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Dr. Maria Montessori developed the Montessori model over 100 years ago and, in the past 20 years, the model has rapidly expanded into the public sector. The necessary components for authentic Montessori include multiage groupings that foster peer learning, uninterrupted blocks of work time, and guided choice of work (Lillard, 2016). In addition, specific hands-on Montessori learning materials are carefully arranged, no extrinsic rewards are offered or grades assigned, and children are encouraged to explore personal interests while widely engaging with others (Lillard, 2016).

Given the increase in public Montessori programs, it is important to consider who participates in these programs. The history of Montessori in America is intertwined with questions of race and class (Debs, 2019). Previous research on who participates in public Montessori indicates that students of color and those from families with lower incomes are often underrepresented (Culclasure et al., 2018; Debs & Brown, 2017). Our study will expand on previous work on this question by examining Montessori participation patterns across state contexts. This question of who participates in public Montessori has very important implications for the role that Montessori education may have in decreasing or increasing educational inequalities.

The fit of Montessori education in the public sector may seem precarious. Montessori brings a unique approach to education that is often in stark contrast to traditional public schooling and has been associated with enhanced student outcomes (Ansari & Winsler 2014; Brown and Lewis 2017; Byun, Blair, and Pate 2013; Culclasure, Fleming, and Riga 2018; Dohrmann et al. 2007; Hanson 2009; Lillard 2012; Lillard and Else-Quest 2006; Lillard et al. 2017; and Peng and Md-Yunus 2014). These results and Montessori's popularity in the private sector has made Montessori a popular approach for public schools of choice. However, there are components of Montessori education that do not fit neatly into the standards and accountability movement that has permeated public schooling in the United States. Of paramount importance is the role of standardized testing. In many ways, standardized testing is antithetical to Montessori. However, as public schools, public Montessori programs must follow state testing requirements. This may mean that Montessori students exhibit less academic growth as measured by standardized tests. We augment our outcome analysis by also considering attendance and student behavior outcomes, which are more closely aligned with the Montessori model than standardized test scores.

## **OBJECTIVES**

As Montessori education has expanded in the public sector over the past two decades, it is important to consider the impacts this form of education has on student learning and wellbeing. This study examines who participates in public Montessori and the relationship between participation in these programs and student outcomes. We investigate this topic by pooling student-level data from three states across a four-year time period (2016-2019).

Three research questions are examined:

1. Who participates in public Montessori?
2. What is the relationship between public Montessori attendance and student outcomes?
3. Does the relationship between Montessori participation and student outcomes differ by subgroup?

## **DATA & METHODS**

This study relies on student-level databases of public school students in three states, from 2015-16 to 2018-19. The research team identified students who attended a public Montessori school or participated in public "schools-within-a-school" programs. We then compared Montessori students to other public school students in the same district based on race, parental income, gender, ESL status, and disability status.

Given that data on lotteries in oversubscribed schools were not available, we employed an observational, matching technique to examine the relationship between Montessori participation and student outcomes. We used a method called exact matching,

which is an approach used in other education evaluations when a randomized control trial is not possible (e.g., Ash et al., 2021; Center for Research on Education Outcomes (CREDO), 2013). For each Montessori student, we limited the possible matches to non-Montessori public school (NMPS) students who attended a school in the same school district. After identifying NMPS students in the same district as the Montessori student, we exact matched on grade, gender, race, poverty, ESL, and special education.

For the test score analysis, we then examined baseline test scores standardized by subject, year, and grade. Students were matched separately for the math and ELA analyses using the respective baseline test score (t-1). Given that it would be difficult to find sufficient matches if students were exact matched on baseline test scores, we used a different approach, which is consistent with coarsened exact matching. We selected the NMPS student with the closest test score to the Montessori student, as long as it was within 0.10 standard deviations. We used a similar matching procedure for attendance and student behavior. The inclusion of a baseline measure of the dependent variable in the matching process, especially in conjunction with matching with school districts, can significantly reduce bias (Bifulco, 2012; Fortson et al., 2012). This matching procedure produced two groups of Montessori students and NMPS students who were virtually identical on the observable characteristics.

Once the matched samples were constructed, we then estimated pooled OLS and logistic regressions. An advantage of this approach is that it is doubly robust, meaning that if either the matching process or the regression model is correct, then the causal estimates will be consistent (Ho et al., 2007). Both of the procedures do not have to be correctly specified to get consistent estimates.

## RESULTS

We present the results for one state in the analysis below as we are currently analyzing data from the two other states. Those results will be included in future drafts of this paper.

We first examined what types of students enroll in public Montessori programs. This analysis includes eight different public Montessori programs in the respective state. All eight are charter schools. As seen in **Table 1**, enrollment in public Montessori programs included in this analysis increased over the time of this study to over 4,000 students. A key issue regarding public Montessori programs is how they may affect education inequalities. Of primary importance is who participates in Montessori programs. This state has a choice-rich environment with numerous charter schools, “specialty” schools, inter-and intra-district school choice, and an established voucher program. Previous research indicates that different types of students may be more likely to participate in public Montessori than are other students (Debs & Brown, 2017).

**Table 1: Public Montessori Enrollment**

	Montessori Enrollment
<i>2015-2016</i>	3,841
<i>2016-2017</i>	3,947
<i>2017-2018</i>	4,110
<i>2018-2019</i>	4,020

To examine this question, we performed bivariate t-tests comparing the 2018-19 demographics of public Montessori students to non-Montessori public school students. Examining results in **Table 2**, one can quickly see the racial differences between the groups. While Black students make up 53% of the non-Montessori population, only 34% of public Montessori students are Black. Hispanic students are also underrepresented in Montessori programs, but not to the same extent that Black students are. White students, on the other hand, account for 36% of the Montessori student population, but only 9% of non-Montessori student enrollment. These differences are statistically significant. One also sees that public Montessori students are more economically advantaged than other students in the district. This is consistent with previous research (Culclasure et al., 2018; Debs & Brown, 2017). Special education and ESL students also are underrepresented in Montessori programs. The stark demographic differences between public Montessori students and other public school students highlight the need for statistical adjustments. A simple analysis would not be an apples-to-apples comparison.

We next present results from the multivariate analyses using the matched comparison samples. Pooling the three years of data, we find that Montessori students exhibited higher levels of ELA growth (coef: 0.03, s.e.: 0.02), but this difference was not statistically significant. Looking at Math, we find that Montessori students experienced lower growth than matched NMPS students,

although it was not statistically significant (coef: -0.02, s.e.: 0.03). We examined two outcomes for attendance: the average daily attendance rate and chronic absenteeism (student missed more than 10% of days enrolled). Unlike the test score analyses which only included students in grades 3-8, this analysis includes all grades. When comparing the matched samples and controlling for student demographics and the previous year’s attendance rate, we find that Montessori students were less likely to be chronically absent (coef: -0.18, s.e.: 0.09), and this was significant at  $p > 0.10$ . There was no significant difference in attendance rate (coef.: 0.01, s.e.: 0.01). Finally, we examined the change in the number of discipline incidents. We found that Montessori students had fewer disciplinary incidents (coef: -0.02, s.e.: 0.01), controlling for student demographics and the number of incidents by the student in the previous year. This was statistically significant at  $p > 0.10$ .

**Table 2: Montessori Participants: Demographics - 2018-19**

	Montessori Mean	Non-Montessori Mean	Difference	S.E. of Diff.
Black	0.34	0.53	-0.19***	0.01
Hispanic	0.21	0.28	-0.07***	0.01
White	0.36	0.09	0.27***	0.00
Other Race	0.07	0.04	0.03***	0.00
Low Income	0.50	0.83	-0.33***	0.01
Female	0.50	0.48	0.02**	0.01
Special Ed.	0.17	0.21	-0.05***	0.01
ESL	0.05	0.12	-0.07***	0.01

We also completed a large number of subgroup analyses. A summary of a selection of these results is presented in **Table 3**. Given the large number of comparisons, here we simply note the direction of the relationship between Montessori participation and the outcome for those differences that are statistically significant at  $p > 0.10$ . According to Table 3, White Montessori students exhibited greater ELA growth than did white NMPS students. Asian Montessori students scored higher than Asian NMPS students in both ELA and Math. Black Montessori students had higher attendance rates and were less likely to be chronically absent when compared to Black NMPS. Low-income Montessori students, female Montessori students, and male Montessori students had lower chronic absentee rates than their matched NMPS counterparts. Finally, Montessori students who were Hispanic, in the other race category, non-low-income, or male had statistically significantly fewer discipline incidents than NMPS students with similar demographics.

**Table 3: Summary of Montessori Relationship with Outcomes – Subgroup Analyses**

	ELA	Math	Attendance %	Chronic Absentee	# of Disciplinary Incidents
Black			+	-	
White	+				
Hispanic					-
Asian	+	+			
Other Race					-
Low-Income				-	
Non-Low-Income					-
Female				-	
Male				-	-

*Note: + means that Montessori students had statistically significantly higher values when compared to matched comparison students for that outcome. - means that Montessori students had statistically significantly lower values when compared to matched comparison students for that outcome.*

## SIGNIFICANCE

Once complete, this study will add to the literature on who participates in Montessori programs. Like previous studies, we find that White and less disadvantaged students are overrepresented in public Montessori when compared to other students in the district. On one hand, this could exacerbate educational inequalities, as these Montessori programs do not fully reflect the demographics of their communities. On the other hand, public Montessori programs may be a method to retain these parents and students in public schools. Montessori programs are more established in the private sector. It is possible that public Montessori programs are especially attractive to White and higher-income parents who would otherwise send their children to private schools.

This study also joins a growing body of literature on the outcomes of Montessori schooling. Measurement issues and confounding variables make these analyses quite difficult. This analysis takes advantage of large databases of public school students. We acknowledge that the outcomes measures used in this analysis are imperfect. This is especially true for the standardized test scores, which can be seen as antithetical to the Montessori model. That being said, as public schools, these programs are held accountable for these test scores and they may be of interest to parents, school officials, policymakers, and the public.

The final part of our study examined student subgroups. While many previous studies have looked for a “main effect” of Montessori participation on outcomes, they are often unable to consider how the effect of Montessori may differ by subgroup. This is often because the sample sizes in these studies are too small for these types of analyses. Our analysis here includes over 4,000 unique Montessori students over a four-year period, and it will be supplemented by thousands of more students by the end of our study. This allows us to examine subgroups in a more robust way. For most of the comparisons, we find no statistically significant differences. However, each of the 12 statistically significant comparisons was in favor of Montessori students. At a minimum, our analyses suggest that any positive effects associated with Montessori participation are not limited to White or high-income students.

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