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METACOGNITIVE AWARENESS AND ACADEMIC PERFORMANCE

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ABSTRACT

Roughly 25 percent of first-year college students do not return for a second year. This has led to a range of policies and interventions aimed at increasing college performance, persistence, and graduation. In this article, we assess whether cognitive strategy instruction (CSI) has the potential to improve student performance in college. We conducted two randomized controlled trials in a mandatory, year-long, first-year, reading/writing-intensive course at Spelman College, a private historically Black institution for women. We find that CSI at best impacts grade-related outcomes like GPA, but not metacognitive knowledge or persistence. Future work will explore the impacts on longer-run outcomes such as graduation.

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A data appendix is available at http://www.nber.org/data-appendix/w33380
A randomized controlled trials registry entry is available at https://www.socialscienceregistry.org/trials/4840

1 Introduction

According to data from the National Student Clearinghouse Research Center, more than 23 percent of first-year students who started college in fall 2022 did not return for a second year and more than 38 percent of first-year students who started college in fall 2018 have not completed their degree. In addition, Hispanic, Black, and Native American students are retained at rates significantly below the national rate, that is, 63.6, 56.6, and 52.8 percent, respectively, compared to 68.2 percent nationally. These statistics raise at least two questions. First, what are the optimal rates of retention and graduation; should they be 100 percent? This question is beyond our scope. Second, what are some ways to increase retention and graduation given pressures from students, parents, and policymakers? This is our main focus.

Prior work has explored at least three channels for improving college outcomes such as grade point average (GPA), retention, and graduation. First, financial factors like scholarships and tuition reductions (for example, Angrist et al., 2009; Denning, 2017; Lintner, 2024). Second, personal factors like selection and life barriers (for example, Bettinger et al., 2013; Evans et al., 2020). Third, academic factors like peer advising, student coaching, goal setting, learning communities, and text messaging (for example, Angrist et al., 2009; Bettinger and Baker, 2014; Clark et al., 2020; Azzam et al., 2022; Hyman, 2024; Page et al., 2024).

In this article, we add to this third set of factors by assessing whether cognitive strategy instruction (CSI) has the potential to improve student performance in college. CSI is an instructional approach that emphasizes the development of thinking skills and processes to enhance learning. While it has been associated with increased student capacity to identify ineffective learning strategies (for example, Dimmitt and McCormick, 2012), here we rigorously assess its potential to improve academic outcomes using a randomized controlled trial (RCT).

Section 2 explains the basics of the intervention. Section 3 describes the main findings. Finally, section 4 concludes.

2 The Intervention

The intervention was conducted during three academic years at Spelman College, a historically Black institution for women founded in 1881. During this time, 1760 students were admitted and 82.5 percent consented to their data being used. The intervention was implemented in the African Diaspora and the World course (also known, as "ADW") – a

mandatory, year-long, first-year course that is reading and writing intensive.

In the first two academic years, each incoming class was randomly assigned to either a treatment group T in which the professor used CSI or a control group C in which the professor used business-as-usual instruction.[1] In the third year, the above was interacted with CSI by peer tutors. So, the incoming class was randomly assigned to one of four conditions (2×2): (1) a group TT in which both the professor and peer tutor used CSI, (2) a group TC in which the professor used CSI but the peer tutor did not, (3) a group CT in which the professor did not use CSI but the peer tutor did, and (4) a group CC in which neither the professor nor the peer tutor used CSI.[2]

Professors and peer tutors were trained on CSI for almost two days at the start of the fall semester.[3] A "booster" training was also held at the beginning of the spring semester. As part of their typical process, ADW professors met monthly to discuss the course. Treatment and control professors met separately for the duration of the intervention. Peer tutors met on a weekly basis with a coordinator to ensure compliance with the experiment protocol and address any issues. All professors and peer tutors were compensated for participating in the intervention regardless of their condition.

3 Results

3.1 Demographic Characteristics

The student sample has an average high school GPA of 3.67 and SAT score of 1138. Forty seven percent is Pell eligible, 79 percent has a parent with a college degree, 82 percent went to a public high school, and about one third went to a racially diverse high school. The majority of Spelman students are from the south of the United States (55 percent), followed by the northeast (18 percent), midwest (16 percent), and west (8 percent). Almost half of the students declared natural science as their major during the application process, followed by social science (39 percent), humanities (8 percent), and art (3 percent).

Seventy two percent of the ADW professors hold Ph.D. degrees. Fifty five percent are full-time faculty while 30 percent are tenured or tenure track. They have taught ADW 0.33 times in the past. This is because we had to increase the number of course sections (clusters) for purposes of randomization. Thus, Spelman faculty who had not previously taught ADW

[1] There were 13 T professors/sections and 13 C professors/sections as well as 4-6 back-up professors.

[2] To accommodate this and keep tutor sessions small, tutors ran more than one session but all students in a given session had the same professor.

[3] The training slide decks are included as a supplementary appendix on the working paper/author website.

were recruited to teach the course.

The peer tutors were drawn from the student population based on criteria such as their (1) assigned RCT condition as a student, (2) performance in ADW, and (3) commitment to serve as a tutor. So, they were somewhat academically positively selected, as tends to be the case for peer tutors generally.

3.2 Baseline Equivalence and Attrition

For the first RCT (years one and two), there is balance on pre-characteristics at the student and professor levels. For the second RCT (year three), there is some lack of balance. This is to be expected given a smaller number of students (one cohort) was randomized across four (versus two) conditions. We control for these characteristics when estimating the impact of the second RCT. Differential and overall attrition are less than five percent for administrative outcomes like GPA and persistence. For survey-based outcomes like metacognitive awareness, differential attrition is below six percent for the first RCT and nine percent for the second RCT. Meanwhile, overall attrition is in the order of 15 percent.

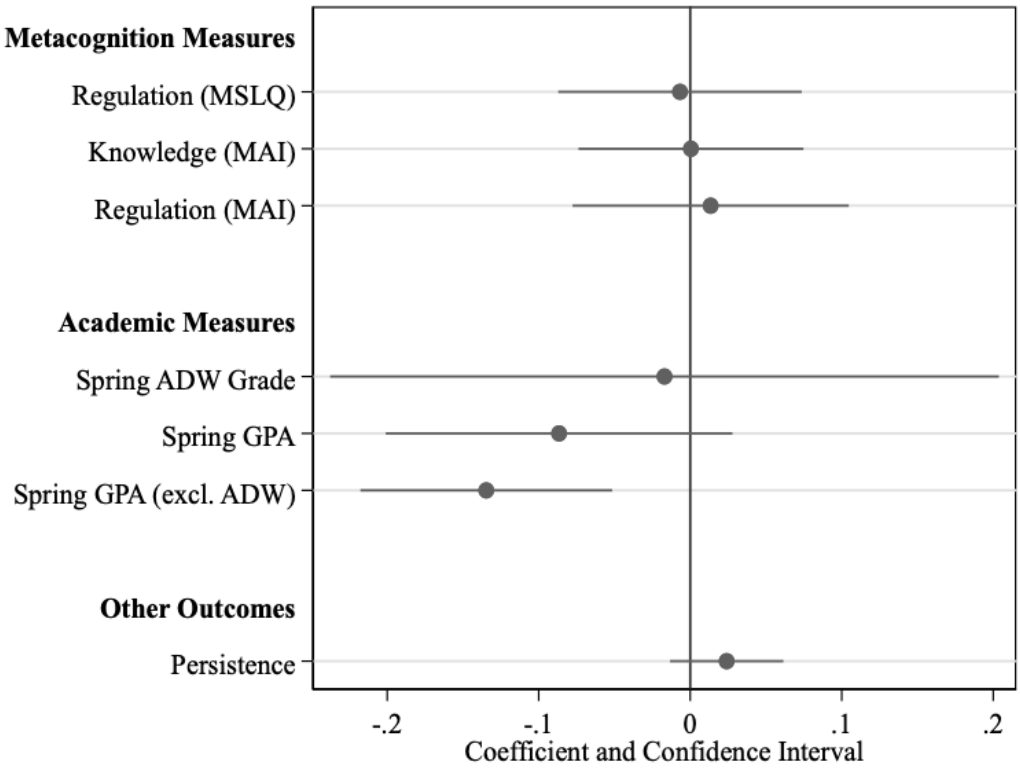
3.3 Impact of Cognitive Strategy Instruction

Figure 1 suggests that the impact of CSI in the classroom is limited. The only outcome that is statistically significantly different from zero is the student's spring GPA, excluding ADW (the course in question). The effect is negative suggesting that CSI induces students to divert effort away from other courses; however, this does not lead to a gain in the course grade itself. The effect represents a reduction of 13.5 percent, the equivalent of 0.19 times the standard deviation of the outcome mean (3.15) in the control group.

Figure 2 suggests that the impact of CSI in the third year (that is, in the second randomized controlled trial) is more pronounced, but only for the spring GPA outcomes. More precisely, the spring GPA (both including and excluding the ADW grade) is now positively impacted by CSI, be that via professors (TC versus CC), peer tutors (CT versus CC), or both (TT versus CC). In the case of the spring GPA excluding ADW, these three effects represent an increase of 19.9, 14.3, and 24.5 percent respectively, the equivalent of 0.29, 0.20, and 0.35 times the SD standard deviation of the outcome mean (3.17) in the control group.

A key question is why the sign of the coefficient for the spring GPA excluding ADW switches between the first and the second RCT. One possible explanation is that the presence of peer tutors in the second trial induces professors to deliver content differently. If so, we might not expect such a pronounced difference between conditions TC and CC since both have business-as-usual tutors.

Figure 1: Impact of CSI in the Classroom

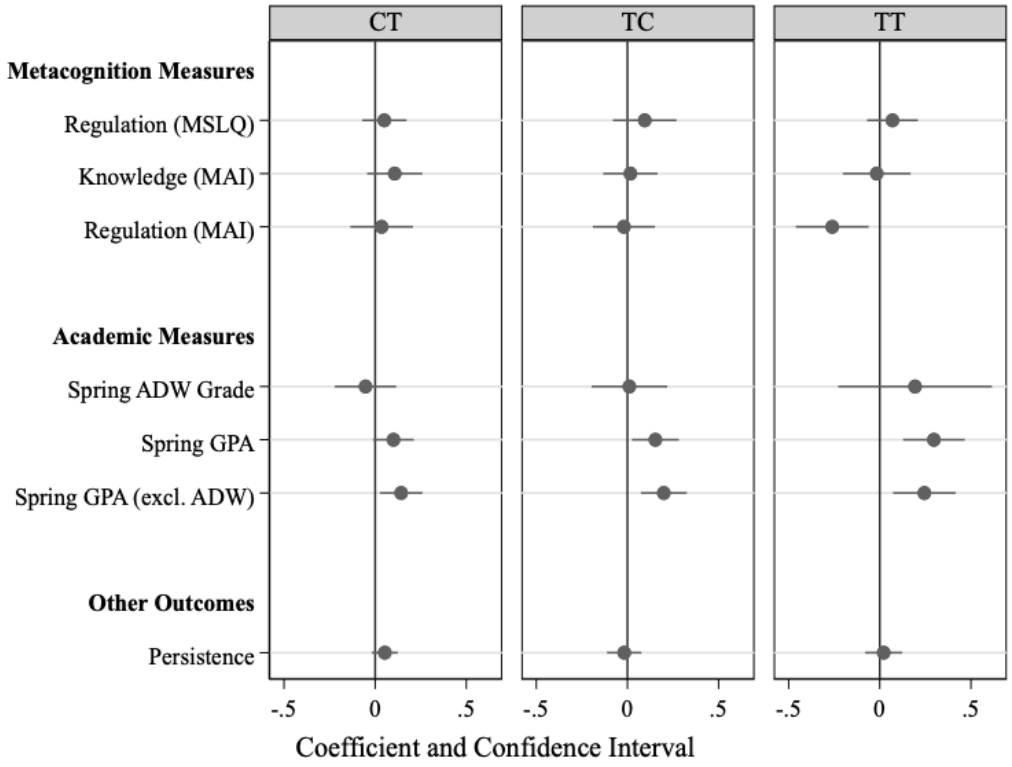


Notes: Each dot represents the coefficient for the effect of cognitive strategy instruction on the respective outcome, that is, for the treatment group relative to the control group. The bars around the dot represent 95%-confidence intervals. The metacognitive measures were collected using (1) the metacognitive strategies learning questionnaire (MSLQ) and (2) the metacognitive awareness index (MAI). The academic measures and other outcomes are administrative data from the registrar's office.

An alternative explanation is that professors (need to) learn how to deliver CSI over time. By the second trial, enough (treatment) professors have used CSI for more than two years. Indeed, there is suggestive evidence of learning. First, the negative effect in figure 1 is driven by the first cohort (year one) of the first randomized trial as opposed to the second cohort (year two). Second, faculty in the third cohort (the second randomized trial) score significantly higher on the metacognitive measures than in the first or second cohort (the first randomized trial).[4]

[4]This suggests that the initial training might have needed to be more intense. Alternatively, professors might have needed extra time to fully integrate metacognitive strategies into the lesson plan. While we considered these design issues at the outset, it was not feasible to increase treatment intensity due to the typical time constraints in a regular semester. Since treatment tutors were taken from the treatment student population, a similar learning curve might not have been present.

Figure 2: Impact of CSI in the Classroom and Peer Tutoring



Notes: Each dot represents the coefficient for the effect of cognitive strategy instruction on the respective outcome, that is, for a treatment group relative to the pure control group CC (where neither the professor nor the peer tutor uses CSI). The treatment groups are: (1) CT where the professor does not use CSI, but the peer tutor does, (2) TC where the professor uses CSI, but the peer tutor does not, and (3) TT where both the professor and the peer tutor use CSI. The bars around the dot represent 95%-confidence intervals. The coefficients are after controlling for unbalanced pre-characteristics, specifically the student's (1) metacognitive knowledge, (2) parental college attainment, and (3) major as well as the professor's (1) highest degree attained, (2) number of years teaching, (3) full-time status, and (4) tenured or tenure-track status. The metacognitive measures were collected using (1) the metacognitive strategies learning questionnaire (MSLQ) and (2) the metacognitive awareness index (MAI). The academic measures and other outcomes are administrative data from the registrar's office. The unbalanced characteristics are from demographic surveys conducted for the study.

4 Conclusion

Overall, the findings suggest that CSI at best impacts grade-related outcomes. However, it does not significantly impact metacognitive knowledge or retention/persistence. Table 1 places our effect sizes in the context of some prior work, underscoring the fact that academic

interventions have a pretty wide range of impacts.

One aspect to keep in mind is that our intervention was implemented at a selective historically Black institution for women. So, not only might the typical student profile be different from that of students in other studies (especially, those in table 1); however, the baseline level of instruction in the control group (what we referred to as "business-as-usual" instruction) might already include CSI. In addition, we cannot fully rule out the presence of spillovers.

Our findings leave several open questions for future work. Among them, are the impacts on longer-run outcomes such as graduation, the role of faculty learning over time, the potential reinforcement effects of peer tutoring, and the potential for spillovers and heterogeneous effects, for example, across students with differential Pell eligibility, high school GPA, or social networks and across faculty with differential profiles, especially pre-metacognitive knowledge and experience teaching the course in question.

Table 1: Effect Sizes of Select Academic-Intervention RCTs

		Outcomes		
Treatment	**Paper**	**GPA**	**Retention**	**Graduation**
Peer Advising/Study Group	Angrist et al. (2009)	0.27SD**	-0.23SD**	–
	table 6, pages 150-151	14.03%	39.91%	–
Student Coaching	Bettinger and Baker (2014)	–	–	–
	table 3, page 10	–	8.96%***	12.82%*
Task Goal Setting	Clark et al. (2020)	0.059SD**	–	–
	footnote 29 & table 5, page 657	6.2%	–	–
Learning Communities	Azzam et al. (2022)	–	–	–
	table 3, page 6 & app. table A3	0.64%	1.98%	–
Text messages (bot)	Page et al. (2024)	–	–	–
	table 8, page 46	0.33-1.05%	0.62-0.70%	-8.69-10.53%
Cognitive Instruction	This paper	-0.19-0.35SD***	0.08-0.16SD	pending
		-13.5-24.5%	2.74-6.06%	–

Notes: Where available, the effect size is indicated as a multiple of the standard deviation of the control group mean (first line) as well as a percent change of the control group mean (second line). For Angrist et al. (2009), the effect sizes are for women only since this is most comparable to the Spelman sample. $^{***} = p < 0.01, ^{**} = p < 0.05, ^{*} = p < 0.10$. Unless otherwise indicated, the effect is not significant below the ten percent level. If significance is indicated for the first line (the SD effect), it is implied for the second line (the percent-change effect).

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