A Comparison of Reading and Math Achievement for African American Third Grade Students in Montessori and Other Magnet Schools

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Abstract

Montessori programs are expanding in public schools, serving a large proportion of African American students (Debs, 2015). Although recent Montessori research has focused on diverse public school populations, few studies have examined outcomes for African American students at the lower elementary level. This quasi-experimental study compares reading and math achievement for African American third grade students in public Montessori and other magnet schools in a large, urban district in North Carolina. Scores from end-of-grade state tests of reading and math are compared using a multivariate analysis of covariance. No significant difference in math scores was identified, but students in Montessori schools scored significantly higher in reading. This suggests that Montessori lower elementary instruction may be beneficial for African American students.

Keywords: Montessori, African American, reading, math, magnet

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Montessori has historically been a popular approach in private school settings in the United States, especially preschools (Whitescarver & Cossentino, 2008), and as such has acquired a stigma as an early childhood educational approach for the elite (Murray, 2012). In reality, Montessori programs have been expanding in public schools since the 1990s (National Center for Montessori in the Public Sector [NCMPS], 2014b; Whitescarver & Cossentino, 2008). Currently, there are almost 500 public schools offering Montessori instruction, including early childhood, elementary, and even middle school programs (NCMPS, 2014a). The vast majority of these programs are choice programs: magnets, like the schools in this study, or charter schools (NCMPS, 2014b). Students of color have a significant presence in these schools; over a quarter of students in whole-school Montessori programs are African American, and almost one-fifth are Hispanic/Latino (Debs, 2015). Advocates of the Montessori method of education argue that the approach has the potential to address many of the persistent problems facing American schools (Lillard, 2005; Noguera, n.d.; Zhao, n.d.), including the failure to adequately serve students of color (Hall & Murray, 2011; Rambusch, 2007/1976). However, the question of how well Montessori fosters achievement for African American elementary students in urban areas remains understudied.

The purpose of this study is to evaluate the effectiveness of Montessori public school programs in urban settings for African American elementary school students. Specifically, this article focuses on third grade math and reading achievement for African American students in public Montessori programs in a large, urban district in North Carolina from 2007 to 2014, as compared to similar students in other magnet programs in the same district. Ultimately, this

study demonstrates that Montessori can be an effective pedagogy for promoting reading and math achievement for African American elementary students.

Background Literature

The Montessori method is a constructivist approach to education characterized by multiage classrooms, hands-on learning materials and extended periods of independent work time (Lillard, 2005; Mallett & Schroeder, 2015). The Montessori motto is "follow the child"; the role of the teacher is to guide and facilitate activities for individual students and small groups rather than lead the class in whole-group, direct instruction. Students are not expected to progress lockstep through the curriculum with their peers, but rather advance at their own pace. Learning is facilitated through the use of specialized, hands-on Montessori materials. Teachers assess student learning through close observation rather than through formal testing. Originally developed by Maria Montessori in Italy in the early 1900s, the Montessori method gained a foothold in suburban private schools in the United States in the 1950s and 1960s (Whitescarver & Cossentino, 2008). Over the last two decades, Montessori programs have been expanding in American public schools as well (NCMPS, 2014b).

African American Students in Public Montessori Schools

Recent research indicates that public Montessori schools serve a substantial number of African American students. Debs (2015) found that the student population in whole-school public Montessori programs is 56% non-White and 28% African American (Debs, 2015). These findings indicate that African American students make up a large part of the public Montessori student population, especially given that African American students make up only 15% of students in grade K through eight in public schools nationwide (Hussar & Bailey, 2014). Yet,

research about how effectively Montessori programs serve these students is lacking (Ansari & Winsler, 2014; Hall & Murray, 2011; Stansbury, 2012; Yezbick, 2007).

Various scholars have published conceptual work examining how the Montessori method could theoretically support achievement for African American students. Nancy McCormick Rambusch (2007/1976), the founder of the American Montessori Society, asserted that Montessori has the potential to improve educational outcomes for urban African American children, who, she argued, were being shortchanged in traditional public schools. Hall and Murray (2011) identified intersections between Montessori methods and culturally responsive teaching techniques for African American students. They position Montessori as an alternative to the behaviorist approach to teaching and learning so often found in high-poverty urban schools serving large populations of students of color, pointing out that the individualization, flexibility, autonomy, and strong relationships fostered by the Montessori approach are consistent with best practice for teaching African American children. Brown and Steele (2015) found that racial discipline disproportionality for African American students was less pronounced in public Montessori schools than in comparable non-Montessori schools.

As a whole, the empirical literature on Montessori reflects a lack of attention to outcomes for African American elementary students. As several scholars (Ansari & Winsler, 2014; Lillard, 2012; Stansbury, 2012; Yezbick, 2007) have pointed out, much of the extant Montessori research has been conducted with predominantly White student populations. While a number of studies of Montessori preschool for low-income, African American children were conducted in the 1960s and 1970s (Bereiter, 1967; Berger, 1970; Karnes, 1969; Kohlberg, 1968; Miller, Dyer, Stevenson, & White, 1975), few studies of Montessori elementary school (Mallett, 2014) have explicitly examined outcomes for African American students. Some studies of Montessori public

elementary education include racially heterogeneous student populations (Dohrmann, Nishida, Gartner, Lipsky, & Grimm, 2007; Lopata, Wallace, & Finn, 2005; Mallett & Schroeder, 2015), but these studies often neglect to disaggregate their findings by race. In one of the most widely cited studies of public Montessori education in recent years (Lillard & Else-Quest, 2006), racial information about student participants was not even collected. These studies represent an attempt to examine Montessori in the context of diverse public school populations, but do not provide specific information about how African American students as a subgroup fare in these programs. The American Montessori Society (AMS) acknowledges this gap in the literature, and has called for further inquiry into outcomes for African American Montessori students (Hall & Murray, 2011). Interpretation of these studies is further complicated by the variation in fidelity of the Montessori model employed in the various school settings studies. Another challenge for researchers studying Montessori is that most public Montessori programs are choice programs. This not only makes random assignment impossible, but also makes parental choice a confounding factor, as parents who actively choose Montessori for their children may be different from parents who do not (Murray, 2010).

Nonetheless, studies from several elementary programs (Dawson, 1987; Duax, 1989; Mallett & Schroeder, 2015) suggest some benefits of Montessori instruction for African American students. Conversely, other studies (Lopata et al., 2005; Mallett & Schroeder, 2015; Moore, 1991) have failed to demonstrate an academic advantage for African American students in public Montessori elementary programs. The studies most relevant to the present study, however, are those that address the element of parent choice by including a comparison group of students who have also self-selected into choice settings. Dohrmann et al. (2007) find some positive long-term effects for a diverse group of high school students, 53% African American,

who attended Montessori elementary. The comparison group consisted of students from the same high schools matched for gender, race, and SES. Because most of the Montessori alumni had gone to attend selective, choice high schools, the comparison group was drawn largely from these choice programs as well. The Montessori students exhibited advantages in math and science that were detectable years after students exited the Montessori program. However, this study does not yield any information about how these students performed at the lower elementary level.

In a study similar to the current one, Lopata et al. (2005) compare academic achievement on state reading and math assessments for fourth and eighth grade public Montessori and non-Montessori students in an urban district in western New York. The sample is described as 53% minority; the generic label "minority" is used without providing specific racial demographics. Montessori students were compared to students at a structured magnet school, an open magnet school, and a traditional school, with schools matched for gender, ethnic composition, and socioeconomic status (SES). At grade four, no significant differences were found in language arts; Montessori students did slightly better in math than the open magnet students, but worse than in traditional.

Overall, these studies do not provide clear or consistent support for the efficacy of Montessori instruction for African American elementary school students. The widespread use of the "minority" student classification is troubling; this term obfuscates the interpretation of outcomes for African American students specifically. Few studies (Dohrmann et al., 2007; Lopata et al., 2005) utilize a comparison group of students from other choice programs. In light of the lack of consensus and specificity in the literature, more high-quality studies of academic achievement for African American students in Montessori schools are needed to better illuminate

this issue. Given the documented relationship between third grade reading and numeracy and later academic outcomes (Fiester, 2010; Ritchie & Bates, 2013), further study of academic achievement at this level is especially warranted. Third grade marks the end of the lower elementary three-year cycle of Montessori instruction, making this an appropriate time for summative assessment and evaluation.

Purpose

The purpose of this study is to evaluate the effectiveness of Montessori reading and math instruction for third grade African American students in urban public schools. Third grade reading and math end-of-grade state assessment scores were used to evaluate program effectiveness. This study utilized a quasi-experimental design to determine if the independent variable (school setting) is significantly related to the dependent variables (reading and math test scores). The treatment group consisted of African American students who had completed third grade in three public Montessori magnet schools in a large, urban district in North Carolina. Because these Montessori schools are magnets, requiring families to self-select into the program, a comparison group was formed of students from families who had also self-selected into a choice program: third grade African American students from similar magnet schools located within the same attendance zones of the same district. The specific research questions this study addresses are: When compared to their peers in similar magnet schools, do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in (1) math or (2) reading? As established in the previous section, the existing literature does not provide clear support for directional hypotheses. Therefore, this study tested non-directional null hypotheses for each research question.

Methodology

Setting

These data come from a larger study of African American students in public Montessori schools; this article reports results from a comparison of these students in Montessori and other magnet school settings. The district selected for this study has three public, well-established, whole-school Montessori programs. Fidelity of implementation of the Montessori model has been shown to impact student outcomes (Lillard, 2012; Lillard & Heise, 2016); studies on alternative math curricula have yielded similar findings, reflecting the importance of fidelity in interpreting outcomes (Tarr et al., 2008). Although classroom observations were not possible given the retrospective design of this study, the programmatic and structural elements of these public Montessori programs are consistent with the recommendations of the American Montessori Society (n.d.a, n.d.b, 2014) and are reported here.

All three Montessori programs employ teachers who have completed or are currently enrolled in a Montessori teacher training program affiliated with AMS. All three programs also utilized multiage classes as deemed appropriate by AMS (2014) during the years examined in this study. For lower elementary, a multiage class consists of grades one through three in the same room. All Montessori classrooms are equipped with standard lower elementary Montessori materials per AMS guidelines (AMS, n.d.b). All three programs report that they regularly provide the two-and-a-half to three-hour daily work cycle recommended by AMS (n.d.a). Classrooms are staffed with one Montessori-trained teacher and one paraprofessional (AMS, n.d.a). These qualifications were verified through correspondence with school- and district-level personnel, and were reported to have been in place during all the years examined in this study. Taken together, these indicators suggest that the three research sites have the proper structures in place to support an authentic public Montessori program.

Sample

The treatment group for this study consisted of African American third grade students enrolled in three public Montessori programs. The comparison group consisted of African American third grade students drawn from the matched magnet schools. Because this treatment was implemented at the school level, each Montessori school (Montessori 1, Montessori 2, and Montessori 3) was matched with one magnet school (Magnet 1, Magnet 2, and Magnet 3) within the same attendance zone of the same school district. The treatment group was sampled at the school level, so propensity score matching was deemed inappropriate for creating the comparison groups. Chi-square tests were conducted (α=.05) to ensure that treatment and comparison schools were similar in terms of percentage of African American students and percentage of students eligible for free or reduced price lunch (FRL). FRL rates at the three Montessori schools ranged from 14% to 44%, while the African American student population ranged from 22% to 68%. No significant differences in FRL rates were identified. Montessori 1 did differ significantly from Magnet 1 with regard to percentage of African American students ($\chi^2(1)=19.79$, $p<.001$). This difference notwithstanding, this comparison school still represented the best possible match within the same attendance zone. No other significant differences in percentage of African American students were found.

Magnet 1 utilizes an educational approach that it labels "Traditional," featuring a high degree of structure, an emphasis on manners and etiquette, and character education. This school serves students in grades K through five. Magnet 3 employs the Traditional program as well, serving students from preK through sixth grade. Magnet 2, a K-8 school, features a schoolwide focus on STEM (science, technology, engineering, and math).

To expand sample size, students from multiple years were included; this study included data from 2006-2007 through 2013-2014. All three Montessori programs enroll students in prekindergarten and kindergarten by lottery. These programs are highly sought-after with long waiting lists and experience little student turnover between kindergarten and grade three, indicating that the vast majority of students present at grade three have been exposed to a full three-year cycle of lower elementary Montessori instruction. This suggests that the effects observed here at grade three generally represent outcomes from the full three-year cycle of Montessori lower elementary education.

Achievement and demographic data were collected for African American students who were enrolled at grade three in the selected Montessori and other magnet schools in a large, urban district in North Carolina between 2006-2007 and 2013-2014. Number of absences and days suspended out-of-school (OSS) were included as covariates. Both reading and math test scores were missing for approximately eight percent of the total, while another five percent were missing data for the covariates. Because these scores could not be reliably imputed, these students were removed from the sample, leaving a total of 1,683 cases to be analyzed. Descriptive statistics for the sample are given in Table 1.

[Insert Table 1]

Attendance data were also collected; students in Montessori schools had the lower mean number of absences (4.71) and days suspended out-of-school (.03). Students in other magnet schools were absent, on average, 5.34 days and suspended out-of-school, on average, .11 days.

Measures

This study utilizes scores from the state-mandated End-of-Grade tests (EOGs), standardized reading and math assessments that all North Carolina students must take beginning

in grade three (North Carolina Department of Public Instruction Division of Accountability Services, 2014). Since the North Carolina testing program began in 1996 (Sanford, 1996), the tests have undergone three revisions. Because this study employed scores from three different editions of the test, raw scores were converted to z-scores before analysis. Z-scores were calculated separately for each edition of the EOG, using the mean and standard deviation established during the creation of each new edition.

Analysis

These data were analyzed using a multivariate analysis of covariance (MANCOVA). Before running the analysis, the assumptions necessary for the MANCOVA procedure were checked. Univariate outliers detected, but were within expected range and not overly influential, and thus were retained. A number of multivariate outliers were detected; these outliers were found to influence the results, so these cases were excluded from the analysis. Box's *M* (92.863) was significant ($p<.001$), indicating that the assumption of homogeneity of covariance matrices was violated. Because this assumption was not met, the Pillai's trace statistic was used (Tabachnick & Fidell, 2013). Tabachnick and Fidell (2013) argue that for robustness, the ratio of largest to smallest variance should be less than 10:1 for all dependent variables. In this case, the largest ratio is 1.24:1, indicating that the risk of a Type I error is not substantially inflated. Lastly, the inclusion of covariates is predicated on the assumption that these covariates are related to the dependent variables; these correlations were found to be significant.

A factorial MANCOVA was conducted to check for statistically significant differences among group mean reading and math scores with school setting as the independent variable. Absences and number of days suspended out-of-school were included as covariates. Dependent variables were adjusted mean EOG reading and math z-scores. Table 2 contains mean scores for

Montessori and other magnet students after adjusting for these covariates. These means indicate high performance from both groups; both Montessori and other magnet students scored over half a standard deviation above average in math. In reading, both groups again performed above the statewide average, although the Montessori mean reading score is higher than the magnet mean reading score. Planned comparisons were conducted to compare reading and math achievement of students in the treatment group (Montessori) to that of students in the comparison group (other magnet).

[Insert Table 2]

Results

Pillai's criterion indicated that school setting significantly affected the combined dependent variables, $F(4, 4250)=3.446$, $p=.008$; however, the effect size was very small, partial $\eta^2=.003$ (Cohen, 1988). Planned comparisons were conducted as part of the larger study to identify which between-group differences were statistically significant and answer the research questions (RQs) established for this study. Adjusted math and reading mean scores between the treatment group (Montessori) and the comparison group (magnet) were compared (Table 3). No significant difference was found for math scores ($p=.086$); this indicates that for RQ1, the null hypothesis must be retained. Reading scores were found to be significantly different between Montessori and magnet school settings ($p=.038$), with Montessori students scoring higher. Thus, for RQ2, the null hypothesis is rejected.

[Insert Table 3]

To ensure that these findings with regard to reading and math outcomes are accurate, the high level of correlation between reading and math scores must be taken into consideration. A Roy-Bargmann stepdown analysis was performed as a follow-up to the MANCOVA to account

for this relationship (Tabachnick & Fidell, 2013). Because the extant literature provides more support for a significant effect of Montessori in reading than in math, reading was given highest priority in the analysis, adjusted for OSS and absences. The Pillai's trace criterion was used. An alpha of .025 was used in each test to achieve an experimentwise alpha of .05. The combined dependent variables were significantly related to the combined covariates, approximate $F(4, 4278)=18.95$, $p<.001$, and to school setting, approximate $F(4, 4278)=28.26$, $p<.001$. After adjusting for differences on the covariates, school setting made a significant contribution to reading, the higher-priority dependent variable, stepdown $F(2, 2139)=27.92$, $p<.001$. The difference in adjusted mean math scores by group was found to be statistically significant even after accounting for reading, stepdown $F(2, 2138)=28.77$, $p<.001$. These results are given in Table 4.

[Insert Table 4]

This indicates that school setting is significantly predictive of both reading and math scores, adjusted for OSS and absences, even after the relationship between reading and math scores is accounted for. Per the results of the planned comparison, Montessori students performed significantly better in reading only (RQ2); there was no difference in math (RQ1). Thus, the MANCOVA suggests that the null hypothesis must be retained for RQ1, but rejected for RQ2.

Discussion

Promoting academic achievement for African American students has been and remains a critical issue facing the American public school system (Lewis, Chambers, & Butler, 2012; Wilson, 2012). Advocates of the Montessori method have argued that the Montessori approach provides a potential model for school reform (Lillard, 2005), with some scholars suggesting that Montessori education could be particularly beneficial for African American students (Hall &

Murray, 2011; Rambusch, 2007/1976). This study was designed to see if this assertion could be supported by evidence. The results of this multivariate analysis suggest that African American, third-grade students in public Montessori schools score significantly higher in reading than their counterparts in magnet schools, but fare the same in math. Though this difference was statistically significant, effect sizes were very small.

Both the work of Lopata et al. (2005) and the present study provide some evidence to suggest that the high performance of students in public Montessori schools in math (half a standard deviation above average, in this study) is due not to the effect of the Montessori curriculum, but rather reflects self-selection among engaged and highly motivated families who seek out educational options for their children. The results for math would seem to support this; Montessori students performed on par with students in magnet schools, who had also self-selected into special programs. However, it is worth noting that one of the magnet schools included in the magnet comparison group, Magnet 2, is a STEM school with an emphasis on math. Thus, another way of interpreting this finding of no significant difference between Montessori and other magnet students in math is that the Montessori schools were just as effective in promoting math achievement as other magnet schools, including one with an explicit focus on math.

Furthermore, the presence of a statistically significant difference in reading between students in Montessori schools and students in other magnet programs calls into question the theory of self-selection articulated with regard to research question one. If math scores between Montessori and other magnets are no different because motivated and engaged families self-select into both Montessori and other magnets, then logically, there would be no difference in reading scores either. A significant difference in reading scores suggests that self-selection alone

is an unsatisfactory explanation for the high achievement of African American students in the Montessori schools included in this study.

Limitations

As an evaluation of the Montessori method, this study is limited to the method's effectiveness in promoting math and reading achievement, as measured by standardized assessments. This study was cross-sectional rather than longitudinal, and as such, does not provide insight into student growth over time. Students were not randomly assigned to treatment and comparison groups, limiting the researcher's ability to infer causality. Furthermore, this study only included students in choice programs, who may be qualitatively different from students who attend neighborhood schools. While an attempt was made to select comparison schools that were as similar as possible to the treatment schools, this comparison was imperfect. While SES was considered at the school level, student-level SES data were not available. Similarly, the sample was biased by a substantial quantity of missing data, which was not found to be missing at random. The markers of fidelity for the Montessori programs included in this study were largely at the programmatic level; classroom observations were not possible due to the retrospective design of the study.

Conclusion

Overall, these results suggest that Montessori instruction at the lower elementary level is somewhat effective for African American students, especially in reading. Although this study does not explore how or why this might be, these findings lend support to Hall and Murray's (2011) assertion that the Montessori method overlaps significantly with research-based best practices for teaching African American students. Along with the work of Hall and Murray (2011) and others who have documented the use of the Montessori method with culturally

diverse students, this study is part of a counternarrative that challenges the prevailing misconception that Montessori is an elite pedagogy for predominantly White students in private schools (Murray, 2012). Another misconception identified by Murray (2012) is that Montessori is primarily an early childhood approach to education. This study indicates that the Montessori method has value for African American students in the elementary years as well. These results indicate that African American students in public Montessori schools at grade three perform *at least* as well as their peers in other magnet schools on traditional measures of academic achievement in math and perform even better in reading. This suggests that concerns about promoting academic achievement are not a valid reason to discourage the use of Montessori instruction for African American students, especially given the many non-academic benefits the method may also confer. On the contrary, public Montessori programs could be a viable tool to improve public education for African American students during the formative early elementary years.

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Appendix

Table 1

Participant Characteristics as Percentages of the Treatment and Comparison Groups

Characteristic	Percent	
	Montessori (n=335)	Magnet (n=1348)
Gender		
Male	46.9	48.6
Female	53.1	50.5
Special education status		
Receiving services	8.4	8.4
Not receiving services	91.6	91.6
Gifted status		
Gifted	6.9	6.6
Not gifted	93.1	93.4
Homelessness status		
Homeless	1.2	1.2
Not homeless	98.8	98.8

Note. Sample 100% African American.

Table 2

Adjusted Math and Reading Means by School Setting

Group	Math		Reading	
	Mean	Standard Error	Mean	Standard Error
Montessori	.57	.08	.32	.09
Magnet	.57	.04	.13	.04

Note. Covariates=absences and OSS. Scores are reported as z-scores.

Table 3

Results of Planned Comparisons

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	*p*
Math	.010	0	.010	.086	.906
Reading	-.187	0	-.187*	.090	.038

*Significant at the .05 level

Table 4

Stepdown Analysis of Covariates and School Setting for MANCOVA

IV	DV	Univariate *F*	df	Stepdown *F*	df	*p*
Covariates	Reading	27.86*	2/2139	27.86**	2/2139	<.001
	Math	32.12*	2/2139	10.34**	2/2138	<.001
School setting	Reading	27.92*	2/2139	27.92**	2/2139	<.001
	Math	42.68*	2/2139	28.77**	2/2138	<.001

*Significance level cannot be evaluated but would reach p<.025 in univariate context.
**p<.001