Jodi Price,
Amber G. Lumpkin,
Eric A. Seemann,
Diana Calhoun Bell

Evaluating the Impact of Supplemental Instruction on Short- and Long-Term Retention of Course Content

Findings from prior research in various content domains have indicated that Peer Assisted Study Sessions (PASS) attendees earned higher final grades than non-attendees. However, what makes PASS effective remains unknown; for example, PASS could improve short-term retention but hinder long-term maintenance of course content given that some methods that facilitate short-term retention of information hurt long-term retention. Of additional interest was what predicts students' attendance in PASS. We tracked 75 introductory psychology students' short- and long-term retention of course content via unit quizzes and a cumulative final exam, respectively, to determine if PASS attendance improved both types of retention. Results indicated that PASS attendees had significantly higher academic self-efficacy and final grades than non-attendees. Attendees outperformed non-attendees on three of the six quizzes and on the cumulative final exam, supporting both the short- and long-term effectiveness of PASS.

Transitioning from high school to college proves difficult for many students (Brinkworth, McCann, Matthews, & Nordstrom, 2009). Students often find themselves ill-prepared for the academic and social challenges of college, which can increase their risk of failing or dropping out (Raths, 2009). One factor that contributes to students' academic struggles is that they enter introductory-level college courses with preconceived notions about how to learn and study based on experiences from their high school classes, but the study strategies that worked for the students in high school may no longer prove effective in the new college learning environment (Congos & Schoeps, 1998; McGuire, 2006). Unfortunately, students who have been using the same strategies for a long time may be reluctant to try a different strategy even if their current strategy is ineffective. Students may also not know which strategies would be most effective or how to implement them.

Kornell and Bjork (2007) found that 80% of the 472 introductory psychology students queried about their study methods said they had never been taught how to study and that students simply improvised their method of studying. Kornell and Bjork's research also revealed that many students were unaware of what Bjork (1994) termed "desirable difficulties," or study methods that introduce difficulties during study, but enhance long-term learning (e.g., self-testing and spacing of study activities). Schmidt and Bjork (1992) noted that many of the study techniques that slow down the encoding process (i.e., these desirable difficulties) serve to enhance long-term retention of information, whereas study methods that facilitate rapid encoding (e.g., massed practice) often hinder long-term maintenance. Ideally students would use study techniques that facilitate long-term retention of course content. However, the results of Kornell and Bjork's survey suggest that without direct instruction students may remain ignorant of the benefits of these study methods.

Many universities have begun implementing supplemental instruction (SI) programs to address these issues in order to help students transition to and succeed in college. SI programs were first developed in 1973 as a way to increase the performance of college students (Hurley, Jacobs, & Gilbert, 2006), in particular in high-risk courses (McGuire, 2006) defined as those with an increased failure or dropout rate, meaning that 30% or more students receive an "F" or withdraw from the course (Lewis, O'Brien, Rogan, & Shorten, 2005; Lockie & Van Lanen, 2008). The courses selected for SI are usually introductory-level courses that

students encounter in their first or second semester of college as part of their general education requirements. Because many of these courses are outside the students' majors, students may need to adopt new study strategies different from those used in their major coursework or from those used in high school. Many students are simply not prepared to adapt to these challenges. Thus, SI programs are designed to help students determine which learning and study strategies will help them pass a specific course (Congos & Schoeps, 1998).

Since the initial development of SI, several types of these programs have been created. All focus on helping college students perform better in their courses. One type of SI is Peer Assisted Study Sessions (PASS; Lewis et al., 2005), which occur in 50-minute periods outside of class three times per week. Students attend on a strictly voluntary basis. The PASS leader, a student who has previously taken and done well in the course, attends each class with the students, takes notes, and reads all assigned reading materials. The PASS leader develops a lesson plan for each session, takes attendance[1], and outlines the material covered in each session. The role of the PASS leader is to facilitate the students' discussion by adding relevant examples, posing questions, and modeling what a successful student would do to reach the correct solution for questions posed by the PASS leader or PASS attendees, as opposed to re-lecturing the material covered by the professor (Martin & Arendale, 1994). The PASS leader allows students to lead the discussion to cover whatever topics the students are having difficulty understanding. However, if students do not have specific questions, the PASS leader draws upon the lesson plan for that session to address and initiate discussion about critical course concepts. Thus, the PASS leader presents information related to the course material and encourages the students to discuss possible solutions to the problems posed by other students (Lewis et al., 2005).

PASS leaders undergo extensive training to ensure they are prepared to meet the goals of the SI program. Because a lack of training is one of the most common reasons for an SI program's failure, proper training of the PASS leader is vital to the program's success (Lipsky, 2006). Once PASS leaders are selected by the class professors and interviewed by those overseeing the PASS program at The University of Alabama in Huntsville, they must attend a 12-hour training course on what being a PASS leader requires, including training on learning and study strategies and on facilitating students' learning. The training is in keeping with national standards for PASS and consists of workshops that emphasize the theoretical bases of learning, teaching methods, study strategies, and possible problems that might be encountered in PASS (Martin &

Arendale, 1994). PASS leaders also hold multiple practice sessions in which they must demonstrate that they understand the learning strategies and course material they will be presenting during the sessions (Martin & Arendale, 1992).

The overall goal of PASS is to increase students' performance in high-risk courses by increasing their knowledge of study strategies. The students learn which strategies will be effective for learning specific course material and how to implement those strategies. Students are also taught to monitor which strategies they utilize while studying and how each strategy affects later recall of course material on the quiz.[2] All of these elements contribute to enhanced student performance in high-risk courses (Lewis et al., 2005).

Studies that have focused on the effectiveness of SI programs such as PASS have found that PASS attendance decreases dropout and failure rates in these high-risk courses. PASS attendees obtain higher final grades on average than the students who choose not to attend (see Congos & Schoeps, 1993, 1998; Lewis et al., 2005). However, none of these studies has addressed what contributes to this difference in final grades. Of particular interest is whether PASS serves to facilitate both short- and long-term retention of course material. One would expect PASS to benefit both types of retention given that PASS incorporates many of the previously noted desirable difficulties (e.g., spaced practice, self-testing, feedback regarding understanding of content; Bjork, 1994). However, it remains possible that PASS could benefit short-term retention without affecting long-term retention of course content. The present study was designed to examine what makes PASS effective and whether students who attend PASS demonstrate enhanced short-term and long-term retention as assessed by unit quizzes and a cumulative final exam, respectively, relative to students who choose not to attend PASS.

An additional question was why some students choose to attend PASS and others do not. Specifically, we wondered whether academic self-efficacy or certain indicators of ability level (e.g., entrance exam scores and high school grade point average) might predict participation in PASS. Within the first week of classes containing PASS leaders, the benefits of PASS are made explicit. The instructor tells all students that prior research has found that students who attend PASS tend to earn higher grades than those who choose not to attend. Nonetheless, some students opt out of this opportunity.[3] We wondered why and whether students' academic self-efficacy and ability levels would affect their tendency to attend PASS.

Self-efficacy, a cognitive construct that influences the acquisition and retention of new information (Bandura, 1977), is a motivating force

behind students' learning (Pintrich & DeGroot, 1990). More specifically, the level of students' self-efficacy reflects their belief that they can accomplish a particular task and influences which tasks they attempt, the amount of effort they expend on the task, and how long they persist in the face of obstacles (Lent, Brown, & Gore, 1997). Individuals with higher levels of self-efficacy will attempt difficult tasks and continue to persist even after encountering several obstacles (Schunk, 1990). In contrast, individuals with lower levels of self-efficacy are more likely to visualize themselves failing, which weakens motivation and undermines their performance, and causes them to give up on a task before even attempting it (Bandura, 1989). Individuals with higher levels of perceived self-efficacy are more likely not only to participate in tasks, but also to excel at them, whereas individuals with lower levels of perceived self-efficacy are more likely to avoid the tasks altogether (Schunk, 1990).

Prior research has found that students who choose to attend PASS early in the semester have higher self-esteem (Peled & Kim, 1996) and are better prepared academically (Martin & Arendale, 1992). Self-esteem reflects individuals' overall evaluations of themselves (Bandura, 1977). Self-efficacy is a concept related to self-esteem, but reflects individuals' beliefs regarding their ability to successfully complete a task (Bandura, 1997). Given Peled and Kim's findings and the relationship between self-esteem and self-efficacy, we expected to find that those with higher academic self-efficacy would be more likely to attend PASS than would those with lower self-efficacy. To test this hypothesis we used a longitudinal design to compare students in an introductory psychology course. Our goal was to compare the students who voluntarily attended PASS sessions with those who chose not to attend this form of SI. We hoped to determine what role PASS played in the students' learning and whether PASS attendees differed from the non-PASS attendees in self-efficacy as well as in short- and long-term retention of course material. Based on the previous research demonstrating that PASS attendees earn on average a full letter grade higher for their final grade than students who do not attend PASS (Congos & Schoeps, 1993, 1998; Lewis et al., 2005), we hypothesized that the PASS attendees would obtain higher final grades than the non-PASS attendees. Because quiz grades and final exam grades contribute to the students' final grades, we also hypothesized that the PASS attendees would obtain higher grades on the unit quizzes and cumulative final exam than the non-PASS attendees. Higher performance by PASS attendees relative to non-attendees on the quizzes and final exam would provide support for both short-term and long-term retention of course material, respectively.

Method

Participants

Seventy-five undergraduate students enrolled in an introductory psychology course at The University of Alabama in Huntsville participated in this study for course credit. However, we removed eight students (one from the PASS group and seven from the non-PASS group) from the analyses because they either withdrew from the course or had missed two or more quizzes (i.e., dropped the course without officially withdrawing), resulting in a failing grade for the course. The remaining 67 students were included in our final sample. Of those 67 participants, 42 attended PASS at least once throughout the course of the semester and 25 did not attend. Demographic information for these two groups, henceforth referred to as PASS and non-PASS attendees, may be found in Table 1. There was diversity in the students' age, gender, ethnicity, and class standing given that The University of Alabama in Huntsville is an urban four-year university that grants both undergraduate and graduate degrees. However, *t* tests indicated there were no significant differences between PASS attendees and non-attendees for these factors or any others listed in Table 1, all *p*s > .05. Thus, any differences in PASS attendees' versus non-attendees' performance cannot be attributed to pre-existing differences in group characteristics.

Design

A 2 (Attendance: PASS vs. Non-PASS attendees) x 7 (Data Collection Sessions) mixed design was used for this study. The between-subjects variable was PASS attendance. The within-subjects variable was the seven in-class data collection sessions during the spring 2009 semester. In addition to descriptive statistics, we used repeated measures analyses of variance (ANOVAs) and *t* tests to examine the impact of PASS attendance on course performance.

Materials

The lectures, unit quizzes, and cumulative final exam were based on material in the *Psychology* (Bernstein, Penner, Clarke-Stewart, & Roy, 2008) textbook. Each of the six unit quizzes contained 30 to 35 multiple-choice questions assessing content from multiple textbook chapters. The cumulative final contained 70 multiple-choice questions covering material from the entire semester.

Academic self-efficacy was assessed using the Self-Efficacy for Learning Form (SELF; Zimmerman & Kitsantas, 2005), a 57-item self-report inventory where participants indicate their ability to accomplish the task set

Table 1
Demographics for PASS and Non-PASS Attendees

	PASS (n = 42)		Non-PASS (n = 25)	
	M	*(SE)*	*M*	*(SE)*
Percent Female	53	64		
Age	19.90	(.34)	19.00	(.22)
Year in School (%)				
Freshman	60		52	
Sophomore	28		28	
Junior	5		12	
Senior	5		8	
Dual Enrollment	2		0	
GPA	3.32	(.09)	3.37	(.11)
ACT	23.76	(.61)	22.88	(.99)
Pretest-SELF	68.77	(1.91)	63.87	(2.05)
Posttest-SELF	68.37	(2.15)	64.36	(2.74)

Note. These represent the mean and standard error. GPA = high school grade point average; ACT = Composite Score on the ACT; Pretest-SELF = self-efficacy scores collected at the beginning of the semester; Posttest-SELF = self-efficacy scores collected toward the end of the semester.

forth in the question on a scale of 0 (definitely cannot) to 100 (definitely can). Items measure students' level of academic self-efficacy regarding "reading, note taking, test-taking, writing and studying," where higher numbers indicate higher self-efficacy (Zimmerman & Kitsantas, 2005, p. 403). The SELF has been demonstrated to be a reliable, valid measure of the self-efficacy construct; for example, Zimmerman and Kitsantas (2007) obtained a Cronbach's alpha of .96 and a correlation of .72 between teachers' ratings of students and students' responses on the SELF.

Procedure

Data were collected seven times throughout the course of the semester. Six of those data collection days were the six unit quizzes. The cumulative final exam provided the last data point. Participants were asked to complete the SELF before the first quiz and a second time before the sixth quiz. The SELF was administered two times to assess whether academic self-efficacy changed across the course of the semester and whether the measure would yield adequate test-retest reliability in our sample. Demographic information was collected on the day of the fourth quiz.

Results

There were two key goals in this study. The primary goal was to investigate PASS effectiveness by examining how PASS attendance affected introductory psychology students' short- and long-term retention of course material, as measured by their performance on the quizzes and the cumulative final, respectively. A secondary goal was to assess whether academic self-efficacy or indicators of ability level would allow us to predict which students would choose to attend PASS. Both goals were designed to yield a more fine-tuned analysis of what predicts PASS effectiveness and attendance than provided by prior research, which has used the final course grades and failure and dropout rates of PASS versus non-PASS students as indicators. However, to allow comparison of our results with prior research, we began by examining whether final grades and failure or dropout rates differed as a function of PASS attendance (Congos & Schoeps, 1998; Lewis et al., 2005; Martin & Arendale, 1994; McGuire, 2006). In all reported analyses, PASS attendees were students who attended PASS one or more times throughout the course of the semester. Table 2 contains information regarding the number of students who attended PASS before each of the six quizzes.

Table 2
Number of PASS and Non-PASS Attendees Before Each Quiz

	PASS	Non-PASS
Quiz 1	4	63
Quiz 2	18	49
Quiz 3	26	41
Quiz 4	20	47
Quiz 5	28	39
Quiz 6	30	37

Note. These represent the total number of students who chose to attend PASS or not attend PASS before each quiz.

PASS Effectiveness

We first conducted an independent samples *t* test to compare final grades between the students who chose to attend PASS and the students who chose not to attend. Consistent with prior research, PASS attendees obtained on average a significantly higher final grade in the class than did the non-PASS attendees, $t(56) = -3.60$, $p < .01$, $d = .69$ (see Table 3 for the means and standard errors). Of our sample of 67 students, only 5% (i.e., 2 out of 42) of the students who attended PASS failed the course, whereas 20% (i.e., 5 out of 25) of the students who did not attend failed (see Figure 1 for the grade distribution). In terms of dropout rates, only one student who withdrew from the course attended PASS. Further examination revealed that these PASS attendees who failed or withdrew from the class had attended only one PASS session early in the semester.

To gain a better understanding of what contributed to this difference in PASS versus non-PASS attendees' final grades, we looked for any group differences in short- and long-term retention of course content as measured by unit quizzes and the cumulative final exam, respectively. We used a repeated measures analysis of variance (ANOVA) and *t* tests to assess whether the observed difference in final grades was due to students' quiz grades, grades on the cumulative final exam, or a combination of both variables. The repeated measures ANOVA,

Table 3
Mean Quiz, Exam, and Final Grades for PASS and Non-PASS Students

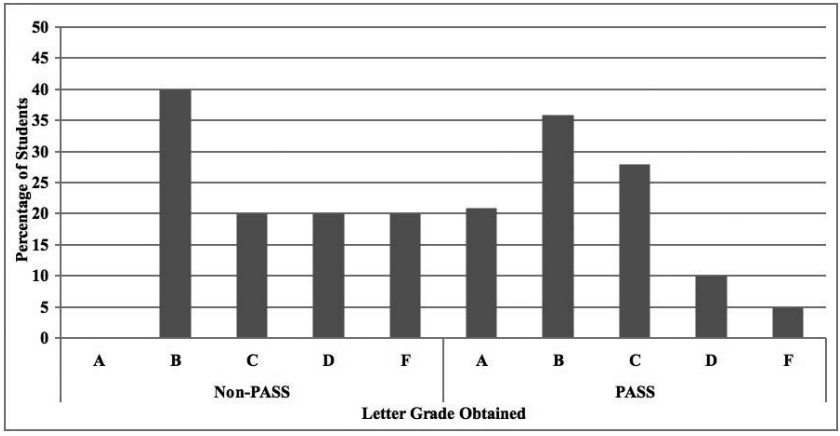
	PASS		Non-PASS	
Quiz	*M*	*(SE)*	*M*	*(SE)*
Quiz 1	72.18	(3.10)	76.00	(3.82)
Quiz 2	67.19	(3.41)	61.13	(4.41)
Quiz 3	62.56	(2.88)	51.88	(4.45)
Quiz 4	74.24	(2.72)	71.40	(3.60)
Quiz 5	80.88	(2.44)	66.35	(3.38)
Quiz 6	77.73	(2.67)	67.29	(4.00)
Final Exam	75.51	(2.05)	63.09	(3.73)
Final Grade	81.64	(1.61)	70.25	(2.66)
Extra Credit	17.98	(.61)	14.96	(.47)

Note. These represent the means and standard errors of the percent score each student obtained on Quizzes 1 through 6 for the reduced data set ($n = 67$); PASS has been defined as attending one PASS session throughout the semester.

which evaluated changes in the quiz grades as a function of PASS attendance, yielded both a main effect for quizzes, $F(5, 61) = 12.23$, $p < .001$, $\eta_p^2 = .50$, and a reliable interaction of quizzes with PASS attendance, $F(5, 61) = 2.47$, $p < .05$, $\eta_p^2 = .17$. Because this omnibus test indicated significant differences in quiz grades across time for PASS versus non-PASS students, we ran additional *t* tests for each quiz to determine where the differences existed.

We first examined performance on Quiz 1 to determine if there were pre-existing differences in performance between PASS and non-PASS attendees that might cloud interpretation of any later differences in performance. PASS and non-PASS attendees began the semester with similar performances on Quiz 1, $t(65) = 0.77$, $p > .05$, $d = .19$, and

Figure 1
Final Letter Grades Obtained by PASS and Non-PASS Attendees



non-PASS attendees actually had slightly higher scores on this quiz than PASS attendees (see Table 3). However, PASS attendees outscored non-PASS attendees on the remaining five quizzes, although only Quizzes 3, 5, and 6 proved to be significantly different, $t(65) = -2.11$, $p < .05$, $d = .52$, $t(65) = -3.15$, $p < .01$, $d = .75$, and $t(65) = -2.25$, $p < .05$, $d = .55$, respectively.[4]

We conducted additional analyses to determine if the PASS attendees performed better on the cumulative final exam than the non-PASS attendees. An independent samples t test indicated PASS attendees scored significantly higher on the cumulative final exam than did non-PASS students, $t(65) = -3.18$, $p < .01$, $d = .69$. Study strategies being taught in PASS facilitated short-term retention of information by helping students encode the information for each quiz and also appeared to enhance their long-term retention of the information.

PASS Attendance and Self-Efficacy

Of additional interest was whether students' self-efficacy might predict whether they chose to attend PASS. To investigate this issue, we first looked at the relationship between both the pretest and posttest global academic self-efficacy scores and PASS attendance. The correlation between pretest SELF scores and PASS attendance was $r(65) = .20$; the correlation between the posttest SELF scores and PASS attendance was $r(62) = .14$. In both cases, the correlations were positive, but neither was significant, $p > .05$. However, in prior research when relationships were

found between self-efficacy and PASS attendance, it was for those with higher self-efficacy levels (Peled & Kim, 1996). We, therefore, divided our sample into groups based on their pretest SELF scores (Zimmerman & Kintsantas, 2005) collected at the beginning of the semester to examine if those with higher self-efficacy were more likely to attend PASS than those with lower self-efficacy. These pretest SELF scores ranged from 44.21 to 89.47 (maximum possible = 100), which we then divided into low, medium, and high self-efficacy groups relatively equal in number. Those with pretest SELF scores less than 61.11 were assigned to the low self-efficacy group (n = 22); those with scores greater than this number but less than 72.74 were assigned to the moderate self-efficacy group (n = 23); and those with scores over 72.75 were assigned to the high self-efficacy group (n = 22). We then examined whether the relationship between PASS attendance and self-efficacy might differ for these three groups. These analyses revealed a significant positive relationship between self-efficacy and PASS attendance for those in the high self-efficacy group, $r(65) = .28$, $p < .05$, but a significant negative relationship between self-efficacy and PASS attendance for those in the low self-efficacy group, $r(65) = -.32$, $p < .01$. In other words, students in the high self-efficacy group were more likely to attend PASS the higher their SELF scores were. In contrast, in the low self-efficacy group, students with lower self-efficacy scores were more likely to attend PASS than were those with higher SELF scores. No relationship existed between PASS attendance and self-efficacy for those in the moderate self-efficacy group, $r(65) = .04$, $p > .05$. However, by the end of the semester, the students' level of self-efficacy did not correlate significantly with PASS attendance, despite the overall pattern of behavior being the same for low ($r[62] = -.13$, $p > .05$), medium ($r[60] = .01$, $p > .05$), and high self-efficacy students ($r[62] = .13$, $p > .05$). Test-retest reliability analyses of pretest and posttest SELF scores, $r(67) = .66$, $p < .01$, and a repeated measures ANOVA revealed that self-efficacy ratings did not change significantly across the semester, $F(1, 62) = .10$, $p = .75$, $\eta_p^2 = .01$; thus, the absence of significant correlations between the posttest global self-efficacy scores and PASS attendance cannot be attributed to changes in ratings. These results suggest that early in the semester those highest and lowest in self-efficacy are more likely to attend PASS than are those with moderate self-efficacy levels, but that self-efficacy has less impact on PASS attendance later in the semester.

PASS Attendance and Academic Performance

Finally, we examined the relationship between the two measures of performance: high school grade point average (GPA) and ACT scores[5]

and PASS attendance. Here we found no significant relationship between PASS attendance and either GPA, $r(50) = -.06$, $p > .05$, or ACT test scores, $r(56) = .11$, $p > .05$.

Discussion

Although SI and PASS have been studied extensively (see, e.g., Lewis et al., 2005; Lipsky, 2006; Martin & Arendale, 1992), to date no research has focused specifically on the issue of what makes PASS effective. Our primary goal in this study was to understand what predicts PASS effectiveness by examining whether the previously observed differences in final grades (e.g., Congos & Schoeps, 1993, 1998) were due to improvements in the short-term or long-term retention of course content. This question of what drives PASS effectiveness is important from both a theoretical and a practical standpoint. From a theoretical perspective, it seems important to evaluate whether the desirable difficulties (Bjork, 1994) that have proven beneficial in lab-based settings yield similar benefits when tested in classroom settings. If these desirable but difficult behaviors that are modeled and implemented in PASS (e.g., spacing practice, gaining feedback about one's understanding of critical course concepts, and ideal learning strategies) do not translate into better quiz and exam performance, then questions about the generalizability of these earlier lab-based findings would arise.

In addition, studies such as this one provide important prescriptive information about where supplemental instruction programs such as PASS can be expected to impact students' performance and which students are likely to attend. That is, the data in the present study suggest that PASS, at least as it is implemented at this university, can be expected to help students perform better on unit quizzes as well as to retain information across the entire semester. Although PASS and non-PASS attendees began the semester performing similarly on the first quiz, PASS attendees scored higher on each of the remaining quizzes and significantly higher on three of the five. For each of these three quizzes, the Cohen's d values were moderate to large (i.e., $d > .50$), suggesting that the impact of PASS was substantial in that PASS attendees scored half a standard deviation, or more, higher than the non-PASS attendees. These differences in quiz grades support the idea that PASS attendance benefits short-term retention of course information. Even more impressive was the finding that PASS attendees scored significantly higher on the cumulative final exam, again with Cohen's d suggesting a moderately large effect of PASS. Apparently the study skills the students learned in PASS allowed them to encode the information more effectively initially and to facilitate the long-term retention of course information as reflected by their performance on the cumulative final exam.

In addition to insight about how PASS might affect retention of course material, PASS was found to influence the distribution of final grades and attrition rates. Whereas no students in the non-PASS group earned an A in the course, 21% of students who attended PASS did. Only 15% of PASS attendees earned a D or F, whereas 40% of non-PASS attendees did. PASS attendees not only performed better but also were less likely to withdraw from the class, either officially or unofficially. These results, in keeping with prior research about the benefits of PASS attendance, combine with the observed Cohen's *d* and partial eta-squared values to suggest that PASS directly affected students' short- and long-term performance in the class. That PASS had such a large impact when so many factors combine to influence class grades further supports how beneficial and effective the PASS program is.

Of additional interest were the factors that correlated with PASS attendance. Early in the semester, academic self-efficacy (as assessed with the SELF) correlated with PASS attendance, but only when students with low and high levels of self-efficacy were examined separately. Later in the semester when students had learned more about the course as well as about the professor's teaching and testing style, self-efficacy no longer predicted PASS attendance. This result suggests self-efficacy seems to matter only when students have little knowledge of the course or other information upon which to base their decision to attend PASS. Performance measures (high school GPA and ACT scores) did not correlate with PASS attendance. Unlike the results from prior research conducted by Martin and Arendale (1992), we did not find that academically prepared students were more likely to attend PASS. Examination of Table 1 suggests that there might have been too little variability in these measures for the correlations to prove reliable. Because PASS and non-PASS students were so similar on both performance measures, it would have been difficult to see any relationship between these measures and PASS attendance. Nonetheless, the differences between the PASS and non-PASS students' quiz, exam, and final grades suggest that students of all levels of academic preparation benefitted from PASS attendance.

Such findings have important prescriptive implications for administrators eager to identify which students are likely to attend PASS or other SI programs voluntarily and who might need additional encouragement. Our data suggest that knowing about students' academic self-efficacy levels might provide more information about PASS attendance than traditional measures of ability, but that both academically weak and strong students may benefit from PASS. Specifically, our results suggest that administrators who are concerned about students in high-risk courses should focus PASS recruitment efforts on those with lower self-efficacy, given that these students are less likely to participate in SI activities

such as PASS that could affect their grades in the short-term and their academic self-efficacy in the long-term.

These results are important both because they support the benefits of desirable difficulties (Bjork, 1994) when implemented in supplemental instruction programs such as PASS, and because they provide important information to university administrators about who is likely to participate in academic enrichment programs. Academic institutions concerned about attrition and students' preparedness to transition to college must find ways to help students under tight budget constraints. Results from studies such as this one provide insight about where administrators could allocate resources to gain maximum benefit for the largest number of students.

Of course, while many practical implications stem from studies such as this, limitations apply as well. For example, the multiple-choice quizzes and the final exam that we used are common in large sections of introductory-level courses, but are neither complete nor ideal measures of course knowledge. Nonetheless, the very courses most likely to use multiple-choice measures (large introductory-level courses) are also the classes most likely to be classified as high-risk. Multiple-choice measures may prove problematic if they provide an inaccurate reflection of students' knowledge. Multiple-choice measures may also lead students to overestimate their ability to do well, which might affect their decision to participate in SI programs such as PASS. Although the type of test might influence attendance decisions, a second limitation in this study was that a variety of additional factors could have affected students' decisions to attend PASS (e.g., work and class schedules, when the PASS sessions were held). Given the large number of variables that likely combine to influence students' decisions to participate in SI programs, it becomes difficult to identify which variables have the greatest influence on PASS effectiveness and attendance. Moreover, we do not know whether the factors are the same for different students. Other limitations were our sample size and the fact that we did not include or assess alternate treatments (e.g., individual tutoring) that might also yield enhanced course performance.

Future research could examine these issues as well as the long-term benefits of PASS. Specifically, it would be helpful to know whether students who experience the benefits of PASS in one course are able to transfer those skills to other high-risk courses. Although PASS is currently designed to teach course-specific study skills, it would be ideal to evaluate empirically which courses might be more or less likely to allow transfer of study skills and which might necessitate their own PASS leaders. Furthermore, it would seem worthwhile to determine how long course information is retained. Our results provided evidence that PASS benefits long-term

retention of course content throughout a semester, but it remains an open question as to how long the material is maintained after the semester is over. Bahrick's (1984) work suggests that individuals remember more information for longer periods of time than they might suspect. Yet it remains possible that the forgetting curve is different for PASS versus non-PASS attendees. Researchers' ability to demonstrate that the study methods taught and used in PASS alter how much information is forgotten and how quickly could provide justification for initiating SI programs even in these austere economic times. Such findings would also provide more support for the PASS program's effectiveness.

References

Bahrick, H. P. (1984). Semantic memory content in permastore: Fifty years of memory for Spanish learned in school. *Journal of Experimental Psychology: General, 113*(1), 1-29. doi: 10.1037/0096-3445.113.1.1

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. doi:10.1037/0033-295X.84.2.191

Bandura, A. (1989). Regulation of cognitive processes through perceived self-efficacy. *Developmental Psychology, 25*(5), 729-735. doi:10.1037/0012-1649.25.5.729

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bernstein, D. A., Penner, L. A., Clarke-Stewart, A., & Roy, E. J. (2008). *Psychology* (8th ed.). Boston, MA: Houghton Mifflin.

Bjork, R. A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 185-205). Cambridge, MA: MIT Press.

Brinkworth, R., McCann, B., Matthews, C., & Nordstrom, K. (2009). First year expectations and experiences: Student and teacher perspectives. *Higher Education: The International Journal of Higher Education and Educational Planning, 58*(2), 157-173. doi:10.1007/s10734-008-9188-3

Congos, D. H., & Schoeps, N. (1993). A model for evaluating retention programs. *Journal of Developmental Education, 21*, 2-9.

Congos, D. H., & Schoeps, N. (1998). Inside supplemental instruction sessions: One model of what happens that improves grades and retention revisited. *Research and Teaching in Developmental Education, 15*(1), 47-61.

Hurley, M., Jacobs, G., & Gilbert, M. (2006). The basic SI model. *New Directions in Teaching and Learning, 106*, 11-21. doi:10.1002/tl.229

Kornell, N., & Bjork, R. A. (2007). The promise and perils of self-regulated study. *Psychonomic Bulletin & Review, 14,* 219-224. Retrieved from http://pbr.psychonomic-journals.org/content/14/2/219.full.pdf+html

Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Discriminant and predictive validity of academic self-concept, academic self-efficacy, and mathematics-specific self-efficacy. *Journal of Counseling Psychology, 44*(3), 307-315. doi:10.1037/0022-0167.44.3.307

Lewis, D., O'Brien, M., Rogan, S., & Shorten, B. (2005). Do students benefit from supplemental education? Evidence from a first-year statistics subject in economics and business. *University of Wollongong Economics Working Paper Series, 5,* 1-19. Retrieved from http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1128&context=commwkpapers

Lipsky, S. A. (2006). A credit-bearing course for training SI leaders. *New Directions For Teaching and Learning, 106*, 33-41. doi:10.1002/tl.231

Lockie, N. M., & Van Lanen, R. J. (2008). Impact of the supplemental instruction experience on science SI leaders. *Journal of Developmental Education, 31*(3), 2-14. Retrieved from http://eric.ed.gov/PDFS/EJ832676.pdf

Martin, D. C., & Arendale, D. R. (1992). Supplemental instruction: Improving first-year student success in high-risk courses. *Monograph Series, 7*, 3-29. Retrieved from http://www.eric.ed.gov/PDFS/ED354839.pdf

Martin, D. C., & Arendale, D. R. (1994). Review of research concerning the effectiveness of SI from the university of Missouri-Kansas city and other institutions from across the United States. *Paper presented at the Annual Conference of the Freshman Year Experience.* Columbia, South Carolina, 1994. Retrieved from http://eric.ed.gov/PDFS/ED370502.pdf

McGuire, S. Y. (2006). The impact of supplemental instruction of teaching students how to learn. *New Directions in Teaching and Learning, 106*, 3-10. doi:10.1002/tl.228

Peled, O. N., & Kim, A. C. (1996). Evaluation of supplemental instruction at the college level. *Research, 143*, 1-19. Retrieved from http://eric.ed.gov/PDFS/ED410777.pdf

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40. doi:10.1037/0022-0663.82.1.33

Raths, D. (2009). Making it through the first year. *Campus Technology, 22,* 32-34. Retrieved from http://campustechnology.com/Articles/2009/07/01/Portals.aspx?p=1

Schmidt, R. A., & Bjork, R. A. (1992). New conceptualizations of practice: Common principles in three paradigms suggest new concepts for training. *Psychological Science, 3*(4), 207-218. doi:10.1111/j.1467-9280.1992.tb00029.x

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist, 25*(1), 71-86. doi:10.1207/s15326985ep2501_6

Zimmerman, B. J., & Kintsantas, A. (2005). Homework practices and academic achievement: The mediating role of self-efficacy and perceived responsibility beliefs. *Contemporary Educational Psychology, 30*(4), 397-417. doi:10.1016/j.cedpsych.2005.05.003

Zimmerman, B. J., & Kintsantas, A. (2007). Reliability and validity of self-efficacy for learning form (SELF) scores of college students. *Journal of Psychology, 215*(3), 157-163. doi:10.1027/0044-3409.215.3.157

Jodi Price *is an assistant professor of psychology at The University of Alabama in Huntsville. Her research examines learning and memory across the lifespan.*

Amber G. Lumpkin *obtained her master's degree in experimental psychology from The University of Alabama in Huntsville in 2009. She contributed to this research as part of her thesis project.*

Eric A. Seemann *is an associate professor of psychology at The University of Alabama in Huntsville. His research interests are psychological testing, personality, measurement, and chronic pain.*
Diana Calhoun Bell *is currently associate professor of English specializing in composition and rhetoric at The University of Alabama in Huntsville as well as past editor of the Journal of College Reading and Learning and current president-elect of the College Reading and Learning Association. She is the author of a book and numerous articles on pedagogy, theory, feminism, and writing/learning centers.*

Footnotes

1 Although students attend PASS on a voluntary basis, PASS leaders are asked to track students' attendance to allow comparison of attendees and non-attendees' performance in the class. Participation levels are also monitored by administrators to determine ideal times for PASS sessions to be held.

2 PASS leaders are required to track whether the material discussed in PASS sessions was assessed on quizzes/exams as well as how PASS attendees performed, so as to allow the leaders to adapt their sessions and strategies taught as needed. To facilitate this reporting process, the quizzes and final exam were provided to the PASS leader the day before each quiz/exam. In no case was any PASS session held after the PASS leader received the quizzes or final exam to eliminate any concerns of "teaching to the test."

3 It remains unknown how many students opt out of PASS or their reasons for doing so. Once students declined to participate in our study, we no longer kept statistics on them.

4 All reported analyses were run twice—first with PASS treated as a binary variable (attended vs. did not attend) and again with PASS attendance classified in a more fine-tuned manner where participants were only considered attendees for the quizzes for which they had actually attended PASS—to assess whether this would alter our results. In all cases the pattern of results was similar. We opted to report the results based on the binary classification for PASS under the assumption that this classification scheme should work against rather than in our favor. Specifically, grouping those who attended PASS once with those who attended multiple times would reduce rather than increase the apparent benefits of PASS. We found this to be the case. Specifically, when examining quiz scores for those who had actually attended PASS before each quiz versus those who had not attended for that quiz, we found that the quiz scores were reliably different for all but the first quiz – Quiz 1: $t(65) = .10$, $p > .05$, $d = .07$; Quiz 2: $t(65) = .-3.30$, $p < .01$, $d = .88$; Quiz 3: $t(65) = .-2.55$, $p < .05$, $d = .66$; Quiz 4: $t(65) = .-3.17$, $p < .01$, $d = .96$; Quiz 5: $t(65) = .-4.38$, $p < .01$, $d = 1.14$; Quiz 6: $t(65) = .-2.58$, $p < .05$, $d = .63$.

5 Students were asked to self-report their high school grade point average and ACT or

SAT scores. However we later verified these scores by examining each student's academic record, with students' permission, and all SAT scores were converted to their ACT equivalent to provide a consistent basis for comparison.