W. & Craven, R.G. (2005). *Are peer tutoring programmes effective in promoting academic achievement and self-concept in educational settings: A meta-analytical review.* Paper presented at the Conference of Australian Association of Research in Education, Melbourne, Australia.

Macher, D., Paechter, M., Papousek, I. & Ruggeri, K. (2012). Statistics anxiety, trait anxiety, learning behaviour, and academic performance. *European Journal of Psychology of Education, 27*(4), 483–498. doi:10.1007/s10212-011-0090-5

McGrath, A.L. (2014). Content, affective, and behavioural challenges to learning: Students' experiences learning statistics. *International Journal for the Scholarship of Teaching and Learning, 8*(2), 1–21. doi: 10.20429/ijsotl.2014.080206

Miller V., Oldfield, E. & Bulmer, M. (2004). *Peer assisted study sessions (PASS) in first year chemistry and statistics course: Insights and evaluations.* Paper presented at the Proceedings of the Australian Conference on Science and Mathematics Education (formerly UniServe Science Scholarly Inquiry Symposium Proceedings), 30–35.

Onwuegbuzie, A.J. & Daley, C.E. (1999). Perfectionism and statistics anxiety. *Personality and Individual Differences, 26*, 1089–1102.

Onwuegbuzie, A.J. & Wilson, V.A. (2003). Statistics anxiety: Nature, etiology, antecedents, effects, and treatments – a comprehensive review of the literature. *Teaching in Higher Education, 8,* 195–209.

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

Peterson, D.J. (2016). The flipped classroom improves student achievement and course satisfaction in a statistics course: A quasi-experimental study. *Teaching of Psychology, 43*(1), 10–15. doi: 10.1177/0098628315620063

Prabhakar, G.P. (2008). Stats for the terrified: Impact of different teaching and learning approaches in the study of business statistics. *International Journal of Business and Management, 3*(6), 21–28.

Rabin, L., Krishnan, A., Bergdoll, R. & Fogel, J. (2018, November). *Use of the Math Assessment for College Students (MACS) to predict performance in an undergraduate statistics course.* Presented at the 11th Annual International Conference of Education, Research and Innovation, Seville, Spain.

Rodarte-Luna, B. & Sherry, A. (2008). Sex differences in the relation between statistics anxiety and cognitive/learning strategies. *Contemporary Educational Psychology, 33*, 327–344.

Sandoz, E.K., Butcher, G. & Protti, T.A. (2017). A preliminary examination of willingness and importance as moderators of the relationship between statistics anxiety and performance. *Journal of Contextual Behavioural Science, 6*, 47–52.

Schacht, S.P. & Aspelmeier, J.E. (2005). *Social and behavioural statistics: A user friendly approach* (2nd ed.). Boulder, CO: Perseus Books.

Schram, C.M. (1996). A meta-analysis of sex differences in applied statistics achievement. *Journal of Educational and Behavioural Statistics, 21*(1), 55–70.

Sibulkin, A.E. & Butler, J.S. (2008). Should college algebra be a prerequisite for taking psychology statistics? *Teaching of Psychology, 35*, 214–217. doi:10.1080/00986280802286399

Smith, T. (2017). Gamified modules for an introductory statistics course and their impact on attitudes and learning. *Simulation & Gaming, 48*(6), 832–854.

Stoloff, M., McCarthy, M., Keller, L. et al. (2010). The undergraduate psychology major: An examination of structure and sequence. *Teaching of Psychology, 37*(1), 4–15. doi:10.1080/00986280903426274

Stone, A., Meade, C. & Watling, R. (2012). Peer-assisted learning in research methods and statistics. *Psychology Teaching Review, 18*(2), 68–73.

Stout, J.G., Dasgupta, N., Hunsinger, M. & McManus, M.A. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology, 100*(2), 255–270. doi: 10.1037/a0021385

Sun, D.L., Harris, N., Walther, G. & Baiocchi, M. (2015). Peer assessment enhances student learning: The results of a matched randomised crossover experiment in a college statistics class. *PLoS ONE, 10*(12), e0143177. doi:10.1371/journal.pone.0143177

Sun, Z., Xie, K. & Anderman, L.H. (2018). The role of self-regulated learning in students' success in flipped undergraduate math courses. *The Internet and Higher Education, 36*, 41–53.

Szu, E., Nandagopal, K., Shavelson, R.J. et al. (2011). Understanding academic performance in Organic Chemistry. *Journal of Chemical Education, 88*(5), 1238–1242.

Tomasetto, C., Matteucci, M., Carugati, F. & Selleri, P. (2009). Effects of task presentation on students' performance in introductory statistics courses. *Social Psychology Education, 12*(2), 191–211.

Topping, K.J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education, 32*, 321–345.

Topping, K. (2015). Peer tutoring: Old method, new developments/Tutoría entre iguales: Método antiguo, nuevos avances. *Infancia y Aprendizaje, 38*(1), 1–29.

Vandiver, D.M. & Walsh, J.A. (2010). Assessing autonomous learning in research methods courses: Implementing the student-driven research project. *Active Learning in Higher Education, 11*(1), 31–42. doi: 10.1177/1469787409355877

van Es, C. & Weaver, M.M. (2018). Race, sex, and their influences on introductory statistics education. *Journal of Statistics Education, 26*(1), 48–54.

Voyer, D. & Voyer, S.D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin, 140*(4), 1174–1204.

Walker, E.R. & Brakke, K.E. (2017). Undergraduate psychology students' efficacy and attitudes across introductory and advanced statistics courses. *Scholarship of Teaching and Learning in Psychology, 3*(2), 132–140.

Wasserstein, R. (2015). Communicating the power and impact of our profession: A heads up for the next executive directors of the ASA. *The American Statistician, 69*(2), 96–99. doi:10.1080/00031305.2015.1031283

Wright, R.R. (2003). Real men don't ask for directions: Male student attitudes toward peer tutoring. *Journal of College Reading and Learning, 34*(1), 61–75. doi:10.1080/10790195.2003.10850156

Zimmerman, B.J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3–17.