Parent Skills and Information Asymmetries: Experimental Evidence from Home Visits and Text Messages in Middle and High Schools

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This paper studies the ability to foster parent skills and resolve information problems as a means to improving student achievement. We conducted a three-arm randomized control trial in which community-based organizations provided regular information to families about their child's academic progress in one arm and supplemented this with home visits on skills-based information in a separate arm. Math and reading test scores improved for the treatment arm with home visits. There are large effects on retention for both groups during the year, though learning gains tend to accrue for students with average-and-above baseline performance and students at the lower end of the distribution appear marginally retained.

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I Introduction

Family environment is one of the strongest determinants of student achievement disparities. As their children get older, families may become less informed about how to best to help their children in school. For instance, parents may no longer have the know-how to directly assist with their child's schoolwork, and they may have difficulty helping their child navigate a complex set of graduation requirements and post-secondary options (Coleman, 1966; Todd and Wolpin, 2003; Heckman, 2006; Cunha and Heckman, 2007; Hoxby and Turner, 2013). These complexities could impede parents' investments in the human capital of their children (Cunha et al., 2013; Fryer, 2011).

Home-visiting programs represent an important strategy that has been used to improve parenting skills. In the United States, home-visiting programs serve an estimated 300,000-400,000 families across 40 states each year (Astuto and Allen, 2009). They are supported in part by states and the federal government. In 2017, the federal government allocated $372 million to support state efforts at providing home visits through the Maternal, Infant and Early Childhood Home Visiting (MIECHV) program (Astuto and Allen, 2009). In line with the focus of the MIECHV program, much of the literature on home visits examines prenatal and early childhood (under age of 5) services. One program in particular, the Nurse-Family Partnership program, which aims to improve parenting skills and behaviors, has demonstrated success through multiple studies (Olds et al., 1997; Olds et al., 2004; Duncan and Magnuson, 2004; Heckman et al., 2010; Heckman et al., 2013; Heckman et al., 2017). Evidence on a broader array of programs, however, finds more mixed results (Raikes et al., 2006; Sweet and Appelbaum, 2004; Gomby et al., 1999; Geeraert et al., 2004; Gomby, 2005). For school-aged children, there is a growing literature showing the promise of teacher home visits, though most of this evidence is correlational and focuses on elementary school children (Lee, 2014).

There is a dearth of rigorous evidence on improving parenting skills, and in turn academic

achievement, among parents of children in secondary schools (Desforges and Abouchaar, 2003; Furstenberg, 2011; Cullen et al., 2013). Recent experimental evidence focuses on information problems (as opposed to skills) between parents, their children and the secondary schools they attend. Reducing these information problems can improve student outcomes, often at low cost (Kraft and Dougherty, 2013; Kraft and Rogers, 2014; Bergman, 2015; Bergman and Chan, 2017). Fewer interventions study parenting skills in later years of child development. One exception to this is an experiment conducted in Paris middle schools by Avvisati et al. (2013), which provided at-school sessions about how parents can support their children. The authors found no impacts on test scores but did find impacts on student attendance and discipline. A key issue with school-based parent meetings in low-test score, urban schools in the United States, is the difficulty in bringing parents to schools for these types of workshops. For instance, Bergman (2015) found that only 15% of parents attended the parent-teacher conference night at the study school in Los Angeles, and a study by Fryer et al. (2015) on the effects of an early-childhood parent academy, for which parents were offered $100 incentives and free child care to attend, found that parents attended less than half of the sessions, on average.

This paper contributes to the existing literature by reporting on a randomized-controlled trial testing whether text messages and home visits can address both parent-skill deficiencies as well as parent-child information problems among families with children in middle and high school. Our first intervention (hereafter called the Info treatment or intervention) addresses parent-child information problems by sending information to parents about their child's academic performance in their native language via twice-monthly text messages. These messages, based on work by Bergman (2015), contain detailed information about students' assignments, grades and attendance. Our second intervention (hereafter called the Info+Skills treatment or intervention) innovates on this by addressing potential parent-skill deficiencies via home visits that aim to enhance parents' know-how about: using school resources to track student progress, understanding graduation requirements and

college readiness, and improving home-learning environments. While early-childhood home visits that aim to affect parental skills and home environments have shown success at improving child outcomes, to our knowledge home visits for parents of children in middle and high school have not been experimentally evaluated. The ability to reach parents in the home can be key to delivering information when it is difficult to bring parents to schools for this type of information.

We evaluate these interventions using a multi-armed randomized controlled trial across three schools in a low-income, urban-area school district in the Midwest. During the 2014-2015 school year, 1,120 families with children in three of the lowest-performing middle and high schools in a state were randomly assigned to the Info intervention, the Info+Skills intervention, or the control group.

In an effort to maintain sustainability, we worked with community-based organizations to deliver these interventions across the three schools. This strategy is akin to other home-visitation programs that partner with local agencies and non-profit organizations (Smith, 2011; Duke Center for Child and Family Policy, 2017; Bryk et al., 2010). We trained members of five local community-based organizations to interpret student data, to transmit data to parents via text messages, phone calls or emails, and to visit parents or guardians in their homes. Students were followed across schools within the district. Nearly all families in the intervention groups received academic progress text messages and 54% of families assigned to receive a home visit actually received one or more visits.

Both interventions significantly increased district retention during the year. Compared to the control group, students in the intervention groups were roughly 4 percentage points less likely to leave the district (40% to 50% of the control mean).GPA increased by 0.13 standard deviations for the Info intervention and 0.08 standard deviations for the Info+Skils intervention, respectively, however the latter is not statistically significant. Student percent grades improved by three percentage points on average (six percent of the control mean). Math and reading standardized test scores improved by 0.13 and 0.12 standard deviations

when information asymmetries were addressed in conjunction with the parent skills (the Info+Skills) intervention via home visits, but they did not improve as a result of addressing information asymmetries alone (the Info intervention). The test score effects are equivalent to three-percentile-point gains on a national scale for math and reading scores. Because only 54% of the home visit group actually received a visit, effects are nearly twice as large (0.26 standard deviations in math and 0.19 standard deviations in reading) for those who received a home visit under the Info+Skills intervention.

Overall, the retention effects are large but learning gains appear to accrue to students with average-and-above GPA at baseline. Retention effects are qualitatively larger for students with below-average GPA but achievement and behavior impacts are larger for those with higher GPA at baseline. For instance, in the latter subgroup, students in the Info+Skills intervention were present an additional 5.6 full days of school compared to the control group, while those with low GPAs experienced an increase in the days enrolled and the days absent, suggesting the latter were only marginally engaged in school. In general, there was little other heterogeneity, though there were several subgroups of interest and randomization was stratified according to all subgroups of interest.

The rest of this paper proceeds as follows. Section II describes the participating schools and experimental design. Section III reviews the data and empirical strategies. Section IV shows the impacts of the interventions, and Section V concludes with a discussion of limitations and potential future work.

II Context and Experimental Design

Background

The experiment took place during the 2014-2015 school year. The three participating schools were in an urban school district serving roughly 20,000 students in a low-income area; 81% of students in the district receive free or reduced-price lunch. According to state education

data, the four-year and five-year district graduation rates were roughly 50% during the 2013-2014 school year. That year the district student population was one-third Black, one-third Hispanic, and one-fifth white. As part of a state policy fostering inter-district choice, the vast majority of school districts allowed students from other districts to enroll. This policy is important context for the study as it reflects the potential for student mobility. For instance, at the time of the study, just under 40% of students living in the area were not enrolled in their assigned schools.

We approached three schools, one middle school and two high schools, and all three schools agreed to participate. These three schools were chosen specifically because of their low performance. The participating schools overwhelmingly serve low-income students, with 80% to 90% of students at each school receiving free or reduced-price lunch, and each school was in the bottom 5% of Title I schools in the state according to test scores and graduation rates.[1] Table 1 shows the summary statistics of study participants by school. The majority of students in Middle School I and High School I were Black, while students in High School II were predominantly Hispanic. Though we do not have individual-level data on all students at the participating schools, we can compare the demographics of those in the study with school-level aggregates at the time of the experiment. In the middle school, 73% of the school was Black and 17% Hispanic compared to 75% and 17%, respectively, in the study sample. In High School I, 76% of the school was Black and 13% was Hispanic, compared to 82% and 9% in the study sample. Finally, in High School II, 28% of the school was Black and 47% was Hispanic compared to 26% and 49% in the study sample. Thus, at least in terms of demographics, the study sample reflected the school population well.

The academic performance of the sample was low. The average GPA for each school was below 2.00. Percentile scores on the district's standardized tests, which are nationally normed, ranged between the 20th and 29th percentile for reading and between the 16th to 23rd percentile for math. Students missed, on average, 10 school days (8%) across the three

[1]The exact criteria can be found here: https://www.ed.gov/sites/default/files/demonstrating-meet-flex-definitions.pdf.

schools. Strikingly, 40% of participating students in the middle school had been suspended or expelled at some point during the previous school year. Roughly 30% were suspended or expelled in the two high schools in the previous school year.

Research Design

The Info intervention consisted of text messages sent once every two weeks to parents detailing their child's grades, absences and missed assignments. We used a web-based text messaging platform to deliver information to parents. An example of the information provided via text message is shown in Figure 1. The information showed missed assignments by class as well as by-class daily attendance. Text messages were translated into Spanish at the request of parents during study intake. Though 21% of the sample listed their primary language at home as Spanish, only 16% of all families requested that this information be communicated to them in Spanish.

An important innovation we undertook under the Info+Skills intervention was the delivery of home visits to parents with children in middle or high schools. This component of the intervention intended to improve parent skills through up to three informational home visits. These visits focused on teaching parents how to: check and interpret their child's grades, test scores, and attendance; set up home learning environments; review high-school graduation requirements; and learn about making their child college ready. Visits were scheduled on an individual basis between members of the community-based organizations and the participating parents. Finding an available time was challenging however, which meant many fewer families received a home visit than intended, as discussed further below.

Rather than using dedicated research staff, we aimed for scalability and sustainability by leveraging community-based organizations to gather and deliver information rather than dedicated research staff. These interventions were implemented by five such organizations. Paid staff from these groups spent roughly 2.5 days per week providing information to 150 parents per staff member. Staff attempted to make 30-40 home visits per month and spent

one day per week gathering and organizing student data for the project. In the Appendix, we have included protocols and staff training materials.

The control group received the default amount of information and services provided by the schools. This primarily consisted of an online gradebook that parents could use to check their child's grades, robo-calls for absences, report cards mailed home four times per semester, and parent-teacher conferences. While gradebook information could be accessed by parents online, Bergman (2017) found that many parents never log onto parent portals that display this information, and this is particularly true in low-income area schools with low test scores.

To test the impact of the Info and the Info+Skills interventions, we randomized 1,120 students at the three participating schools into one of three groups: the Info group, the Info+Skills group, and a control group. Students whose parents consented to participate were randomly assigned to these groups in equal proportion. Randomization was stratified by indicators for student gender, chronic absentee status, and below-average GPA at baseline. Students, teachers and school staff were blinded to study-arm assignment. Randomization implies that each group should be similar along baseline observable and unobservable factors, in expectation. This similarity across groups at baseline helps ensure that any difference in subsequent outcomes at the end of the study can likely be attributed to the interventions and not to other factors, such as parents in one group being more involved in their child's education at the outset.

III Data and Analysis

Data

This study uses administrative from the district and program data from our implementing partners. Administrative data includes math and reading test scores and grade point averages (GPAs), which are standardized according to the control group to have mean zero and

standard deviation one by grade level. GPA is measured by the grade point average across a student's classes throughout the school year using the district weights for honors classes versus non-honors classes. Grades are also measured using a finer continuous measure: average percent score across a student's classes, though the analysis of this outcome should be considered exploratory as we did not know we would have this measure at the outset of the study. Students with no outcome GPA or course grades are assigned a GPA of zero (prior to standardization) and an average percent grade of zero as they have taken no courses. This imputation is a limitation that stems from the substantial non-random effects on attrition, as shown below. Attendance is measured as the number of days present, and we explore changes in the possible number of days attended and the number of days absent since the interventions may affect both of these variables.[2] We also generate an indicator variable for whether a student was suspended or expelled during the school year.

Lastly, we define a student as retained if they enrolled in classes and received course grades after the intervention began. Students are not retained otherwise as they have not taken classes in the district. The latter is a significant predictor of performance: those who were not retained had baseline GPAs 0.70 points lower than students who were retained. We also obtained enrollment into the following school year, after the study concluded, to examine the effects on subsequent retention.

Program data include indicators for whether a family received an alert about their child's missed assignments and grades and when these alerts first began. 98% of families in the Info treatment arm received at least one alert and 95% of families received at least one alert in the Info+Skills treatment arm. Similarly for the Info+Skills intervention, program data show whether a family received a home visit and when visits occurred. Compared to the alerts, many fewer families who were assigned to receive a home visit actually received at least one. Of those families assigned to receive a visit, 54% received at least one home visit. This low-visit rate was due to difficulties coordinating schedules between program providers

[2]This measures the total days present in the district as opposed to the number of days absent. The latter is affected by the total days a student remains in the district; if a student is retained they have more days they potentially miss.

and families.

Randomization

We can examine empirically whether our randomization created balanced, or similar, groups at baseline according to observable characteristics. Table 2 presents evidence that this is the case. Column (1) shows the control group mean. Column (2) shows the difference between the Info treatment group's mean and the control group's mean. Column (3) shows the p-value for this difference. Column (4) shows the difference between the additional Info+Skills group's mean and the control group's mean. Column (5) shows the p-value for this difference. Column (6) shows the number of observations available for the baseline variable. Observation counts are lower for baseline test scores because the district does not have these scores for all students. None of the differences across groups is statistically significant across groups. Though not shown, there are no significant differences between the control group and the pooled treatment group of receiving any intervention. A joint test of the significance of covariates regressed on an indicator for receiving any treatment does not reject the null (p-values equal 0.49 and 0.88 for the Info and Info+Skills treatments, respectively).

Despite randomization, attrition that correlates with treatment status may bias impact estimates. Attrition from the district is an outcome as well, but it could also bias estimated effects on test scores if the intervention affects the likelihood that students take standardized tests in a way that correlates with test scores. Appendix Table A.1 shows the share of students missing test scores and the treatment effects on an indicator for missing math scores and an indicator for missing reading scores. Students in the 12th grade, 8% of the sample, do not take the standardized tests. At baseline, 21% of eligible students were missing test scores, and, in line with the student-retention data shown below, Column (1) shows that 31% and 32% of students in grades six through eleven were missing math and reading test scores at endline, respectively. Among those who remained enrolled in the district, test taking rates at endline are similar to the rates at baseline: 19% of retained students have

at least one test score compared with 17% at baseline. This is all to say that the test-taking rates in the previous year and during the study year were similar. Neither the Info treatment nor the Info+Skills treatment had a significant impact on the likelihood of missing math scores (p-values are 0.46 and 0.93, respectively). Both coefficients are insignificant for missing reading scores as well (p-values equal to 0.97 and 0.44, respectively). This, as shown below, is likely because any students retained were unlikely to take the exams.

While students who took the tests are comparable across treatment groups, students who took the tests tend to be higher-performing than those students who did not take the tests. Table A.2 shows the correlates of missing test score data by regressing an indicator for missing a test score on baseline measures of absences, GPA, test scores, and an indicator for ever being suspended using the sample of eligible test takers. Students who missed a test have significantly higher absence rates and lower baseline GPAs, and they were much more likely to have been suspended at some point during the previous year. Conditional on these variables, baseline test scores do not significantly correlate with missing post-treatment test scores. Nonetheless, more than three fourths of students have a test score, and it is important to keep in mind the overall level of achievement in these schools: students who *did* take the tests still have baseline GPAs below 2.00 and a 30% rate of suspension in the last year.

Empirical Strategy

We assess the effects of the Info and Info+Skills interventions using an intent-to-treat (ITT) framework to compare outcomes across program groups. The ITT analysis compares the outcomes of those assigned to a particular group to the outcomes of the control group irrespective of whether they actually received the intervention or not. For instance, we assign someone to the Info+Skills group if that was their original assignment even if they did not ultimately receive a home visit.

To estimate ITT effects, we use the following estimating equation:

$$Y_i = \alpha + \beta_I * T_i^I + \beta_S * T_i^S + X_i\gamma_1 + \varepsilon_{i1}$$

Where Y_i is an outcome for student i, T^I and T^S are indicators for receiving the Info treatment and the Info+Skills treatment, respectively, and X_i is a vector of baseline characteristics described below.[3] Heteroskedasticity-robust standard errors are used in all estimations. In addition to reporting statistical significance for β_I and β_S, for completeness we also report the p-value for a test of their equivalence and a test of significance of the pooled treatments as well.

We use several control variables in these regressions. Strata were selected based on subgroups of particular interest: chronically absent students, as defined by the district, students by gender, and students with above- and below-average GPAs. All regressions control for these strata indicators to control for the design of the experiment (Bruhn and McKenzie, 2009). We also include several baseline measures: standardized math and reading scores, indicators for race/ethnicity, IEP and English Language Learner categorization, and parents' education levels. For missing baseline variables we generate indicator variables for missingness and impute values. Robustness checks show the potential sensitivity to controls.

Lastly, we explore heterogeneous effects by interacting treatment indicators with indicators for each of the subgroups of interest. As mentioned above, these subgroups are defined by the strata for gender, above-average and below-average GPAs, and for chronic absentee status.

[3]This specification in which both treatment indicators are included in a single regression is slightly restrictive in that it constrains the coefficients γ_1 to be the same across treatment groups. However the results tend to be slightly larger if each intervention group is analyzed in a separate regressions.

IV Results

Retention and Behavior Outcomes

Table 3 shows the effect of the interventions on attrition from the district in the spring of 2015 (Column 1) and the start of the next school year in fall 2015 (Column 2). The control mean shows that 10% of the control group left the district by the spring of 2015, while the intervention was ongoing. The Info and Info+Skills interventions reduced district attrition by approximately 4 percentage points, or 40% of the control mean. Each individual treatment effect is significant at the 5% level, and the p-value for the pooled treatment effect indicates the combined effect of the Info and Info+Skills treatments is significant at the 1% level. Unsurprisingly, given their similar magnitudes, the p-value for whether the two interventions are statistically different from each other indicates that the two produce similar effects on retention.

This impact on within-year retention is large and significant. To give an idea of its significance, students who attrit from the district had GPAs 0.70 points lower than other students, on average, which implies the intervention is helping to retain some of the most at-risk students. District retention is important both in terms of student performance and district funding. In terms of the former, student mobility is associated with lower student performance (Rumberger and Larson, 1998). In terms of student funding, student retention generates just over $7,000 in per-pupil funding according to district administrators.

In Column 2 of Table 3 presents the same analysis for enrollment in the following school year, which is the fall of 2015. For students from these schools, attrition is much higher from one school year to the next compared to the within-year attrition: 38% of the control mean was no longer enrolled by the next school year. As part of a state policy, students can opt to apply to schools outside the district, and many do, as reported above. The treatment effects are similar in magnitude, though much noisier. The Info treatment has a point estimate of 6 percentage points (significant at the 10% level), and the Info+Skills treatment has a point

estimate of 3 percentage points (not statistically significant). With a baseline of 0.38 in the fall of the following school year and a baseline of 0.10 in the spring during the year of the study, the variance is higher in the following year and therefore the power to detect effects in the fall is lower.

Remaining columns of Table 3 present the impacts on other measures of student behaviors. There are no statistically significant effects on student attendance, suspensions, or status as chronically absent. These results should be interpreted in light of the retention findings described above. Student behaviors are tracked conditional on enrollment. This means enrolled students have more opportunity to be recorded for suspensions while attriting students do not. Given that the intervention retains students who are more at risk than the average student, the treatment effects may be negatively biased. Alternatively, the intervention may retain students but have no impact on the their in-class behaviors. We examine the latter by studying impacts on test scores and grades. We examine the former explanation, selection into measurement that is correlated with behaviors and performance, by exploring heterogeneity in effects for those who would be less likely to be missing outcome data, such as those who were higher-performing at baseline.

Achievement Outcomes

While retention is an important outcome, we also examine several continuous measures of academic performance. Table 4 shows the impacts on students' GPA, percent grades, and test scores. Column (1) shows GPA increases of 0.13 and 0.08 standard deviations for the Info and Info+Skills treatments, respectively, with the former statistically significant at the 5% level while the latter is not statistically significant. GPA has a standard deviation roughly equal to one, so the raw effects on GPA are similar to the standardized effects.[4] Effects on course percent grades, shown in Column (2), are 4 and 3 percentage points for the Info and Info+Skills treatment, respectively. These results are statistically significant at the 5% level.

[4]The pooled treatment effect is significant at the 5% level (p-value equals 0.048) and the test of equivalence between the two treatments does not reject the null hypothesis that both treatment effects are equal.

Overall, the results suggest that both interventions had a *joint* effect on course performance and retention, though the impact on course performance is not as definitive as the impacts on retention.

Columns (3) and (4) show effects on math and reading test scores. The Info+Skills intervention impacts test scores, but the Info intervention alone does not. The Info+Skills intervention has a 0.13 impact on math scores, which is significant at the 5% level, though a series of specification checks in Table 10 show that significance levels vary slightly by specification. The addition of addressing parent skills in the Info+Skills intervention also impacts reading scores, which is significant at the 10% level. These effects are statistically different from the info intervention, given the latter had no impact.

The ITT impacts on test scores are roughly one half to one third the size of impacts found from effective charter schools over the course of a school year. Using treatment assignment as an instrumental variable for receipt of the Info+Skills intervention, the treatment impact is 0.26 standard deviations for math. This effect is 0.19 standard deviations for reading. For comparison, the Harlem Children's Zone charter school in New York increased math scores and reading scores by 0.23 and 0.05 standard deviations. KIPP Lynn charter school in Massachusetts increased these scores by 0.35 and 0.12 standard deviations (Dobbie and Fryer, 2010; Angrist et al., 2010).

Differential Effects

We stratified treatment assignment according to several subgroups of interest: above- and below-average GPA students, male and female students, and chronically absent students.

There is suggestive evidence that there are greater effects on retention for those with below-average baseline GPAs, while learning and behavior gains accrue to those with higher baseline GPAs. Table 5 examines this heterogeneity with respect to baseline GPA. Though students with low GPAs are retained, it appears this does not yield much in terms of learning gains. GPA effects tend to be smaller for this group, as do impacts on attendance. Reading

and math scores are smaller but not significantly so, perhaps because students with below-average GPAs are less likely to take the tests.

In contrast, the interventions yield larger gains for students with above-average GPAs. GPA increases by 0.20 standard deviations and there are behavioral improvements in the Info+Skills group: they attend 5.6 more days of school and there is evidence they are less likely to be suspended. While both above-average and below-average GPA students exhibit an increase in the number of days enrolled in school, only those with above-average GPAs actually experience a reduction in absences during those additional days. Thus low-performing students may be retained but only marginally in school.

Tables 6 and 7 show whether there is heterogeneity by chronic absentee status or gender. The number of observations change across columns because the interaction term has missing data. There is little evidence of differential effects as few subgroup effects are significantly different from the effects on other groups.

Missing Data and Robustness

A key potential concern with the analysis of test score outcomes is missing data, due in part to substantial student attrition. We address this concern in two ways. First, we use multiple imputation, following Little and Rubin (1987). Second, we estimate Lee bounds (Lee, 2009), which relies on the assumption that assignment to treatment only reduces (in this case) the likelihood of missing data.

Table 8 shows the test-score results after imputing the missing data. The results are similar to the original findings; there are no significant impacts of the Info treatment on test scores. For the Info+Skills intervention, the impact on math test scores is 0.12 standard deviations and the impact on reading test scores is 0.12 standard deviations as well. The latter results are significant at the 5% level and the 10% level, respectively.

Table 9 shows the estimated upper and lower bounds for each treatments' effect on test scores. Unsurprisingly, the upper and lower bounds for the Info treatment contain zero.

Even the upper bound is less than 0.10 standard deviations. For the Info+Skills treatment, the Lee bounds are tight, though imprecise for math: the lower bound is 0.11 and the upper bound is 0.12 standard deviations. For reading, the bounds are wider, though both are positive (0.05-0.15 standard deviations).

A second potential concern is whether the test score results are robust to alternative regression specifications. Table 10 shows that these results are robust to the set of baseline covariates included in the analysis and to whether the raw scale scores are used instead of z scores, though the results are not significant if there are no controls in the model. Table 10 also shows that the test-score impacts are equivalent to a 2.5-percentile point increase in nationally-normed math and reading scores.

V Conclusion, Limitations and Future Work

While much of the existing evidence on home visits and parent-skills oriented interventions focus on the parents of younger children, this paper provides evidence on the effectiveness of these interventions for the parents of children in middle and high school. Overall, the combination of providing information on academic progress and skill-oriented information via home visits leads to positive impacts on various academic outcomes. We leveraged community-based organizations to schedule and deliver the information and meet with families. We did encounter difficulties in reaching the intended number of parents, but we found impacts nonetheless, which suggests that home visits for parents of older children are a promising avenue to affect parent behaviors and to improve student outcomes that is worthy of further research.

While both the Info and Info+Skills interventions had large effects on retention, the Info+Skills intervention, which includes a skills component via home visits, produced increases in math standardized test scores and marginally-significant increases in reading scores. The high level of district attrition, particularly for lower-performing students, posed

problems from an analytical perspective. There is significant missing test-score data, which we addressed by using multiple imputation and estimating treatment-effect bounds. The results appear robust. Relatedly, our achievement findings appear to be stronger for those with higher average GPAs. Those at the lower-end of the GPA distribution were more likely to be retained, but this did not appear to yield measurable gains in learning. In this context however, even students in the upper-half of the GPA distribution still have baseline math and reading scores at the 30th percentile and under, nationally.

The results for the Info treatment show some similarity and important differences from earlier findings of a similar Info intervention by Bergman (2015) in Los Angeles. There are positive effects on transcript-related outcomes, similar to those found in Los Angeles. However, there are no test-score impacts. Two possible reasons for this are that: first, the findings from Los Angeles are spurious, and second, that there are important contextual differences. The first possibility is difficult to provide further evidence on, but the second possibility can be explored more readily. While the experimental context in Los Angeles was also a low-income area school with low test scores, the three schools in the present study are much lower performing academically. For instance, comparing high schools across the studies, baseline GPA is roughly 0.30 standard deviations lower and suspension rates are 28 percentage points higher for the high schools studied in this paper compared to the high school studied in Los Angeles. A possible interpretation of the different findings is that information alone may be insufficient to improve a broad array of outcomes in schools with high rates of suspensions and very poor transcript grades; in these contexts home visits may be a particularly important complement.

A simple accounting exercise provides a rough estimate of the potential revenue changes from reducing information problems and improving parent skills. An increase in retention of just over 4 percentage points and 744 students treated by either the Info intervention or the Info+Skills intervention implies a $218,736 increase in per-pupil revenue for the district. There are a number of costs: we hired a full-time coordinator, a part-time supervisor and

a data manager. There are also driving costs, the costs of phones and laptops, printing and other administrative costs, and training costs. We budgeted for all of these costs, and estimate that implementation costs $123 per student, or $91,512 in total for the students in our sample.[5] These costs are not trivial, but given the benefits in terms of learning outcomes and the potential monetary value of retention, the program passes a basic cost-benefit test.

There are several limitations to the results. First, while there are budget implications for retained students, an important caveat is that those who are most likely to be retained are marginally engaged in school and in turn reap few benefits academically, particularly for the information-only intervention. Second, these are three of the lowest-performing schools in the state, and they were chosen for the study for that reason. This is an important study population given the need for successful interventions in such a setting, but the results of home visitations may differ in other, less disadvantaged settings. Lastly, and perhaps most significantly, we were not able to survey participants to parse the mechanisms in each treatment arm. Bergman (2015) was able to survey participants and estimate a structural model to disentangle several mechanisms in the context of the Info treatment, however the mechanisms in the Info+Skills arm are much more parenting-skills oriented. The latter focuses on information about graduation requirements, navigating the school system and setting up home learning environments. Future work could assess what content changes parent behaviors and know-how and how these changes map into student outcomes. Parents' information sets can vary widely within and across school districts, and understanding these mechanisms would have important implications for external validity and the ability to bring this intervention to scale.

[5]Some of these costs include the consent process and data extraction for the research, but it is hard to separate these out from the program costs, so this estimate is likely an overestimate of the actual costs.

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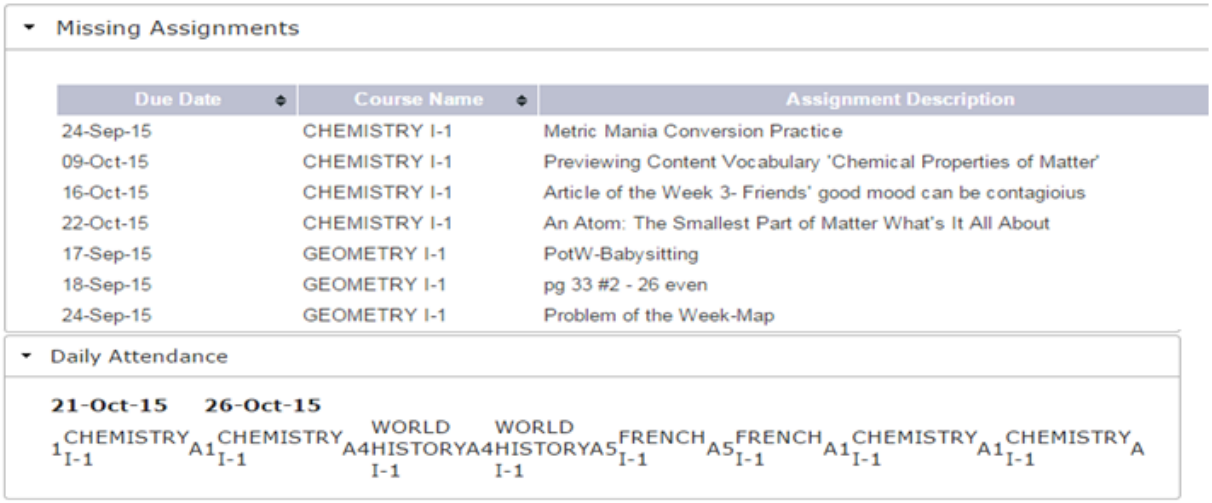
Figure 1: Example Report



Missing Assignments

Due Date	Course Name	Assignment Description
24-Sep-15	CHEMISTRY I-1	Metric Mania Conversion Practice
09-Oct-15	CHEMISTRY I-1	Previewing Content Vocabulary 'Chemical Properties of Matter'
16-Oct-15	CHEMISTRY I-1	Article of the Week 3- Friends' good mood can be contagioius
22-Oct-15	CHEMISTRY I-1	An Atom: The Smallest Part of Matter What's It All About
17-Sep-15	GEOMETRY I-1	PotW-Babysitting
18-Sep-15	GEOMETRY I-1	pg 33 #2 - 26 even
24-Sep-15	GEOMETRY I-1	Problem of the Week-Map

Daily Attendance

21-Oct-15 **26-Oct-15**

1 CHEMISTRY I-1 A1 CHEMISTRY I-1 A4 WORLD HISTORY I-1 A4 WORLD HISTORY I-1 A5 FRENCH I-1 A5 FRENCH I-1 A1 CHEMISTRY I-1 A1 CHEMISTRY I-1 A

This figure shows an example of the type of data collected and transmitted to parents bimonthly.

Table 1: Baseline Summary Statistics by School

Baseline Variable	(1) Middle School 1	(2) High School 1	(3) High School 2
Share Black	0.75	0.82	0.26
Share Hispanic	0.17	0.09	0.49
Share White	0.04	0.04	0.13
Baseline GPA	1.78	1.71	1.90
Reading Nat'l Percentile	20.49	25.15	29.19
Math Nat'l Percentile	16.48	17.13	22.52
Days Absent	10.52	9.39	9.64
Ever Suspended	0.40	0.33	0.27
Participants	284	333	485

This table shows baseline summary statistics from the district's administrative data. Column (1) shows the Middle School means. Column (2) shows the High School 1 means. Column (3) shows the High School 2 means.

Table 2: Baseline Summary Statistics

Baseline Variable	(1) Control Mean	(2) Info Diff.	(3) P-value	(4) Info+Skills Diff.	(5) P-Value	(6) N
Black	0.56	-0.05	0.13	0.02	0.55	1121
Hispanic	0.28	0.01	0.74	0.02	0.61	1121
White	0.08	0.01	0.72	-0.02	0.38	1121
Baseline GPA	1.79	-0.05	0.28	0.03	0.56	1121
Reading Nat'l Percentile	25.03	1.32	0.46	0.06	0.97	887
Math Nat'l Percentile	19.36	1.05	0.51	-1.02	0.49	898
Days Absent	9.55	0.44	0.46	-0.30	0.61	1121
Suspended Last Year	0.31	0.00	0.97	0.02	0.44	1121
Parent Graduated HS	0.59	-0.03	0.54	-0.05	0.26	720
English Language Learner	0.18	-0.02	0.58	-0.03	0.20	1120

This table shows baseline summary statistics from the district's administrative data. Column (1) shows the control group mean. Column (2) shows the difference between the Info treatment group mean and the control group mean. Column (3) shows the p-value for this difference. Column (4) shows the difference between the Info+Skills group mean and the control group mean. Column (5) shows the p-value for this difference. Column (6) shows the number of observations available for the baseline variable.

Table 3: Attrition and Behaviors

	(1) Spring Attrition	(2) Fall Attrition	(3) Days Attended	(4) Ever Suspended	(5) Chronically Absent
Info	-0.043**	-0.058*	1.21	0.01	0.01
	(0.019)	(0.035)	(2.85)	(0.03)	(0.03)
Info+Skills	-0.041**	-0.028	2.82	-0.02	0.00
	(0.019)	(0.035)	(2.69)	(0.03)	(0.03)
Observations	1,120	1,120	1,120	1,120	1,111
Mean for Control	0.10	0.38	138.10	0.43	0.60
P-Value Pooled Treatment=0	0.01	0.22	0.41	0.89	0.87
P-Value Info=Info+Skills	0.90	0.25	0.54	0.30	0.92

Regressions include controls for parents' education, baseline test scores and GPA, IEP status, indicators for race/ethnicity and ELL categorization. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. The p-value for pooled treatment is derived from a test whether the coefficient on an indicator for being either in the Info or Info+Skills treatment equals zero. The p-value for the equality of the Info and Info+Skills treatments is derived from a test of whether the impacts of these interventions is equal. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Academic Results

	(1) Standardized GPA	(2) Percent Grade	(3) Math Scores	(4) Reading Scores
Info	0.13**	3.68**	0.01	-0.06
	(0.07)	(1.58)	(0.06)	(0.07)
Info+Skills	0.08	3.36**	0.13**	0.12*
	(0.06)	(1.54)	(0.06)	(0.07)
Observations	1,120	1,120	701	705
Mean for Control	0.00	64.30	0.00	0.00
P-Value Pooled Treatment=0	0.06	0.01	0.17	0.60
P-Value Info=Info+Skills	0.44	0.82	0.06	0.01

Regressions include controls for parents' education, baseline test scores and GPA, IEP status, indicators for race/ethnicity and ELL categorization. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. The p-value for pooled treatment is derived from a test whether the coefficient on an indicator for being either in the Info or Info+Skills treatment equals zero. The p-value for the equality of the Info and Info+Skills treatments is derived from a test of whether the impacts of these interventions is equal. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Heterogeneity by Baseline GPA

	(1) Attrition	(2) GPA	(3) Math Scores	(4) Reading Scores	(5) Ever Suspended	(6) Days Attended	(7) Chronically Absent
Info	-0.03*	0.20**	0.04	-0.00	-0.00	1.98	-0.01
	(0.02)	(0.08)	(0.07)	(0.08)	(0.05)	(3.23)	(0.04)
Info×Low GPA	-0.03	-0.13	-0.09	-0.14	0.04	-1.50	0.02
	(0.04)	(0.13)	(0.12)	(0.14)	(0.07)	(5.96)	(0.06)
Info+Skills	-0.02	0.19**	0.15**	0.13*	-0.08*	5.60**	-0.07*
	(0.02)	(0.08)	(0.07)	(0.08)	(0.04)	(2.82)	(0.04)
Info+Skills×Low GPA	-0.05	-0.23*	-0.05	-0.05	0.12*	-6.26	0.15**
	(0.04)	(0.13)	(0.14)	(0.15)	(0.07)	(5.61)	(0.06)
Observations	1,120	1,120	701	705	1,120	1,120	1,111

Regressions include controls for parents' education, baseline test scores and GPA, IEP status, indicators for race/ethnicity and ELL categorization. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Heterogeneity by Chronic Absentee Status

	(1) Attrition	(2) GPA	(3) Math Scores	(4) Reading Scores	(5) Ever Suspended	(6) Days Attended	(7) Chronically Absent
Info	-0.04**	0.15**	-0.00	-0.07	-0.01	1.93	-0.03
	(0.02)	(0.07)	(0.05)	(0.07)	(0.04)	(2.91)	(0.04)
Info×Chronic	-0.05	0.10	-0.04	0.36*	0.00	-0.20	0.11
	(0.06)	(0.16)	(0.18)	(0.19)	(0.09)	(8.60)	(0.07)
Info+Skills	-0.03	0.09	0.11*	0.07	-0.04	3.88	-0.03
	(0.02)	(0.07)	(0.06)	(0.07)	(0.04)	(2.63)	(0.04)
Info+Skills×Chronic	-0.06	0.11	-0.16	0.45**	-0.04	-1.85	0.08
	(0.06)	(0.16)	(0.16)	(0.19)	(0.08)	(8.26)	(0.07)
Observations	920	920	590	592	920	920	915

Regressions include controls for parents' education, baseline test scores and GPA, IEP status, indicators for race/ethnicity and ELL categorization. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Heterogeneity by Gender

	(1) Attrition	(2) GPA	(3) Math Scores	(4) Reading Scores	(5) Ever Suspended	(6) Days Attended	(7) Chronically Absent
Info	-0.02	0.12	0.04	-0.07	-0.06	0.19	0.01
	(0.03)	(0.09)	(0.09)	(0.10)	(0.05)	(4.02)	(0.04)
Info×Female	-0.06	0.05	-0.09	0.03	0.15**	2.23	-0.02
	(0.04)	(0.13)	(0.11)	(0.13)	(0.07)	(5.73)	(0.06)
Info+Skills	-0.04	0.05	0.14	0.14	-0.04	0.18	0.05
	(0.03)	(0.09)	(0.10)	(0.10)	(0.05)	(3.67)	(0.04)
Info+Skills×Female	-0.00	0.07	-0.03	-0.05	0.03	5.07	-0.11*
	(0.04)	(0.12)	(0.12)	(0.14)	(0.07)	(5.36)	(0.06)
Observations	1,120	1,120	701	705	1,120	1,120	1,111

Regressions include controls for parents' education, baseline test scores and GPA, IEP status, indicators for race/ethnicity and ELL categorization. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Imputed Test Score Results

	(1) Math Z Score	(2) Reading Z Score
Info	-0.01	-0.06
	(0.06)	(0.07)
Info+Skills	0.12**	0.12*
	(0.06)	(0.07)
Observations	1,029	1,029

This table shows the effects of the Info and the Info+Skills treatments on Math and Reading Z scores after imputing missing values of the test scores following Little and Rubin (1987) with 100 replication data sets. Covariates are those from the primary test-score specification described in the text.

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Lee-Bounds Test Score Results

Info Treatment	(1) Math Lower Bound	(2) Math Upper Bound	(3) Reading Lower Bound	(4) Reading Upper Bound
Info	-0.05	0.05	-0.06	0.07
	(0.07)	(0.06)	(0.016)	(0.12)
Observations	673	673	673	673
Info+Skills Treatment	**(5) Math Lower Bound**	**(6) Math Upper Bound**	**(7) Reading Lower Bound**	**(8) Reading Upper Bound**
Info+Skills	0.11	0.12	0.04	0.15
	(0.15)	(0.19)	(0.11)	(0.10)
Observations	690	690	690	690

This table shows upper and lower-bound estimates of the Info and the Info+Skills treatments on residualized math and reading Z scores by estimating Lee Bounds (Lee, 2009). Covariates to compute residuals are those from the primary test-score specification described in the text.

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Robustness: Test Score Results

Panel A.	(1) Math Z Score	(2) Reading Z Score	(3) Math Scale Score	(4) Reading Scale Score	(5) Math Z Score	(6) Reading Z Score
Info	-0.01	-0.06	0.05	-1.49	-0.01	-0.06
	(0.06)	(0.07)	(1.23)	(1.50)	(0.06)	(0.07)
Info+Skills	0.12*	0.11	2.44**	2.83*	0.13**	0.11
	(0.06)	(0.07)	(1.24)	(1.60)	(0.06)	(0.07)
Observations	701	705	701	705	701	705

	(7) Math Scale Score	(8) Reading Scale Score	(9) Math Z Score	(10) Reading Z Score	(11) Math Scale Score	(12) Reading Scale Score
Info	0.18	-1.47	-0.00	-0.06	0.32	-1.38
	(1.21)	(1.49)	(0.06)	(0.07)	(1.21)	(1.49)
Info+Skills	2.47**	2.85*	0.13**	0.11	2.55**	2.85*
	(1.24)	(1.60)	(0.06)	(0.07)	(1.24)	(1.58)
Observations	701	705	701	705	701	705

The regressions in Column (1)-(4) includes controls for parents' education, baseline test scores and indicators for race/ethnicity. The regressions in columns (5)-(8) add indicators for the English Language Learner test-score categorization. Columns (9)-(12) add controls for baseline GPA, standardized, IEP status, an indicator for being ever suspended, and baseline number of absences and days enrolled. All regressions include strata indicators. The sample is all students for whom the outcome variable is not missing. Missing values for covariates are imputed and indicators for missingness are included in the regression. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Appendix Tables

Table A.1: Missing Test Scores

	(1) Missing Math Scores	(2) Missing Reading Scores
Info	0.025	0.01
	(0.03)	(0.03)
Info+Skills	-0.01	-0.03
	(0.03)	(0.03)
Observations	1,029	1,029
Mean for Control	31%	32%

This table shows the share of students missing math and reading standardized test scores and the effects of the Info treatment and the Info+Skills treatment on the likelihood a student is missing scores. Sample is the set of students eligible to take the standardized tests; 12th grade students do not take these exams. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Table A.2: Missing Test Scores

	(1) Missing Math Scores	(2) Missing Reading Scores
Percent Absent	0.658***	0.713***
	(0.117)	(0.100)
Baseline Math Score	0.020	0.001
	(0.021)	(0.018)
Baseline Reading Score	-0.010	-0.024
	(0.019)	(0.019)
Baseline GPA	-0.072***	-0.078***
	(0.018)	(0.017)
Ever Suspended	0.130***	0.133***
	(0.032)	(0.031)
Observations	1,029	1,029

This table shows the results of a regression of an indicator for a missing standardized test score regressed on baseline covariates. Baseline GPA and baseline math and reading scores are standardized according to control-group mean by grade level. Sample is the set of students eligible to take the standardized tests; 12th grade students do not take these exams. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Figure A.1: Training Materials

Project LIFT Training Protocol

The overall goal of the Project LIFT home visit was to support parents in taking positive action in their children's academic lives. The targeted dosage per treatment group family was three visits spaced out every two months, each up to 45-60 minutes in duration. LIFT coordinators were projected to visit ten families per week. The overall format for each visit was structured as follows:

1. Engagement and check-in (building rapport and trust)
2. Follow up on actions (from previous interaction if applicable)
3. Deliver new education-related information and key messaging
4. Support parents in taking action (through referrals to school liaisons, or school and community resources)

Share upcoming academic milestones (end of marking period/semester deadlines, exam dates, parent teacher conferences, school events, etc)

Each visit followed the same overall format, however the content delivered at each visit may have varied depending on the academic status of the student, and level of parent engagement. The goals of the visits were as follows:

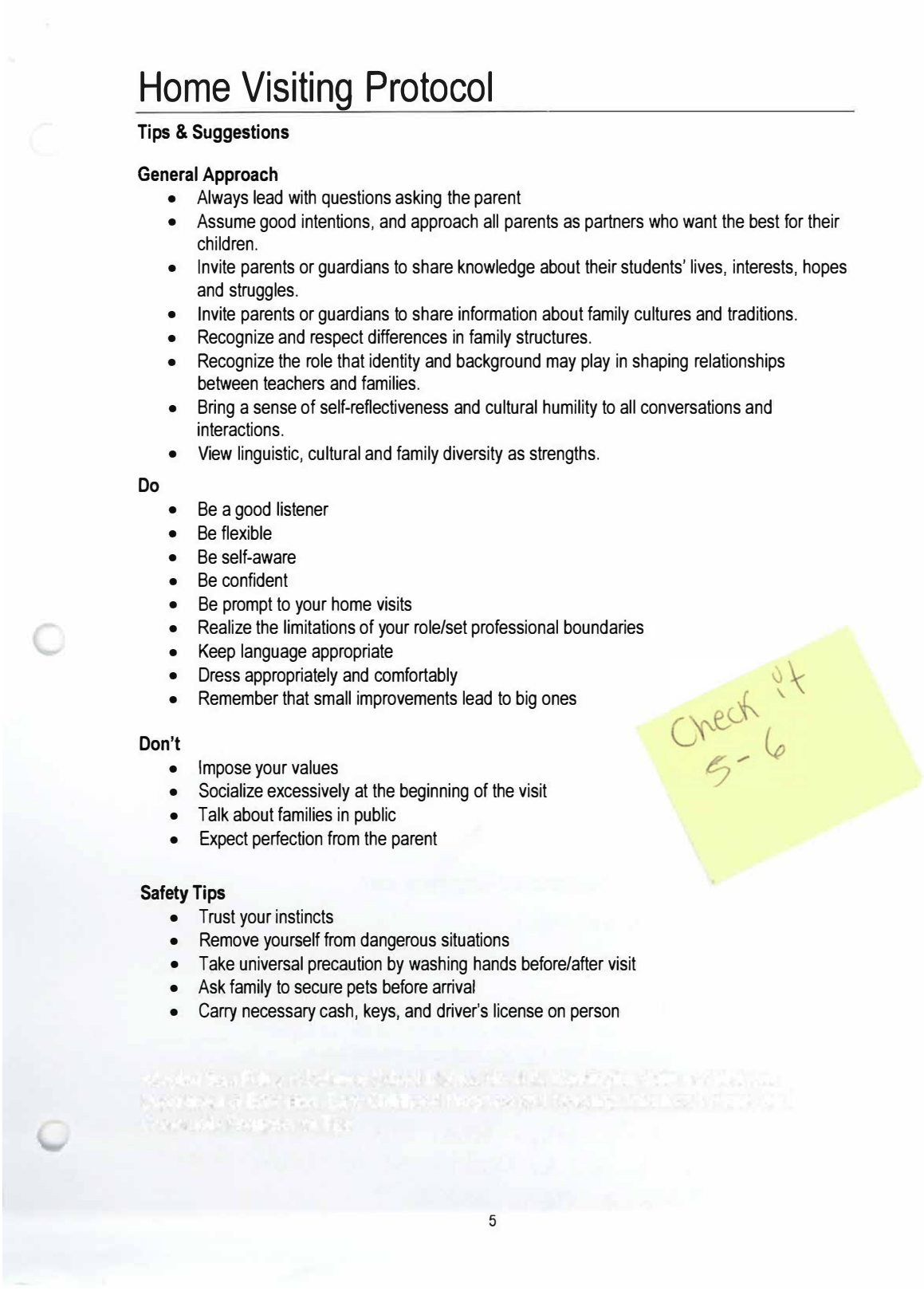
1. Teaching parents how to access attendance, assignment and grade information through the district's parent portal.
2. Raising parent awareness regarding high school credits and graduation requirements.
3. Directing parents and students to opportunities for pursuing advanced classes and college and career readiness information and resources to ensure they are college and career ready.

Training was offered in a series of five half day workshops beginning in late summer. The focus of each workshop was as follows:

- Workshop #1 presented an overview of the program, communications protocols and strategies, and provided an opportunity for LIFT staff to hear from a panel of experienced home visitors in the community.
- Workshop #2 covered alert and home visit protocols, opportunities to role play home visit scenarios, an overview of program forms, and an opportunity to co-design the program's first parent orientation.
- Workshop #3 allowed LIFT staff to hear directly from public school staff regarding graduation requirements, policies and protocols for attendance, suspensions, documentation of assignments and grades, and more. Staff was also provided a demonstration of the school's parent portal where they were able to access students' grades and assignments.
- Workshop #4 provided an understanding of FERPA laws, and the data security and confidentiality required for Project LIFT. It also provided an overview of the specific technology tools used to view, collect and track program data.
- Workshop #5 provided an additional training on the program data collection software.

This figure outlines training protocols used to train staff around the interventions.

Figure A.2: Training Materials



Home Visiting Protocol

Tips & Suggestions

General Approach

- Always lead with questions asking the parent
- Assume good intentions, and approach all parents as partners who want the best for their children.
- Invite parents or guardians to share knowledge about their students' lives, interests, hopes and struggles.
- Invite parents or guardians to share information about family cultures and traditions.
- Recognize and respect differences in family structures.
- Recognize the role that identity and background may play in shaping relationships between teachers and families.
- Bring a sense of self-reflectiveness and cultural humility to all conversations and interactions.
- View linguistic, cultural and family diversity as strengths.

Do

- Be a good listener
- Be flexible
- Be self-aware
- Be confident
- Be prompt to your home visits
- Realize the limitations of your role/set professional boundaries
- Keep language appropriate
- Dress appropriately and comfortably
- Remember that small improvements lead to big ones

Check it 5-6

Don't

- Impose your values
- Socialize excessively at the beginning of the visit
- Talk about families in public
- Expect perfection from the parent

Safety Tips

- Trust your instincts
- Remove yourself from dangerous situations
- Take universal precaution by washing hands before/after visit
- Ask family to secure pets before arrival
- Carry necessary cash, keys, and driver's license on person

5

This figure outlines training materials provided to staff about conducting the home visits.