RUNNING HEAD: TEACHER COMMUNICATION AND STUDENT ENGAGEMENT

The Effect of Teacher-Family Communication on Student Engagement: Evidence from a Randomized Field Experiment

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The idea for this experiment was originally conceived by Michael Goldstein of MATCH Teacher Residency, and is the first research partnership between MATCH Teacher Residency and EdLabs. The methodology was reviewed and approved by the Harvard Committee on the Use of Human Subjects in Research. An accompanying essay - "Overcoming The Transaction Costs Associated With School-Based Randomized Research" - is forthcoming. This study was made possible in part thanks to the financial support of EdLabs and the Institute for Quantitative Social Sciences at Harvard University. The authors would like to thank Michael Goldstein, Orin Gutlerner, Erica Winston, Laura Schwedes, Brittany Estes, Veronica Gentile and the staff and teacher residents of Match Charter Public Schools for their continued support throughout this research. We are also indebted to Richard Murnane, Heather Hill, John Willett, Lindsay Page, and Angela Boatman for their invaluable advice and helpful feedback on earlier drafts. All errors and omissions are the authors' own.

Abstract

In this study, we seek to evaluate the efficacy of teacher communication with parents and students as a means of increasing student engagement. We estimate the causal effect of teacher communication with parents and students on student engagement by conducting a randomized field experiment in which 6th and 9th grade students were assigned to receive both a daily phone call home and a text/written message during a mandatory summer school program. We find that frequent teacher-family communication immediately increased student engagement as measured by homework completion rates, on-task behavior and class participation. On average, teacher-family communication increased homework completion rates by 6 percentage points and decreased instances in which teachers had to redirect students' attention to the task at hand by 32%. Class participation rates among 6^{th} grade students increased by 33% while communication appeared to have no effect on 9^{th} grade students' willingness to participate. Drawing upon surveys and interviews with participating teachers and students, we identify three primary mechanisms through which communication likely affected engagement: stronger teacher-student relationships, expanded parental involvement, and increased student motivation.

> *Increased communication improved student engagement in class. I was able to look students in the eye at class and remind them of what I spoke to them about the previous evening on the phone, or spoke to their parents about on the phone. The students knew that I noticed everything and that I was going to hold them accountable for their actions. I found students more eager to appear vulnerable in class, less reticent, and more compliant to rules and procedures. I saw students improve on noted weakness quickly.*
>
> – 9th grade non-fiction MATCH summer academy teacher

Two widely documented findings in educational research, that teachers profoundly affect student achievement (Rivkin, Hanushek & Kain, 2005; Nye, Konstantopoulus & Hedges, 2004) and that some teachers are far more effective than others (Sanders & Rivers, 1996; Gordon, Kane, & Staiger, 2006), have been catalysts for a wide variety of education policy reforms aimed at improving the quality of teaching in U.S. public schools. These facts have been used to justify rapid changes to the ways in which districts recruit, evaluate, and dismiss teachers. However, this body of research provides little practical information that might help the 3.5 million current U.S. teachers become more effective. While it is clear that teachers matter a great deal, we still know very little about why some teachers are better than others or what effective teaching looks like. A review of the Institute for Educational Sciences' (IES) What Works Clearinghouse reveals that researchers have produced little in the way of usable teacher practices (Yoon et al., 2007).

We sought to begin filling this gap by asking the question - what can teachers do to make their students more engaged in their schooling? A large body of literature finds that a high level of student engagement is the cornerstone of effective classroom instruction (Wang & Holcombe, 2010). Descriptive research (Connell & Welborn, 1991) and anecdotal evidence (Mahler, 2011) suggests that the nature of relationships between teachers, students and their parents play an important role in determining a child's level of engagement with school. In this paper, we attempt to determine whether teacher communication with parents and students causes students

engagement to increase. Furthermore, studying teacher-family communication is attractive because it is a low-cost, easily implemented, and potentially underutilized teaching practice. Findings from the 2007 National Household Education Surveys Program (Herrold et. al., 2008) show that less than half of all families with school-age children report receiving a phone call from their child's school, and only 54% report getting a note or email about their student. If communicating with parents and students is an effective method of stimulating higher levels of academic engagement, far more teachers and students in the United States could be benefitting from this practice.

We evaluate the efficacy of teacher-family communication by working in partnership with a charter school in Boston, Massachusetts to conduct a cluster-randomized trial during a mandatory summer school academy. Our research design allows us to directly address three fundamental challenges researches are faced with when attempting to conduct causal research on educational practices. First, the non-random sorting of teachers and students across and within schools presents a major challenge for any type of observational research in schools (Clotfelter, Ladd, & Vigdor, 2006). We overcome this non-random sorting by randomizing both students and teachers to classes. Secondly, the presence and dynamic nature of peer effects – i.e. how a student and their classroom peers affect each other – often confounds attempts to isolate the effect of educational practices on individual students. We eliminate the possibilities of within classroom spillover effects due to peer interactions by randomizing entire groups of students who take their classes together to either the treatment or control condition. Thirdly, researchers who aspire to conduct experimental research in schools, particularly in the U.S. context, must address many important concerns about equity and the potential for adverse effects. We do this by

staggering the treatment in a way that allows for both an experimental evaluation while eventually providing all students with the potential benefit of additional communication.

In conducting this experiment, we make two important contributions to the literature. To our knowledge, we present the first causal evidence of the effect of personal communication between teachers and parents, and teachers and students on student engagement in U.S. public schools. Past evaluations of teacher-parent communication have largely focused on generic pre-recorded messages or written progress reports sent home with students, neither of which have the potential to be interactive. Secondly, we capture extremely fine-grained measures of student engagement in the classroom by conducting classroom observations of well-defined, quantifiable student behaviors. These data provide a unique opportunity to examine how teacher-family communication affects students' behavior and participation in the classroom.

In what follows, we present evidence of the importance of student engagement and the link between engagement and teacher-family communication. We continue by describing our research site and our experimental design. We outline the multiple sources of data we draw upon and the methods we use to analyze these data. We then present our findings and discuss three potential mechanisms behind our results that emerge from surveys and interviews with teachers and students who participated in the study. Lastly, we conclude by outlining the policy implications of our findings and highlighting important areas for further research.

II. Student Engagement in the Literature

Our overall theory of change views student engagement as an important mediator of academic achievement with teachers and parents as the principal actors influencing student engagement. A large body of research has documented the strong positive relationship between

student engagement and learning outcomes (Connell, Spencer, & Aber, 1994; Connell & Wellborn, 1991; Finn & Rock, 2007; Klem & Connell, 2004; Marks, 2000; Skinner, Wellborn, & Connell, 1990). Because student engagement appears to be a meaningful means of promoting learning, it is important to know how to conceptualize and operationalize this concept.

Student engagement has been theorized as a multi-dimensional construct. In their review of the literature on student engagement, Fredricks, Blumenfeld, and Paris (2004) divide engagement into three dimensions: behavioral, emotional, and cognitive. Behavioral engagement has been defined in several ways but may be best described as two sub-constructs: the avoidance of negative and disruptive classroom behaviors (Finn, 1993; Finn, Pannozzo, & Voelkl, 1995; Finn & Rock, 1997), and positive participation evidenced through attentiveness and asking questions (Birch & Ladd, 1997; Skinner & Belmont, 1993). The literature defines emotional engagement as related to student attitudes and affective responses towards schooling (Connell & Wellborn, 1991; Skinner & Belmont, 1993). Cognitive engagement is understood as students' investment in learning, and is defined both as their willingness to exceed requirements (Connell & Wellborn, 1991; Newman, 1992), and their motivation or ability to self-regulate (Brophy, 1987; Pintrich & De Groot, 1990). In their consideration of the literature that examines each of these dimensions, Fredricks, Blumenfeld, and Paris note the interrelated nature of these dimensions and suggest that though there have been studies that seek to measure each of these dimensions separately, there has been insufficient study undertaken to measure engagement as a unified construct.

Existing research has documented that a students' engagement in school is continuously shaped by their relationships with adults and their schooling environment (Connell, 1990; Finn & Rock, 1997). There is a large body of evidence that documents the important role teachers play

in molding student engagement (Battistich, Solomon, Watson, & Schaps, 1997; Furrer & Skinner, 2003; Ryan & Patrick, 2001). Specifically, demonstrated teacher caring has been shown to be associated with increases in students' academic effort (Wentzel, 1997, 1998), which is suggestive of how emotional engagement might translate into cognitive engagement. Parents also play a central role in shaping their children's behavior and engagement in school. Earlier work has shown that involving parents in their children's schooling can improve students' academic achievement (Barnard, 2004; Seitsinger et al., 2008).

Together, these studies suggest that an intervention focused on influencing students' engagement through teacher and parent communication has the potential to affect student engagement and academic outcomes in positive ways. However, the only experimental evidence available for the impact of teacher communication on student engagement was produced by one small scale study of four Algebra I classes. In this study Shirvani (2007a & 2007b) found that sending individualized "monitoring" reports home to parents twice a week for twelve weeks increased homework completion and decreased disciplinary referrals among the treatment group.

Several other studies provide suggestive evidence that communicating with students' families by phone can result in positive academic benefits for students (Bittle, 1975; Burstyn, 2010; Chapman & Heward, 1982). In a small-scale study to look at the effects of school to home communication in a rural community Bittle (1975) used pre-recorded, automated phone calls to parents from teachers and found that the system resulted in larger numbers of parent-initiated contacts to the teacher, and improved performance on spelling assessments. Chapman and Heward (1982) replicated the Bittle experiment in a special education classroom and find similar results. While these two studies directly examined communication between the teacher and

parents, their results rely solely on changes in one classroom over time and are not contrasted against comparable trends in a non-treated comparison group.

In a larger and more recent study, Burstyn (2010) conducts several randomized trial with parents living in the favelas of Rio de Janeiro, Brazil in which he finds that parents show a clear preference for receiving communication from schools regarding their child's attendance. In this experiment, parents received text messages from schools indicating whether or not their child had attended school. Though this recent paper produces plausibly causal results that are evidence of parental desire to receive communication from schools regarding their student's presence, it does not examine student behavioral or academic outcomes. The Burstyn study is also designed in a different cultural context where preferences for schooling may differ substantially from the U.S. context. We aim to expand this literature by examining experimentally whether increased teacher-family communication affects widely recognizable and easily measured indicators of student engagement.

III. Research Design

MATCH Charter Schools and Teacher Residency

We conducted this experiment during the 2010 summer academy at MATCH Charter Public Middle School and High School in collaboration with the Founder of MATCH, Michael Goldstein. Like many Boston Public Schools, MATCH serves a largely low-income, minority student population; 78% of students are eligible for free or reduced priced lunch and 93% of students are Hispanic or African-American. Like most oversubscribed charter schools, students at MATCH are admitted through a lottery. Incoming sixth and ninth grade students at MATCH are required to attend a four week summer academy in which they take a math, two English

(fiction and non-fiction) classes and a class about the culture and norms of the schools. With the support of the MATCH staff, we obtained active written consent from the parents of 140 out of 145 students, a 97% consent rate.

Classes during the summer academy are taught by members of MATCH Teacher Residency, a year-long teacher training program operated by and embedded within MATCH. Resident teachers spend the academic year working as tutors for a group of 7-8 students as well as developing their teaching practices in small classes one day a week. The summer academy serves as the residents' student teaching practicum requirement in order to obtain an initial teaching license. Twenty-one resident teachers taught during the 2010 summer academy.

Experimental Framework

In order to isolate the causal effect of teacher-family communication on student engagement we designed a cluster randomized trial that addressed concerns about both equity and potential spillover effects. The MATCH summer academy schedule is organized so that students take all of their classes with the same classmates throughout the program. We began by randomly assigning students to their class-taking groups and teachers to their classes. We then randomly assigned entire class-taking groups to either the treatment or control condition so that students in the treatment group would only attend classes with their treatment group peers. This design effectively eliminates the possibility of classroom spillover effects by clustering the control and treatment group students into non-overlapping classes (Cook, 2005). By assigning treatment at the class-taking group level, we capture both the effect that communication has on an individual student as well as any effect that a change in peer engagement has on a student's own engagement. MATCH summer academy teachers all teach two classes per day, which allowed us to prevent the potential confounding of teacher quality with the treatment effect by

assigning each teacher to one class of control students and one class of treatment students. Additional steps were also taken to limit the variability of call quality across teachers by training them to follow a set conversation protocol which consisted of four main topics: academic progress, classroom behavior, improvement goals, and homework assignments.

The experimental treatment consisted of two components of increased teacher communication. Treatment students were assigned to receive one phone call home per day from either their fiction or non-fiction teacher. These calls were shared across the two teachers to lessen the overall time burden of making the calls for each teacher. In addition, treatment students were also assigned to receive daily text/written messages from their math teacher. We provide a timeline of the study in Figure 1. Students received treatment for a total of five consecutive days during the second week of the summer academy. In order to accommodate important concerns about equity, the treatment regime was switched to the control group midway through the summer. While this immediate contamination of the control group prevents us from analyzing the persistence or fadeout of any treatment effects, it was the key design feature that allowed school administrators to gain parental support for the experiment.

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Student Engagement Measures

In order to obtain fine-grained, reliable measures of student engagement, we designed a classroom observational protocol specifically for this purpose. We began by selecting and training a group of 16 raters to collect data for every single student in every class during the summer academy. We trained raters to observe and record the number of instances each student participated in class as well as the number of instances when a teacher redirected a student's attention or behavior.

Rater training took place in two phases, an introductory phase and a live training phase. In the first phase, we trained raters how to survey the classroom to simultaneously observe all (8-12) students and established consistent criterion for what constituted a redirection or voluntary participation. Redirections were defined as instances in which the teacher clearly addressed herself to specific students in an effort to refocus their attention or to instruct them to improve their behavior. Participation was defined as instances in which students either voluntarily offered to respond to a question posed by the teacher to the entire class or independently asked a question or made a comment that was relevant to the academic content of the lesson. Raising a hand in response to a teacher's question to the class was coded as an instance of participation while responding to a question posed directly to a student was not.

The live phase of the training took place over the course of two days at the beginning of the MATCH summer school academy. Groups of raters conducted four practice observations over two days, with debriefing sessions held after each observation to calibrate responses and resolve rating discrepancies. Throughout the experiment, we rotated teams of raters at each school across classes to maximize the number of possible rater-student combinations in an effort to minimize any potential impact of rater bias. Additionally, each classroom had a designated seat for the raters to ensure all raters had the same vantage point in every class. Throughout the experiment, rotating pairs of raters were assigned to observe the same classroom. Using 816 pairs of ratings captured for the same students in the same class, we calculate Cronbach's alpha reliabilities of 0.76 and 0.87 for our count measures of redirections and participation, respectively. These high levels of inter-rater reliability suggest our raters were quite consistent at reliably observing and counting instances of student participation and redirections for all the

students in a given class. Raters were also kept blind to the assignment of treatment throughout the experiment to prevent any potential for rating bias across treatment and control group classes.

We complement these observational measures of student engagement in the classroom with class-specific homework completion records. Students were assigned homework on a daily basis in each of their three academic classes and required to hand in their homework upon arriving at school the next day. School administrative staff would then review the homework and record whether the students had turned in an on-time, completed assignment. Finally, we combine these measures of student engagement with student demographic characteristics, which we use to examine the efficacy of our randomization process, and student academic data, which we use to demonstrate the association between student engagement and academic achievement. These data include traditional demographic information such a race, gender, age, low-income status, special education status, preferred home language and English proficiency status.

Using these data, we construct a panel data set that consists of 140 students, clustered into 14 class-taking groups, observed in three classes across the three day pre-experimental period and the five-day experimental phase. This results in 3,360 unique student-day-subject observations. We conduct our analyses of homework completion rates, *HWK_COMPLETE*, in this student-day-subject dataset. We then sum observations across the three subjects in a given day to obtain a student-day panel data set that consists of 1,120 observations. We use this data set to model our two count variables of classroom engagement, the number of times a student was redirected, *REDIRECT*, and participated, *PARTICIPATE*, during the course of the school day.

In order to monitor the implementation of our treatment regime, we asked teachers to complete daily phone and text/written message logs. These logs captured data on whether a call

was made, whether someone answered the call, and who the teacher spoke with if someone did answer. A research aid followed up with any teacher that did not fill out their phone or text logs within 24 hours after the phone calls and text messages were scheduled to occur. At the end of the summer academy, each resident teacher also completed an anonymous survey that consisted of eleven open response questions designed to elicit feedback about their experience implementing the focused communication. Finally, we conducted four student interviews, two students each from 6th and 9th grade, to better understand students' perceptions of the increased communication.

Data Analysis

In our analyses, we seek to capitalize on all the information captured in our panel of data while appropriately modeling the distinct data generating processes and hierarchical nature of our data. Our quantities of interest are the intent-to-treat (ITT) effects of teacher-family communication on three measures of student engagement. These quantities represent the average treatment effect of the assignment to receive frequent communication rather than the direct effect of the communication itself. We focus our analysis on the ITT effects because these are the relevant quantities of interest for policy makers and principals when considering whether to implement a teacher-family communication initiative. We begin by modeling the probability a student turned in a completed homework assignment using a random-effects linear probability model. Our results are not sensitive to our choice of a logistic or linear-probability model, so we favor the linear probability model since it produces results that are more easily interpreted. We express the dichotomous outcome *HWK_COMPLETE* as the following linear equation:

$$\text{(I)} \quad P(HWK\_COMPLETE_{ijt} = 1) = \beta_1 EXP\_PHASE_t + \beta_2 EXP\_PHASE * TREAT_{it} + \pi_g + \upsilon_i + \varepsilon_{ijt}$$

where $P(HWK\_COMPLETE_{ijt} = 1)$ represent the probability student *i* turns in a completed homework in class *j* on day *t*. This specification has several important features that allow us to maximize the information contained within our panel of data while appropriately modeling the clustered error structure. The variable *EXP_PHASE* is an indicator for observations that occur during the experimental phase of the study and captures any common change in homework completion rates for all students during the experimental phase. We also interact *EXP_PHASE* with an indicator for treatment assignment status, *TREAT*. This interaction term takes on a value of 1 for all students assigned to treatment during the experimental phase of the study. Thus, the coefficient β_2 represents the intent-to-treat effect of teacher-family communication on the probability a student will turn in a completed homework assignment. Finally, we include fixed effects for all 14 class-taking groups, π_g, and random effects for students, υ_i, in order to account for the hierarchical nature of our data where observations are nested within students and students are nested within class-taking groups. We omit the main effect of treatment assignment status, *TREAT*, and fixed effects for schools because these indicators are collinear with fixed effects for class-taking groups.

Modeling the causal effect of teacher-family communication on our two count variables of classroom engagement, *REDIRECT* and *PARTICIPATE*, requires an important modification to the model specified in equation (I). The highly skewed distributions of our count variables shown in Figure 2 cause us to modify equation (I) by modeling the data generating process of our event count variables using the negative binomial distribution (Cameron & Trivedi, 1998).

Unlike other common event count models such as Poisson regression, the negative binomial model does not assume that the probability of an event occurring is independent of the past history of events. Our data would clearly violate this independence assumption. For example, if a teacher praises a student for a correct answer she might be motivated to volunteer again for the next question. Likewise, a student might be less likely to disturb the class after being reprimanded. As before, we include random effects for students, which in the negative binomial model allows for the rate of event occurrences to systematically differ across individuals. This decision is supported by the data where we observe some students being redirected or participating in class many more times than their peers.

We can express the stochastic component of our random-effects negative binomial model as:

$$\text{(IIa)} \qquad \Pr(Y_{it} = y_{it}|\lambda, \delta) = \frac{\Gamma(\lambda_{it}+y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it}+1)}\left(\frac{1}{1+\delta_i}\right)^{\lambda_{it}}\left(\frac{\delta_i}{1+\delta_i}\right)^{y_{it}}$$

where *y* represents the discrete probability distribution that we observe *y* number of events for student *i* during day *t*. Here the parameter λ represents the expectation of the number of events conditional on the data and the dispersion parameter, δ. When δ equals zero, the negative binomial model is equivalent to the Poisson distribution. We conduct a likelihood ratio test of the null hypothesis that δ is equal to zero to test the appropriateness of our choice of event count distributions. Finally, we express the parameter λ as a function of the same structural components specified in equation (I):

$$\text{(IIb)} \qquad \lambda_{it} = \exp[\beta_1 EXP\_PHASE_t + \beta_2 EXP\_PHASE * TREAT_{it} + \pi_g\ ]$$

where λ represents the predicted number of times a student is redirected or participates in three class periods for student *i* during day *t*. As before, β_2 is our coefficient of interest which captures the intent-to-treat effect of teacher-family communication on student classroom behavior (participation). We present exponentiated parameter estimates, commonly referred to as incidence rate ratios, and their corresponding t-statistics from equation (II) in Tables 3 and 4 for ease of interpretation.

IV. Communication Increases Engagement

It is important to highlight that our findings focus on the effects of *prescribing* teacher-family communication. Although systems were in place to monitor and support teachers in the implementation of the treatment, phone call logs reveal that not every student received a phone call on a daily basis. Of the 345 total phone calls that we prescribed for students to receive, 299 were made by teachers – a compliance rate of 86.4%. Ultimately, only 54.9% of all prescribed calls resulted in a live conversation with a parent or guardian. Given this modest communication success rate, our ITT estimates of the effect of prescribing communication will necessarily understate the direct effect of communication on student engagement.

We begin by examining the validity of our random assignment by calculating treatment- and control-group averages for our set of student demographic variables as well as pre-treatment measures of student engagement. We present these values in Table 1 along with the results of t-tests of mean differences across the treatment and control groups for each variable. We find no statistically significant differences on any of the student demographic or pre-treatment measures of student engagement variables at an alpha level of 0.05 suggesting that our treatment and

control groups are equal in expectation on both observable and unobservable characteristics. However, when we examine the averages of our measures of student engagement across treatment and control groups, students in the treatment group appeared to be consistently less engaged during the pre-experimental phase. Their homework completion rate was 5% lower (p=.144), they were redirected more frequently by teachers (p=.056) and they participated less in class on average (p=.408). Although these differences are not statistically significant, we address this common trend in pre-experimental differences in two ways. First we focus on the relative change in average measures of student engagement across the pre-experimental and experimental phases of the study rather than a simple t-test of means during the experimental phase. Secondly, we estimate equations (I) and (II) with student fixed effects. This serves to restrict our estimates to changes within students over time thus removing any time-invariant differences in students' levels of engagement with school.

We present pre-experimental and experimental averages as well as their difference for each outcome in Table 2. These statistics reveal strikingly different trends across the treatment and control groups. On average, students in the control group became measurably less engaged over time; their homework completion rate dropped by 6.5%, they were redirected more frequently by teachers and they participated less in class. In comparison, students in the treatment group largely maintained their initial levels of engagement and improved their behavior; their homework completion rate dropped by only 0.6%; teachers had to redirected their attention less frequently and their class participation remained at a similar level. Importantly, the literature on student engagement suggests that engagement typical starts at high levels at the beginning of the school year and then varies in response to how students' efforts are being rewarded through teacher responses (Skinner & Belmont, 1993) and academic outcomes

(McIver, Stipek, and Daniels, 1991). As a result, evidence of an effective intervention could be one that raises engagement, that maintains initial levels of engagement, or that creates a less-dramatic drop off in levels of engagement. The divergent trends presented in Table 2 provide initial evidence that teacher-communication affects student engagement by maintaining students' initial levels of engagement.

We present estimates from equations (I) and (II) of the intent-to-treat effects of teacher-family communication on our three measures of student engagement in Table 3. Odd-numbered columns contain parameter estimates from our random-effects specifications with class-taking group fixed effects. Even-numbered columns contain estimates where we have replaced student random effects and class-taking group fixed effects with student fixed effects. Across all our measures and model specifications, teacher-family communication has a large, positive and significant effect on student engagement. Results from our linear probability models demonstrate that teacher-family communication increased the probability a student turned in a completed homework by 6.3 percentage points. This estimate remains practically unchanged when we include student fixed effects to account for the possibility of any initial imbalance in our treatment and control groups.

We also find that teacher-family communication had a large and significant effect on students' on-task behavior and classroom participation. Estimates from equation (II) show that students in the treatment group were redirected 0.685 times for every one time students in the control group were redirected. Interpreting this incident rate ratio as a percent change, we find that teacher-family communication reduced the frequency with which a student's attention or behavior in class had to be redirected by 31.5%. The addition of student fixed effects to our model results in an even larger estimated effect of a 38.5% reduction, suggesting that equation

(II) might underestimate the full treatment effect. Classroom participation also increased for students in the treatment group by 15.3%. Again, we find that including student fixed effects to correct for potential imbalance among the treatment and control group results in a larger estimated effect of 28.5%.

We extend these analyses to examine whether these treatment effects were uniform across the incoming 6th and 9th grade cohorts. We replace *EXP_PHASE*TREAT* with two mutually exclusive indicators for observations of 6th grade treatment students during the experimental phase, *EXP_PHASE*TREAT*6GRADE*, and for 9th grade treatment students during the experimental phase, *EXP_PHASE*TREAT*9GRADE* in both equations (I) and (II). This specification allows us to simultaneously estimate the intent-to-treat effect for the 6th and 9th grade cohorts. We present results from these regressions as well as Wald tests of the difference of the coefficients on these treatment variables in Table 4. These disaggregated results reveal that, while there were no meaningful differences in the homework completion rates or frequency of redirections, the effect of teacher communication on class participation appears to be entirely concentrated among the 6th grade students. Estimates from equation (II) show that 6th grade students who were assigned to receive focused teacher-family communication participated 33.2% more often than their control group counterparts. As we found before, when we augment equation (II) with student fixed effects, our estimate doubles to become 66.6%. Wald-tests confirm that these difference in estimated treatment effects are statistically significant (p=.001). In contrast, the estimated incidence rate ratios for 9th grade students drop below one and are insignificant in both models suggesting that there was no effect on participation among the 9th grade cohort. These differences among 6th and 9th grade effects are less surprising in light of literature suggesting that, on average, student become progressively less engaged in school as

they become older (Harter, 1981; Gentry, Gable, & Rizza, 2002; Yair, 2000). We speculate that that this differential treatment effect might be caused by high school students placing a lower priority on pleasing teachers and a reluctance among older adolescents to appear overly academic in front of their peers.

Converting these estimated percentage effects into numbers easily interpreted by practitioners helps to make the effects of teacher-communication even more tangible. MATCH 6th grade summer school teachers teaching a class of ten students in the treatment group received one more complete homework per every two class periods, had to redirect students almost two fewer times per class and had students volunteer 20 more times per class. If we assume these effects are linear across class size, we can scale our findings by using the 2008 national averages for class size in elementary and secondary school of 20.0 and 23.4 students. This exercise suggests that, on average, a typical 6th grade teacher would receive one more complete homework per class, would have to redirect students over three fewer times per class, and would have students participate 40 more times per class. A typical 9th grade teacher would also benefit from this higher rate of homework completion and decreased frequency of redirecting student behavior, but would not enjoy an increased rate of participation

V. Exploring Potential Mechanisms

We identify three key mechanisms through which we believe increases in teacher-parent and teacher-student communication caused changes in student engagement emerge from our teacher follow-up surveys and student interviews: stronger teacher-student relationships, expanded parental involvement, and increased student motivation. We illustrate these

mechanisms using qualitative evidence collected during our study. All names of teachers and students have been replaced with pseudonyms to protect their identities.

Stronger Teacher-Student Relationships

In our follow-up teacher survey, MATCH summer school teachers consistently described positive changes they experienced in their relationships with students. In their words, calling home and texting/writing notes "foster[ed] a better rapport" and "heightened our relationship" with students. Middle school teachers in particular perceived that their improved relations increased students' willingness to ask for help and to seek out approval and praise. At a basic level, taking the time to follow up with a student outside of class demonstrates a teacher's care and concern for that student. Student responses in our interviews suggest that teachers' perceptions of improved rapport were shared by students. One young man at the high school remarked,

> "When she started giving me the notes it helped me start building a bond with the school, making me feel like it was my second home, like she was like a sister or mother to me, and giving me the support, and if there was a problem knowing that she could help me fix it."

Three of the four students that we interviewed expressed similar views about how communicating with their teachers enhanced relational trust between them and their teachers.

Teachers also consistently described how their improved relationships with students helped them to be more effective at classroom management and behavior modification. Teachers perceived that these strengthened relationships allowed a teacher to "ask more of [students] in class without risk of backlash," and caused students to be "much more willing to allow me to push them/talk them down." One high school math teacher wrote,

> "Students had more trust and compliance when behavioral adjustments needed to be made. They didn't see it as dictatorship but rather a reasonable request."

These quotes help to illustrate the likely ways in which more personalized communication caused teachers to have to redirect students' attention and behavior less frequently.

Expanded Parental Involvement

A second complementary mechanism that likely contributed to improved student engagement was enhanced parental involvement. Parental involvement in their children's academics is often limited by the information asymmetry that exists between students and their parents, especially with students in secondary school who see five or more teachers in a day. At a basic level, phone calls home provide parents with more detailed information about their child's academic progress and behavior that has not been filtered by students. Students may then become more accountable at home for their actions and efforts at school. MATCH teachers frequently mentioned instances where a phone call home provided them with increased "leverage." These calls also allowed parents to provide teachers with important contextual information and to suggest strategies for addressing behavior that are successful at home. For instance, a middle school fiction teacher describes one such experience during the experiment:

> "Jorge had a pretty bad day . . . which I discussed in depth with his dad. We discussed ways to bring positive attention to him without allowing room for misbehavior. I never had any trouble with him behaviorally after that point. He was one of the most trustworthy students in the class."

This quote illustrates how parents can support teachers' efforts to address inappropriate behavior. Communicating with parents also allows teachers to provide specific advice about ways in which parents can support the academic achievement of their son or daughter. A fiction teacher wrote,

> "Earl's reading quiz scores were steadily decreasing. I spoke with his mom a couple of times about the necessity of reading really carefully during his homework. His grades went up significantly."

Teachers can empower parents by providing them with specific information about an area in need of improvement and giving them guidance on how to help their child to improve.

Students also noted that the increased involvement of their parents impacted their own perceptions of, and response to the school.

> "I felt relieved that the school actually wanted family support, and then I was also, kind of weird with my mom asking me about this, because usually a school won't call home, they will just make it the parents responsibility to call, but this school they actually want to get the parents involved."

Here a high school student is expressing a degree of surprise about the proactive rather than reactive nature of the calls home. Both middle-school students similarly allude to this same fact. All four of student interviewees mentioned that their general conception of when a teacher would call home was related to something being wrong or their being in trouble.

Increased Student Motivation

Finally, many teachers described ways in which teacher-parent and particularly teacher-student communication impacted student engagement by increasing student motivation. For example, when a high school fiction teacher was asked about how increased communication affected her relationships with students she wrote:

> "During the time the increased communication occurred my students definitely showed more interest and investment in their learning. For instance, some would call or text for clarifying [homework] problems etc. Students inquired on their own accord as to how they did in the class."

Several teachers also wrote that students responded positively to the challenges they posed in their texts and notes. Examples of such texts include, "Thank you for responding so professionally to your demerit today. I know that your talking reflects your enthusiasm and I'd love to see you channel that into a hand raise!" and "I know that math might not be your favorite

subject, but I am looking forward to seeing the courage I know you have as you continue to contribute in class! Let's see that hand raised!" One teacher described how a middle school student was particularly motivated by being awarded "all-star status" on a note for his behavior and participation in class. From then on, the student inquired about what it would take to earn "all-star status" on the final exam. "It's quite likely that Tyson would not have made it through my class had he not had that motivator," his teacher asserts. These examples show how communication that reinforces positive behavior and sets manageable goals can increase student motivation.

VI. Implications for Policy and Practice

In this experiment, we estimate the causal impact of daily teacher-parent and teacher-student communication on student engagement during a mandatory summer academy for entering 6th and 9th grade students at MATCH Charter Public School. We find large and immediate effects of communication on homework completion rates, classroom behavior and participation in class.. The willingness and ability to complete homework and be an on-task and active participant in class are important skills as well as key mediators of academic achievement and progress in school. Homework assignments often comprise a large portion of end-of-course grades, particularly in elementary and middle school. Teachers also commonly include student behavior and class participation in their calculations of grades. Student classroom behavior and participation likewise play a role in mediating the quality of academic instruction that takes place in the classroom. Students who are participating in the task at hand rather than misbehaving are far more likely to be absorbing instructional content and contributing positively to the learning of their peers (Figlio, 2007; Lavy, Paserman, & Schlosser, 2008). Teachers who spend less time

addressing inappropriate behavior have more time for uninterrupted instruction. Studies have shown that teachers who are more effective at behavior management also produce higher student achievement gains (Grossman et al., 2010). In these ways, reducing the misbehavior and increasing the participation of a few students can create positive externalities for all students in the class.

The data lend further support for the importance of homework completion, on task behavior, and participation as key mediators of academic achievement. Homework completion is positively correlated with average summer academy end-of-course and final exam grades (.57 & .38) as is classroom participation (.29 & .26). As expected the average number of redirections students received has a moderate negative association with both end-of-course (-.44) and final exam grades (-.21) averaged across the three summer classes. While our experimental design does not permit us to examine the causal impact of communication on end-of-course and final exam grades, together these correlations suggest that teacher-family communication affects important determinants of student academic achievement.

Generalizing about teacher-family communication policies is inherently difficult because the effect of communication is mediated through the effectiveness of the communicator. Although we attempted to minimize these differences by providing teachers with a conversation protocol, our findings are specific to the ways in which MATCH resident teachers chose to implement our conversation protocol and utilize written texts/notes to students. We also benefited from a relatively high phone call implementation rate of 86.4%. It is unclear whether a mandated teacher-family communication policy would result in such a high rate of compliance at other schools without systems in place to track calls and follow up with teachers who do not complete their calls.

It is also important to acknowledge that the conditions that allowed us to conduct a randomized field experiment place limitations on the generalizability of our findings. Several aspects of this study are different from the typical context in U.S. public schools. The classes, while mandatory and academically rigorous, were during the summer, the teachers were all teachers in training, the class sizes were relatively small, and the students were all from families who were willing and able to actively enroll their son/daughter in a charter school. One can imagine a scenario in which the parents of these students are more engaged in their child's academic experience than the typical parent, causing communication to be particularly effective because of the parents' receptiveness and concern. Going forward, it will be important to replicate this work in other school settings in order to better understand the role that school context plays in mediating the effectiveness of teacher-family communication.

Despite these factors, our results suggest that school-wide efforts to formalize teacher-family communication have the potential to be an effective and low-cost policy to improve student academic engagement. The primary cost to schools of promoting increased communication between teachers and families is the opportunity cost of teachers' time. In many instances, formal time for communicating with parents and students might be provided to teachers by reallocating it from other non-core academic duties such as lunch supervision or hallway monitoring. Evidence from our study suggests that the frequency of calls might also be dramatically reduced with a minimal decrease in effectiveness. Some teachers reported that the daily calls began to feel forced and inauthentic, and perceived that this limited the effectiveness of the communication. Several teachers also reported that parents simply stopped answering their calls. This perception is supported by the data which show that the percentage of calls resulting in a live conversation with a parent or guardian fell steadily over the treatment week

from 75.8% to 56.0%. Calling on a daily basis is an inefficient use of teachers' limited time if calling home less frequently can produce the same or similar effects on student behavior and academic engagement. It is even possible that calling on a less frequent basis would increase the effectiveness of teacher-parent communication because calls would become more genuine and merit stronger attention.

MATCH resident teachers also suggested that calling a predetermined list of students regardless of the days' events was an inefficient approach to teacher-parent communication. Allowing teachers to selectively call students in response to specific issues would likely be a second logical policy modification that would save time and potentially increase effectiveness. The potential downside to a flexible policy is that it would likely result in a far lower than desired frequency of communication and leave open a greater possibility for the inequitable distribution of teacher-family communication.

Discerning what teacher practices meaningfully impact student behavior, engagement and achievement continues to be both a challenging and critically important task for education researchers. This experiment serves as an example of how researchers and practitioners can navigate these challenges in order to conduct rigorous causal research on specific teaching practices in U.S. public schools. Future studies might investigate the direct effect of longer term, but less frequent teacher-family communication on semester grades or standardized test scores. Subsequent studies might also attempt to explore the independent effects of teacher-parent and teacher-student communication. However, these findings strongly suggest that a formalized and frequent teacher-family communication policy can have an immediate impact on important mediators of student academic achievement.

Tables

Table 1: Average student demographic characteristics and pre-experimental measures of student engagement across treatment and control groups (n=140).

	Treatment	Control	Difference	p Value
Student Demographic Characteristics				
Female (%)	44.928	43.662	1.266	0.881
African American (%)	60.870	66.197	-5.328	0.516
Hispanic (%)	37.681	25.352	12.329	0.118
Low-income (%)	73.529	85.294	-11.765	0.091
Limited English Proficient (%)	30.435	16.901	13.533	0.061
Native English Speaker (%)	73.913	76.056	-2.143	0.772
Individualized Education Program (%)	13.043	19.718	-6.675	0.289
Average Age (years)	12.642	12.796	-0.154	0.576
Pre-experimental Measures of Engagement				
Average Homework Completion *(%)*	80.173	85.186	-5.013	0.144
Average Redirections *(per class)*	0.624	0.434	0.190	0.056
Average Participation *(per class)*	5.732	6.247	-0.515	0.408

Table 2: Average homework completion rates and average daily total counts of redirections and class participation during pre-experimental and experimental phases.

	Pre-Experimental	Experimental Phase	Difference
HWK COMPLETE (% per class)			
Treatment	80.541	79.879	-0.662
	n=591	n=994	
Control	85.246	78.682	-6.564
	n=610	n=1032	
REDIRECT (per day)			
Treatment	1.790	1.339	-0.451
	n=207	n=345	
Control	1.197	1.383	0.185
	n=213	n=355	
PARTICIPATE (per day)			
Treatment	16.531	16.331	-0.200
	n=207	n=345	
Control	17.415	15.914	-1.502
	n=213	n=355	

Note: The pre-experimental and experimental phases consisted of three classes observed over the course of three and five days, respectively. Samples sizes vary across phases because of the difference in days observed. Sample sizes vary across treatment and control groups within phases because of student absenteeism.

Table 3: Parameter estimates of the intent-to-treat effect of teacher-family communication on homework completion rates, class redirections, and class participation from models using random and fixed effects for students.

	HWK_COMPLETE		*REDIRECT*		*PARTICIPATE*	
	(I)	(II)	(III)	(IV)	(V)	(VI)
EXP_PHASE	-0.07 ***	-0.071 ***	1.073	1.145	0.885 **	0.873 **
	(0.019)	(0.020)	[0.714]	[1.378]	[2.585]	[2.881]
*EXP_PHASE*TREAT*	0.063 *	0.064 *	0.685 **	0.615 ***	1.153 *	1.285 ***
	(0.026)	(0.028)	[2.800]	[3.592]	[2.149]	[3.754]
Class-taking group fixed effects	Y		Y		Y	
Student random effects	Y		Y		Y	
Student fixed effects		Y		Y		Y
n	3227	3227	1120	1120	1120	1120
Likihood Ratio Statistic δ=0			503.18	1238.15	256.40	97.22
P-value			0.000	0.000	0.000	0.000

Note: * p<0.05, ** p<0.01, *** p<0.001. Result from linear probability model estimates for *HWK_COMPLETE* are presented as parmeter estimates and standard errors (se). Results from negative binomial model estimates for *REDIRECT* and *PARTICIPATE* are reported as incidence rate ratios and t-statistics [t-stat]. We present likelihood ratio statistics for models estimated using negative binomial regression. In each model we easily reject the null hypothesis that the overdispersion parameter, δ, is zero.

Table 4: Parameter estimates of the differential intent-to-treat effect in middle school of teacher-family communication on homework completion rates, class redirections, and class participation from models using random and fixed effects for students.

	HWK_COMPLETE		*REDIRECT*		*PARTICIPATE*	
	(I)	(II)	(III)	(IV)	(V)	(VI)
EXP_PHASE	-0.070 ***	-0.071 ***	1.073	1.145	0.885 **	0.874 **
	(0.019)	(0.020)	[0.713]	[1.378]	[2.595]	[2.908]
*EXP_PHASE*TREAT*6GRADE*	0.079 *	0.079 *	0.709 *	0.599 **	1.332 ***	1.666 ***
	(0.032)	(0.034)	[2.143]	[3.220]	[3.570]	[6.531]
*EXP_PHASE*TREAT*9GRADE*	0.045	0.046	0.657 *	0.635 **	0.994	0.930
	(0.033)	(0.034)	[2.496]	[2.655]	[0.079]	[0.863]
Class-taking group fixed effects	Y		Y		Y	
Student random effects	Y		Y		Y	
Student fixed effects		Y		Y		Y
n	3227	3227	1120	1120	1120	1120
Test for differential grade effects						
Wald Statistic	0.80	0.78	0.17	0.10	10.24	38.55
P-value	0.371	0.378	0.679	0.754	0.001	0.000
Likihood Ratio Statistic δ=0			256.41	97.24	510.53	1180.76
P-value			0.000	0.000	0.000	0.000

Note: * p<0.05, ** p<0.01, *** p<0.001. Result from linear probability model estimates for *HWK_COMPLETE* are presented as parmeter estimates and standard errors (se). Results from negative binomial model estimates for *REDIRECT* and *PARTICIPATE* are reported as incidence rate ratios and t-statistics [t-stat]. We present likelihood ratio statistics for models estimated using negative binomial regression. In each model we easily reject the null hypothesis that the overdispersion parameter, δ, is zero.

Table 5: Pearson product moment correlations between average measures of student engagement and final exam and course grades student behavior and academic engagement outcomes with exam and course grades across all classes (n=140).

	Homework Completion	Redirection	Participation	End-of-Course Grade	Final Exam Grade
Homework Completion	1.000				
Redirection	-0.491	1.000			
Participation	0.288	-0.071	1.000		
End-of-Course Grade	0.573	-0.438	0.287	1.000	
Final Exam Grade	0.382	-0.213	0.264	0.784	1.000

Note: We calculate averages for every student using all observations across the 13 days data was collected during the summer academy. All pairwise correlations are significant at the 0.05 level except the correlation between Redirection and Participation.

Figures

Figure 1: Experimental Timeline

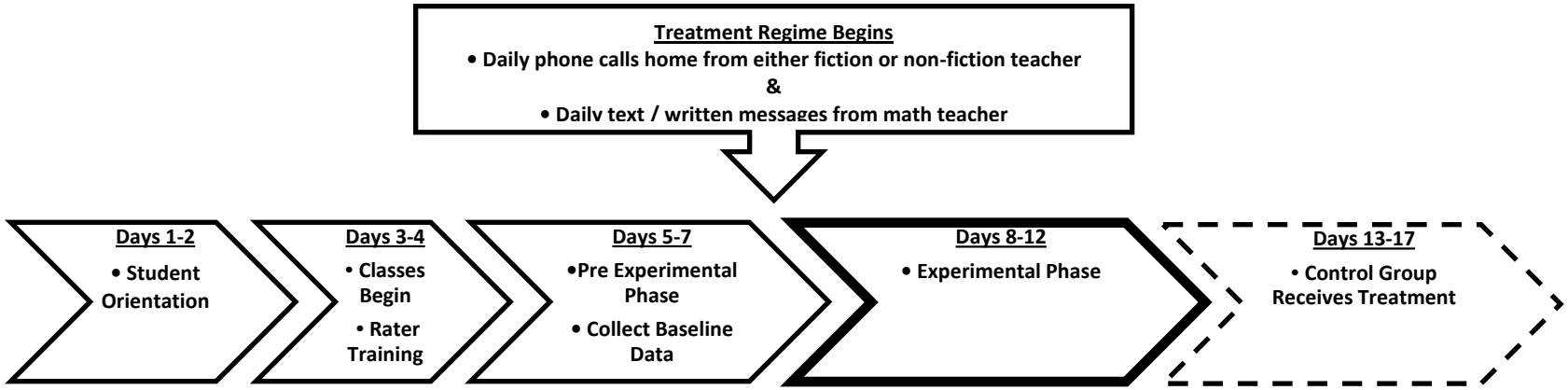
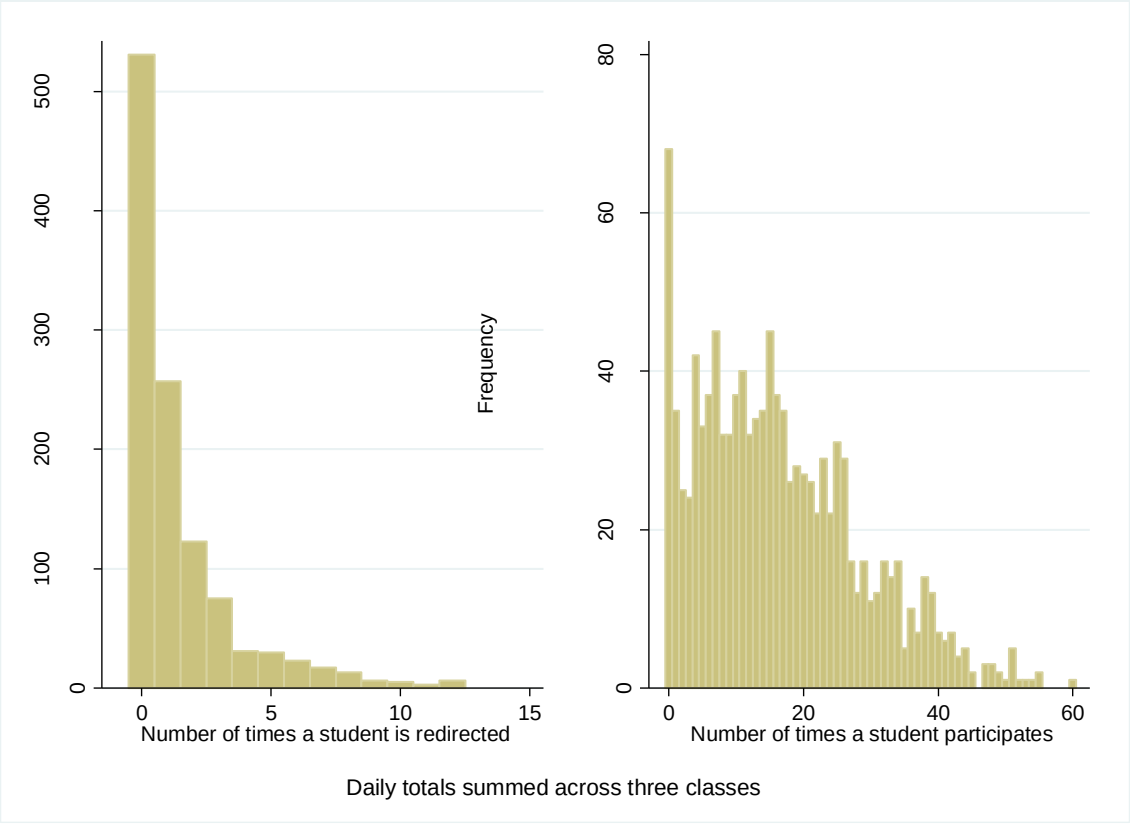


Figure 2: Distributions of count variables for the total number of times a student is redirected by a teacher and participates in class per day (n=1120; 140 students across 8 days).



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