Journal of Education for Students Placed at Risk (JESPAR)

ISSN: 1082-4669 (Print) 1532-7671 (Online) Journal homepage: https://www.tandfonline.com/loi/hjsp20

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To cite this article: Tammy Kolbe, Peter Kinsley, Rachel Carly Feldman & Sara Goldrick-Rab (2018) From the (Academic) middle to the top: an evaluation of the AVID/TOPS college access program, Journal of Education for Students Placed at Risk (JESPAR), 23:4, 304-335, DOI: 10.1080/10824669.2018.1530114

To link to this article: https://doi.org/10.1080/10824669.2018.1530114

Published online: 28 Jan 2019.

JOURNAL OF EDUCATION FOR STUDENTS PLACED AT RISK (JESPAR)
2018, VOL. 23, NO. 4, 304–335
https://doi.org/10.1080/10824669.2018.1530114

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From the (Academic) middle to the top: an evaluation of the AVID/TOPS college access program

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ABSTRACT

Despite overall increases in college-going, college enrollment rates remain inequitable. Many programs attempt to address these persistent racial/ethnic and social class disparities in college attendance by intervening in the high school curriculum. Advancement Via Individual Determination (AVID) is among the longest standing and prevalent of these college access programs. In this paper, we present findings from a multi-year evaluation and cost analysis of the AVID/TOPS program – an enhanced AVID model – in place in Madison Metropolitan School District (Wisconsin). Taken together, the evaluation's findings characterize AVID/TOPS as a promising program model that is associated with an increased likelihood for college readiness and matriculation, particularly for student groups underrepresented in higher education. We also report on the resources and costs required to implement the program, and show that the program's benefits appear to exceed its costs.

In recent years, the overall rate at which high school students transition to college has steadily increased - however, this trend has not been shared equally among all students (Baum, Kurose, & McPherson, 2013). Student groups historically underrepresented in higher education – low-income, racial and ethnic minorities, English language learners, and those whose parents did not attend college – continue to enroll at far lower rates than their majority peers (Kena et al., 2015). Even among students with comparable tested abilities, such disparities are, in part, attributable to differences in academic preparation, college-going expectations, aspirations, knowledge about college and its importance, and how well students and families understand college costs and navigate the financial aid process (Cahalan & Perna, 2015; Flores, Park, & Baker, 2017; Hossler & Stage, 1992; Vargas, 2004). These circumstances have spurred a broad range of organizations to sponsor college access programs that provide educational and other supports and services to youth who are most at risk for not attending and completing college.

One program aimed at improving both academic success in high school and college attendance rates among underrepresented student groups is Advancement via Individual Determination (AVID). Developed nearly 35 years ago to prepare students for college, the AVID program targets middle-achieving students and places them in college

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preparatory coursework with their higher achieving peers, while offering a system of academic supports designed to provide students with the skills, academic behaviors, and knowledge necessary to attend and succeed in these high school courses and in college (Black, Little, McCoach, Purcell, & Siegle, 2008; Watt, Powell, Mendiola, & Cossio, 2006). AVID has been adopted by more than 5,700 schools and 43 postsecondary institutions in the United States and internationally ("The History of AVID", n.d). Given its broad reach, there have been repeated calls for rigorous program evaluations to better understand the program's efficacy and costs (e.g., U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse, 2010; Black et al., 2008; Ford et al., 2014).

We present findings from a multi-year evaluation of an enhanced AVID model: The AVID/TOPS program. Put in place in Madison, Wisconsin in 2008 by the Madison Metropolitan School District (MMSD), AVID/TOPS combines the national AVID college access program model with a local initiative, the Teens of Promise (TOPS) program. Operated by the Boys and Girls Club of Dane County (BGCDC), TOPS expands AVID to incorporate community-based mentoring, a summer internship experience, and college transition support. The two programs are tightly integrated and operated through a long-standing partnership between MMSD and BGCDC. In this evaluation, we examined differences in outcomes between students who participated in the AVID/TOPS program and a matched comparison group of non-participants. In addition, the evaluation incorporated a cost study that documented the resources and costs used to implement the program. Incorporating resource and cost information into an evaluation of AVID-type programs and college access programs, more generally, is a novel and important contribution of this paper. The costs of college-readiness programs, generally, and AVID-type models, specifically, are not well understood (Bowden & Belfield, 2015; Haskins & Rouse, 2013). However, at a time when policymakers and educational leaders must make careful choices about how they allocate scarce resources, there is a critical need for evaluations that document the costs associated with program implementation and that compare these costs to student outcomes to gauge the potential return to investment. This study provides estimates of program costs for participating students, per academic year, and across four years of participation during high school. Additionally, these costs are compared to the earning differentials associated with a college degree to shed light on the relative productivity of the District's investments in AVID/TOPS.

Taken together, the study's findings suggest that the AVID/TOPS program holds promise for improving high school attendance and college readiness for students at risk of not matriculating to and completing college.

Perspective

Increasingly, a college degree is viewed as a critical determinant for economic and social well-being in the contemporary United States (Bailey & Dynarski, 2011). In the past 40 years, the share of jobs requiring some form of postsecondary education has nearly doubled, leaving those with a high school degree or its equivalent, struggling to find stable work that pays a livable wage (Carnevale, Smith, & Strohl, 2010). Not only do

college graduates out-earn their peers with high school diplomas over the course of their lifetimes (Barrow & Malamud, 2015), a college degree is also associated with substantial non-monetary benefits to individuals (e.g., improved health and social welfare) and society (e.g., lower crime, increased taxes paid, and civic engagement) (Dee, 2004; Lochner & Moretti, 2004; Oreopoulos & Salvanes, 2011).

Despite the importance of a college degree, college access remains largely unequal. Low-income, racial/ethnic minority, and first-generations students are underrepresented in higher education. In 2013, the immediate college enrollment rate for students from high-income families was 31% higher than that of students from low-income families (Kena et al., 2015). Similarly, White high school graduates transition to two- and four-year colleges immediately following high school at higher rates than their African-American peers (67 vs. 57%, respectively) (Kena et al., 2015). First-generation students also enroll in college at significantly lower rates. Students whose parents did not attend college are 19–24 percentage points less likely to attend college than those with parents who did (Smith, 2015).

In response, a broad range of organizations have developed or adopted college access programs targeting youth at risk of not attending college, including federal and state government agencies, colleges and universities, school districts and schools, and community organizations. These programs typically focus on improving students' academic preparation and predispositions toward college, as well as supporting students in the college choice process (Perna, 2002). Access to guidance, support, and resources underlie differences in college attendance and completion. Students at risk of not attending college often attend high schools without strong college-going cultures; are less academically prepared for college; have insufficient counseling; lack knowledge about college; lack encouragement and family support for college; are less informed about financial aid; and are more likely to believe that college is unaffordable (Bell, Rowan-Kenyon, & Perna, 2009; Cabrera & La Nasa, 2001; Conley, 2001; De La Rosa, 2006; Goodwin, Li, Broda, Johnson, & Schneider, 2016; Roderick et al., 2008). Moreover, establishing college expectations early on in students' academic careers reinforces the view that college is an attainable aspiration (Destin & Oyserman, 2009; Elliott, 2009; Plank & Jordan, 2001; Schneider & Stevenson, 1999).

While college access programs have been widely adopted and are seen as a promising direction for policy, limited evidence exists about which programs hold the greatest potential for improving college attendance, especially for youth underrepresented in college (Haskins & Rouse, 2013). Furthermore, most targeted programmatic interventions that provide support to at-risk students assign resources above and beyond what students might receive during their regular schooling (Hollands et al., 2014). Given these additional investments, stakeholders need a better understanding of such program costs as well as a mechanism for identifying programs that are most cost effective at serving targeted student groups (Bowden & Belfield, 2015).

Advancement via individual determination (AVID)

AVID is one of the most widely-adopted and longest standing college access program models – both in the United States and internationally. AVID differentiates itself from

other programs in its focus on increasing college attendance and success for high school students in the "academic middle" who are most at risk for not attending college, particularly low-income, non-White, and first-generation college students.

AVID secondary students enroll in a rigorous college-preparatory curriculum while concurrently participating in specialized programing that features: (a) an AVID-specific elective course on organizational and study skills, critical thinking, and questioning, and (b) a tutorial that provides students with small group academic support and problem-solving models (AVID Center, 2016). The AVID program also incorporates an experiential component focused on familiarizing students with college, including college visits, college and financial aid applications, and career planning. To experience these components, students are selected based on criteria established by the national AVID organization. Eligible students have a 2.0–3.5 cumulative GPA and pass state-mandated assessments. Priority in admissions is given to students who: (a) are from ethnic, linguistic, or socioeconomic backgrounds underrepresented at four-year colleges and universities; (b) are first-generation college students; and (c) face other obstacles to college matriculation. Personal assessments, oftentimes from teachers, are also used to evaluate students' academic and college potential (AVID Center, 2016).

Over time, AVID has built a reputation for improving students' academic preparation for college. Evaluations of AVID secondary programs suggest that AVID students are more likely to enroll in advanced coursework and courses that yield college credit (e.g., Advanced Placement) (Pitch, Marchand, Hoffman, & Lewis, 2006; Rorie, 2007; Watt et al., 2006). In comparison to non-AVID students, AVID participants also tend to attain higher overall grade point averages (Protas, 2010; Watt, Yanez, & Cossio, 2002–2003), earn higher standardized test scores (Lozano, Watt, & Huerta, 2009; Protas, 2010; Watt, Powell, & Mendiola, 2004), and have higher rates of school attendance (Watt, Powell, & Mendiola, 2004).

Past research suggests that the AVID program's impact on students' academic preparation depends on the extent of their exposure to the AVID curriculum. For instance, Smith, Elder and Stevens (2014) found that high school students who participated in AVID for 7–16 high school semesters had higher ACT scores, GPAs, and college acceptance rates than non-AVID participants; there were no similar effects for students who participated for fewer semesters. Pugh and Tschannen-Moran (2016) also found that the length of exposure to AVID programing was positively related to students' GPA and school attendance, especially for African-American students. Huerta, Watt and Butcher (2013) found that high school seniors who participated in AVID in middle *and* high schools took more rigorous high school courses and had higher GPAs than seniors who only participated in the high school program.

AVID participation also has been linked with college enrollment. Gándara, Larson, Mehan, and Rumberger (1998) reported that students who participated in AVID for 3–4 years in high school were more likely to enroll in college than their peers who started but did not complete the AVID program; and African-American & Latino AVID participants entered college at higher rates than the national average for respective student subgroups. Once enrolled in college, nascent evaluation evidence suggests that AVID students continue to attend college one-to-two years post matriculation and that they remain on track to graduate within 4–6 years (Guthrie & Guthrie, 2002; Mendiola, Watt, & Huerta, 2010).

Despite this body of research, several common limitations constrain our ability to make more definitive statements about AVID's impacts on students. First, very few existing studies use experimental or quasi-experimental approaches to minimize bias in their estimates. Just one study, conducted in Canadian schools, randomized students into treatment and control conditions (Ford et al., 2014). Unlike the other studies, the Canadian study found few differences between AVID and non-AVID students on academic outcomes. A few studies have incorporated matching strategies, pairing AVID and non-AVID participants on observable demographic characteristics and academic performance (Lozano et al., 2009; Rorie, 2007; Smith et al., 2014). However, these studies failed to include either family socioeconomic background or parental education in their matching models, both of which have been linked to students' educational aspirations and expectations (Choy, 2001; Hossler & Stage, 1992; Warburton, Bugarin, & Nunez, 2001). Alternatively, other evidence is either correlational (e.g., Pugh & Tschannen-Moran, 2016; Rorie, 2007) or based on naïve comparisons between AVID and non-AVID participants (e.g., Gándara et al., 1998; Mendiola et al., 2010).

Second, although a stated goal for the AVID program is to increase college participation and success among groups historically underrepresented in higher education, only a limited number of studies report evaluation evidence for specific student subgroups. Several studies examine the Hispanic student participant experiences and compare academic outcomes for African-American and Hispanic participants to their peers who did not participate in AVID (Mendiola et al., 2010; Pugh & Tschannen-Moran, 2016; Watt, Huerta, & Lozano, 2007). These existing studies do not account for the specific effects of AVID participation for students from low-income families, and for those whose parents do not have a college degree.

Finally, very little is known about the cost of implementing AVID in public schools and how these costs compare to the program's benefits for students. In its evaluation of BC AVID (Canada), Social Research and Demonstration Corporation (SRDC) systematically analyzed the resources used by school sites to implement the program. After valuing these resources, the authors found per pupil costs ranging from $4,100 to $6,600 for the 2009–10 school year (in Canadian dollars) (Ford et al., 2014). While we know of no evaluations that compare measured effects of AVID-related programs to implementation costs, other efforts by Bowden and Belfield (2015), Harris (2013), and Hollands et al. (2014) systematically examine the resources used to implement other college access and readiness programs, including Talent Search, TRIO, Upward Bound, and GEAR UP. The evidence from these studies, however, is mixed as to the programs' cost effectiveness in improving academic readiness, high school graduation, and matriculation to and success in college. More information on the resources and costs associated with implementing AVID in US public schools is necessary for replicating and taking programs to scale and for understanding the productivity of investments in AVID programing.

The AVID/TOPS program

MMSD is a large and diverse metropolitan school district, serving 27,000 students in 48 schools. Forty-four percent of students identify as non-White, of which 19% are African American and 19% Hispanic. Nearly half of the students reside in low-income

AVID	TOPS
• AVID coursework	• Mentoring program
• Tutorial	• Supplemental tutoring
• Intensive student support & monitoring	• Summer experience program (internships and career exploration)
• Professional development in AVID methods	• College transition and continuation support

Figure 1. AVID/TOPS programmatic elements.

households and one-quarter are English language learners (ELL) (Madison Metropolitan School District, 2015).

Persistent achievement gaps are a serious concern in MMSD. The District is home to one of the largest Black-White achievement gaps in the nation (Becker, 2015). While overall, MMSD students perform better than the state average on the ACT and state reading and math tests, in 2014–15 just 7% of African-American students were proficient in math, compared to 62% of White students (Madison Metropolitan School District, 2015). In 2011, just half of MMSD's African-American youth graduated from high school, in stark contrast to the nearly 85% of White students who graduated that year (Wisconsin Council on Children & Families, 2012). Unsurprisingly, these differences translated into disparities in students' prospects for college. Among MMSD's students who graduated between 2011 and 2013, two-thirds of White students went on to attend a 4-year college whereas just 30% of African-American graduates did the same (McCready & Vaade, 2015).

In 2008, as part of an effort to close achievement gaps in the district, MMSD and BGCDC joined forces to pair the national AVID program model with BGCDC's Teens of Promise (TOPS) program to form the AVID/TOPS program (Figure 1). The TOPS program expands the AVID program to include mentoring activities, academic support, internships and career exploration opportunities, and college transition support for students. Additionally, the TOPS program provides ongoing support to students as they transition to college, including navigating the financial aid process, accessing campus resources, and course registration. BGCDC provides all TOPS resources. AVID/TOPS targets students from the "academic middle" who are viewed capable of attending college but at-risk of falling short of their potential. Although tightly integrated, AVID and TOPS offer distinct supports and enrichment opportunities for students.

Students participate in an AVID elective course each school day. Course content is split between instruction in academic engagement strategies; coaching on problem solving techniques and small group work on homework from other courses; and experiential learning related to the college-going process, including college field trips, guest speakers, and career panels. Students' academic progress is monitored by AVID coordinators and teachers who underwent professional development in AVID's model and methods. The TOPS program expands AVID to provide mentors, additional tutoring opportunities, and summer internships. Additionally, TOPS offers ongoing support to students transitioning to college (e.g., ombudsman with college officials; periodic "check-ins" with students).

MMSD and BGCDC share responsibility for implementing AVID (Figure 2). They jointly staff the AVID elective course, with MMSD teachers responsible for instruction

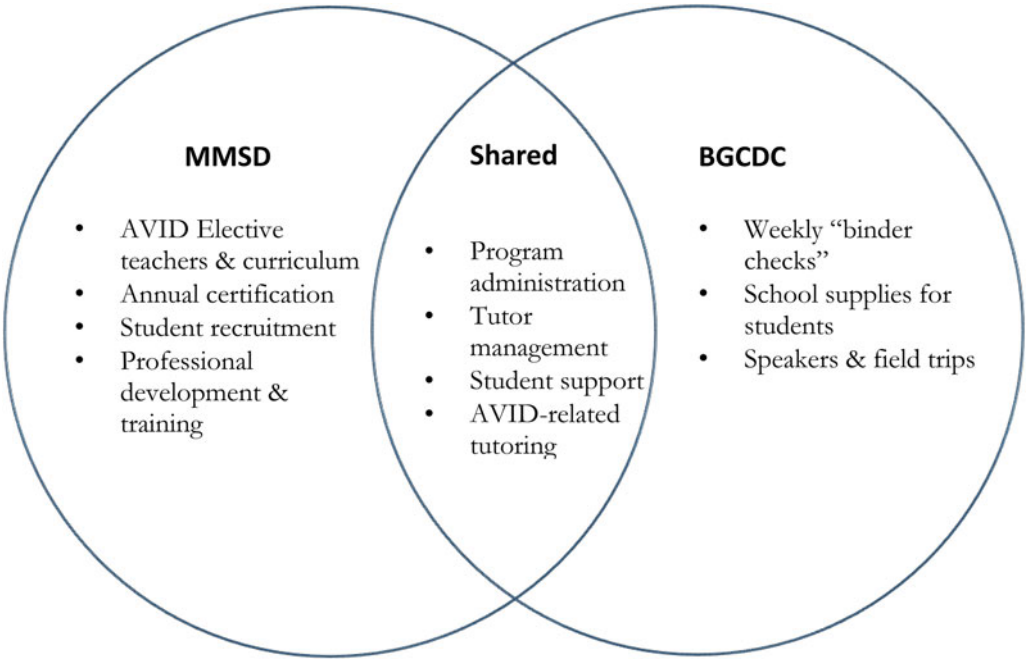

Figure 2. Division of responsibilities between MMSD and BGCDC.

on curriculum days, and BGCDC personnel overseeing and providing tutors for the AVID tutorial and the mandatory weekly "binder checks" that track student progress. BGCDC organizes weekly experiential learning opportunities that occur as a part of students' AVID elective course. MMSD oversees school site operations for AVID, including annual certification, student recruitment and selection, and AVID-related training. AVID program activities are jointly funded by MMSD and BGCDC, while TOPS is operated and funded solely by BGCDC.

Student recruitment and selection for the AVID/TOPS program is done in accordance with the guidelines promulgated by the national AVID organization. Eighth-grade students attending MMSD's middle schools are screened for eligibility based on their GPA, standardized test scores, attendance, behavior, whether they have a disability, and English language learner status. Students meeting initial eligibility criteria are invited to apply to the ninth-grade AVID/TOPS program. School-based admissions committees review all applications and interview applicants. Program admission is competitive—in a given year about 30% of students who apply are selected to participate as ninth graders. Due to program attrition (voluntary and involuntary), students not accepted into the program as ninth graders may reapply for admission to the program in the tenth or eleventh grades. (Appendix 1 summarizes year-to-year enrollment and attrition rates.)

Evaluation design

Our evaluation of the AVID/TOPS program has two complementary components. First, we examine differences in outcomes for AVID/TOPS participants and a matched sample

of MMSD students who did not participate in the program. We consider potential differences in students' academic readiness for college and the likelihood of college entry for students who participated in the AVID/TOPS program for any amount of time during high school (i.e., 1–4 years), and for those who participated all four years. (See Appendix 2.) We also investigate differences in outcomes for student subgroups, including students from racial and ethnic minority groups underrepresented in higher education (e.g., Black, Latino), low-income students, and first-generation students. Second, we develop estimates of program costs and compare these costs to potential longer-term benefits of completing high school and college attendance. This provides new evidence for understanding the costs of implementing interventions intended to improve academic preparation and college attendance among students at risk for not matriculating to college.

Student outcomes

Randomized controlled trials are considered the gold standard for yielding unbiased estimates of a program's causal effects. However, such an approach to evaluating the effects of the AVID/TOPS program was practically infeasible. Instead, we compared students who participated in the AVID/TOPS program to a matched comparison of MMSD students who did not participate in the program. The matched comparison was constructed using propensity score matching (PSM), a pre-processing strategy to control for systematic differences between program participants and non-participants on a large set of covariates (Ho, Imai, King, & Stuart, 2007). However, this design cannot control for unobservable characteristics of students. As a result, even with this matching strategy there is the potential that estimated differences between groups are not solely the result of program participation. Accordingly, our findings are *not* readily interpretable as indicators of program impact. Rather, our evaluation describes observed differences in outcomes between AVID/TOPS program participants and non-participants.

Below, we first describe the data used in our analysis. We then discuss how we applied PSM to construct the study's comparison group. Finally, we explain our analytic approach to estimating differences between students who did and did not participate in the AVID/TOPS program.

Sample selection

From MMSD's student information system we obtained detailed data on all students who entered the District's four comprehensive high schools as a freshman during the 2009–10, 2010–11, or 2011–12 academic years, and students who were enrolled in eighth grade in one of the District's middle schools the prior year. Using these data, we identified two groups of students: (1) those who participated in the AVID/TOPS program at any point in high school; and (2) those whose eighth-grade profiles matched the academic eligibility criteria for participation in the AVID/TOPS program, but who did not participate in the high school program.

We identified eligible non-participants using MMSD's selection criteria. Specifically, we used the program's selection rubric to assign point scores to each eighth grader

Table 1. Descriptive statistics for unmatched analysis sample.

	Full Sample		AVID/TOPS		Non-AVID/TOPS		
	Mean	SD	Mean	SD	Mean	SD	*t*
Outcomes							
Cumulative GPA	3.135	0.673	2.605	0.602	3.239	0.637	−20.29 ***
Unexcused Days Absent	3.220	8.301	6.668	10.967	2.548	7.493	10.21 ***
Attendance Rate	92.715	7.070	90.699	8.917	93.109	6.581	−6.95 ***
Took any AP Courses	0.661	0.474	0.534	0.499	0.685	0.464	−6.52 ***
Total AP Courses	3.970	4.385	1.849	2.506	4.384	4.550	−11.97 ***
Took any Honors Courses	0.699	0.459	0.585	0.493	0.721	0.449	−6.05 **
Total Honors Courses	4.866	4.810	2.912	3.622	5.248	4.920	−9.98 ***
Took the ACT	0.912	0.283	0.918	0.274	0.911	0.285	0.51
Graduated High School On Time	0.960	0.197	0.937	0.244	0.964	0.186	−2.83 **
Attended Any College	0.799	0.401	0.728	0.445	0.813	0.390	−4.30 ***
Student Characteristics							
Free or Reduced Price Lunch	0.269	0.444	0.675	0.469	0.190	0.468	24.14 ***
Male	0.485	0.500	0.456	0.499	0.491	0.500	−1.42
White	0.626	0.484	0.209	0.407	0.708	0.455	−22.56 ***
Black	0.077	0.267	0.266	0.442	0.040	0.197	18.00 ***
Hispanic	0.121	0.326	0.307	0.462	0.085	0.278	14.24 ***
Other Race/Ethnicity	0.176	0.381	0.219	0.414	0.168	0.374	2.73 **
English Language Learner	0.183	0.387	0.405	0.491	0.140	0.347	14.31 ***
Special Education	0.075	0.264	0.059	0.236	0.078	0.269	−1.45
Parent Education							
High School or Less	0.229	0.357	0.434	0.491	0.197	0.301	11.72 ***
Some Coll./Tech. School Deg.	0.210	0.387	0.293	0.452	0.197	0.370	4.71 ***
Four-Year Degree or Higher	0.561	0.485	0.272	0.433	0.606	0.461	−13.99 ***
Eighth Grade Academics							
Cumulative GPA	3.372	0.452	3.003	0.360	3.444	0.433	−21.14 ***
Core GPA	3.189	0.584	2.775	0.523	3.270	0.561	−18.04 ***
Attendance Rate	96.344	3.219	96.374	3.145	96.338	3.233	0.22
Behavioral Referrals	0.624	2.055	1.299	3.167	0.493	1.729	8.01 ***
WKCE Reading Score (Z-score)	0.342	0.800	−0.202	0.564	0.448	0.796	−17.24 ***
WKCE Math Score (Z-score)	0.380	0.752	−0.203	0.609	0.494	0.724	−19.95 ***
Sample Size	2996		489		2507		

Notes: $+p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$. Other race/ethnicity category includes East and Southeast Asian, Native American, Middle Eastern and Pacific Islander. Students categorized as ELL if they scored lower than native proficiency in the 8th grade.

based on their standardized test scores, cumulative and core GPA, ELL level, IEP status, attendance rate, and behavioral referrals. Only students scoring above a pre-specified cut score were invited to apply to the AVID/TOPS program. We therefore restricted our pool of non-participants to those with a rubric point total above the eligibility cut score. Altogether, we identified 489 students who participated in the AVID/TOPS program for at least one year of high school and who were enrolled in a district high school for at least four years. We also identified 2,507 students who were similarly enrolled in the district for four years and who met the program's eligibility criteria but who did not participate in the AVID/TOPS program at any point during their high school career. Table 1 offers a summary profile of student demographics for the unmatched student sample of AVID/TOPS program participants and non-participants. Statistically significant differences between the two groups, especially in eighth grade academic performance, suggest that at the outset the two groups were systematically different from one another.

Table 2. Variables used in propensity score model.

Variable name	Description
Free or reduced price lunch	Indicator of free or reduced price lunch status in 8th grade
Male	Indicator of male gender
White	Indicator that student primarily identifies as White, non-Hispanic
Black	Indicator that student primarily identifies as Black, non-Hispanic
Hispanic	Indicator that student identifies as Hispanic ethnicity regardless of race
Other race/ethnicity	Indicator that student identifies as non-Hispanic minority from a group other than Black (combines Asian, Native American and Pacific Islanders into one category due to small n for each)
English language learner	Indicator of English Language Learner status in 8th grade (student's language proficiency is less than native fluency)
Special education	Indicator that student has an IEP in the 8th grade
First generation	Indicator that neither parent attended college (highest education is high school diploma or less)
Some coll./tech. school degree	Indicator that at least one parent attended some college and may have earned a one-year or two-year degree
Four-year degree or higher	Indicator that at least one parent earned a four-year bachelors degree or higher
Cumulative GPA	Student's cumulative GPA at the end of 8th grade
Attendance rate	Student's 8th grade attendance rate
Behavioral referrals	Number of student's behavioral referrals in 8th grade
WKCE reading score (Z-score)	Student's standardized 8th grade reading score on the Wisconsin Knowledge and Concepts Examination–a statewide test to measure progress toward academic standards
WKCE math score (Z-score)	Student's standardized 8th grade math score on the Wisconsin Knowledge and Concepts Examination–a statewide test to measure progress toward academic standards
School	Indicator of 9th-grade high school attended
Cohort year	Indicator of 9th-grade cohort year

Constructing matched comparisons

PSM was used to construct a synthetic matched sample of students who participated in AVID/TOPS during high school and a comparison group of non-participants who substantially resembled the AVID/TOPS students on observable characteristics. PSM attempts to address bias due to observed confounding variables by first creating a matched analysis sample of subjects exposed to a "treatment" condition (e.g. the AVID/TOPS program), and those not exposed to the condition (Caliendo & Kopeinig, 2008; Song & Herman, 2010). Although PSM, like traditional regression-based methods, is still subject to threats from omitted variables and therefore cannot not produce causal estimates of program impact, it may reduce the potential for biased estimates resulting from model misspecification (Austin, 2011; Ho et. al., 2007).

We first constructed a predictive logistic regression model to calculate the probability of participation in the AVID/TOPS program as a function of available pre-program observables that were also conceptually related to our outcomes of interest (Caliendo & Kopeinig, 2008; Guo & Fraser, 2010). The models included measures of students' pre-program academic performance as represented by eighth-grade cumulative GPA, standardized test scores, behavioral referrals, and attendance. We also included indicators for other student and family attributes known to be associated with students' academic performance, educational aspirations, and outcomes—gender, race/ethnicity, parental education, and free or reduced price lunch (FRPL) eligibility. (See Table 2 for variable list.) Additionally, we incorporated indicators for high school attendance and cohort year to account for variability in program participation related to unobserved institutional or

Table 3. Baseline comparison of covariates for matched sample.

	AVID/TOPS		Comparison group			
	Mean	SD	Mean	SD	*t*	ES
Student characteristics						
Free or reduced price lunch	0.676	0.469	0.672	0.470	0.11	0.01
Male	0.459	0.499	0.452	0.498	0.20	0.01
White	0.211	0.408	0.198	0.399	0.50	0.03
Black	0.258	0.438	0.253	0.435	0.18	0.01
Hispanic	0.310	0.463	0.303	0.460	0.24	0.01
Other race/ethnicity	0.221	0.415	0.246	0.431	−0.93	−0.06
English language learner	0.407	0.492	0.401	0.491	0.20	0.01
Special education	0.060	0.238	0.073	0.261	−0.84	−0.05
Parent education						
High school or less	0.454	0.491	0.439	0.490	0.38	0.02
Some coll./tech. school deg.	0.273	0.451	0.316	0.454	−1.20	−0.07
Four-year degree or higher	0.273	0.433	0.245	0.427	0.84	−0.05
Eighth grade academics						
Cumulative GPA	3.003	0.360	3.011	0.342	−0.34	−0.02
Core GPA	2.774	0.521	2.798	0.496	−0.74	−0.04
Attendance rate	96.367	3.158	96.534	3.165	−0.82	−0.04
Behavioral referrals	1.273	3.129	1.398	3.628	−0.58	−0.03
WKCE reading score (Z-score)	−0.200	0.564	−0.224	0.691	0.59	0.03
WKCE math score (Z-score)	−0.195	0.607	−0.188	0.532	−0.20	−0.01
Sample size	484		641			

Notes: $+p < 0.10$. $*p < 0.05$. $**p < 0.01$. $***p < 0.001$. Effect sizes calculated according to What Works Clearinghouse (2014).

temporal differences. The final model incorporated both higher order terms, as well as interaction terms between academic performance measures and subgroup membership indicators (race/ethnicity, FRPL status, and parent education). This resulted in non-significant differences ($p > 0.05$) between students in AVID/TOPS and the matched comparison group on all baseline academic performance measures within each subgroup and allowed us to examine differences in outcomes with greater confidence that our estimates were unbiased by group imbalance (Green & Stuart, 2014).

We subsequently matched AVID/TOPS participants to similar non-program students based on their estimated propensity scores using the *PSMATCH2* program in STATA (Leuven & Sianesi, 2003). Matching was conducted using multiple nearest neighbor matching within caliper, with replacement. Consistent with recommended practice, we used .20 standard deviations of the logit of the propensity score to define our caliper width (Austin, 2011). Matches for five AVID/TOPS participants could not be identified and these students were dropped from subsequent analyses. The resulting matched sample consisted of 484 students who participated in the AVID/TOPS program for at least one year in high school and a matched comparison group of 641 students who never participated in the program. A comparison of baseline covariates between the two groups showed tight balance, with no significant differences across measures (Table 3). In summary, the propensity score matching process resulted in a matched sample of AVID/TOPS participants and non-participants that were largely similar to one another on a broad range of observable pre-program characteristics.

We also used PSM to develop a second analytic sample of students who participated in the AVID/TOPS program for all four years of high school (i.e., full exposure) and a comparison group of non-program counterparts. We first modeled full program exposure as a function of baseline academic and demographic covariates, student cohort, and

high school attended. We then matched full exposure students with similar non-program comparison group students based on comparable probabilities of full program exposure (Lochman, Boxmeyer, Powell, Roth, & Windle, 2006). The matching process resulted in treatment and comparison groups that closely resembled each other on observed baseline covariates (standardized difference of .05 SD or less). The resulting sample consisted of 225 students who participated in the program all four years, and a matched comparison group of 406 non-participants.[1]

Analysis

We examined differences in outcomes between AVID/TOPS program participants and our full matched sample of non-participants. We considered the following outcomes in our analysis: (a) cumulative high school GPA; (b) unexcused days absent; (c) attendance rate; (d) enrollment in Advanced Placement (AP) courses; (e) the total number of AP courses attempted; (f) enrollment in "honors" courses; (g) the total number of honors courses attempted; (h) ACT exam participation; (i) on-time high school graduation; and (j) matriculation into to a two- or four-year college in the year following high school graduation. Each measure of students' academic preparation for college corresponded with the end of their fourth year in high school, when most students were graduating seniors. To account for variation in grading practices across schools, we utilized a z-score transformation of student cumulative GPA. "On time" high school graduation indicated diploma or equivalency by the end of the spring semester of the fourth year in high school.

To investigate potential differences in college attendance between groups, we obtained student-level records from the National Student Clearinghouse (NSC) on matriculation to two- and four-year colleges or universities.[2] We categorized students as college entrants if NSC records showed enrollment at any postsecondary institution within five academic years from the student's first year in high school. Our data contained missing values for some variables; approximately 8 percent of the student observations in the analytic sample had missing values for covariates used in our analyses. We imputed missing values prior to analysis using multiple imputation (Allison, 2001; Rubin, 2004). We then calculated propensity scores for program participation within 10 samples and took the average of those scores to create the matched sample used for our estimates of differences in outcomes between students who participated in the program and the matched sample of those who did not participate (Mitra & Reiter, 2016).

For each outcome measure, we used weighted regressions adjusted for the number of matches associated with each observation to estimate the difference between AVID/TOPS and non-program participants. We used OLS models for continuous dependent variables and logistic models for binary dependent variables according to:

$$y_i = \alpha + \beta(AVID_i) + \gamma(X_i) + \delta(Z_i) + \varepsilon_i \quad (1)$$

where y_i is a student outcome, $AVID_i$ is a dummy variable of AVID/TOPS program participation, X_i is a vector of individual-level baseline academic performance covariates used in our propensity score model, Z_i is a vector of individual-level demographic characteristics used in our propensity score model, and ε_i is an error term. We also included dummy variables for the student's high school and cohort year to adjust for other

unobserved institutional or cohort factors that could bias our estimates. In the case of the OLS models, the resulting coefficient for the $AVID_i$ dummy indicates the estimated difference in an outcome between students who participated in the program and those who did not. For our logistic models, we calculated and reported the difference in predicted probabilities for an outcome by AVID/TOPS participation status (Ai & Norton, 2003). All models utilized cluster-robust standard errors to adjust for within-school error correlation (Cameron & Miller, 2015).

We were also interested in understanding the extent to which outcomes associated with AVID/TOPS differed across student subgroups. This was accomplished by introducing interaction terms into our initial regression models:

$$y_i = \alpha + \beta(AVID_i) + \gamma(X_i) + \delta(Z_i) + \theta(AVID_i \text{x } Z_i) + \varepsilon_i \quad (2)$$

where $AVID_i$x Z_i is a vector of interaction terms between the AVID/TOPS indicator and indicators for student demographic characteristics, including minority race/ethnicity, FRPL eligibility, and first-generation college status. We report estimates for each subgroup in our results.

We estimated the models represented by Equations 1 and 2 using our propensity-matched samples of AVID/TOPS participants and non-participants. Regression analysis after matching provided some additional insurance against residual bias due to confounding observable variables in case matching was less than perfect (Ho et al., 2007). For comparison, we also report non-covariate adjusted estimates with standard errors that are heteroskedasticity-consistent (Abadie & Imbens, 2006).

Cost analysis

Resource identification

We employed the "ingredients method" to identify the resources used to implement the AVID/TOPS program during the 2013–14 school year in MMSD's four comprehensive high schools.[3] The ingredients method entails enumerating and categorizing all of the personnel and non-personnel resources used by a program (Levin & McEwan, 2001). These resources reflect the actual – not budgeted – level of effort to implement the program. For instance, ingredients included the actual time spent by AVID elective teachers and TOPS coordinators, as well as other BGCDC and school personnel. We also identified the amounts and types of non-personnel resources used, including supplies and materials, program fees, and facilities.

Data

To identify the ingredients used to implement the AVID/TOPS program, we collected data from multiple sources, including: (a) documents such as program descriptions, school schedules, personnel rosters, and interagency agreements; (b) program budgets and expenditure summaries; and (c) site visits to schools and BGCDC, and interviews with key district, school, and program personnel. The process resulted in a detailed descriptive profile of the AVID/TOPS program and an inventory of the types and amounts of resources used by MMSD and BGCDC.

Analysis

We used cost templates to systematically categorize resources and estimate costs. Cost templates are analytic frameworks that itemize the ingredients used by educational programs, assign prices, and compute programmatic resource costs (Levin & McEwan, 2001; Rice, 1997, 2001). For this study, we adapted templates used in previous evaluations of educational programs (Kolbe & O'Reilly, 2016; Rice, 2001; Rice & Hall, 2008). Templates facilitated a systematic process for enumerating and categorizing resources according to a common framework and imposed standardized assumptions when developing cost estimates that supported "apples-to-apples" comparisons among sites.

Cost estimation

Program costs were estimated by assigning a dollar value to each ingredient (Chambers, 1999; Levin & McEwan, 2001). Market prices determined an ingredient's value. For instance, school personnel time was valued using district-wide average compensation (salary and benefits) for teachers and other instructional, student support, and administrative staff. Similarly, the time spent by volunteers who served as tutors and mentors was valued in terms of what they typically might be paid for that time (e.g., average wages for tutors). We used actual expenditures to value the cost of supplies and materials, program fees, and other non-personnel resources. Facilities costs were valued according to prevailing rates for renting space of similar size and quality in the Madison, Wisconsin metropolitan area. The sum of the value of the costs for all ingredients was the AVID/TOPS program's total cost. Taken together, the resulting cost estimates represent the cost – in local dollars – of a particular program ingredient for the 2013–14 school year.

Findings

Sample description

Baseline measures suggest that the AVID/TOPS program was successful in targeting students from disadvantaged social and economic backgrounds (Table 1). Compared to eligible students who did not participate in the program, AVID/TOPS participants were more than three times as likely to qualify for FRPL (68% vs. 19%). They also were less likely to be White (21% vs. 71%), and more likely to be Black (27% vs. 4%) or Hispanic (31% vs. 9%). A greater share of students participating in the AVID/TOPS program were ELL (41% vs. 14%) and came from families with potentially less exposure to and knowledge about college. Nearly half of AVID/TOPS program participants (43%) had parents with a high school education or less, compared to 20% of academically eligible students who did not participate in the program.

On average, AVID/TOPS participants began high school academically behind their peers. At the close of eighth grade, participants had significantly lower levels of achievement than non-participants.

Student outcomes

Table 4 presents effect size estimates (ES) for the mean differences in outcomes between students who participated in the AVID/TOPS program at any point during high school and a matched comparison group. Column 1 presents unadjusted estimates and Column 2 presents regression-adjusted estimates accounting for residual bias from potentially imperfect matching. We found no difference between groups in students' GPAs, unexcused days absent, or attendance rates. However, results suggest a positive and statistically significant relationship with the likelihood of attempting academically challenging coursework during high school. Program participation was associated with an increased likelihood of AP and honors course taking amounting to 18–19 percentage points on average, or about a third of a standard deviation. The program also appeared to have a small positive relationship with the total number of AP and honors courses taken, though these estimates were insignificant once cluster-robust regression adjustments were included. Program participants were significantly more likely than their matched peers to take the ACT test and to graduate high school within four years. They were also significantly more likely to enroll in a two- or four-year college the year following high school graduation. Estimates suggest that, on average, program participants enrolled in college at a rate 12–13 percentage points higher than their comparison group peers—translating into a standardized effect size of 0.21–0.27 standard deviations.

Table 4, Columns 3 and 4 report the effect sizes for the mean differences in outcomes between students who participated in the AVID/TOPS program for all four years of high school. Students who participated in AVID/TOPS were more likely to have a higher rate of attendance and take AP and honors courses than their matched nonparticipating peers (25 and 29 percentage points, respectively). Results also suggest that participating in the AVID/TOPS program for four years during high school was associated with higher levels of ACT test taking (about an 11 percentage point difference). Finally, four-year AVID/TOPS participants were also more likely to enter college than similar non-participants. The difference in college entry between the two groups amounted to nearly 21 percentage points, or half a standard deviation.

Differences in outcomes among student groups

Our estimates for differences in AVID/TOPS program outcomes between participating and nonparticipating students were somewhat larger for subgroups typically underrepresented in higher education (see Table 5). Our findings suggest that low-income students (i.e., FRPL eligible students) may particularly have derived benefits from the program relative to their non-program peers. This was true on average for students who participated at any point during high school, but especially for low-income students who participated for four years. Four years of participation among low-income students was associated with higher cumulative GPAs, about one-third of a standard deviation higher than the matched comparison group of their peers ($p < 0.05$). They were also more likely to take AP and honors courses at rates 32 and 28 percentage points higher than their non-program peers ($p < 0.001$). Similarly, they participated in the ACT test at a rate 14 percentage points higher than the matched comparison sample and graduated high school on time at a rate 8 percentage points higher than this group (Table 5). Perhaps most notably, low-income

Table 4. Estimated effect sizes for mean differences in outcomes, by program exposure.

	Any exposure						Full explosure (4 years)					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	(1)			(2)			(3)			(4)		
Outcome	Comp. Mean	Effect	ES	Comp. mean	Effect	ES	Comp. Mean	Effect	ES	Comp. mean	Effect	ES
College readiness												
Cumulative GPA (Z-score)	−0.355	0.030	0.03	−0.358	0.036	0.05	−0.288	0.219 **	0.28	−0.271	0.184 +	0.26
		(0.058)			(0.028)			(0.066)			(0.047)	
Unexcused days absent	7.500	−0.828	−0.05	7.565	−0.957	−0.08	7.595	−2.415 *	−0.17	7.380	−1.986	−0.15
		(0.948)			(0.854)			(1.158)			(0.764)	
Attendance rate	90.343	0.340	0.03	90.286	0.454	0.05	90.238	1.719 +	0.14	90.378	1.439 +	0.15
		(0.723)			(0.640)			(0.996)			(0.487)	
Took any AP classes	0.343	0.192 ***	0.34	0.362	0.187 *	0.32	0.355	0.300 ***	0.57	0.359	0.288 ***	0.60
		(0.034)			(0.041)			(0.044)			(0.037)	
Total AP classes	1.396	0.462 **	0.17	1.400	0.452	0.17	1.395	0.995 ***	0.38	1.436	0.913	0.35
		(0.161)			(0.197)			(0.219)			(0.504)	
Took any honors classes	0.398	0.187 ***	0.32	0.424	0.179 ***	0.31	0.448	0.251 ***	0.48	0.449	0.248 ***	0.54
		(0.035)			(0.023)			(0.044)			(0.037)	
Total honors classes	2.015	0.912 ***	0.25	2.031	0.880	0.24	2.297	1.429 ***	0.38	2.341	1.343	0.36
		(0.219)			(0.473)			(0.313)			(0.516)	
Took the ACT	0.865	0.052 *	0.14	0.868	0.063 ***	0.18	0.868	0.114 ***	0.42	0.874	0.105 **	0.37
		(0.022)			(0.015)			(0.023)			(0.012)	
Graduated high school on time	0.897	0.039 +	0.11	0.902	0.043 +	0.15	0.911	0.062 **	0.23	0.911	0.063 +	0.25
		(0.022)			(0.025)			(0.023)			(0.028)	
Attended any college	0.612	0.117 ***	0.21	0.630	0.125 **	0.27	0.614	0.224 ***	0.48	0.621	0.213 ***	0.48
		(0.034)			(0.044)			(0.039)			(0.043)	
Sample size	641	484		641	484		406	225		406	225	

Table 5. Estimated effect sizes for mean differences in outcomes, by subgroup and program exposure.

	White		Minority		Low-Income		First Generation	
Outcome	Any Exposure Diff.	Full Exposure Diff.	Any Exposure Diff.	Full Exposure Diff.	Any Exposure Diff.	Full Exposure Diff.	Any Exposure Diff.	Full Exposure Diff.
College Readiness								
Cumulative GPA (z-score)	−0.160	0.149 *	0.086	0.190 *	0.210 **	0.285 *	0.149	0.340
	(0.095)	(0.030)	(0.047)	(0.050)	(0.011)	(0.066)	(0.068)	(0.134)
Unexcused Days Absent	0.196	−2.311	−1.306	−1.943	−1.380	−2.788 +	−2.230	−2.866
	(1.698)	(1.600)	(0.699)	(0.811)	(1.397)	(0.685)	(1.943)	(1.970)
Attendance Rate	−0.403	1.633	0.717	1.456	0.848	2.161 *	1.469	2.224
	(1.135)	(0.832)	(0.502)	(0.526)	(0.921)	(0.324)	(1.160)	(1.243)
Took any AP Classes	0.125	0.322 ***	0.206 ***	0.290 ***	0.220 ***	0.318 ***	0.240 ***	0.307 ***
	(0.079)	(0.025)	(0.023)	(0.045)	(0.019)	(0.043)	(0.028)	(0.063)
Total AP Classes	0.176	1.112	0.543	0.889	0.632	1.121	0.443	0.748
	(0.414)	(0.461)	(0.281)	(0.579)	(0.287)	(0.621)	(0.277)	(0.576)
Took any Honors Classes	0.125 *	0.245 ***	0.192 ***	0.248 ***	0.209 ***	0.277 ***	0.220 ***	0.362 ***
	(0.056)	(0.034)	(0.027)	(0.043)	(0.031)	(0.021)	(0.050)	(0.048)
Total Honors Classes	−0.057	0.790 +	1.139	1.479	1.137 +	1.544 +	1.268	1.905 *
	(0.270)	(0.140)	(0.519)	(0.671)	(0.358)	(0.414)	(0.453)	(0.341)
Took the ACT	0.121 **	0.176 +	0.056 ***	0.093 *	0.066 ***	0.144 ***	0.071 ***	0.164 ***
	(0.041)	(0.051)	(0.011)	(0.014)	(0.015)	(0.018)	(0.008)	(0.025)
Graduated High School On Time	0.016	0.072	0.050	0.054	0.069 *	0.080 **	0.079 *	0.105 +
	(0.040)	(0.040)	(0.035)	(0.037)	(0.031)	(0.031)	(0.032)	(0.045)
Attended Any College	0.075 +	0.291 ***	0.134 **	0.193 ***	0.173 ***	0.241 ***	0.172 ***	0.276 ***
	(0.041)	(0.063)	(0.042)	(0.036)	(0.038)	(0.041)	(0.041)	(0.062)
Sample Size	102	47	382	178	327	151	220	91

Notes: $^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. Cluster robust standard errors in parentheses. Full exposure students in AVID/TOPS program for four years in high school. Sample sizes are for AVID/TOPS subgroups. Effect estimates are covariate-adjusted. Underrepresented minority includes African American, Hispanic, Southeast Asian, Native American, Middle Eastern, Pacific Islander, and multiracial categories.

Table 6. Total and per pupil costs (2013–14 school year).

	Total cost (1)	Program participants[a] (2)	Per participant[b] (3)	4-year cost (4)	4-year cost (present value)[c] (5)
Total	$2,977,770	689	$4,440	$17,770	$16,990
Site C	$431,540	84	$5,140	$20,550	$19,660
Site D	$599,240	146	$4,100	$16,420	$15,700
Site B	$945,370	210	$4,500	$18,010	$17,220
Site A	$1,001,620	249	$4,020	$16,090	$15,390

Note: Sites are sorted according to Total Cost.
[a]Total number of program participants includes all MMSD students who were enrolled in AVID/TOPS during the 2013–14 school year.
[b]Overall per participant cost is a weighted average of per participant costs among the four school sites.
[c]Costs in present value at high school graduation and assume four years of program participation, using 3% discount rate. Dollars are 2013 and rounded to nearest 10.

students who enrolled in AVID/TOPS for four years entered college at a rate 24 percentage points higher than the matched sample of peers who did not participate in the program ($p < 0.001$).

Similar to low-income students, we also found differences in outcomes between AVID/TOPS first-generation students and their comparison group peers. Participating in the program at any time in high school was associated with an increased probability of first-generation students taking honors and AP courses (24 percentage point difference; $p < 0.001$) (Table 5). First generation students with program exposure also were more likely to transition to college following high school graduation (17 percentage points). That said, the difference in outcomes was largest for first generation college students who participated in the AVID/TOPS program for all four years. First-generation students with four years of participation were about 31 percentage points more likely than their non-program peers to take at least one AP course, and 36 points more likely to have taken an honors class in high school ($p < 0.001$). They were also 16 percentage points more likely to take the ACT exam ($p < 0.001$) and 11 percentage points more likely to graduate high school on time ($p < 0.10$). Finally, participating in the program for four years was associated with a 28-point increase in the likelihood of attending college among first-generation students ($p < 0.001$).

Finally, we found differences in outcomes for minority and White students who participated in the AVID/TOPS program. On average, participating in AVID/TOPS at any point during high school was associated with a 19-percentage point increase in the likelihood of honors course taking for minority students, versus a 13-point increase in the likelihood for White students (Table 5). While the discrepancy between minority and White students was non-existent for those students who participated in AVID/TOPS for four years, both groups increased participation in honors course taking by approximately 25 points over non-participants. Minority students who participated in the program at any point during high school were also more likely to have taken AP courses (21 points more than nonparticipating minority students) and the likelihood of AP course taking increased for both minority and White students who participated for all four years (29 and 32 points, respectively). Additionally, the likelihood of taking the ACT increased for four-year program participants for both White and minority students (18 percentage points for White students and 9 percentage points for minority students).

Further, our findings also suggest that AVID/TOPS program participation was associated with an increased likelihood that students attended college (2- or 4-year) during the fall semester following graduation. Minority and White students with any program participation matriculated to college at higher rates than non-participants (13 vs. 8 points). Further, minority students who participated in the program at any point in their high school career attended college at a rate 13 percentage points higher than their matched comparison peers and those who participated for each of four years during high school attended at a rate of 19 percentage points higher than their peers. White students who participated in the AVID/TOPS program had similar experiences, with those who participated at any point during high school matriculating to college at a rate 7 percentage points higher than the matched comparison sample and 29 percentage points higher for those who participated all four years during high school.

Program costs

The total annual cost (both MMSD and BGCDC) to operate the AVID/TOPS program during the 2013–14 school year was slightly less than $3.0 million for 689 participants in grades 9–12 (Table 6). This corresponds to a per participant cost of about $4,440. Approximately 85% of the per pupil costs were associated with AVID-specific programming, with the remaining 15% of costs attributable to TOPS-specific program activities (Kolbe & Feldman, 2016).

Per participant costs differed among the District's four high schools, ranging from $4,020 to $5,140. Differences were at least partly related to the number of program participants at a school site. This is not entirely surprising given the standardization of resources across school sites (e.g., the district allocated the same number of full-time equivalent staff for program administration and oversight to each school site) and other fixed costs associated with operating the AVID program (e.g., annual program fees and certification requirements). However, not all of the variation among sites can be explained by differences in program size. Schools dedicated different resource packages to program implementation in their schools. For instance, schools adopted different models for program administration, drawing more and less on school principals' time; included different types and numbers of faculty on AVID oversight committees and assigned teams with different levels of involvement in student monitoring; and incorporated to varying extents school guidance counselors' time in college readiness activities. Accordingly, the site-specific estimates provide insights into possible lower- and upper-bound estimates around the district-wide average for per participant costs.

Table 6, Columns 4–5 provide the cost per participant in the program for each of the four years of high school. Column 4 shows the 4-year cost and Column 5 presents the four-year cost adjusted to present values that account for multiple years of program participation. On average, the total cost per student who participated in the program all four years of high school was $16,990 (present value) after four years of high school. As was the case with annual per participant costs, the four-year cost varied across sites, ranging from $15,390 to $19,660. Similarly, these values illustrate the potential range of

Table 7. Comparison of costs and outcomes, overall and by student subgroups.

	Total 4-year program participants[a] (1)	% Gain[b] (2)	Yield per outcome (3)	Cost per outcome[c] (4)	Extra graduates per $100k (5)	Comparison to lifetime earning differentials for college degree (vs. high school diploma) 4-year degree (@$444,000) (6)	Some college (@$185,000) (7)
On-time High School Graduation							
All Students	225	6.3%	14	$271,492	0.37		
White	47	1.6%	1	$1,061,875	0.09		
Underrepresented minorities[d]	178	5.0%	9	$339,800	0.29		
Low income	151	8.0%	12	$212,412	0.47		
First generation	91	10.5%	10	$162,362	0.62		
Enrolled in 2- or 4-Year College							
All Students	225	21.3%	48	$79,601	1.26	$364,399	$105,399
White	47	29.1%	14	$58,385	1.71	$385,615	$126,615
Underrepresented minorities[d]	178	19.3%	34	$88,031	1.14	$355,969	$96,969
Low income	151	24.1%	36	$70,446	1.42	$373,554	$114,554
First generation	91	27.6%	25	$61,510	1.63	$382,490	$123,490

[a]Pooled cohorts of students (2013–15) who participated in MMSD's AVID/TOPS program for four years of high school.
[b]Percent gains for all students correspond with estimated treatment effects for students with full program exposure (Table 5).
[c]Assumes a standard 4-year cost of $16,990 (present value) per student (Table 6).
[d]Underrepresented minority includes African American, Hispanic, Southeast Asian, Native American, Middle Eastern, Pacific Islander, and multiracial categories.

costs associated with a student participating in the program all four years of high school.

Comparing costs and benefits

To compare program costs and student outcomes, we merged the four-year cost estimates with our findings describing program gains for on-time high school graduation and college enrollment among students who participated in the AVID/TOPS program for four years during high school.[4] This comparison approximates a ratio of program costs and effects, providing a "cost effectiveness" ratio. Table 7, Column 2 reports the percentage differences in outcomes between students who participated in AVID/TOPS for four years during high school and their matched comparison counterparts. This provides an estimate of the approximate number of additional high school graduates or college enrollees potentially attributable to the AVID/TOPS program, above and beyond the number expected without the program (Column 3). The cost per extra graduate or enrollee is the metric used as the cost effectiveness ratio (Column 4).

AVID/TOPS' cost-effectiveness varied across outcomes and among student subgroups. The program's pooled ratio for on-time high school graduation was $271,492 per extra graduate, whereas it was about $79,601 per additional college enrollee. That the program was comparatively less cost effective for producing high school graduates is not unexpected. The program aims to boost college attendance of students in the

"academic middle" – not necessarily those most at risk of not completing high school. That said, it is noteworthy that program implementation was associated with approximately 14 additional on time high school graduates that may not have been otherwise expected, with larger potential gains among low-income and first-generation students. Differences in gains are reflected in relatively lower costs per additional high school graduate for student subgroups, compared to the overall cost per graduate. For instance, the cost per additional on-time high school graduate for low-income students was $162,362 and $212,412 for first generation students.

We found fewer differences among student subgroups in the program's cost effectiveness in producing additional college enrollees. The cost per additional college enrollee was similar for low-income and underrepresented minority students ($70,446 and $88,031, respectively) and slightly less for first generation and White students ($61,510 and $58,385, respectively). Across groups, this translates into a yield of approximately 1.26 additional college enrollees per $100,000 in resources invested in the program.

To put these findings in context, we compared the average lifetime discounted earnings of individuals with a four-year college degree to the program's costs per additional college enrollee. This comparison considered the benefits associated with the well-documented earnings advantage for students who have college experience relative to those with only a high school diploma or equivalent. Barrow and Malamud (2015) estimated the returns to a four-year degree to be approximately $444,000 for men (present value at age 18, net college tuition) over those of a high school graduate.[5] The individual returns to a four-year college degree exceeded cost per additional college enrollee associated with the AVID/TOPS program; ranging from $355,969-$385,615 per participant. While these findings suggest that the program's benefits to students exceeded program costs, it is important to consider that not all students who enroll in college complete a four-year degree. In fact, about half of students who start college do not finish a degree within six years of starting (Shapiro et al., 2015). Barrow and Malamud (2015) estimated the individual returns to "some college" are approximately half that as those for a four-year degree – about $185,000 for men. Even with this more restrictive assumption for expected benefits, the lifetime earnings gain per college enrollee exceeds the program's cost per additional college enrollee, overall and for student subgroups. The magnitude of the benefit, however, is considerably smaller – ranging between $96,969 (underrepresented minorities) and $123,490 for first generation and $126,615 White students. Overall, we found that the AVID/TOPS program's benefits were greater than costs, even if all students matriculating to college do not complete a two- or four-year degree.

Limitations

The study's findings should be considered in light of several limitations. AVID/TOPS is an enhanced AVID model and, while MMSD seeks to implement the AVID program component with fidelity, findings may not be generalizable to other schools implementing AVID as a standalone program. At MMSD, the AVID and TOPS programs are tightly integrated, and it is impossible to differentiate the potential influence of one program versus the other. That said, it is worth noting, however, that while integral to

the program, the TOPS program represents a small share of the resources invested in student success (about 15%).

The study's findings also are specific to the MMSD context. As is the case with most college access models like AVID, local school districts may refine the models to reflect local context and circumstances. The findings from our cost study, in particular, provide some indication of the differences in how the District's four high schools approached implementing the AVID/TOPS program. This suggests that rather than interpreting the study's findings as explicitly generalizable to how the program might be implemented elsewhere, the findings should be thought of as adding to the growing body of knowledge about how the AVID program is implemented in practice and the relationship between implementation approaches and student outcomes, resources, and costs. In doing so, other states, districts and schools may use the findings as guideposts for their own decision making – both in terms of whether and how to implement AVID and AVID-like programs.

That said, when considering the outcome estimates for the AVID/TOPS' participants presented in this study, it is important to recognize the potential for bias in these estimates. While PSM improved comparisons between AVID/TOPS participants and non-participants, like all non-experimental designs it is subject to internal validity threats and generates non-causal estimates of program impacts. Rather, findings can be considered descriptive differences in outcomes between the two groups. Matching can only be accomplished using observable characteristics of participants and non-participants. However, it may be the case that other unobserved factors, such as student aspirations and expectations for attending college, could bias estimates if levels systematically differed between propensity-matched groups. We were unable to directly control for such characteristics in our estimates, and as a result, we cannot rule out the possibility of selection bias.

That said, several factors boost our confidence in the validity of our estimates. Our pool of students – for both the matched and unmatched samples – includes only those who met MMSD's academic eligibility criteria. This step eliminates potential matches who, at the outset, could not qualify for the program. MMSD does not keep records of unsuccessful applicants, so we were unable to restrict our comparison pool to students who applied but were rejected. However, because 60–70% of program applicants are rejected in a given year, the comparison group includes a sizeable number of rejected applicants in addition to eligible non-applicants. Additionally, in our propensity score calculations we included indicators for observable student and family attributes such as parent education and family economic constraints that are known to be associated with students' academic performance, educational aspirations, and outcomes (Choy, 2001; Hossler, Schmidt, & Vesper, 1999; Hossler & Stage, 1992; Mau & Bikos, 2000). In doing so, we at least partially control for known confounding unobserved variables in our matching strategy. Finally, we conducted post hoc sensitivity tests to examine the implications of possible omitted variable bias (Appendix 3). These tests indicate some sensitivity to omitted variable bias in our estimates of any program participation. However, to nullify our results, omitted variables would have to make a full exposure student nearly 2.5 times more likely to participate in the program, net of all the other factors we included in our matching model.

Discussion

The study's findings suggest that AVID/TOPS is a promising program for promoting high school completion and college attendance, particularly for student groups traditionally underrepresented in higher education. Among participating students – even those who enrolled for less than four years – there were meaningful differences in their high school experience; AVID/TOPS students were more likely to meet or exceed benchmarks for academic progress thought to be predictors for college and career readiness, including participate in AP and honors-level courses and ACT test taking. There also were differences in GPA between students who participated in the program for all four years and the comparison group of non-participants.

Most notably, AVID/TOPS students were more likely to attend college immediately after high school than their peers who did not participate in the program – about 13 percentage points higher for students who participated in the program at any point during high school, and 21 percentage points for students who participated for all four years. These matriculation rates are higher than those found by Harvill, Maynard, Nguyen, Robertson-Kraft, and Tognatta (2012) in their meta-analysis of college readiness programs. Overall rates, however, mask differences across student subgroups. Minority, low-income, and first generation college students with any exposure to the AVID/TOPS program enrolled in college at rates 14–17 percentage points higher than peers who did not participate in the program. The difference was even larger for students who participated for four years; there was a 24- and 28-point difference for low-income and first generation students, respectively.

At the same time, we also found that AVID/TOPS is a resource-intensive program that required sustained investments. Together, MMSD and BGCDC dedicated considerable human resources to implement the program. For instance, schools reallocated classroom teacher and other instructional personnel time to the program and the districts' central office employed dedicated staff to coordinate program activities, community partnerships, and ongoing professional development. BGCDC provided additional instructional support personnel who worked in the schools, as well as operating its own mentoring, internship, and college-transition support programing. The value of these resources translated to an average annual cost per student of about $4,400. To put these costs in perspective, that same year, MMSD's average per pupil spending was $12,572 ("Mapping Spending Per Student", 2016) – suggesting that the annual per pupil cost for an AVID/TOPS student was about one-third more than what was spent for the typical nonparticipating student.

A key question for decision makers, however, is to what extent were investments in the AVID/TOPS program productive? Calibrating the program's benefits in terms of average additional lifetime income for college vs. non-college graduates, we found that benefits outweighed the costs. In other words, there was a positive return to the resources invested by MMSD and BGCDC in the AVID/TOPS program. Our findings are consistent with the positive returns to investment effort for the Talent Search TRIO program, an alternative college-access program (Bowden & Belfield, 2015). However, this study provides new evidence that the ratio of costs and benefits differs among student subgroups; returns were highest for minority and low-income students. This

finding suggests that implementing similar programs may find different returns to investment depending on the demographic characteristics of their student population.

Implications

The study's findings have several implications for how policymakers and educators might think about implementing college-access programs.

First, the study reaffirms that AVID and AVID-like programs are a promising policy direction for improving college matriculation rates for student groups underrepresented in higher education. The package of instructional strategies, academic supports, extracurricular opportunities, and mentoring embedded in the AVID/TOPS program worked together to orient and prepare minority, low-income and first generation students for college.

While we see the program as holding promise for alternate locations, replication efforts should carefully consider the capacity of schools and communities to provide the resources necessary for implementation. Replicating the AVID/TOPS program elsewhere relies on assumptions that similar resources are available or that similar resources could be purchased. By understanding the tangible resources used to implement a program such as AVID/TOPS, this study provides a fundamental building block for program replication. Additionally, the partnership between MMSD and BGCDC offers one potential model for leveraging community support and resources to assist schools with implementing similar programs. However, where similar partnerships are unavailable, the burden of providing the necessary resources will fall to districts and schools.

The study's findings also suggest a related consideration – if college access programs are impactful, then why limit the programs, practices and resources embedded in these efforts to small groups of students and, instead, make them more generally available to all students? Certainly, other AVID and AVID-like programs are available and have been implemented as school-wide initiatives. Given this study's findings on potential program cost as well as differences in returns to investment across student groups, decision makers will need to carefully consider where expanding student participation is the most productive use of limited education dollars. Universal student participation may be most beneficial in schools with higher concentrations of non-White, low-income and first generation students.

This study also has implications for future research and evaluation. More research on the resources, and corresponding costs, to implement college access programs is needed. This evaluation joins a very limited number of studies that include estimates of program cost and returns to investment in college access programs. Yet, this information is essential for deciding both program selection and program feasibility, particularly given existing resource constraints in education. The "resource recipe" derived from the ingredients method, provides a starting point for considering whether and how a program might be replicated.

Additionally, like many school-based interventions, there is a need to incorporate stronger methods capable of quantifying program impact. One challenge facing evaluations of college access programs, including this one, is the inability to randomly assign students to treatment and intervention groups. Instead, the bulk of existing research relies upon approaches that describe student outcomes, thus falling short of managing to equivocally

determine whether programs like AVID/TOPS were "successful." Going forward, we suggest that where programs have large pools of applicants for a limited number of slots, considering strategies that support strong experimental designs would be worthwhile.

For evaluating program impact, more research is also needed on the relative contributions program components have for student outcomes. This study suggests that the resources required to implement comprehensive college access programs, particularly at scale, may be substantial. Thus, determining the effectiveness of specific program components as well as programs in their entirety may provide new information that helps policymakers and educators target interventions in ways that reduce program costs while maximizing student outcomes.

Notes

1. For space considerations, we do not report these figures in this paper, but they are available upon request.
2. All public colleges and universities in Wisconsin participate in the NSC. However, NSC coverage is more limited among private, for-profit, four-year institutions in the state (85%) and private, for-profit two-year institutions (21%) (NSCRC, 2016). Accordingly, our postsecondary enrollment rates are likely conservative. Nevertheless, we found no evidence that AVID/TOPS program participants were more, or less, likely than their non-program counterparts to attend private, for-profit institutions that participate in the NSC. This gives us greater confidence in our estimates of average postsecondary enrollment effects.
3. We identified resources that were used to implement the AVID/TOPS program and did not enumerate resources for other educational or student support activities in place at MMSD or BGCDC.
4. We combine our estimates for differences in student outcomes between AVID/TOPS participants and our matched sample comparison groups. The resulting ratio cannot be readily interpreted as a measure of the program's cost-effectiveness; instead, we focus our discussion on the dollar cost per observed outcome.
5. Assessment of the lifetime value of a college degree does not include the value of other non-pecuniary benefits such is improvements to health, marriage, and child outcomes as well as consumption. Nor does it include the value of pecuniary and non-pecuniary benefits to society. As such, comparisons might be considered conservative.

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Appendix 1

Year-to-year enrollment and retention

Table A. Year-to-year AVID/TOPS enrollment and retention.

		Year in School			
	Total	Year 1	Year 2	Year 3	Year 4
Full sample	484	405	381	354	290
Entering students		–	(61)	(25)	(2)
Year-to-year retention rate		–	79%	86%	81%
Male	222	190	170	155	127
Entering students		–	(24)	(9)	(1)
Year-to-year retention rate		–	77%	86%	81%
Female	262	215	211	199	163
Entering students		–	(37)	(16)	(1)
Year-to-year retention rate		–	81%	87%	81%
Minority	382	316	298	283	234
Entering students		–	(49)	(23)	(1)
Year-to-year retention rate		–	79%	87%	82%
White	102	89	83	71	56
Entering students		–	(12)	(2)	(1)
Year-to-year retention rate		–	80%	83%	77%
Low Income	327	273	251	238	199
Entering students		–	(40)	(19)	(2)
Year-to-year retention rate		–	77%	87%	83%
Non-low income	157	132	130	116	91
Entering students		–	(21)	(6)	(0)
Year-to-year retention rate		–	83%	85%	78%

Note: Represents propensity score matched analysis sample (n = 484). Parentheses indicate number of students entering AVID/TOPS who were not enrolled the prior year.

Appendix 2

Total years participating in program

		Years in AVID/TOPS			
	Total	1 Year	2 Years	3 Years	4 Years
Full sample	484	85	77	97	225
Percent of total		18%	16%	20%	46%
Male	222	48	31	40	103
Percent of total		22%	14%	18%	46%
Female	262	37	46	57	122
Percent of total		14%	18%	22%	47%
Minority	382	66	61	77	178
Percent of total		17%	16%	20%	47%
White	102	19	16	20	47
Percent of total		19%	16%	20%	46%
Low income	327	60	52	63	152
Percent of total		18%	16%	19%	46%
Non-low income	157	25	25	34	73
Percent of total		16%	16%	22%	46%

Note: Represents propensity score matched analysis sample (n = 484).

Appendix 3

Upper bounds on one-sided significance levels testing no effect

Any Exposure					
	$\Gamma = 1$	$\Gamma = 1.25$	$\Gamma = 1.5$	$\Gamma = 1.75$	$\Gamma = 2$
Cumulative GPA (z-score)	0.220	0.889	0.998	1.000	1.000
Unexcused days absent	0.998	1.000	1.000	1.000	1.000
Attendance rate	0.234	0.993	1.000	1.000	1.000
Took any AP courses	0.000	0.000	0.000	0.012	0.139
Total AP courses	0.000	0.025	0.274	0.707	0.938
Took any honors courses	0.000	0.000	0.000	0.018	0.183
Total honors courses	0.000	0.001	0.031	0.238	0.611
Took the ACT	0.000	0.022	0.193	0.541	0.828
Graduated high school on time	0.002	0.055	0.288	0.624	0.860
Attended any college	0.000	0.002	0.100	0.534	0.897
Full exposure	$\Gamma = 1$	$\Gamma = 1.5$	$\Gamma = 2$	$\Gamma = 2.5$	$\Gamma = 3$
Cumulative GPA (z-score)	0.000	0.035	0.431	0.862	0.983
Unexcused days absent	0.920	1.000	1.000	1.000	1.000
Attendance rate	0.004	0.320	0.856	0.988	0.999
Took any AP courses	0.000	0.000	0.002	0.054	0.279
Total AP courses	0.000	0.007	0.171	0.576	0.870
Took any honors courses	0.000	0.000	0.015	0.195	0.580
Total honors courses	0.000	0.002	0.085	0.406	0.753
Took the ACT	0.000	0.000	0.000	0.000	0.002
Graduated high school on time	0.000	0.004	0.043	0.160	0.339
Attended any college	0.000	0.000	0.003	0.069	0.310

Notes: Sensitivity analysis based on permutational t-test of ATT (Rosenbaum, 2007; 2013). Numbers represent upper bound p-values at designated values of gamma.