

# WORKING P A P E R

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## Professional Development Participation and the Role of Administrator Involvement in the Math Science Partnership of Southwest Pennsylvania

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**Professional Development Participation and the Role of Administrator Involvement in the  
Math Science Partnership of Southwest Pennsylvania**

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## **I. Introduction**

The Math Science Partnership of Southwest Pennsylvania (MSP) is a partnership among forty-eight school districts, four regional institutions of higher education, and four regional education service agencies called Intermediate Units. It began in 2003 and is funded largely by a five-year grant from the National Science Foundation's Math and Science Partnership initiative, which aims to improve math and science education by partnering higher education institutions with K-12 school districts. Consistent with that aim, the goals of the Math Science Partnership of Southwest Pennsylvania are to increase K-12 students' knowledge of math and science, to increase the quality of the K-16 educator workforce, and to create sustainable working relationships between higher education institutions and K-12 districts through coordination by the Intermediate Units.

The MSP uses three intervention strategies to meet these goals: professional development for content and leadership; curriculum alignment and course refinement; and dissemination of research-based resources and tools (Williams, Pane, Tananis, Olmsted, and Ciminillo, 2006). In this study, we focus on implementation of the first strategy, professional development, within K-12 districts. In particular, we examine district and school administrators' roles in facilitating professional development participation among school staff.

Qualitative findings from the MSP's Year Two and Year Three evaluation reports suggest that teachers' participation in professional development varied considerably among districts (Williams et al., 2005; 2006). Variation in professional development participation levels is worth investigating because professional development is an important mechanism by which the MSP seeks to foster adult learning and thereby improve math and science instruction in schools.

This study examined the extent to which the levels of professional development participation among district and school administrators were associated with the participation levels of their school-based staff. We hypothesized that participation at the top of an organizational hierarchy would be associated with participation among teachers and other school-based staff members. Consistent with this hypothesis, we found that central (i.e., district) administrator participation hours and superintendent participation were associated with aggregate district participation among school staff, and with whether or not an individual school-based staff member participated at all. We also found that participation among non-administrative school staff was associated with school administrator participation only in districts where the superintendent also participated. Finally, we found that neither central nor school administrators' participation was associated with the number of hours completed by individual teachers, given that those teachers participated at all.

In the next section, we describe our rationale for exploring the relationship between administrator participation and staff participation, after which we explain our hypothesis and research questions. We then describe our research design, followed by our results. Finally, we discuss the findings and their limitations, and we conclude with implications for MSP implementation.

## **II. Background and Context**

### *Professional Development in the MSP*

The design of the MSP is based on evidence that mathematics and science curricula in the United States lack focus and cover too many concepts in too shallow a manner. International curriculum comparisons suggest that math and science curricula in the U.S. are “a mile wide and

an inch deep” (Schmidt, Houang, and Cogan, 2002, p. 3), especially relative to the curricula in nations that outperform the U.S. in these subjects. This characterization of math and science curricula in the U.S. is often applicable to educator professional development as well (Kennedy, 2002). Yet, there is evidence that teacher professional development is most successful when it is related to the content teachers are delivering, when it is connected to the student curriculum, and when teachers are given time to focus thoroughly on the relevant content and pedagogy (Cohen and Hill, 2002). The MSP is designed to facilitate focused, coherent classroom instruction, and its approach to professional development similarly emphasizes deep and sustained learning over time.

The MSP’s professional development offerings are based on research about best practices in educator professional development (Williams et al., 2006). Collectively, they are designed to build human resource capacity in three main areas: leadership, pedagogy, and content knowledge. Though the majority of the offerings target teachers, some are aimed specifically at school administrators, and some also target central administrators and school guidance counselors.

Specifically, the *Leadership Action Teams* (LATs) for each district consist of six teachers, one guidance counselor, and one central or school-based administrator per district (often an assistant superintendent or curriculum coordinator, but sometimes a superintendent or a principal). These LATs meet four times a year in Leadership Action Academies to analyze data for the district, determine areas in which growth is needed, and select participants for certain other MSP activities, such as the Teacher Leadership Academies. The LATs also attend twice-yearly conferences called *Network Connections*, at which researchers present best practices in math and science education. Network Connections conferences are designed as resources for the

local education community. Participation is open not only to members of the Leadership Action Teams but also to math and science educators across the region.

*Lenses on Learning* constitutes a year-long professional development program targeted primarily at principals and other school administrators. This program is designed to help administrators support effective pedagogy through skilled observation of student learning and through post-observation conferring with teachers about their math and science instruction.

Much of the professional development for teachers proceeds according to a train-the-trainer model, wherein a few teachers are selected at each school level to become Teacher Leaders. These Teacher Leaders participate in *Teacher Leadership Academies* (TLAs) during the summer. During the school year, they attend follow-up sessions and deliver similar professional development to their peers through *On-Site Academies* in their respective districts.

Other forms of teacher professional development are also intended to build teachers' instructional leadership capacity. For instance, *Content Deepening Seminars* are designed to improve teachers' understanding of mathematics and science content knowledge, and thereby to create pockets of content expertise within schools. Also, *Educator Networks* provide support for teachers who use specific inquiry-driven curricular materials like Connected Math or Investigations in Data, Time, and Space. These sessions are intended not only to enhance participants' mastery of the curriculum, but also to help the participants become resources for other teachers.

The *Teacher Fellows* program is an additional form of professional development that the MSP offers. Teachers in this program spend a summer, semester, or a school year away from their schools, working with higher education faculty members toward curriculum alignment between K-12 and higher education institutions and taking coursework to deepen their content

knowledge. When these teachers return to their schools, they bring back their relationships with higher education faculty members, their understanding of the higher education institution's expectations for students, and the content knowledge they developed from their coursework.

The MSP weaves together these diverse professional development strands in an effort to build teachers' and administrators' leadership and pedagogical skills, as well as their math and science content knowledge. Thus, the MSP pursues the goal of improved student learning by offering a range of sustained, adult learning opportunities to meet the needs of a variety of educators.

### *The Importance of Administrator Participation*

As the train-the-trainer model of professional development suggests, building leadership capacity lies at the heart of the MSP's theory of action. This theory of action is based in part on Spillane's (2006) theory of distributed leadership, which takes the view that effective leadership for school improvement relies not on finding a charismatic or visionary figurehead but on fostering collaborative thinking and shared responsibility among staff members.

Nevertheless, the MSP places a high value on administrators' participation and engagement in professional development. As described above, a key professional development offering is Lenses on Learning, which prepares administrators to observe, identify, and cultivate effective math and science instruction. In fact, MSP directors believed that administrators' Lenses on Learning participation was so critical to the partnership's success that they made principals' participation a requirement for districts wishing to join the MSP as part of a planned expansion in Year Three.

MSP directors also believe it is important for administrators at the central office, including superintendents, assistant superintendents, and curriculum coordinators, to be involved in MSP activities. In interviews conducted at the beginning of the present study, MSP directors explained that participation among central office staff is often delegated to assistant superintendents and curriculum coordinators. They also acknowledged that such delegation practices may be reasonable given the many responsibilities facing superintendents, including responsibility for subjects beyond math and science, as well as broader organizational responsibilities such as labor negotiations, community outreach, and school finance. Nevertheless, MSP directors suggested that superintendents' involvement in a large-scale initiative like the MSP may be optimal for advancing the vision of the initiative throughout a district.

The theory that central administrators' participation is important in promoting instructional reform is supported by empirical evidence. For instance, Elmore's and Burney's (1997) case study of Community School District 2 in New York City demonstrated the role that strong central office leadership can play in driving an emphasis on teacher professional development throughout a district. The research also showed gains in student achievement that corresponded to district leaders' implementation of intensive professional development. Hightower's (2002) case study of large-scale reform in San Diego similarly illustrated the importance of a strong, shared vision at the district level in driving professional development and instructional reform at the school level. Finally, Marsh and colleagues (2005) conducted case studies of three districts and concluded that "Investing in the professional development of central office staff can enhance capacity to lead instructional reform" (p. xxiv).

Empirical research also suggests the importance of school-level administrators in shaping the professional cultures and instructional norms of their schools. Using path analysis to explore the relationship between school leadership and student engagement, Leithwood and Jantzi (2000) found a correlation of 0.68 ( $p < .05$ ) between the survey-reported transformational leadership behavior of principals and the organizational culture of schools, though they detected only a small indirect relationship between transformational leadership and student engagement. In another path analytic study of principal effects, Hallinger, Bickman, and Davis (1996) found a positive relationship between survey reports of principals' instructional leadership and teachers' instructional practice, though principal's direct effects on students' reading achievement were not discernable.

Drawing from the literature on administrator effectiveness and the centrality of administrative leadership to the MSP's theory of action, this study explored the relationship between both central and school administrators' participation in the MSP and the participation behavior of their staff. We theorized that evidence of such a relationship would lend support for the MSP's current advocacy of administrator participation, and that evidence to the contrary would prompt the MSP to seek other policy-responsive factors associated with differences in staff members' professional development participation.

### **III. Hypothesis and Research Questions**

Our hypothesis was that administrators' participation in MSP activities would be associated with increased participation among staff members. We believed there were a number of complementary reasons this association might exist. First, administrators' understanding of the MSP's vision for improved math and science instruction might spur the administrators to

encourage staff participation and to prioritize the delivery of on-site professional development in their districts. Second, administrators' attendance at MSP events might indirectly signal to their staff members the importance of attending. Third, administrators' implementation of leadership strategies promoted by the MSP (such as a focus on math or science content in conversations with teachers) might indirectly convey to staff members the usefulness of improved math and science pedagogy.

A second part of our hypothesis concerned the role of central administrators' participation in professional development activities. As noted above, we knew that while some superintendents do participate directly in the MSP, many delegate involvement to other central administrators. We also understood that such delegation may be a rational response by superintendents to the many responsibilities they face. Nevertheless, we wondered whether staff participation levels were higher in districts where at least a portion of central office participation hours were attributable to the superintendent.

Our overarching question asked to what extent administrators' participation in MSP activities was related to the participation of their staff members. Our analysis considered three levels of participation: district level, school level, and individual level. In particular, we asked to what extent:

1. Districts with more central administrator participation, or any superintendent participation, have more participation among school-based staff
2. Schools with more central and school administrator participation, or any superintendent participation, have more participation among non-administrative staff.

3. Individual teachers and school administrators are more likely to participate when central office administrators participate more, or when the superintendent participates.
4. Individual teacher participants complete more hours when central and school administrators participate more, or when the superintendent participates.

The next section describes our strategy for answering these questions.

## **IV. Research Design**

### *Data*

Our analysis used a detailed database of participation hours maintained by the MSP. The database contained the number of hours in which an individual participated in MSP professional development, by activity title and date. It also included annually updated records of all eligible staff members in the MSP districts, even if they had not participated in MSP activities. Eligible staff members included administrators such as superintendents, assistant superintendents, and curriculum coordinators; school administrators such as principals and assistant principals; guidance counselors; and teachers of math and/or science, including elementary school teachers and some special education teachers.<sup>1</sup>

The version of the dataset that we used in this study was last updated with the names of all eligible district staff in the summer of 2005, though names of some new staff members were added as they participated in MSP professional development activities during the 2005-06 school year. Also, some participation hours for the second half of Year Three (spring and summer

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<sup>1</sup> The database contained some representatives of other job categories as well, including substitute teachers, student teachers, paraprofessionals, business managers, and librarians. If these individuals were assigned to a particular school within the district, we gave them the designation “school-based other” for purposes of our analysis. If they were assigned only to a district and not to a particular school, we designated them “district other.”

2006) were missing at the time of data collection. For this reason, and because not all of the activities had been implemented in Year One, we combined the participation hours across all three years in our analysis, rather than examining participation on a year-by-year basis. It is important to note that data that were missing for Year Three were missing uniformly for all districts, and thus there should not be bias associated with nonrandom missing data.

Descriptive information about districts and individual schools, including demographic data for 2003 and prior test scores from 1998 through 2003, were collected from the National Center for Education Statistics' Common Core of Data (CCD), the Pennsylvania Department of Education, the U.S. Census Bureau, and the Pennsylvania State Education Association.

### *Sample*

Our sample included the forty-eight school districts that had participated in the Math Science Partnership since Year One. Forty of these districts were funded by the original 2003 grant from the National Science Foundation, and eight districts were funded by a supplemental Math Science Partnership grant from the Pennsylvania Department of Education. In Year Three, five additional districts were added as part of a planned expansion, though these expansion districts were not included in this analysis.

Districts in the sample included, on average, three elementary schools, one middle school, and one high school. Student enrollment ranged among sample districts from 687 to 7646, with a mean of 2481 students. Pupil-teacher ratios also tended to be low, ranging from 10.5 to 18.3, with a mean of 14.8. According to the CCD, 77% of the districts were based in "urban fringe" areas or in suburbs, and 23% were located in small towns or rural areas. The average percentage of minority students among the districts ranged from 0.7% to 98%.

However, the distribution had a strong positive skew of 1.6, indicating that most of the districts were composed mainly of white students, while a few were composed mainly of students of color. Because of the skewed distribution, the mean share of minority students among districts was 20%, while the median was only 8.5%.

The percentage of students qualifying for free or reduced-price lunch ranged among districts from 4% to 88%. The distribution had only a small positive skew of 0.5, with a mean of 37% and a median of 34%.

Within districts, the sample included 212 schools, of which 116 were elementary schools, 47 were middle schools, and 49 were high schools. We used school level codes provided by the Common Core of Data (CCD), such that K-8 schools were classified as elementary schools, while schools spanning grades four through six or five through eight were classified as middle schools. There were three schools in the sample to which the CCD had given a school level designation of “other.” These included a grade eight/nine school that we coded as a middle school, a grade nine/ten school that we coded as a high school, and a grade six-through-twelve school that we also coded as a high school. Using the CCD codes, grades kindergarten through three always fell within elementary schools, and grades ten through twelve always fell within high schools. Grades four through nine, however, fell within different levels of schools depending on school structure. We adhered to the CCD codes with the assumption that school structure (whether the schools self-identified as elementary, middle, or high in federal and state reporting) was more important for our purposes than the actual grade taught, because the school structure would likely dictate whether a teacher functioned primarily as a generalist or a subject-area specialist.

The dataset contained records for 6755 individuals eligible for MSP participation, 5329 of whom were teachers. Among the teachers with non-missing qualification data (n=5220), 77% were reported by their districts as being highly qualified under the No Child Left Behind Act of 2001. Their years of experience ranged from 0 to 49, with a mean of 13.

Aggregate participation among districts ranged from 1.7 to 52 hours per eligible participant in the first three years of the MSP, with a mean of 18 and a standard deviation of 11, and the percentage of eligible teachers participating at all ranged from a 7% to 92%, with a mean of 51% and a standard deviation of 22 percentage points. Among individual teacher participants, the number of hours completed ranged from 0.5 to 278, with a mean of 30.8 and a standard deviation of 41.5.<sup>2</sup>

## *Measures*

### Job categories

The study set out to estimate the relationship between the MSP professional development participation levels of administrators and their staff by examining participation at the district, school, and individual levels. Understanding the dependent and independent variables in each stage of the analysis requires an understanding of the seven job categories in the dataset. The first category, *district superintendent*, includes only individuals with that job title. The second category, *district administrator*, includes individuals working in supervisory roles at the district level with titles including administrator, assistant superintendent, curriculum coordinator, director, and director of counseling. The third category, *district other*, includes individuals whose work is conducted in schools, but who are assigned only to districts in the MSP

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<sup>2</sup> The professional development hours of Teacher Fellows were excluded from the analysis because their recorded participation hours are so high (e.g., 1200 for a full school year) that they dramatically skew the distribution. However, whether or not an individual has been a Teacher Fellow will be included in subsequent parts of the five-year study linking teachers' MSP participation to growth in student achievement.

participation database. Their titles, which include principals, assistant principals, substitute teachers, student teachers, aides, interns, and technology coordinators, do not imply supervisory responsibility at the district level.<sup>3</sup> The fourth category is *school principals*, which includes only individuals who hold this title. *School administrators*, the fifth category, includes assistant principals, vice principals, and deans. The sixth category, *guidance counselors*, includes only individuals who hold that title. *School teachers* make up the seventh category, which includes regular teachers, as well as individuals with other permanent positions typically held by teachers, including reading coaches and department heads. The eighth category is *school-based other*, which includes school staff members who do not fit into the other categories, such as nurses, social workers, substitutes, student teachers, and technology coordinators. MSP participation among each of these categories is displayed in Table 1.

In subsequent descriptions of our analyses, we often refer jointly to superintendents and district administrators as *central administrators*, since their participation hours were combined in one of our independent variables of interest.

**Table 1. Individual participation hours in the MSP’s first three years, by job category**

Job Category	n	n participants	Mean Hours Per Eligible Individual	Mean Hours Per Participant
Superintendent	48	12	5.44	21.75
District Administrator	84	45	27.13	50.64
District Other	506	234	3.67	7.94
Principal	299	119	14.20	35.68
School Administrator	77	26	10.69	31.67
Guidance Counselor	89	40	13.88	30.88
Teacher	5,324	2,948	17.06	30.81
School Other	328	52	1.91	12.08
<b>Total</b>	<b>6,755</b>	<b>3,565</b>	<b>15.12</b>	<b>29.39</b>

<sup>3</sup> While the *district other* designation contains individuals with school-based jobs such as principal or teacher, those with the *district other* designation are not linked to particular schools and were not included in any of the school-level or individual-level analyses. They were included only in the district-level analysis, where they were aggregated with other school-based staff. In the next subsection, we describe in greater detail the groups included in each portion of our analyses.

### Dependent and independent variables at each level of analysis

Our dependent variable, broadly speaking, was the quantity of MSP professional development in which school staff members participated during the first three years of the MSP. Participation was measured in hours. Because we wished to gain a broad understanding of how districts, schools, and individuals varied in their overall participation rates, and because data were incomplete for some activities in Year Three, we aggregated those hours across professional development activity types at the district, school, and individual levels. However, future analyses may explore how districts vary by participation in each type of professional development activity, and how the quality of professional development varies across districts and activity types. We return to this point in the Limitations section.

We also aggregated hours across years rather than undertaking a year-by-year analysis because, as noted above, data for some activities were incomplete for Year Three, and some activities had not been introduced until Year Two. We controlled for district size in the district-level regression analysis and for school size in the school-level analysis.

The independent variable of interest in each part of our analysis was the quantity of MSP professional development hours completed by administrators. However, whether the administrators of interest were based at the district level, the school level, or both varied by the level of our analysis, so we will describe the dependent variables and the independent variables of interest for each portion of our analysis in turn.

In the district-level analysis, the dependent variable was the aggregate number of participation hours among staff members in school-based job categories, including principals, school administrators, counselors, teachers, school-based other, and district-based other. Staff classified as district-based other were included because, as noted above, their job titles are

largely consistent with school-based assignments, though they are not assigned to particular schools within the database. To address the first research question, the primary independent variable in the district-level analysis was central administrators' participation hours, which, as noted above, includes both superintendents and other district administrators, and thereby encompasses people who have supervisory roles within their districts. The other independent variable of interest was a dichotomous variable indicating whether or not a portion of the central administrator hours were attributable to the superintendent.

In the school-level analysis, the dependent variable was aggregate school-level participation hours among non-administrative staff members in schools, including guidance counselors, teachers, and other school-based employees. The independent variables addressing research question two were central administrators' participation hours (superintendents and other district administrators) and school-level administrators' participation hours (principals and other school administrators), in addition to a dichotomous variable indicating whether or not a portion of the central administrator hours were attributable to the superintendent.

Because 46% of eligible school level staff did not participate in any MSP activities within the first three years, we conducted two distinct individual-level analyses. The first analysis, which addressed research question three, looked at *whether* a school staff member participated in the MSP at all, where school staff members included all school staff, such as principals, other school administrators, counselors, teachers, and other school-based employees. In this analysis, the dependent variable was a dichotomous indicator coded 1 if the individual had participated in any MSP professional development activities and 0 if the individual had not. The independent variables of interest were central administrators' participation hours and a dichotomous variable indicating whether or not some of the central hours were attributable to the superintendent.

In the second individual-level analysis, which addressed research question four, the dependent variable was the number of participation hours completed by teachers who *had* participated in MSP activities. We focused only on teachers in this portion of the analysis because we wanted to include control predictors that applied only to teachers. The independent variables of interest were central administrators' participation hours (superintendents and other district administrators) and school-level administrators' participation hours (principals and other school administrators), as well as the dichotomous variable indicating whether or not a portion of the central administrators' hours were attributable to the superintendent.

#### Control variables

We controlled for a number of district, school, and individual variables in our analyses. District-level control variables included the number of student enrollments, number of district staff members, student attendance rates in the district, average teacher salaries in the district, and average test score slopes in math for each district from 1998 through 2003. We systematically explored the need to control for a range of other district-level characteristics, including percent of students in the district qualifying for free or reduced-price lunch, student graduation rates; average 2003 state math scores for fifth graders, eighth graders, and eleventh graders, respectively, and for all three grades combined; teachers' average years of experience in the district; and percentage of teachers with master's degrees in the district.

School-level control variables that we tested included the grade level of the school (elementary, middle, or high), the percentage of students qualifying for free or reduced-price lunch in the school, and the percentage of minority students in the school.

Individual-level control predictors for all school staff members included dummy variables for each job title, where job titles are defined as described in the first paragraph of this

subsection. Individual-level control predictors for teacher participants included years of experience and whether or not the teacher was highly qualified as defined by the No Child Left Behind Act of 2001.

### *Data Analysis*

Because we were examining the behavior of individuals nested within schools nested within districts, most of our analyses were conducted with multilevel modeling. To answer our first research question, however, we included only district-level aggregate measures, and thus we used ordinary least squares regression to conduct this part of the analysis. Using the *regression* procedure in Stata 9.0, we estimated the following hypothesized population model:

$$SCHLHRS_d = \mu + \alpha(CENTHRS_d) + \beta(SUPER_d) + \delta(X_d) + \zeta_d \quad (1)$$

where  $SCHLHRS_d$  is the number of hours that school staff within each district participated in MSP activities;  $\mu$  is the intercept term indicating the estimated number of school hours in a district with zeroes on all predictors;  $CENTHRS_d$  is the number of hours completed by the superintendent and other district administrators;  $SUPER_d$  is a dummy variable indicating whether a portion of the central administrator hours are attributable to the superintendent;  $X_d$  is a vector of district-level control predictors as described in the Measures subsection above; and  $\zeta_d$  is a residual for each district. If more central administrator hours were associated with more school staff participation hours, the estimated coefficient  $\hat{\alpha}$  would be statistically significant and positive. The estimated coefficient  $\hat{\beta}$  would be statistically significant and positive if school

staff participation were higher when a portion of the central hours were completed by the superintendent.

To answer our second research question, which asked whether MSP participation hours among central *and* school administrators were positively associated with participation among non-administrative school staff, we fit a two-level linear regression model that reflected the nesting of schools within districts. Using the *xtmixed* procedure in Stata 9.0, we estimated the following equation:

$$\sqrt{NONADMHRS_{ds}} = \mu + \alpha(CENTHRS_d) + \beta(SUPER_d) + \delta(X_d) + \gamma(ADMHRS_{ds}) + \lambda(Y_{ds}) + \zeta_d + \omega_{ds} \quad (2)$$

where  $\sqrt{NONADMHRS_{ds}}$  is the square root of the number of hours that non-administrative staff members within each school (teachers, guidance counselors, and school-based other staff) participated in MSP activities;  $ADMHRS_{ds}$  is the number of hours completed by principals and other school-based administrators in the school;  $Y_{ds}$  is a vector of school-level control variables;  $\omega_{ds}$  is a residual term for each school, and the other terms are the same as defined for equation 1. We used a square root transformation of the outcome variable, non-administrative hours, to mitigate a strong positive skew in the data and to generate residuals that were homoscedastic and normally distributed.

To answer our third research question, which asked whether MSP participation hours among central administrators were related to the probability that a school staff member would participate in the MSP at all, we fit a three-level logistic regression model that reflected the nesting of individuals within schools within districts. Using *proc glimmix*, a downloadable procedure available for SAS 9.1, we estimated the following equation:

$$p(PARTICIP_{dsi}) = 1 / \{1 + e^{-[\alpha(CENTHRS_d) + \beta(SUPER_d) + \delta(X_d) + \lambda(Y_{ds}) + \varphi(TITLE_{dsi})]}\} \quad (3)$$

where  $p(PARTICIP_{dsi})$  is the probability that an individual school-level employee will participate in an MSP activity;  $TITLE_{dsi}$  is a system of dummy variables indicating the job title of the school-level individual (principal, other school administrator, counselor, or school-based other, with teacher as an omitted reference category); and the other predictors are the same as defined above. The coefficients of each predictor are the natural logarithms of the odds ratios of participating associated with a unit difference in that predictor. We also explored whether there were two-way interactions between the independent variables of interest and the job title dummy variables.

To answer our fourth research question, which asked whether more MSP participation hours among central and school administrators were associated with differences in the number of hours completed by teachers who *did* participate, we fit a three-level linear regression model that reflected the nesting of teachers within schools within districts. Using the *xtmixed* procedure in Stata 9.0, we estimated the following equation:

$$\log_2(TCHHRS_{dsi}) = \mu + \alpha(CENTHRS_d) + \beta(SUPER_d) + \delta(X_d) + \gamma(ADMHRS_{ds}) + \lambda(Y_{ds}) + \eta(Z_{dsi}) + \zeta_d + \omega_{ds} + \varepsilon_{dsi} \quad (4)$$

where  $\log_2(TCHHRS_{dsi})$  is the base-2 logarithm of total hours completed by each teacher participant;  $Z_{dsi}$  is a vector of individual-level controls including years of experience and whether or not the teacher was reported to be highly qualified under NCLB; and  $\varepsilon_{dsi}$  is an

individual residual term. All other predictors are the same as described above. We used the logarithm of the outcome variable because doing so not only removed the individuals with zero hours from this portion of the individual analysis (the log of zero is undefined) but also mitigated a strong positive skew in the number of hours that persisted in the raw data even after the zeroes were removed.

## **V. Findings**

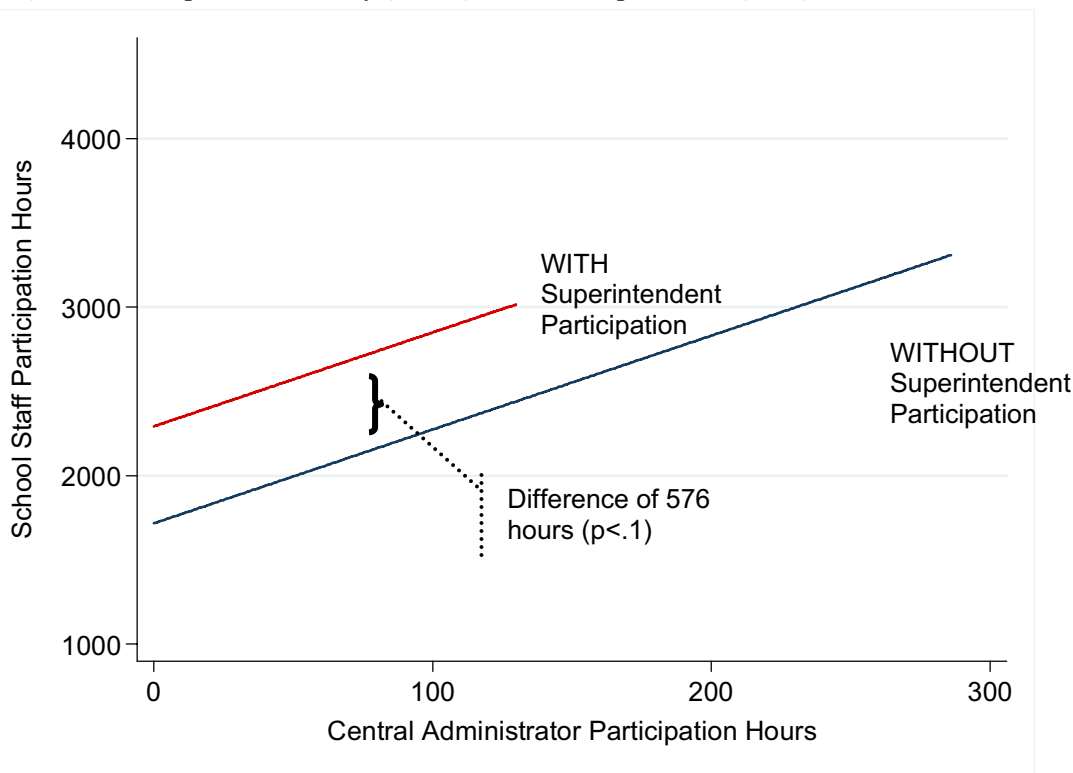
In response to our first research question, we found that central administrators' participation hours and whether or not the superintendent participated were both associated with the aggregate participation hours of school-based staff in a district, controlling for the main effects of district enrollment and the percent of minority students in the district. The estimated coefficients for this portion of the analysis are displayed in Table 2. Specifically, an hour difference in central administrators' participation hours is positively associated with a 5.6 hour difference in participation hours among school staff in a district ( $p < .05$ ). Furthermore, in districts where at least a portion of central office participation hours were attributable to the superintendent, school staff participated an average of 576 hours more than in districts where none of the hours were attributable to the superintendent ( $p < .1$ ). Given that districts' aggregate number of participation hours ranged from 122 to 4420, with a mean of 1925 and a standard deviation of 1221, this difference between districts with and without superintendent participation represents 47% of a standard deviation. These relationships are displayed in Figure 1.

**Table 2. Estimated coefficients for the best district-level model. Outcome variable is district aggregate number of participation hours among school-based staff. (n=48)**

Predictors	Estimated Coefficients
District Enrollment Divided by 100	25.19*
District Percentage of Minority Students	-12.53*
District Hours of Central Administrator Participation	5.57*
Superintendent Participation (1=Y; 0=N)	575.78~
Intercept	1266.59***

~p<0.1 \*p<0.05 \*\*p<0.01 \*\*\*p<0.001

**Figure 1. District hours of participation among school-based staff, holding constant district enrollment size (2481) and district percent minority (18.4%) at their sample means (n=48)**



As noted, the significant control variables in this district-level analysis were district enrollment size and the percent of minority students in the district. When the other predictors were held constant, a difference in district enrollments of 100 students was positively associated with a difference of 25 hours of participation among school-based staff (p<.05). Because a

larger district would have had more staff members eligible to participate, this positive relationship was consistent with our expectations.

However, holding all else constant, we found that a positive one-percentage point difference in the share of minority students in a district was associated with a negative 12.5-hour difference in the number of participation hours completed by school staff ( $p < .05$ ).

In response to research question two, we found that whether or not the superintendent participated in MSP activities was associated with aggregate school-level participation among non-administrative staff, and that school administrators' participation hours were significant *only* in districts with superintendent participation, controlling for district staff size, district percent minority, number of eligible school staff, and grade level of the school (elementary, middle, or high school). The estimated coefficients for the school-level analysis are displayed in Table 3.

**Table 3. Estimated coefficients for best school-level model. Outcome variable is the square root of total participation hours among non-administrative staff members. The school-level reference category is Elementary. (n=216)**

Predictors	Estimated Coefficients
District Percentage of Minority Students	-0.10***
Superintendent Participation (1=Y; 0=N)	2.64
Hours of School Administrator Participation	0.02
Superint. Particip.* Hours of School Administrator Participation	0.06*
Middle School	3.54***
High School	8.64***
Number of Eligible School Staff	0.35***
Intercept	6.87***

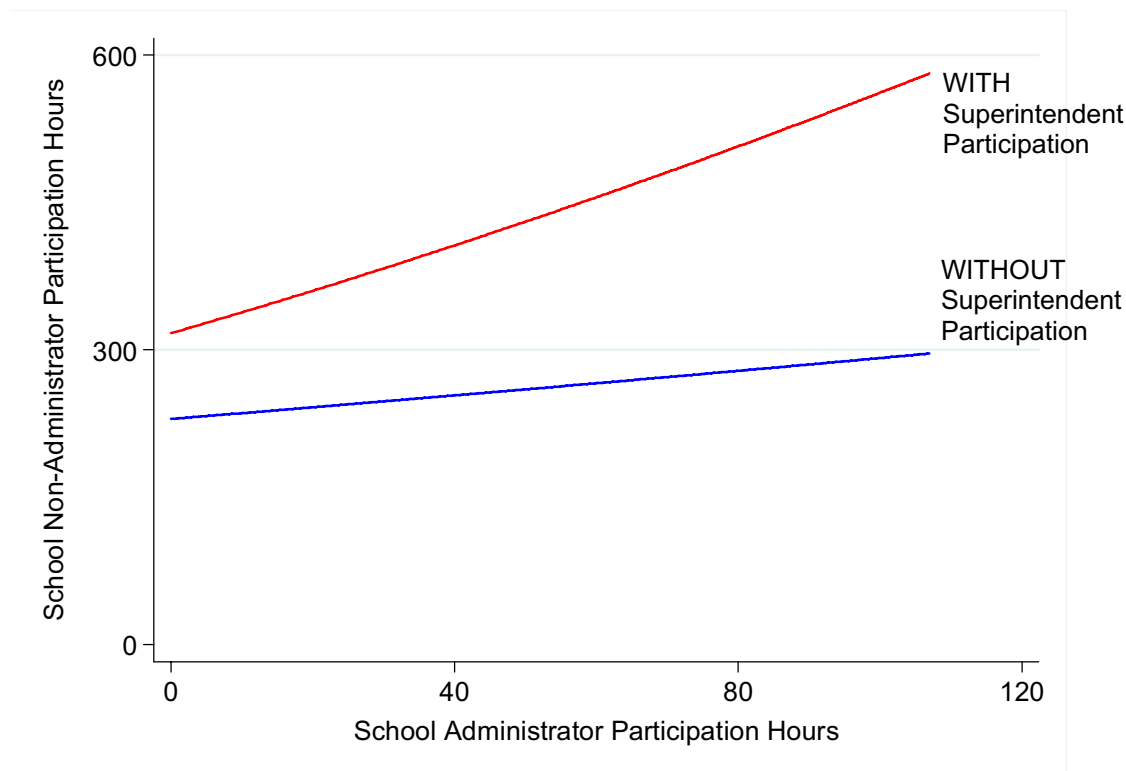
~ $p < 0.1$  \* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$

Note: The main effects of Superintendent Participation and Hours of School Administrator Participation were retained in the model because their two-way interaction is statistically significant.

In the school-level analysis, there was no statistically significant relationship between the number of hours completed by central administrators and the number of hours completed by non-administrative staff within schools. Also, in districts *without* superintendent participation, there was no statistically significant relationship between school administrators' participation hours

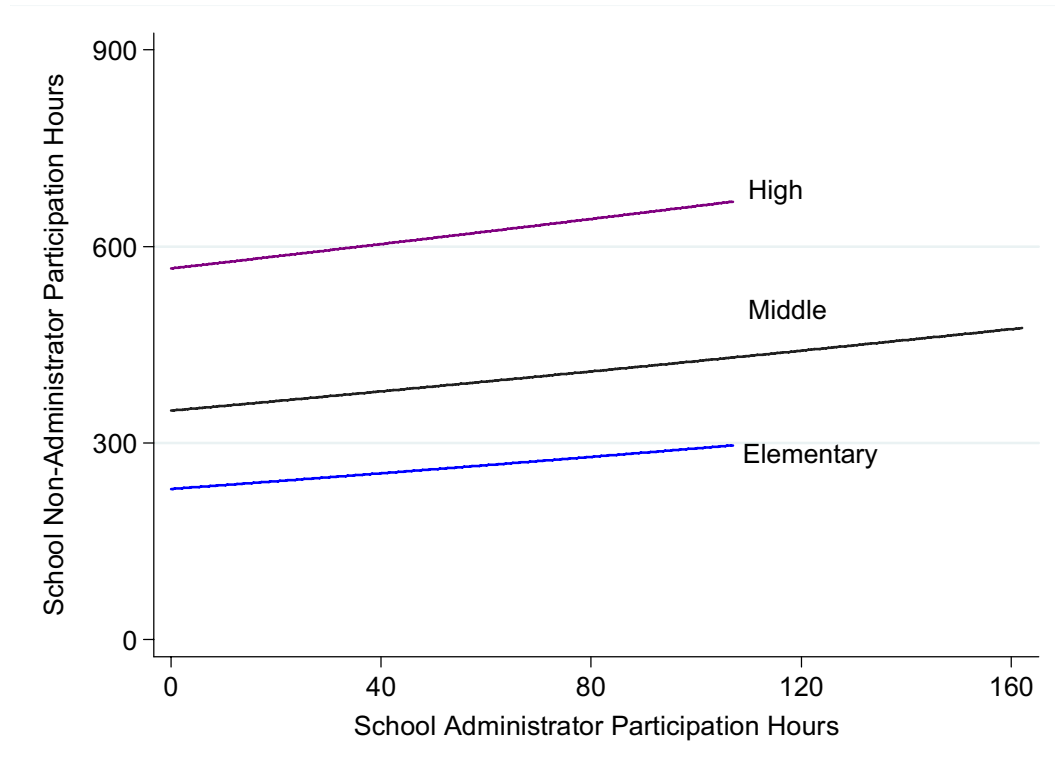
and the participation hours of non-administrative staff. However, in districts where the superintendent had participated at least to some extent, there was a positive relationship between school administrators' participation hours and the participation hours of non-administrative staff, such that an hour difference in the school administrators' participation hours was positively associated with a difference of 0.08 in the square root of the aggregate school participation hours among non-administrative staff ( $p < .05$ ). This relationship is shown in Figure 2, where, because the effect size was small, the curvilinear fitted line appears linear. The effect can be interpreted as follows: For a school with forty school administrator participation hours located in a district with superintendent participation, an additional hour of school administrator participation hours was positively associated with a difference of 2.4 hours among non-administrative school staff.

**Figure 2. School participation hours among non-administrators in elementary schools, holding constant district percent minority (18.4%) and school eligible staff size (28.9) at their sample means (n=116)**



As noted above, the control variables that were significant in the school-level analysis were the percentage of minority students in the district, the number of eligible school staff members, and the school grade level. Holding all else constant, a positive difference of one percentage point in the share of minority students in a district was associated with a negative 0.1 difference in the square root of school-level participation hours among non-administrative school staff ( $p < .001$ ). Again holding other predictors constant, a unit difference in the number of eligible school staff was associated with a positive difference of 0.35 in the square root of school-level participation hours among non-administrative school staff ( $p < .001$ ). When other predictors were held constant, including number of eligible participants per school, the number of non-administrator participation hours in high schools was 5.1 square root units greater than that of middle schools, and 8.6 square roots greater than that of elementary schools. In more intuitive terms, if a school has 29 eligible staff members and 40 hours of school administrator participation, knowing that it is a high school would suggest that it has 225 more non-administrator participation hours than if it were a middle school, and 350 more non-administrator participation hours than if it were an elementary school. This relationship is illustrated in Figure 3.

**Figure 3. School participation hours among non-administrators in districts where superintendents have not participated, holding constant district percent minority (18.4%) and school eligible staff size (28.9) at their sample means (n=165)**



To answer research question three, we asked whether individual administrators and teachers were more likely to participate *at all* in MSP activities based on the number of central administrator participation hours in their districts and on whether the superintendent in their district had participated at all. The estimated coefficients from the multilevel logistic regression analysis are displayed in Table 4. We found a small main effect of central administrators' participation hours on the likelihood that a school-based employee would participate. Specifically, the fitted odds of participating in a given district were 1.2 times the fitted odds of participating in a district with 50 fewer hours of central administrator participation, all else being

equal ( $p < .1$ ).<sup>4</sup> However, because this finding was small and significance was marginal, it should be interpreted with caution.

**Table 4. Multilevel logistic regression coefficients estimating the probability that an individual school staff member participates at all in MSP professional development. The reference job category is Teacher. (n=5867)**

Predictors	Estimated Coefficients
District professional staff size divided by 10	-0.026**
District Percentage of Minority Students	-0.013**
Superintendent Participation (1=Y; 0=N)	0.743**
District Hours of Central Administrator Participation	0.004~
Number of Teachers in the School	0.014***
Principal	-0.426**
School Administrator	-0.847**
Guidance Counselor	-0.452~
School-Based Other	-0.332
Superintendent Participation*Principal	-0.706*
Superintendent Participation*School Administrator	-0.596
Superintendent Participation*Guidance Counselor	-0.903~
Superintendent Participation*School-Based Other	-1.143~

~ $p < 0.1$  \* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$

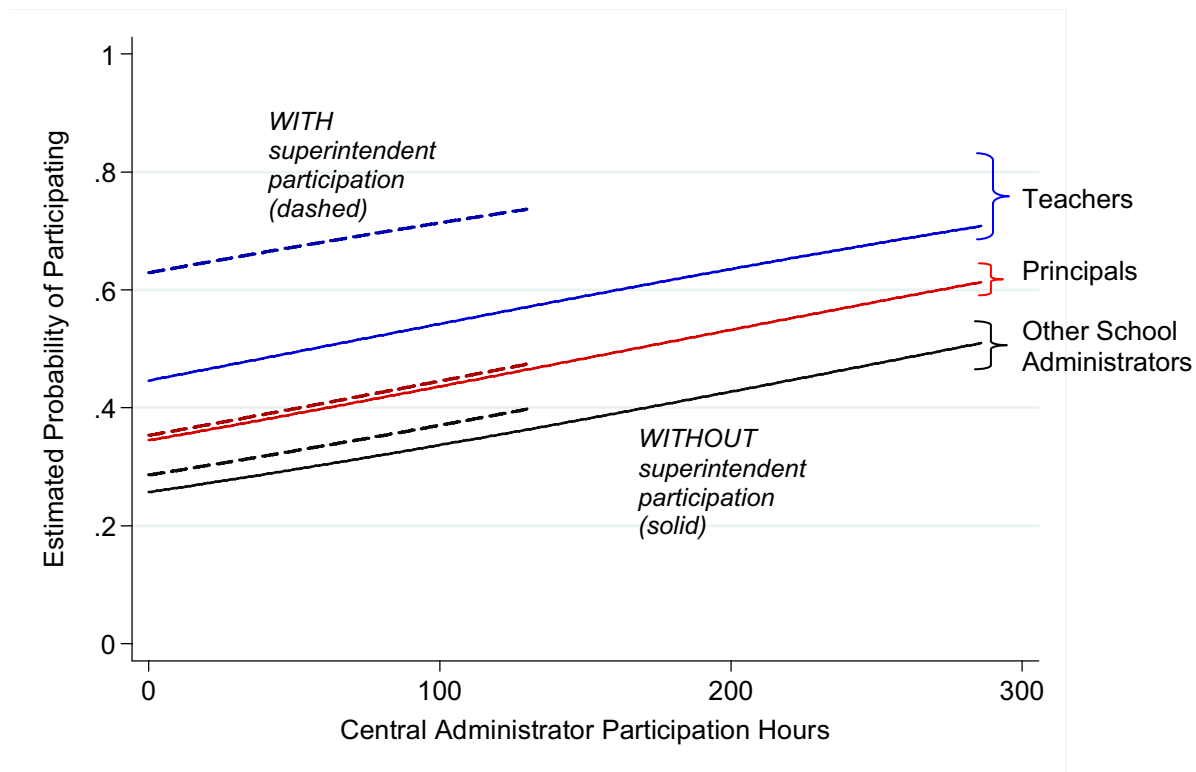
Note: The job categories function jointly in the model, as do their interactions with superintendent participation. The interactions are jointly significant at the .05 level.

It also appeared that the probability that a teacher would participate in MSP professional development was higher than the probability that other school-based staff would participate, but how *much* higher was related to whether the individual worked in a district with or without superintendent participation. In other words, there was a joint, two-way interaction between job categories and superintendent participation, as illustrated by the four interaction terms in Table 4. In districts without superintendent participation, the fitted odds that a teacher would participate were 1.5 times the odds for principals, 2.3 times the odds for other school administrators, 1.6 times the odds for guidance counselors, and 1.4 times the odds for other school-based staff members including substitutes, student teachers, paraprofessionals, and technology coordinators.

<sup>4</sup> Because the effect size is small, the odds ratio corresponding to a single hour difference in central administrator participation hours is close to 1.

In contrast to the odds ratios described above for districts *without* superintendent participation, the fitted odds that a teacher would participate in districts *with* superintendent participation were 2 times the odds for principals, 1.8 times the odds for other school administrators, 1.8 times the odds for counselors, and 2.1 times the odds for other school-based staff. In other words, the probability that teachers would participate was roughly 18 percentage points higher than in districts without superintendent participation, while the probability that other administrators would participate was not markedly different. These differences between districts with and without superintendent participation are displayed in Figure 4.

**Figure 4.** Probability that a school-based staff member will participate as a function of job title, central administrator participation hours, and superintendent participation. Held constant at their sample means are district professional staff size (195), district percent minority (18.4%), and percentage of students in the school eligible for subsidized lunch (37.8%). (n=5867)



Our fourth research question asked about the quantity of participation hours among the subset of teachers who did participate in MSP activities. Here, we focused specifically on teachers because we wanted to be able to include certain controls that were particular to teachers, such as whether or not they were highly qualified under No Child Left Behind. We also wanted to examine whether both central and school administrator participation hours were associated with the number of hours that teacher participants completed. Estimated coefficients from this portion of the analysis are shown in Table 5. Independent variables that were not significant at the 0.1 level were removed from the model.

**Table 5. Estimated coefficients for individual teachers’ participation hours, conditional upon participating at all. Outcome variable is the base-2 logarithm of participation hours. The school-level reference category is Elementary. (n=2826)**

Predictors	Estimated Coefficients
District Average Teacher Salary Divided by 1000	-0.065***
District Student Attendance Rate	0.207***
School Percentage Free/Reduced Lunch Eligible	0.006*
Middle School	0.473***
High School	0.788***
Highly Qualified Teacher Under NCLB	1.023***
Intercept	-13.241*

~p<0.1 \*p<0.05 \*\*p<0.01 \*\*\*p<0.001

We found that neither school administrator nor central administrator participation hours were associated with the number of hours individual teachers completed, given that the teachers had participated at all. Moreover, we observed no difference in participation hours associated with whether or not the superintendent participated. Speculating that the statistical effect of superintendents on the number of hours a teacher completed may have been washed out by expanded participation among less-engaged teachers, we also tested whether superintendent participation was related to the number of hours completed by more engaged participants only (those with hours in the top 25%, top 50%, and top 75%), and we found no differences.

The control predictors that were statistically significant were average teacher salary in the district, student attendance rate in the district, percentage of students qualifying for free or reduced-price lunch in the school, school grade level, and whether or not the teacher was highly qualified under NCLB. Surprisingly, the relationship between average district salary and number of participation hours was negative, though small, such that a thousand dollar difference in average teacher salary was associated with a difference of -0.07 in the base-2 logarithm of an individual's total hours of participation, controlling for the other predictors ( $p < .0001$ ). In other words, if two highly qualified teachers both worked in elementary schools with 32.8% of students eligible for subsidized lunch, but one teacher worked in a district with an average teacher salary of \$51,000, and the other worked in a district with an average salary of \$50,000, the model predicted that the latter teacher would complete roughly half an hour more MSP professional development than the former in the first three years of implementation.

Teachers in districts with higher student attendance rates completed more hours, on average, than their counterparts in districts with lower attendance rates. Controlling for the other predictors in the model, a difference of one percentage point in district attendance rate was positively associated with a difference of 0.2 in the base-2 logarithm of teacher participation hours ( $p < .001$ ). For example, teachers in districts where the attendance rate was 91% were predicted to complete one-and-a-half more hours of MSP professional development than their peers in a district with a 90% attendance rate, assuming their respective schools and districts had traits equal to the sample averages of the other predictors in the model.

Here, attendance rates may function as a proxy for other demographic and achievement traits with which they are correlated, but which are not statistically significant in the model. (For instance, attendance rates had a -.75 correlation with percentage of students in the district eligible

for free or reduced-price lunch, and a 0.7 correlation with 2003 test scores in the district averaged across grades 5, 8, and 11. They had a moderate correlation of -.45 with the percentage of minority students in the district.)

There was also a very weak positive relationship between teacher participants' hours and the percentage of students in the school who qualified for free or reduced-price lunch, such that, controlling for the other predictors, a one-percentage point difference in free or reduced-price lunch was associated with a positive difference of 0.01 in the base-2 logarithm of an individual's total hours ( $p < .05$ ). This relationship, too, is somewhat counterintuitive, since other models showed negative relationships between participation levels and student traits that were correlated with poverty. Still, the relationship is tiny in practical terms. If two highly qualified teachers worked in the same district and at the same school level, but in two different schools, one with 33% of students eligible for free or reduced-price lunch, and the other with 43% of students eligible, the teacher in the higher-poverty school would be predicted to complete only 0.4 more MSP professional development hours than her counterpart in the lower-poverty school during the first three years of implementation.<sup>5</sup>

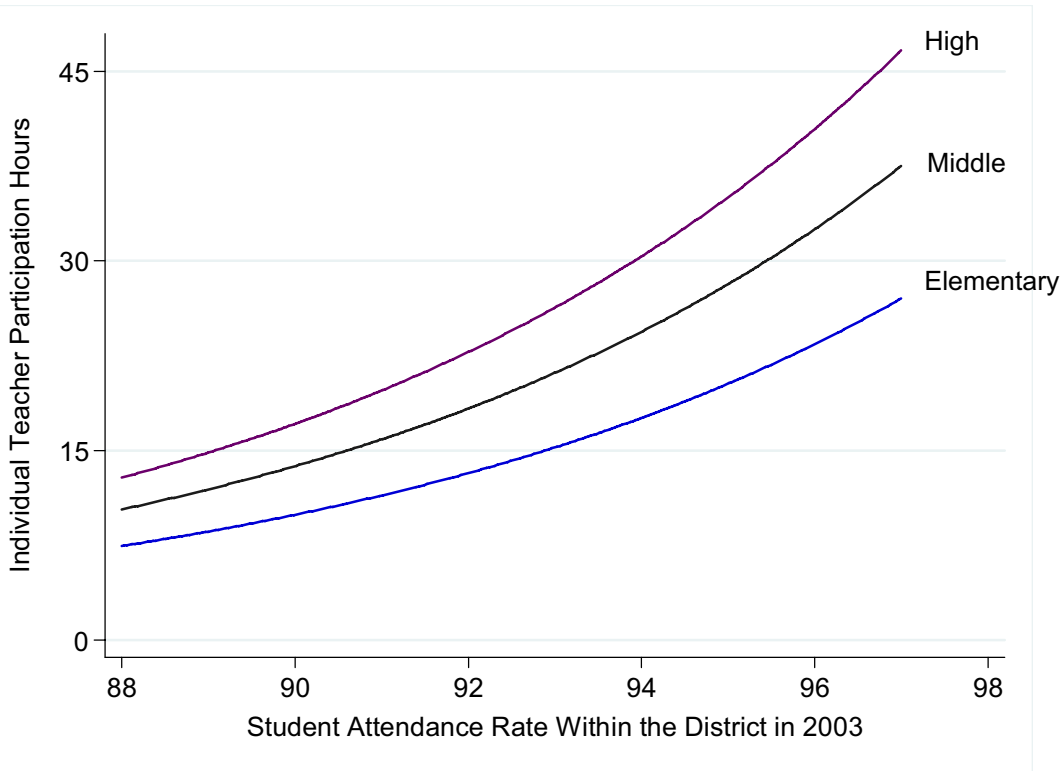
Consistent with the school-level aggregate findings described above, we found that the grade level of a teacher's school was a good predictor of the number of participation hours the teacher completed, given that the teacher participated in MSP activities at all. Holding constant the other predictors in the model, high school teachers completed the largest number of hours, followed by middle school teachers, with elementary school teacher participants completing the fewest hours on average ( $p < .0001$ ). Working in a high school was positively associated with a difference of 0.79 in the base-2 logarithm of total participation hours. Working in a middle

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<sup>5</sup> We report the difference in hours associated with a ten-percentage point difference in students eligible for subsidized lunch, because given the very small effect size, the effect of a one-percentage point difference in subsidized lunch population is negligible.

school was positively associated with a difference of 0.47 in the base-2 logarithm of total participation hours. Thus, for three highly qualified teachers in schools and districts with traits at the sample means, a high school teacher was predicted to complete 17.1 hours of MSP participation during the first three years of the MSP, versus 13.8 hours for a middle school teacher and 9.9 hours for an elementary school teacher. These relationships are illustrated in Figure 5.

**Figure 5.** Estimated participation hours for highly qualified teachers in elementary, middle, and high schools, conditional upon having participated at all, in a prototypical district with an average teacher salary of \$49,948 and a prototypical school with 32.98% of students qualifying for subsidized lunch. (n=2826)



Finally, we found that teacher participants whose districts had reported them as highly qualified under NCLB completed twice as many hours as those who were not reported as highly qualified, all else being equal ( $p < .0001$ ).

Not surprisingly, most of the variance in the number of hours completed by teacher participants existed among individuals rather than among districts or schools. In the unconditional (intercept-only) model, 74% of the variance existed among individuals within schools, while 16% existed among schools within districts, and 10% existed between districts. Our final model for question four, which included district, school, and individual-level predictors, explained 28% of the small variation among districts, but was more successful at the school level, explaining 41% of the variation among schools. It was quite unsuccessful at the individual level, since a teacher's status as highly qualified as defined by NCLB explained only 7% of the variation among individuals within schools.

## **VI. Discussion**

The MSP is designed as a strategy for taking math and science instructional reform to scale. Therefore, it is important that a wide range of educators gain exposure to the MSP's professional development offerings. Still, to achieve the goal of large-scale reform, the MSP aims to create deep and sustained learning opportunities for adults in order to promote classroom instruction that is more than "a mile wide and an inch deep" (Schmidt et al., 2002, p. 3). It is therefore also important that educators in MSP districts gain repeated exposure to learning opportunities, so these educators have time to develop new insights about teaching and to incorporate those insights into their practice.

The relationship between central administrator and superintendent participation and the percentage of teacher participants in a district affirmed a hypothesized, positive relationship between central office participation and teacher participation in MSP activities. Still, we were concerned that the absence of an apparent relationship between administrator behavior and the

*number* of hours completed by each teacher participant might suggest that administrators are directing their efforts toward breadth of staff exposure rather than toward depth of staff engagement. However, this is not the only possible explanation for the finding. A more innocuous explanation could hinge on the process of making On-Site Academies available for teachers. For a Teacher Leader to deliver an On-Site Academy to her peers, she must be able to obtain time slots and physical space, and she must be able to draw attendees, either by publicizing the professional development, or making it mandatory, or both. All of these endeavors require the support of district and/or school administrators.

This project's Year Two Evaluation Report indicated that Teacher Leaders had difficulty making the On-Site Academies part of the professional development agenda in some districts (Williams et al., 2005). Differences among individuals' probability of participation associated with central administrator and superintendent participation could simply reflect differences in administrators' willingness to prioritize On-Site Academies, and this is a possibility that we may examine in future analyses. As noted above, we also tested that possibility that superintendent participation was related to an individual's total participation hours *if* the individual was a person with high participation, though we did not find this to be the case.

At the school level, we did find that school administrator participation was related to non-administrator participation, but only in districts with superintendent participation. One possible explanation is that in districts with superintendent participation, school administrators were more likely to see their own MSP professional development experiences as part of a larger, district-wide initiative that they must advance within their schools, rather than seeing it as a circumscribed part of their own professional learning and growth.

An intriguing finding that was not part of our original research question was that school level (elementary, middle or high school) was a good predictor of aggregate school participation hours and of the number of hours that teacher participants completed, even when the number of eligible teachers in the school was held constant. There are two possible explanations, and they are not mutually exclusive. One possibility is that the availability of participation opportunities at elementary, middle, and high school levels is not the same. Since a number of MSP activities, such as Teacher Leadership Academies, have fairly small enrollment limits, and since almost all elementary school teachers teach math and science, whereas comparatively few middle and high school teachers do, it is possible that a smaller share of elementary teachers than middle and high school teachers actually have access to MSP professional development. Typically, there are only about two Teacher Leaders per subject area and school level in a district. Thus, given that there are typically more eligible teachers of math and science in an elementary school (where most teachers are generalists) than in middle or high schools,<sup>6</sup> it seems reasonable that on average, participants at the high school and middle school levels would complete more participation hours than their counterparts at the elementary school level. Furthermore, while On-Site Academies are not intended to have enrollment caps, anecdotal evidence suggested that in some districts, they may have been limited at the elementary level to teachers of particular grades.

The alternative (but complementary) possibility is that teachers in high schools are simply more interested in math and science professional development than are teachers in middle schools, and that those in middle school are more interested than those in elementary schools. To the extent that this is true, it may be partly because teachers of higher grades have more math and science confidence than their counterparts in lower grades, or because teachers in lower

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<sup>6</sup> Specifically, 77% of elementary school teachers in these districts were subject generalists, compared to 23% of middle school teachers and 6% of high school teachers.

grades must divide their professional development commitments among the subjects they teach, so that a considerable portion of their time is spent in professional development outside the scope of the MSP.

Overall, it seems plausible that the ratio of eligible participants to Teacher Leadership slots is larger for elementary school teachers than for middle or high school teachers, but also that constraints on access are not the only source of differences in participation among schools. For instance, other professional development activities that are available to all three levels, such as the Content Deepening Seminars, are undersubscribed.

Our model predicting the number of hours teacher participants completed explained only 7% of the variation among individuals. This is not especially surprising since the individual-level predictors we tested, highly qualified status and years of experience, would not seem to be particularly nuanced indicators of teachers' propensity to pursue professional training, and only highly qualified status was significant in the final model. Since highly qualified status is an indicator of the teacher's education and preparation, the finding may indicate that teachers who are better prepared are more likely to seek additional professional development. However, highly qualified status might also be interpreted as a measure of a teacher's commitment to the profession. A teacher who has obtained the training needed to be highly qualified may be planning a longer-term career in teaching than a teacher who has not obtained such status, and thus the former teacher might be more inclined to invest time in additional training.

An additional caution is in order when interpreting the highly qualified status coefficient, since districts were required to report this statistic only in the first year of the project, and thus it is possible that teachers listed as *not* highly qualified are disproportionately those who joined their respective districts in Year Two or Year Three of the study. Since the database does not

indicate when an individual entered or left a district, is possible that teachers listed as *not* highly qualified completed fewer hours on average because they had spent less time in their respective districts, and not because they were actually less qualified under NCLB.

In addition, the model of teacher participants' total hours explained only a quarter of the variation among districts, and the effects of the district-level predictors were not consistent with what the previous models had led us to expect. For instance, we were surprised to note that average teacher salary in the district was negatively related to the number of hours a teacher participant completed, though the relationship was small. We wondered whether the average salary in this case may have been a proxy for average years of teacher experience in the district. This interpretation would render the finding less surprising, given that districts with more experienced teachers may be more cautious about embracing large-scale instructional change. However, variation among average district salaries in Pennsylvania is a function of resources and property tax bases as well as of differences in average teacher experience levels. Consequently, the small negative effect of average district salary is difficult to interpret.

The other noteworthy finding at the individual level was that, among teacher participants, student attendance rates were positively associated with hours of participation, while other measures of district effectiveness and district demographics were not. Insofar as district attendance rates are indicators of organizational stability and effectiveness, it was not surprising that attendance rates and participation hours would be positively correlated. However, it was somewhat surprising that demographic indicators that were significant in the prior models were not useful in predicting the number of hours completed by district participants. For instance, the percentage of minority students in a district was negatively related to the number of hours completed within a district and to the probability that an individual school-based staff member

would participate at all. However, it was not related to the number of hours that participants completed, which was instead predicted by district attendance rates. This discrepancy suggests that among teachers who *do* participate in MSP activities, the number of hours they complete is explained less well by predictors of district's aggregate engagement (such as percent of minority students) than by apparent indicators of organizational effectiveness (of which student attendance rates may be one).<sup>7</sup>

The model responding to question four was most effective in explaining variation among schools. Knowing the school level at which a teacher worked and the percent of students qualifying for free or reduced-price lunch in the school explained almost half of the variation in participants' hours among schools. This finding was consistent with the school-level findings discussed above, in which high schools had more hours of participation per eligible staff member than middle schools, and in which elementary schools had the fewest hours per eligible staff member among the three levels.

#### *Limitations of the Study*

The results presented here are informative, but as with the results of any non-experimental analysis, they should be interpreted with caution. A crucial limitation of these findings is that they are correlational and thus cannot be used to draw causal inferences. We looked at the relationship between the participation of administrators and other staff based on our theory that MSP involvement among individuals with official leadership roles may partially drive the involvement of staff members on lower rungs of the organizational hierarchy. While our results are largely consistent with that theory, we cannot rule out the possibilities of reverse causation or omitted variable bias. Reverse causation would suggest that, at least in some cases,

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<sup>7</sup> The negative relationship between a district's share of minority students and its aggregate participation hours among school staff (see Table 2) should also be interpreted cautiously due to the strong positive skew in the share of minority students in the sample districts.

subordinates' engagement with the MSP might drive the engagement of their supervisors. This would seem possible if, for instance, a Teacher Leader were very involved with MSP professional development and strongly advocated its school-wide importance when speaking to her principal or other school administrators. It is also possible that a school staff member would lobby central office administrators, including the superintendent, to attend more MSP activities.

Another limitation of our ability to draw causal inferences is the potential for omitted variable bias, whereby the relationship between administrator participation and other staff participation is the result of other variables that are correlated with both types of participation but are not included in the models. For instance, our predictors did not capture the political and instructional pressures districts face. If, for instance, there were vocal parent support for improved math and science instruction in a certain district, it might explain why administrator and other staff participation hours were similarly high. On the other hand, some districts might have been engaged in other reform initiatives (a literacy reform, for instance) that distracted both administrators and other staff from engaging in MSP activities. Because we did not have information about such variables in our database, we could not control for all such potential sources of bias, nor could we rule out other potential unobserved variables (such as overall district morale) that are intrinsically difficult to measure. In the absence of an experimental design in which districts would theoretically be equal on all unobserved characteristics, we cannot claim that administrator participation causes staff participation—only that the two types of participation are related.

Yet another limitation concerns the small sample size of districts, which limits the statistical power of the study. For instance, because we had only forty-eight districts, there were some cases where we found large effects but also large standard errors. A case in point was the

main effect of superintendent participation on aggregate district participation, where the main effect was a difference of 576 participation hours among school based staff, but where the fact that only twelve of forty-eight districts actually had superintendent participation left us able to reject the null hypothesis at only the 0.1 level ( $p=.075$ ).

Our use of participation hours as a measure of professional development engagement constitutes another limitation of the study, since the number of hours an individual completes tells us little about the amount of learning that individual may have gained from those hours or the amount of commitment to MSP principles the individual then carries into his or her daily work. Though we interviewed MSP directors and one district leader about their perceptions of the relative impact of each type of professional development, the relative importance of each activity was difficult to quantify based on theory alone. Thus, we intend ultimately to estimate the relative impact of each activity on student learning by modeling student achievement growth as a function of educators' involvement in various forms of MSP professional development. In the meantime, we were left to assume that an hour of participation in a given activity yielded as much learning per participant as an hour of participation in a different activity, or in the same activity delivered on a different day or by a different instructor. Because this assumption is questionable, it is difficult to draw strong conclusions about educators' learning of or commitment to MSP content based merely on the total number of hours they spent in MSP activities.

A final limitation concerns the external validity of our results. The largest district in the sample enrolled fewer than 8,000 students in 2003-2004, and thus it is not clear that a superintendent's MSP participation would have had such a strong association with staff behavior in larger districts where more layers of institutional hierarchy existed between the superintendent

and the school-based staff. If the role of the superintendent is to convey a strong vision to school administrators, as our school-level analysis suggests is possible, then perhaps the effect of superintendent participation would remain salient even in larger districts. At this point, however, we can only speculate as to whether apparent superintendent and central administrator effects pertain only to relatively small districts.<sup>8</sup>

### *Conclusion*

This study reinforces findings in the literature showing positive relationships between administrative leadership in central offices and the professional growth and development of school staff. The findings here are largely consistent with our hypothesis that administrator participation is related to staff participation. As we have explained, these findings should not be interpreted as causal, but they do lend support to the idea that MSP participation at or near the top of a school district's organizational hierarchy is related to participation among individuals working in schools. The findings also lend justification to the MSP directors' emphasis on administrator engagement and participation.

While we did not find statistically significant effects for school leaders' participation except in districts that also had superintendent participation, we must caution that 41% of schools (87 out of 212) had no school administrator participation hours on record, and that the results might have looked different if a larger share of school administrators had participated. Thus, continued efforts to engage school leaders seem appropriate, as do continued efforts to encourage central administrators' involvement. In particular, the results suggest that

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<sup>8</sup> Though there is some variation in district size within the sample, the number of districts with superintendent participation is too small to determine whether there is a two-way interaction between district size and superintendent participation.

encouraging superintendent participation in at least some MSP activities would be unlikely to do harm, and might do considerable good.

On the other hand, the findings raise concerns that observed administrator effects are consistent with the “mile wide and inch deep” professional development philosophy that the MSP is working to overcome. Given the finding that central office professional development hours and superintendent participation are associated with higher probabilities of participation but not with more hours among participants, it is possible that administrators are actively focusing their professional development marketing efforts on exposing more individuals to the MSP rather than to enforcing the idea of deep and sustained learning. The project’s K-12 case studies in Year 4 can investigate the extent to which this is the case, and if it appears to be the case, then the MSP may wish to focus even more effort on educating central administrators about the MSP’s vision and foundation in research.

An alternative possibility, however, is that the natural role of central administrators is to help schools provide space and time for On-Site Academies, rather than to stir up enthusiasm for the Academies. In other words, it is not obvious that central administrators are making a concerted effort to advance breadth of exposure over depth of engagement. Perhaps their work naturally is apt to have a greater effect on access than on motivation.

While this study provides some insight about the relationship between administrator and staff participation in MSP professional development, further work is needed to increase our knowledge of how to maximize educators’ engagement in an intensive, comprehensive reform. Supplemental qualitative analyses can help shed light on some of the questions raised in this analysis, and may continue to build our understanding of factors that will shape the lasting impact of the Math Science Partnership.

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