Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 26-1480

Principal Effects on Teacher Working Conditions

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Research on school principals highlights their role in shaping teachers' work environments, but most evidence is qualitative or correlational. We provide plausibly causal estimates of how principals affect a broad swath of teacher working conditions using data from Illinois, where the State Board of Education collects detailed and comprehensive information on teacher working conditions annually. Our identification strategy exploits differences in the persistence of working conditions over time between schools that do and do not experience principal turnover. Under reasonable stationarity assumptions, these differences can be used to estimate the variance of principal effects. Unsurprisingly, we find principals have large effects on working conditions related to leadership directly. Principals also influence teachers' professional work environments and their interactions with students and families, though to a lesser extent.

VERSION: May 2026

Suggested citation: Rahaman, Ataur, and Cory Koedel. (2026). Principal Effects on Teacher Working Conditions. (EdWorkingPaper: 26-1480). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/mfaw-gs64

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Abstract

Research on school principals highlights their role in shaping teachers' work environments, but most evidence is qualitative or correlational. We provide plausibly causal estimates of how principals affect a broad swath of teacher working conditions using data from Illinois, where the State Board of Education collects detailed and comprehensive information on teacher working conditions annually. Our identification strategy exploits differences in the persistence of working conditions over time between schools that do and do not experience principal turnover. Under reasonable stationarity assumptions, these differences can be used to estimate the variance of principal effects. Unsurprisingly, we find principals have large effects on working conditions related to leadership directly. Principals also influence teachers' professional work environments and their interactions with students and families, though to a lesser extent.

JEL Classification: I2, J2, J8

Keywords: School Principals; Teacher Working Conditions; School Management; Principal Effects

Acknowledgement
This research was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C240007 to the American Institutes for Research®. We thank Michael DeArmond, Jason Grissom, David Kaplan, and Marla Ucelli-Kashyup for comments and suggestions. The views expressed are those of the authors and do not represent the views of the states included in the report, the U.S. Department of Education, or anyone else who is not the authors.

1. Introduction

Teacher working conditions worsened with the onset of the COVID-19 pandemic and continued to deteriorate through at least 2023 (Baker and Koedel, forthcoming), compounding a long-standing decline in professional prestige and teacher job satisfaction that began around 2010 (Kraft and Lyon, 2024). This is concerning because teacher working conditions are strongly associated with school performance (Ferguson and Hirsch, 2015; Johnson, Kraft, and Papay, 2012; Kraft, Marinell, and Yee, 2016) and teachers report valuing their working conditions highly—often more than compensation or student demographics (Grissom, Viano, and Selin, 2015; Horng, 2009). The post-pandemic erosion of working conditions raises concerns about both the vitality of the teaching profession and the productivity of schools.

As the primary managers of schools, principals are an intuitive lever for improving teacher working conditions, and a substantial qualitative and descriptive literature highlights their role in shaping school climate and supporting teachers (e.g., Marks and Printy, 2003; Grissom and Loeb, 2011; Liebowitz and Porter, 2019). Yet there is limited causal evidence on the extent to which principals affect teacher working conditions.

We contribute to the literature by estimating the variance of principal effects on teacher working conditions using rich administrative and survey data. Following the framework developed by Bartanen, Husain, and Liebowitz (2024), we compare correlations of teacher working conditions over time in schools that do and do not experience principal changes. Under reasonable stationarity assumptions, differences in these correlations can be used to recover the variance of principal effects. The intuition underlying our research design is that if working conditions are affected by principals, they should be more persistent when the same principal remains in a school than when leadership changes.

Our data on working conditions are from the 5Essentials (5E) Survey in Illinois. The 5E Survey includes 20 different working condition indicators that comprise over 100 individual survey items. It is administered in nearly all Illinois public schools annually and has a high teacher response rate.

We divide the 20 working-condition indicators into three broad categories. The first category includes two individual indicators—teacher-principal trust and instructional leadership—that capture teachers' perceptions of school leadership directly. Both indicators are about leadership, but they measure distinct concepts. Teacher-principal trust captures climate-oriented aspects of leadership, such as whether teachers feel respected by their principal, and whether their principal takes a personal interest in their professional development. Instructional leadership is process-oriented and based on survey items that ask teachers to reflect on whether their principal communicates clearly about expectations, provides appropriate instructional supports, and is knowledgeable about what is happening in their classrooms.

We combine the remaining 18 non-leadership-specific indicators into two indices using factor analysis: one that captures the professional work environment and another that captures teachers' interactions with students and families. The former puts high weight on indicators that measure concepts like collaboration among teachers, professional development, and teacher innovation. The latter emphasizes indicators such as classroom disruptions, student responsibility, and teacher-parent trust.

Our analysis of the leadership-specific indicators reveals large and persistent principal effects. Our estimates imply a one-standard-deviation improvement in principal quality increases teacher-principal trust and instructional leadership by 0.65 and 0.47 school-level standard deviations, respectively. We also find that principals influence other working conditions, but to a lesser extent. We estimate that a one-standard deviation change in principal quality corresponds to a 0.23 school-level standard deviation change in the index that captures the professional work environment, and a 0.18 standard deviation change in the index that captures teachers' interactions with students and families. These results are robust to reasonable modifications to our estimation sample and methodology.

The magnitudes of our estimates seemingly exceed the most credible estimates of the variance of principal effects reported in the test-score literature (Bartanen, Husain, and Liebowitz, 2024; Branch, Hanushek, and Rivkin, 2012; Rivkin et al., forthcoming), but the

differences are smaller than they initially appear. This is because test-score studies scale principal effects in student-level standard deviation units, whereas our estimates are expressed in school-level units. The aggregation from individuals to schools removes the within-school variance, which means that all else equal, moves in the school-level distribution are smaller in real terms. Still, even after adjusting for this difference, our estimates indicate principal effects on teacher working conditions are larger than their test-score effects, especially for aspects of working conditions directly related to leadership.

Our findings contribute to our understanding of how principals shape teachers' work environments. To the best of our knowledge, our result that school leaders have larger effects on climate-oriented compared to process-oriented aspects of leadership is new, both in the causal literature on principals and in management research more broadly. An intuitive, albeit speculative explanation is that procedural aspects of the principal role are easier to incorporate into management training—which would dampen the cross-principal variance—whereas cultivating a positive school climate may depend more heavily on individual-specific skills that are harder to codify and develop.

Regardless of the reason, the very large principal effects on teacher-principal trust are noteworthy. Although we are not aware of causal evidence, prior correlational studies point to strong associations between climate-oriented aspects of leadership quality, teacher well-being, and teacher intentions to leave (Educators Thriving, 2025).

For the non-leadership-specific working conditions, we interpret our results as follows: the variance of principal effects is large enough to suggest efforts to improve these working conditions via principal quality are promising, but with two caveats. First, principals explain only a small fraction of the variance in most working conditions, meaning principal-centered interventions are a partial solution at best. Second, principal effects are smallest on working conditions related to teachers' interactions with students and families, and these are the conditions that have seen the largest declines since the COVID-19 pandemic (Baker and Koedel, forthcoming).

2. Background & Motivation

2.1 Teacher working conditions and student outcomes

Teacher working conditions are closely linked to both teacher behavior and student outcomes. Prior research identifies a strong link between working conditions and teacher turnover (Redding and Nguyen, 2024; Simon and Johnson, 2015). Indirectly, this suggests poor working conditions harm students, as higher turnover negatively affects achievement (e.g., see Ronfeldt, Loeb, and Wyckoff, 2013; Atteberry, Loeb, and Wyckoff, 2017). Several studies also examine the relationship between working conditions and student achievement growth directly and find growth is higher in schools with better working conditions, even among observationally similar schools (Ferguson and Hirsch, 2015; Johnson, Kraft, and Papay, 2012; Kraft, Marinell, and Yee, 2016). Though causal inference is challenging because it is difficult to isolate exogenous variation in working conditions, the best available evidence supports the intuitive position that better working conditions lead to a more stable teaching workforce and improve student outcomes.

This underscores the need to address recently documented declines in teacher working conditions. Using data from the same 5E Survey used here, Baker and Koedel (forthcoming) document large declines in working conditions along many dimensions beginning with the onset of the COVID-19 pandemic in 2020. These declines accelerated between 2021 and 2023 and show no sign of reversing, suggesting they reflect more than a transitory disruption. The magnitude and persistence of the declines motivate efforts to improve our understanding of what factors influence teacher working conditions, which can provide insight into which policy levers are most likely to improve them.

2.2 The role of principals in driving teacher working conditions

School principals are widely recognized as central actors in shaping teachers' work environments and this view is reflected in both professional standards and academic research. For example, the National Policy Board for Educational Administration (2015) articulates professional standards for school leaders that explicitly identify the responsibility of principals to

support teachers' professional capacity and foster collaborative school communities. And in their review of the academic literature, Grissom, Egalite, and Lindsay (2021) identify four domains of principal behavior that drive school outcomes, all of which emphasize teachers (engaging in instructionally focused interactions with teachers, building a productive school climate, facilitating productive collaboration and professional learning communities, and managing personnel and resources strategically).

However, despite this consensus view, there is little causal evidence on how principals affect teacher working conditions. Most studies are qualitative or correlational. The sole prior causal study is Burkhauser (2017), but she uses a research design that permits the attribution of dynamic school effects to principals, potentially inflating her estimates.

3. Methods

Our objective is to estimate the variance of causal principal effects on teacher working conditions. Doing so is challenging because principals and schools are tightly linked. Principals influence schools, but schools also evolve over time in ways that are outside of the principal's control. Most prior studies use school-fixed-effects models in an effort to disentangle principals and schools (e.g., Bartanen, 2020; Branch, Hanushek, and Rivkin, 2012; Burkhauser, 2017; Chiang, Lipscomb, and Gill, 2016; Dhuey and Smith, 2018; Laing et al., 2016), but this solution is problematic because it attributes dynamic school effects to principals, overstating the variance of principal effects. This concern is especially salient because most principal spells are short. When leadership turnover is frequent, even mean-zero dynamic school shocks may not average out over a principal's tenure.

We identify principal effects by leveraging differences in the persistence of teacher working conditions over time in schools that do and do not experience principal changes. The key insight is simple: if principals meaningfully affect teacher working conditions, then working conditions should be more persistent over time when the same principal remains in place than when the principal changes. By comparing the correlations of working conditions in these two groups of schools over time, and under plausible stationarity assumptions, we difference out

dynamic (and fixed) school effects and recover an unconfounded estimate of the variance of principal effects. Our approach follows closely on Bartanen, Husain, and Liebowitz (2024) and builds on earlier, similarly spirited research designs that leverage principal turnover in Branch, Hanushek, and Rivkin (2012) and Coelli and Green (2012). It is also related to applications in the teacher literature that use the covariance of student growth across classrooms with the same teacher to estimate the variance of teacher effects (Kane and Staiger, 2008). We formalize our methodology in the remainder of this section.

For each working condition *j* in school *s* and year *t*, Y^*_{jst}, we begin by regressing it on a vector of observable characteristics, $\mathbf{X}_{st}$, and year fixed effects, τ_{jt}:

$$Y^*_{jst} = \boldsymbol{\beta}_j \mathbf{X}_{st} + \tau_{jt} + \varepsilon_{jst} \quad (1)$$

$$Y_{jst} = Y^*_{jst} - \widehat{\boldsymbol{\beta}}_j \mathbf{X}_{st} - \hat{\tau}_{jt} \quad (2)$$

The **X** vector controls for school enrollment, school-level racial composition, and district-level median household income. τ_{jt} is a year fixed effect to control for broad statewide trends in working condition *j*. We use the residualized values, Y_{jst}, as the basis for estimating principal effects.

Consider the following conceptual model that expresses residualized teacher working conditions as a function of the principal ($\gamma_{jpt(s,t)}$), school (λ_{jst}), and an idiosyncratic error (ν_{jst}):

$$Y_{jst} = \gamma_{jpt(s,t)} + \lambda_{jst} + \nu_{jst} \quad (3)$$

Equation (3) is not directly estimable because the school and principal effects are not separately identified within a year. School-fixed-effects models resolve the identification problem by assuming $\lambda_{st} = \lambda_s$. However, as noted above, this approach risks attributing dynamic school effects to principals.

We can expand equation (3) by separating the school and principal effects into their fixed (*f*) and dynamic (*d*) components:

$$Y_{jst} = \gamma^f_{jp(s,t)} + \gamma^d_{jpt(s,t)} + \lambda^f_{js} + \lambda^d_{jst} + \nu_{jst} \quad (4)$$

The dynamic terms in equation (4), denoted by $\gamma^d_{jpt(s,t)}$ and λ^d_{jst}, capture temporary deviations from the time-invariant principal and school effects, respectively, and by construction, $\text{cov}(\gamma^f, \gamma^d) = \text{cov}(\lambda^f, \lambda^d) = 0$.

Equation (4) is still not directly estimable. However, by applying some structure on the parameters, we can use this model to recover the variance of principal effects. The structure we impose is described by Chetty, Friedman, and Rockoff (2014) as allowing for "drift" in the dynamic parameters and is characterized by the following stationarity assumptions:

$$\begin{gathered} E[\gamma^d_{pt(s,t)}|t] = E[\lambda^d_{st}|t] = E[\nu_{st}|t] = 0, \\ \text{cov}(\gamma^d_{pt(s,t)}, \gamma^d_{p,t+k}) = \sigma_{\gamma^d_k}, \text{cov}(\lambda^d_{st}, \lambda^d_{s,t+k}) = \sigma_{\lambda^d_k}, \\ \text{cov}(\nu_{st}, \nu_{s,t+k}) = \sigma_{\nu_k}, \text{ for all } t \end{gathered} \tag{5}$$

where k is an integer value measuring the distance between two periods. These assumptions imply that temporary deviations in principal and school performance are mean zero and that their covariances decay with temporal distance. We further assume that the dynamic principal and school components (γ^d and λ^d) are orthogonal.

The model in equation (4), combined with the structure imposed by these assumptions, implies the school-level correlation in outcomes between any periods *t* and *t+k* can be written as follows for schools that have the same principal:

$$r_k^{\text{same}} = \frac{\sigma^2_{\lambda^f} + \sigma_{\lambda^d_k} + \sigma^2_{\gamma^f} + \sigma_{\gamma^d_k} + \sigma_{\nu_k}}{\sigma^2_Y} \tag{6}$$

This expression reflects the persistence of both school and principal effects, including the covariances of the fixed school and principal effects—i.e. their variances, denoted by $\sigma^2_{\lambda^f}$ and $\sigma^2_{\gamma^f}$, respectively—and the covariances of the dynamic school and principal effects *k* periods apart, denoted by $\sigma_{\lambda^d_k}$ and $\sigma_{\gamma^d_k}$. It also includes the covariance of the error *k* periods apart (σ_{ν_k}).

For schools that have different principals *m* and *n*, the correlation is:

$$r_k^{\text{diff}} = \frac{\sigma^2_{\lambda^f} + \sigma_{\lambda^d_k} + \sigma_{\gamma^f_{m\neq n}} + \sigma_{\nu_k}}{\sigma^2_Y} \tag{7}$$

The key difference between equations (6) and (7) is that equation (7) excludes the variance of the fixed principal effects, $\sigma^2_{\gamma^f}$, because different principals lead the school in the different years. This term is replaced with the analogous term $\sigma_{\gamma^f_{m\neq n}} = \text{cov}(\gamma^f_{m(s,t)}, \gamma^f_{n(s,t+k)}) < \sigma^2_{\gamma^f}$ for $m \neq n$, which captures the covariance of fixed principal quality over time for different principals in the same school and depends on how principals are sorted to schools.

In addition to the assumptions listed above, the expressions in equations (6) and (7) also require the following additional assumptions. First, $\text{cov}(\lambda^d_k, \gamma^f_k) = \text{cov}(\lambda^f_k, \gamma^d_k) = 0$. This rules out sorting of principals to schools based on the dynamic components of school and principal effects. In the same spirit, we assume $\text{cov}(\gamma^d_{mt(s,t)}, \gamma^d_{nt(s,t+k)}) = 0$, which means the dynamic components for different principals of the same school are uncorrelated over time. These conditions permit principals to sort to schools, but only by their fixed components.[1]

Comparing the correlations in equations (6) and (7) yields a difference-in-differences-style estimand that isolates the contribution of principals to outcome persistence. The difference in correlations between schools that do and do not experience a principal change can be expressed as:

$$r_k^{\text{same}} - r_k^{\text{diff}} = \frac{\sigma^2_{\gamma^f} + \sigma_{\gamma^d_k} - \sigma_{\gamma^f_{m\neq n}}}{\sigma^2_Y}. \tag{8}$$

When multiplied by the variance of *Y* to cancel out the denominator, equation (8) is an estimate of the policy-relevant variance of principal effects, $\sigma^2_{\gamma^f}$, along with two other terms. We refer to equation (8), multiplied by σ^2_Y, as the "correlation gap."

[1] There is some subtlety in how equations (6) and (7) allow principals to sort to schools. They allow principals to "cluster" in schools by quality—i.e., the fixed quality of principals *m* and *n*, who both lead school *s* at different times, can be correlated, per the term $\sigma_{\gamma^f_{m\neq n}}$. However, as shown, they do not allow fixed principal quality to sort to fixed school quality. Permitting this latter type of sorting adds an extra term to both equations reflecting the covariance of fixed principal and school quality. The extra term belongs in both equations because it is the same in expectation across principals *m*≠*n*. Given that it belongs in both equations, it is inconsequential to our estimation because it cancels out when we take the difference in equation (8) below. Accordingly, we follow the presentational lead of Bartanen, Husain, and Liebowitz (2024) and show equations (6) and (7) under the assumption that fixed principal and school quality are independent.

The first of the two extra terms in equation (8) is $\sigma_{\gamma_k^d}$. It denotes the covariance of the dynamic principal component *k* periods apart. While this term technically reflects variation attributable to principals, it does not capture persistent differences in principal quality and from a policy perspective, the persistent differences are of primary interest. To minimize $\sigma_{\gamma_k^d}$, and noting its influence diminishes over time, we emphasize our estimates of the correlation gap at higher values of *k* where it will be smaller. Focusing on our estimates at higher values of *k* also helps assuage concerns about bias from disruptions in schools concurrent with principal changes.

The other extra term is $\sigma_{\gamma^f_{m\neq n}}$. If principals are assigned to schools randomly this term is zero and if principals are purposefully assigned to schools, it can be positive or negative depending on the assignment process. Though we cannot estimate $\sigma_{\gamma^f_{m\neq n}}$ directly, evidence based on other measures of principal quality suggest it is positively signed, but small. For instance, Bartanen, Husain, and Liebowitz (2024) find a small positive covariance between principals assigned to the same school over time in their supervisor ratings. Similarly, they find the within-school correlation of principal qualifications—e.g., experience, education levels, etc.—is also weakly positive, ranging between 0 to 0.2 depending on the qualification.

The presence of these extra terms in equation (8) implies that the correlation gap gives an approximation of the variance of persistent principal quality. The dynamic component will bias our estimate of $\sigma^2_{\gamma^f}$ upward, though less so over long horizons, while (likely modest) positive sorting of principals to schools will bias our estimate downward. Because these biases operate in opposite directions and are likely small, the resulting estimates are broadly informative about the policy-relevant variance of principal effects. We further note that a contribution of our analysis is to understand heterogeneity in principal effects across different dimensions of teacher working conditions. In comparisons of the correlation gap across working conditions, whatever small biases arise from the inclusion of $\sigma_{\gamma_k^d}$ and $\sigma_{\gamma^f_{m\neq n}}$ in equation (8) will almost surely cancel out.

Finally, we note that the evolution of the correlation gap with k allows us to gain new insight into timing of principal effects. Cullen et al. (2024) and Rivkin et al. (forthcoming) intuitively argue that principal effects may be offset from their tenures—e.g., because procedural and other constraints may prevent a principal from fully affecting the school on day-1, and/or because principal effects are sticky and partially persist after they leave. If true, this will show up in our framework through correlation trends that do not diverge immediately when a principal change occurs, but rather with a lag.

4. Data

We combine two primary datasets for our analysis. The first is an administrative data panel of schools provided by the Illinois State Board of Education (ISBE) covering the school years 2018-19 through 2023-24 (hereafter, we refer to school years by the spring year—e.g., 2018-19 as 2019). The school panel includes principal assignments each year. We merge the school panel with demographic and socioeconomic data at both the school and district levels. At the school level, we incorporate annual data on student enrollment and racial composition from the Common Core of Data (CCD). At the district level, we add local-area median household income from the Education Demographic and Geographic Estimates (EDGE) program of the National Center for Education Statistics (NCES). The EDGE data are derived from the American Community Survey and available as an average from 2017-2021, which we apply uniformly across years. Table 1 reports summary statistics for the school panel.

Most school-year observations indicate just one principal (more than 97 percent), in which case coding principal changes is straightforward. In schools with two principals in a year, we identify changes using the following rule: if at least one principal is the same between years $t - 1$ and t, we code the school as having the same principal; otherwise, we code it as a change. About 0.2 percent of school-year observations indicate more than two principals in the same year and we drop these observations. Our findings are robust to alternative treatments of multi-principal schools, including dropping all school-years with more than one principal or excluding schools that ever report more than one principal.

Our second dataset includes information on teachers' self-reported working conditions from the 5E Survey. The 5E Survey was incorporated into Illinois's Every Student Succeeds Act (ESSA) plan beginning with the 2019 school year. Subsequently, it has become an annual fixture in most public schools statewide, save for the year 2020, when the onset of the COVID-19 pandemic disrupted school operations during the spring survey window. Our 5E Survey data panel runs from 2019 to 2024, excluding 2020.[2]

The broad coverage of the 5E Survey is documented in Appendix Table A1 and is a key strength of our study. The table shows that between 77 and 81 percent of Illinois schools listed in the CCD are in the 5E Survey dataset each year, and these schools account for 90 to 93 percent of total student enrollment. Missing schools are mostly small, and a mix of schools that are truly missing and schools for which data are suppressed by ISBE because of small teacher sample sizes (i.e., N<8 teachers).

Appendix Table A1 also documents teacher participation conditional on school coverage. The teacher response rate ranges from 75-82 percent annually. These rates are comparable to the highest reported in the literature for similar surveys (e.g., in Burkhauser, 2017, and Kraft, Simon, and Lyon, 2021) and exceed those of most other surveys. For instance, Redding and Nguyen (2024) report a teacher response rate of 62 percent for the 2021 Schools and Staffing Survey, and response rates on surveys that ask similar questions about working conditions are often in the 50s, or lower, when reported (e.g., EdChoice, 2024; Horng, 2009).[3]

The 5E Survey includes 20 different Measures of teacher working conditions. Each Measure in each year is a school-level indicator that aggregates responses across multiple survey items within a domain and across teachers within a school. The information is aggregated using Rasch analysis, which is a method for aggregating over survey items and respondents that accounts for imprecision due to a variety of factors (Hart et al., 2020). The Rasch analysis is

[2] The 5E Survey was also administered in Illinois prior to 2019 (and our school panel goes back further too), but survey coverage was much less comprehensive—e.g., only about half of schools administered the survey in 2017 and 2018. For this reason, we focus on the period from 2019 onward.

[3] A surprising number of studies that rely on surveys in this literature do not report survey response rates.

conducted by the developers and administrators of the 5E Survey—the University of Chicago Consortium on School Research—prior to providing the results to the Illinois State Board of Education (ISBE). Data disaggregated below the school-level Measures are not available. As a result, our analysis is necessarily conducted at the school level, which aligns naturally with principals as the unit of treatment.[4]

We elaborate briefly on the Rasch analysis to provide a deeper understanding of our data. Rasch analysis employs principles of item response theory (IRT) to estimate "attitude" parameters for each respondent and "difficulty" parameters for each survey item. A respondent "attitude" is estimated based on his or her answers to survey items in a particular domain (i.e., in a Measure). Item "Difficulty" reflects how frequently items are endorsed. These estimates are used to down-weight responses from teachers that are statistically inconsistent or uninformative and up-weight responses on items that provide greater discrimination across respondents. The resulting school-level Measures are more informative than simple averages of raw survey responses, analogously to how IRT is used to construct scaled scores on tests that are more informative than the simple number of correct answers. Bond and Fox (2012) provide a detailed discussion of Rasch methods.

Table 2 lists the 20 working condition Measures on the 5E Survey, which together are comprised of 105 total survey items. Appendix Table B1 shows the individual survey items under each Measure. The Measures span most dimensions of working conditions covered in the literature (Merrill, 2021), including interactions with principals, colleagues, students, and parents; professional development; and safety. Though they do not cover every dimension—e.g., the quality of facilities is notably absent— the Measures reflect aspects of working conditions that teachers consistently report valuing most, including effective leadership, collaborative work

[4] Teacher-level data are not made available to researchers by the Consortium on School Research, nor are they provided to the ISBE. In fact, to our knowledge, they are not used in any capacity. We believe this is because the survey is not designed to study individual teachers, but rather to measure conditions of schools.

environments, and professional support (Grissom, Viano, and Selin, 2015; Johnson, Kraft, and Papay, 2012; Simon and Johnson, 2015).

Table 2 reports teacher-weighted means and standard deviations of the Measures in 2019, the first year of our data panel. Higher values always indicate more favorable conditions; for example, the "level of classroom disruptions" Measure is reverse-coded. Each Measure is standardized and scaled from 1-99. The standardization is with respect to the 2013 school distribution in Illinois—a value of 50 indicates the 2013 average and a 20-point move is equivalent to one standard deviation in the 2013 distribution. For our empirical analysis, we re-standardize all Measures to have mean zero and variance one within each year, following convention in the principal-effects literature.[5]

Columns (2) and (3) of Table 2 divide schools into above- and below-median groups based on district median income from the EDGE data. Comparing across these columns shows the familiar pattern from research that teacher working conditions are better at high-SES schools (Johnson, Kraft, and Papay, 2012; Kraft, Simon, and Lyon, 2021). This is true on average as indicated by the bottom row of the table, as well as for 16 of the 20 Measures individually, though only 6 individual differences are statistically significant.

5. Results

We present our results in three steps. We start with a simple illustration of our research design using the two working-condition Measures that directly capture teachers' perceptions of school leadership. This illustration provides intuition for how principal effects manifest in the correlations that underpin our identification strategy. We then conduct a descriptive variance decomposition exercise to get a broad sense of the role of principals in explaining variation in teacher working conditions. We conclude by presenting our main estimates of the variance of

[5] The standardization in the raw survey data with respect to the 2013 distribution is useful for tracking working-condition trends over time and is discussed in more detail in Baker and Koedel (forthcoming). However, this feature of the data is not important for our analysis so we do not elaborate here.

principal effects.

5.1 Simple illustration

The two Measures that focus on principals directly are teacher-principal trust and instructional leadership. The questions on the 5E Survey under teacher-principal trust are primarily relational and climate-oriented (e.g., whether teachers feel respected by their principal), whereas the questions under instructional leadership are process-oriented (e.g., whether teachers believe school leaders communicate clear instructional expectations and provide useful feedback). Appendix Table B1 shows the full set of questions under each Measure.

Figure 1 plots correlations over time for these Measures in each year of our data panel, relative to 2019, for three subgroups of schools: (1) where the same principal remained in place during the full period from 2019 to 2024, (2) where there was one principal change in 2022 and no other changes, and (3) where there was one principal change in 2023 and no other changes. We focus on these three subgroups because they have simple and distinct principal turnover profiles. The correlations in the figure are weighted by the number of teachers in each school.

For schools without a principal change, Figure 1 shows the correlations in working conditions are high and attenuate gradually over time. The attenuation is consistent with the presence of dynamic school and principal effects. For schools that experience a principal change, the correlation paths closely track those of the no-change group prior to the transition, then diverge sharply at the time of the change. The divergence is especially pronounced for teacher–principal trust, though it is substantial for instructional leadership as well. After the transition, the correlation paths stabilize and follow a similar, modestly declining trajectory.

Figure 2 presents analogous results for a Measure that our subsequent analysis suggests is less affected by principals: teacher-parent trust. In this case, the correlation paths do not visibly diverge following a principal change, suggesting factors outside of the principal's control primarily drive teacher-parent trust. Together, Figures 1 and 2 illustrate the intuition of our

design: to the extent principals causally affect working conditions, outcomes should be more persistent when the same principal remains in place than when the principal changes.

5.2 Factor analysis

Due to the potential for especially large principal effects on teacher-principal trust and instructional leadership, we treat these Measures separately throughout our analysis. For the other 18 Measures, which capture broader aspects of teacher working conditions not explicitly focused on leadership, we use factor analysis to reduce dimensionality and facilitate a more parsimonious presentation of our results.

We follow the approach of Baker and Koedel (forthcoming) for the factor analysis. Specifically, we apply oblique rotation and use the eigenvalues from the correlation matrix of the 18 Measures to identify the number of factors. Appendix Figure A1 presents a scree plot of the eigenvalues. Using the Kaiser–Guttman criterion, which retains factors with eigenvalues greater than one, we identify two factors.

Table 3 reports the factor loadings for each Measure, which we use to construct weighted-average composite indices of working conditions. The first factor loads most heavily on Measures related to the professional work environment, including collaborative practices, reflective dialogue, teacher innovation, and the quality of professional development. The second factor loads primarily on Measures related to teachers' interactions with students and families, such as classroom disruptions, student responsibility, teacher safety, and teacher-parent trust. Based on these patterns, we adopt the terminology of Baker and Koedel (forthcoming) and label the two factors "professional work environment" and "interactions with students and families."

5.3 Variance decomposition

Before turning to our causal estimates, we estimate descriptive models to get a sense of the relative importance of principals and schools in explaining variation in teacher working

conditions. We estimate random-effects models that decompose the variance in residualized working conditions into components attributable to principals, schools, and transitory shocks. For each working condition *j*, we estimate the following model:

$$Y_{jspt} = \alpha_{jsp} + \alpha_{js} + \epsilon_{jspt} \quad (9)$$

Here, α_{jsp} is a principal-by-school random effect, α_{js} is a school random effect, and ε_{jspt} is an idiosyncratic error term. Equation (9) is incomplete because it does not account for dynamic school and principal effects, with the implication that it likely overstates the variance explained by principals by misattributing dynamic school-level factors. Still, the model gives a general sense of the importance of schools and principals in explaining the variance of teacher working conditions.

Figure 3 reports the variance shares associated with principals, schools, and the residual for four outcomes: teacher-principal trust, instructional leadership, the index capturing the professional work environment, and the index capturing teacher interactions with students and families. Principals account for a larger share of the variance in the two leadership-specific indicators, and especially teacher-principal trust. For the broader working-condition indices, schools explain most of the variance and the principal component is substantially smaller.

These patterns preview the findings from our more rigorous causal analysis. They suggest that principals matter most for working conditions directly related to leadership—and among these, more so for climate-oriented aspects—and least for conditions that capture student behavior and family engagement. Appendix Figure A2 shows variance decompositions for each of the 18 individual Measures in the indices, which reinforce these summary conclusions.

5.4 Main Results

We now present our main estimates of the variance of principal effects. Our approach compares the correlations of residualized outcomes between year t and year $t + k$ for schools with the same principal versus schools with a different principal, as described in Section 3. For each outcome and horizon k, the difference in correlations identifies the variance of principal effects up to the additional covariance terms previously discussed. Our full data panel permits estimation for horizons up to $k = 5$, corresponding to comparisons between 2019 and 2024.[6]

Figure 4 plots the correlations for teacher-principal trust, instructional leadership, the professional work environment, and interactions with students and families. Like in Figures 1 and 2, the correlations are weighted by the number of teachers in each school. The results for teacher-principal trust and instructional leadership follow from our simple illustration above—the correlations are substantially higher in schools that retain the same principal, and the gap emerges immediately when a principal transition occurs.

Table 4 shows that at *k*=1, the standard deviation of principal effects implied by equation (8) is 0.84 for teacher-principal trust and 0.59 for instructional leadership. These effect sizes attenuate as *k* increases, settling at 0.65 and 0.47, respectively, at *k*=5. These are our best estimates of the effect of a one-standard-deviation improvement in principal quality measured on these dimensions.

The results using the broader working-condition indices indicate much smaller principal effects. For the professional work environment index, the estimated standard deviation of

[6] Note that an increment of *k* is always equal to one year. So, for instance, because there are no working-conditions data in 2020, there are no *k*=1 correlations involving 2019 (the correlations between 2019 and 2021 are at *k*=2), though there are *k*=1 correlations involving the other years.

principal effects is approximately 0.23 at k=5, and for interactions with students and families, it is 0.18.

Two aspects of how principal effects vary with k are notable. First, we find no evidence of delayed principal effects. For all four outcomes, the correlation gap between same-principal and different-principal schools opens immediately following a leadership change. This finding is inconsistent with models in which principals affect schools with a lag due to institutional inertia or sticky policies from the prior principal.

Second, the correlation gap generally declines as k increases, except when the outcome is the factor-2 index. The declining pattern is consistent with a diminishing role for the dynamic component of principal effects—$\sigma_{\gamma_k^d}$ in equation (8)—as k increases. For outcomes outside of the factor-2 index, our estimates of the standard deviation of principal effects at k=5 are approximately 80 percent as large as our estimates at k=1, with little change between k=4 and k=5. If we take this as evidence that $\sigma_{\gamma_k^d}$ is close to zero at k=5, it suggests the k=1 estimates overstate the standard deviation of the principal fixed effects by about 25 percent.

In contrast, for the factor-2 index capturing interactions with students and families, the estimates do not decline with k, and they even increase modestly. There is no theoretical reason to expect an increasing pattern and the most likely explanation is sampling variance. Accordingly, we do not interpret the increase substantively; instead, we interpret it as indicating there is no meaningful dynamic component to principal effects for this outcome.

Table 4 also reports additional details from the estimation, including sample sizes and p-values from tests of the null hypothesis that the correlations are equal between same-principal

and different-principal schools for each outcome and at each value of k.[7] Appendix Table A2 and Appendix Figure A3 present analogous results for each of the 18 individual working-condition Measures in the indices, which again reinforce our broad conclusions.

5.5 Comparisons with other studies of principal effects

We begin by comparing our estimates to Burkhauser (2017), which is the most closely related study. Burkhauser (2017) also estimates principal effects on survey-based indicators of teacher working conditions. Her setting is North Carolina, and she relies on school-fixed-effects models to identify principal effects.

The North Carolina survey includes 34 individual items, which Burkhauser aggregates using factor analysis into four composite indices: teacher empowerment/school leadership, teacher time use, physical environment, and professional development. In her preferred specifications, she estimates principal effect sizes of 0.60, 0.28, 0.37, and 0.24 school-level standard deviations for these indices, respectively.

Although our study and hers are conceptually similar, the outcome measures are not directly comparable. This is because the survey instruments in North Carolina and Illinois only partially overlap, and Burkhauser does not isolate leadership-specific working conditions. For instance, her teacher empowerment/school leadership index combines concepts that in our framework are distributed across teacher-principal trust, instructional leadership, and the professional work environment index.

With this interpretive caveat in mind, Burkhauser's estimates are generally larger than ours. Her 0.60 effect size on the teacher empowerment/school leadership index is similar in magnitude to our estimate for teacher-principal trust. However, only a subset of items in her

[7] Generally speaking, as k increases we have fewer observations k years apart, though due to the COVID-19 gap year when the 5E Survey was not administered in 2020, the relationship between k and the sample size is lumpy.

index explicitly pertain to climate-oriented aspects of leadership. If her index is interpreted as comparable to a weighted average of our teacher-principal trust, instructional leadership, and professional work environment outcomes, her estimate substantially exceeds ours. Likewise, for non-leadership-specific domains, her reported range of effect sizes, from 0.24 to 0.37 school-level standard deviations, is well above the corresponding effect sizes in our study.

The larger estimates in Burkhauser (2017) are consistent with expectations based on methodological differences between our studies. In the literature on principal test-score effects—where more studies are available for comparison—effect sizes from estimation approaches that account for dynamic school effects, like ours, tend to be substantially smaller than those obtained from traditional school-fixed-effects models.[8] This suggests that at least part of the gap between our findings and the findings in Burkhauser (2017) reflects the difference in research design.

We also compare our findings to the test-score literature to assess how principal effects on working conditions compare to their effects on student achievement. This comparison requires careful attention to scaling. Our outcomes are school-level measures of teacher working conditions, and we standardize them using the school-level distribution. This aligns them in scale with the level at which principals plausibly exert influence. However, it complicates comparisons with the test-score literature, where principal effects are expressed in student-level standard deviation units.

A rationale for scaling principal effects using student-level standard deviations is that it facilitates comparisons with the effects of other education interventions, which are commonly

[8] Grissom, Egalite, and Lindsay (2021) summarize findings from six studies that use school-fixed-effects models and report an average effect size of 0.13 student-level standard deviations (the six studies are: Branch, Hanushek, and Rivkin, 2012; Grissom, Kalogrides, and Loeb, 2015; Chiang, Lispcomb, and Gill, 2016; Laing et al., 2016; Dhuey and Smith, 2018; Bartanen, 2020). Alternatively, studies using ours or a similar approach to mitigate bias from dynamic school effects estimate effect sizes on the order of 0.03 to 0.06 student standard deviations (Bartanen, Husain, and Liebowitz, 2024; Branch, Hanushek, and Rivkin, 2012; Rivkin et al., forthcoming).

reported in the same units. However, it attenuates principal effect sizes by including within-school variance—over which principals have no control—in the denominator. Because a student-level standard deviation of test scores is larger than a school-level standard deviation, reporting principal effects in student-standard-deviation units makes them appear smaller.

To facilitate the comparison of our estimates to estimates from the test-score literature, we make an *ad hoc* adjustment to translate published test-score estimates from student-level to school-level standard deviation units. Specifically, we multiply existing estimates by the ratio of the former to the latter. This ratio, which is greater than one, reflects the fact that a move of X units in student standard deviations is equivalent to a move of more than X units in school standard deviations. We are not aware of any principal studies that directly report the ratio of student- to school-level standard deviations to inform this translation, but Hedges and Hedberg (undated) estimate this ratio for many state tests and report it is typically around 2.5.[9]

We apply this scaling factor to estimates from test-score studies that use ours or a similar research design to mitigate bias from dynamic school effects (Bartanen, Husain, and Liebowitz, 2024; Branch, Hanushek, and Rivkin, 2012; Rivkin et al., forthcoming).[10] These studies estimate principal effect sizes on math achievement on the order of 0.03 to 0.06 student-level standard deviations. Multiplying by 2.5 implies effect sizes of 0.075 to 0.15 school-level standard deviations.

Our estimate of the variance of principal effects on the index that captures teachers' interactions with students and families is only slightly above this range, at 0.18. The variance of

[9] Hedges and Hedberg (undated) report the ratio of variances. The square root of the ratio of variances gives the ratio of standard deviations.

[10] The six studies covered by Grissom, Egalite, and Lindsay (2021) are Branch, Hanushek, and Rivkin (2012), Grissom, Kalogrides, and Loeb (2015), Chiang, Lispcomb, and Gill (2016), Laing et al. (2016), Dhuey and Smith (2018), and Bartanen (2020). Note that Branch, Haunshek, and Rivkin (2012) estimate both types of models. Rivkin et al. (forthcoming) use a substantively different randomized-inference approach that accounts for dynamic school effects empirically.

principal effects on the index that captures teachers' professional work environments is somewhat larger, and the variance in terms of the leadership-specific working conditions is substantially larger.

6. Extensions

6.1 Teacher turnover

Next we examine teacher turnover, which we prefer to treat as a working-conditions-adjacent outcome. We measure turnover in year t as the fraction of teachers in the school in year t who are not in the same school in year $t+1$, inclusive of movers and leavers. Because calculating turnover requires forward-looking data, the maximum value of k is 4 rather than 5. We standardize the turnover variable by school and year to make it comparable in scale to our other outcomes. As a point of context for these estimates, teachers' unions in Illinois are strong and this may dull principal effects on turnover in our setting—one might expect larger effects in states with weaker unions.

Table 5 reports estimates of the variance of principal effects on teacher turnover. At k=1, a one standard deviation change in principal quality corresponds to a 0.28 school-level standard deviation change in turnover. This estimate is comparable in magnitude to our k=1 estimate for the professional work environment and equivalent to a 3.3 percentage-point change in the turnover rate, relative to a mean value of 17.5 percent.

Principal effects on turnover decay more rapidly with k than their effects on working conditions. In fact, for $k > 1$, we cannot statistically detect principal effects. Within our estimation framework, this indicates dynamic effects drive the influence of principals on turnover; or in other words, principal effects on turnover do not persist. Moreover, the estimate at k =1 is driven by a relatively high same-principal correlation, not a low correlation in schools where the principal changes. This pattern suggests turnover does not respond sharply to changes in leadership. Instead, principals appear to influence turnover primarily in the short run and within stable principal-school matches, with effects that dissipate quickly. A plausible

explanation is that principals' behaviors can accelerate or delay teachers' exit decisions over short horizons, but they do not affect the final outcome.

Given the short-lived nature of these effects, it is also possible that the estimate at k=1 is spurious. However, below we show principal effects on turnover at k=1 are correlated in the expected direction with their effects on teacher working conditions, suggesting the turnover effects at least partly reflect something real.

Finally, while we prefer to think of teacher turnover as a working-conditions-adjacent outcome, an alternative is to view it as a control variable. Using the terminology of Angrist and Pischke (2009), turnover is likely a "bad control" because it can be influenced by principals. Still, for completeness, we estimate our working-condition models after including a control for teacher turnover in the residualization process (i.e., in equations 1 and 2). Despite the conceptual concern with including turnover as a control variable, it does not meaningfully influence our results—Appendix Table A3 shows our working-condition findings are similar if we directly control for teacher turnover.

6.2 Correlations of principal effects across working conditions

We estimate the correlations between principal effects across outcomes by extending our principal-turnover based variance estimator to composite measures of teacher working conditions. For any pair of outcomes A and B—e.g., teacher-principal trust and the factor-1 index for the professional work environment—we construct a combined outcome $Z = A+B$. We then use our correlation-based approach to estimate the variance of principal effects on Z. Under our stationarity and orthogonality assumptions, this variance decomposes into the sum of the variances on A and B, plus two times the covariance. Thus, with the variance of principal effects on Z, combined with the variances on A and B, we can recover the covariance of principal effects on A and B, which we convert to a correlation for ease of interpretation.[11]

[11] There are some additional technical requirements for this estimation approach to work. First, outcomes A and B must be on the same measurement scale, which is ensured by our standardization. It is also important that the sample

Like with our variance estimates, the covariance estimates reflect the persistent component of principal effects across outcomes, along with cross-outcome analogs to the extra terms from equation (8). Here these extra terms capture (a) the cross-outcome covariance of dynamic principal effects over time and (b) the cross-outcome covariance associated with any principal sorting to schools. As above, we expect the net impact of these terms to be smaller at longer horizons, and thus we report correlation estimates at k=5.[12]

The results are reported in Table 6. The correlations are uniformly positive across working conditions, though their magnitudes vary considerably. The largest correlation is between instructional leadership and the factor-1 index for the professional work environment, at 0.82. This points to a strong link between principal effects on process-oriented aspects of leadership and teachers' perceptions of their work environments.

Principal effects on instructional leadership and teacher-principal trust are also highly correlated, at 0.71. Notably, however, this correlation is smaller than the correlation between instructional leadership and the factor-1 index. One might expect principal effects on the two indicators explicitly focused on leadership to be the most strongly correlated, but this is not the case. The 0.71 correlation leaves considerable room for distinguishing these two dimensions of leadership.

A last notable finding from Table 6 is that principal effects on teachers' interactions with students and families are consistently the least correlated with their other effects. This indicates that effectiveness along this dimension is relatively distinct from effectiveness in other areas.

We also briefly consider the correlations between principal effects on working conditions and teacher turnover. Because principals' turnover effects are concentrated in the dynamic component per above, we estimate these correlations at k=1. With the caveat that the larger role

used to estimate the variance of principal effects on the composite outcome, Z, is the same sample used to estimate the variance on both A and B separately. We meet this requirement by restricting the sample in this section to school-year observations for which all four working-condition indicators are observed.

[12] Inference is substantively similar for all k; like with the variances, the covariances (and thus correlations) are generally decreasing in k.

of the dynamic component complicates interpretation, we find that principal effects on teacher turnover are negatively correlated with their effects on working conditions. The k=1 correlations between turnover and teacher-principal trust, instructional leadership, the factor-1 index, and the factor-2 index are -0.16, -0.20, -0.06, and -0.62, respectively. This is consistent with expectations: principals who improve working conditions reduce teacher turnover.

7. Robustness and Heterogeneity

7.1 Robustness to alternative residualization models

We consider two alternatives to our preferred residualization model in equations (1) and (2). First, we estimate a version of equation (1) that includes school-by-principal fixed effects, μ_{sp}. These fixed effects are omitted from the analog to equation (2)—their value is entirely in forcing $\boldsymbol{\beta}$ to be identified using within school-by-principal variance.[13] This approach is used in Bartanen, Husain, and Liebowitz (2024), though related work in the teacher literature suggests our preferred approach likely produces marginally less-biased estimates.[14]

As a practical matter, incorporating school-by-principal fixed effects into our residualization procedure has no meaningful impact on our results. Appendix Table A4 reports estimates using this alternative specification, which closely mirror our main findings.

In the second alternative, we explore models that control for lagged working conditions. Our correlation-based framework does not require lagged outcomes for identification but including them provides a useful robustness check. A concern is that directly controlling for lagged working conditions is problematic because these outcomes may themselves be influenced by principals.[15] To address this concern, we estimate a restricted value-added-style model using a

[13] Note that when we include μ_{sp} in equation (1) we must omit the median-income control, which does not vary within principal spells.

[14] Chetty, Friedman, and Rockoff (2014) lead with a residualization procedure like the one used by Bartanen, Husain, and Liebowitz (2024). In their application analyzing teachers, they include teacher fixed effects in the first equation. However, they also show results using a residualization procedure like our preferred approach—which in their application means omitting the teacher fixed effects from the initial residualization equation—and find it produces less biased estimates. This result is replicated in Parsons, Koedel, and Tan (2019).

[15] This concern is not specific to our study and applies to other school and principal value-added applications. In studies of high school effectiveness by Jackson et al. (2020) and Jackson et al. (2024), the authors restrict their value-added models to 9th grade students only (i.e., students in their first year of high school) to address it.

subsample of schools that experienced a principal change in 2021. For these schools, we use 2019 working conditions as lagged controls for all subsequent years (i.e., 2021 to 2024), ensuring that the lagged outcomes are not affected by the principals we use for identification.

We estimate the variance of principal effects for k=1,2,3 using this restricted sample. The results are in Appendix Table A5. Although the estimates are noisy due to the small sample size, they are substantively similar to our main results. This reinforces the point that lagged-outcome controls are not essential for identification within our framework.

7.2 Heterogeneity by schooling level

We test whether principals are differentially influential in elementary versus middle and high schools by splitting our sample based on schools' 2019 categorizations in the Common Core of Data. Of our full sample of schools, 63.5 percent are elementary schools and 36.5 percent are middle and high schools.

The results for elementary schools are reported in Appendix Table A6, and the results for middle and high schools are in Appendix Table A7. The variance of principal effects is broadly similar across schooling levels, though it is somewhat larger in elementary schools for the non-leadership-based indices.

7.3 The COVID-19 pandemic

Our data panel spans the COVID-19 pandemic, raising concerns about whether the pandemic disruption confounds our estimates. The direction of potential bias is ambiguous. The pandemic could have amplified differences in principal quality if leadership became more important during the disruption, or the disruption could have compressed differences in quality if principals' roles shifted toward basic operations.

To assess the sensitivity of our estimates to the pandemic period, we re-estimate our models using data from the post-pandemic period only, from 2022 to 2024. Restricting the sample reduces the maximum horizon to k=2 but still permits informative comparisons with our full-sample results at k=1,2. We report the results in Appendix Table A8. They are similar to our

results using the full sample, which suggests the disruption associated with the pandemic does not meaningfully influence our findings.

8. Conclusion

We estimate the variance of principal effects on teacher working conditions using rich administrative and survey data from Illinois. Principal effects vary widely on working conditions directly related to leadership, and especially climate-oriented aspects of leadership. A one-standard-deviation improvement in principal quality corresponds to improvements in teacher-principal trust (climate-oriented) and instructional leadership (process-oriented) of 0.65 and 0.47 school-level standard deviations, respectively. Principal effects on other aspects of teacher working conditions also vary, but to a lesser degree. We estimate moderate effects on teachers' professional work environments (0.23 standard deviations) and their interactions with students and families (0.18 standard deviations). The effect size we estimate for the latter is just above the range of the most credible estimates of principal effects on student test scores, after adjusting for differences in scaling.

Our findings point to climate-oriented aspects of leadership as a potentially important lever for improving teachers' work environments. Descriptive evidence emphasized by teacher policy and advocacy organizations like Educators Thriving (2025) suggests climate-oriented leadership is central to teachers' perceptions of their schools. The substantial variation we document across principals in this domain highlights its relevance for principal selection and, to the extent it is malleable, principal training. However, Educators Thriving reports that few districts currently train principals to strengthen climate-oriented leadership, and the extent to which university-based principal preparation programs prioritize climate is not well documented in empirical research.

Whether our findings for the non-leadership-specific working conditions are large or small is in the eye of the beholder. Readers expecting principals to be the primary determinant of teacher working conditions broadly may interpret our estimates as small. Alternatively, readers familiar with the range of effect sizes typically produced by well-identified causal research in

education may view them as more meaningful (Kraft, 2020). Our view is that our estimates imply the scope for principal effects is large enough for principal-based interventions to improve teacher working conditions, though there are limits on what we can expect. Most of the variance in non-leadership-specific working conditions is attributable to factors other than principals, and principal effects are smallest on working conditions related to teachers' interactions with students and families, which Baker and Koedel (forthcoming) show have seen the largest decline since the COVID-19 pandemic.

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Table 1. Descriptive Statistics.

	Mean	Std Dev.
School characteristics:		
Number of teachers	47.5	36.1
Enrollment	499.0	452.6
District median income	$52,635	$19,104
Student demographics (shares)		
Enrolled for free or reduced-price lunch	0.50	0.30
Asian	0.04	0.09
Black	0.18	0.28
Hispanic	0.23	0.27
White	0.50	0.35
Two or more races	0.04	0.04
Native Hawaiian or other Pacific Islander	<0.01	<0.01
American Indian or Alaska Native	<0.01	<0.01
Number of Districts	846	
Number of Schools	3802	
Number of Principals	5650	
Number of Principal-by-Schools	6509	
Number of School-by-year Cells	16932	

Notes: The sample consists of 5E schools, i.e., schools participating in the 5E survey. All statistics are drawn from the 2019 and 2021–2024 survey years. The survey was not administered in 2020 due to COVID-19, so that year is not included in the sample. The reported numbers of districts, schools, and principals reflect the total number of unique entities observed across the full sample period.

Table 2. Means and Standard Deviations of Each Survey Measure in 2019, Overall and in High- and Low-SES Schools.

	All Schools	High-SES Schools: Above-median district median-income	Low-SES Schools: Below-median district median-income
	Mean (Std Dev)	Mean (Std Dev)	Mean (Std Dev)
Teacher-Principal Trust	49 (18)	50 (18)	48 (19)
Instructional Leadership	46 (21)	46 (20)	47 (22)
Classroom Disruptions	75 (20)	80* (16)	68* (23)
Collaborative Practices	49 (24)	50 (22)	49 (25)
Collective Responsibility	47 (20)	48 (19)	45 (21)
Teacher Influence	39 (13)	40 (12)	39 (13)
Teacher Innovation	41 (23)	42 (21)	41 (25)
Program Coherence	54 (20)	53 (19)	55 (21)
Parent Influence on Decision Making in Schools	52 (21)	53 (19)	52 (22)
Parent Involvement in School	51 (21)	56 (19)	46 (22)
Student Responsibility	55 (21)	60* (18)	48* (23)
Quality Professional Development	55 (22)	54 (20)	57 (24)
Reflective Dialogue	50 (22)	50 (20)	52 (23)
School Commitment	48 (20)	51* (18)	45* (21)
Quality of Student Discussion	53 (24)	56 (20)	50 (26)
Socialization of New Teachers	83 (22)	87* (19)	78* (23)
Teacher-Parent Trust	56 (24)	63* (21)	48* (25)
Teacher-Teacher Trust	53 (19)	55 (18)	51 (20)
Teacher Safety	43 (20)	47* (18)	38* (21)
Expectations for Postsecondary Education	54 (20)	58 (18)	48 (21)
Simple Average	53 (15)	55 (13)	50 (16)

Notes: The reported means and standard deviations are teacher-weighted averages based on school-level survey Measures. Schools are classified as high-SES or low-SES depending on whether their district median income falls above or below the median. The standard deviations presented in the table reflect the original survey scale, in which 20 points correspond to one standard deviation in the 2013 distribution. In the main analysis, we re-standardize all Measures to have a mean of zero and a standard deviation of one.

* indicates that the difference between high- and low-SES schools is statistically significant at the 5 percent level, with district-level clustering.

Table 3. Factor Weights.

	Factor 1 - Professional Work Environment	Factor 2 - Interactions with Students and Families
Classroom Disruptions	-0.02	0.15
Collaborative Practices	0.10	-0.02
Collective Responsibility	0.09	0.03
Teacher Influence	0.05	0.02
Teacher Innovation	0.11	0.01
Program Coherence	0.07	0.04
Parent Influence on Decision Making in Schools	0.08	0.03
Parent Involvement in School	0.03	0.10
Student Responsibility	0.00	0.14
Quality Professional Development	0.10	0.02
Reflective Dialogue	0.12	-0.04
School Commitment	0.04	0.09
Quality of Student Discussion	0.03	0.11
Socialization of New Teachers	0.05	0.00
Teacher-Parent Trust	0.04	0.11
Teacher-Teacher Trust	0.09	0.02
Teacher Safety	0.00	0.14
Expectations for Postsecondary Education	0.01	0.05

Notes: We build two composite indices of working conditions, calculated as weighted averages of the underlying survey Measures, using these factor loadings as weights.

Table 4. Sample Sizes, Correlations, Differences in Correlations, and Estimates of the Standard Deviation of Principal Effects for Different Working Conditions and Working-Condition Composites, Over Different Horizons of Estimation, *k*.

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	7749	1375	0.784	0.058	0.727	0.000	0.836
2	6410	2593	0.667	0.078	0.589	0.000	0.753
3	3570	2356	0.606	0.075	0.530	0.000	0.715
4	1531	1484	0.566	0.104	0.462	0.000	0.667
5	1244	1716	0.548	0.112	0.436	0.000	0.648
Pooled							0.767
Panel B: Instructional Leadership							
1	7737	1375	0.757	0.386	0.371	0.000	0.589
2	6396	2590	0.658	0.350	0.308	0.000	0.536
3	3565	2350	0.592	0.336	0.255	0.000	0.488
4	1525	1479	0.559	0.361	0.198	0.000	0.430
5	1240	1710	0.522	0.291	0.231	0.000	0.465
Pooled							0.538
Panel C: Factor 1 - Professional Work Environment							
1	7760	1377	0.805	0.649	0.156	0.000	0.277
2	6421	2597	0.714	0.575	0.139	0.000	0.261
3	3576	2357	0.641	0.537	0.104	0.000	0.225
4	1533	1484	0.621	0.519	0.101	0.000	0.223
5	1244	1716	0.566	0.463	0.104	0.000	0.225
Pooled							0.257
Panel D: Factor 2 - Interactions with Students and Families							
1	7760	1377	0.816	0.763	0.052	0.000	0.156
2	6421	2597	0.714	0.657	0.057	0.000	0.162
3	3576	2357	0.678	0.636	0.042	0.005	0.140
4	1533	1484	0.685	0.604	0.081	0.000	0.194
5	1244	1716	0.648	0.578	0.070	0.002	0.180
Pooled							0.160

Notes: This table reports correlations of residualized teacher working conditions for schools led by the same principal (r_k^{same}) versus different principals (r_k^{diff}) over horizons *k*, along with the corresponding sample sizes. Correlations are weighted by the number of teachers in each school and are computed between year *t* and *t* + *k* for the same school. Residualized measures are obtained using Equation 2, which adjusts for school-level student demographics and enrollment, district median income, and year fixed effects. Of the twenty original 5E Survey Measures, we report instructional leadership and teacher-principal trust individually and aggregate the remaining eighteen Measures into two indices using the factor structure in Table 3. For each *k*, diff_k is the difference between r_k^{same} and r_k^{diff}, and the associated *p*-values are from tests of whether the difference is zero. The final column (SD_k) shows the implied standard deviation of principal effects estimated using the correlations, as described in the text. The bottom row of each panel presents the pooled estimate of the standard deviation of principal effects over all *k*.

Table 5. Results Analogous to our Main Results in Table 4, for Teacher Turnover.

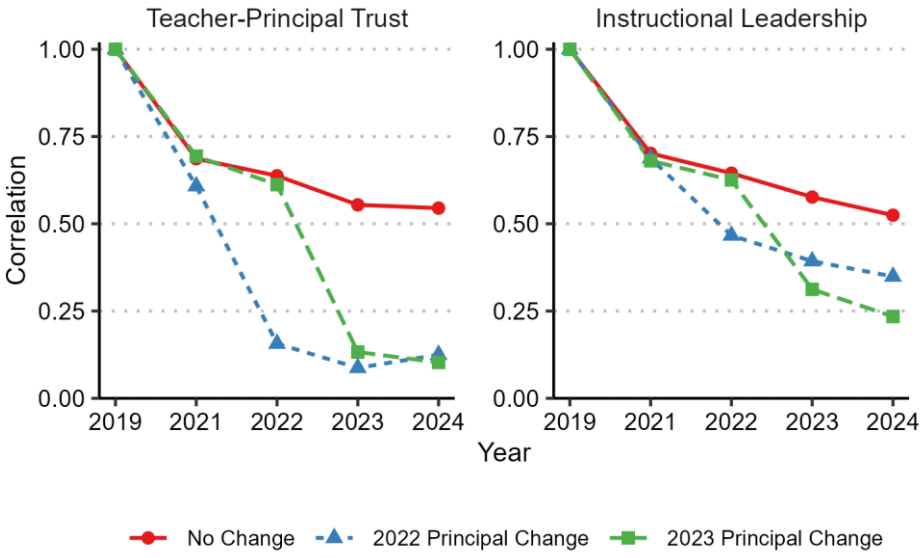
k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Teacher Turnover							
1	5738	1052	0.349	0.252	0.097	0.002	0.279
2	4899	1850	0.278	0.250	0.028	0.267	0.150
3	2138	1171	0.250	0.241	0.009	0.800	0.083
4	1705	1609	0.248	0.218	0.029	0.372	0.153
Pooled							0.206

Notes: This table reports correlations of residualized teacher turnover for schools led by the same principal (r_k^{same}) versus different principals (r_k^{diff}) over horizons *k*, along with the corresponding sample sizes. Correlations are weighted by the number of teachers in each school and are computed between year *t* and *t* + *k* for the same school. Residualized teacher turnover is estimated using Equation 2, which adjusts for school-level student demographics and enrollment, district median income, and year fixed effects. For each *k*, diff_k is the difference between r_k^{same} and r_k^{diff}, and the associated *p*-values are from tests of whether the difference is zero. The final column (SD_k) shows the implied standard deviation of principal effects estimated using the correlations, as described in the text. The bottom row of the table presents the pooled estimate of the standard deviation of principal effects over all *k*.

Table 6. Correlations of Principal Effects Across Outcomes, estimated at k=5.

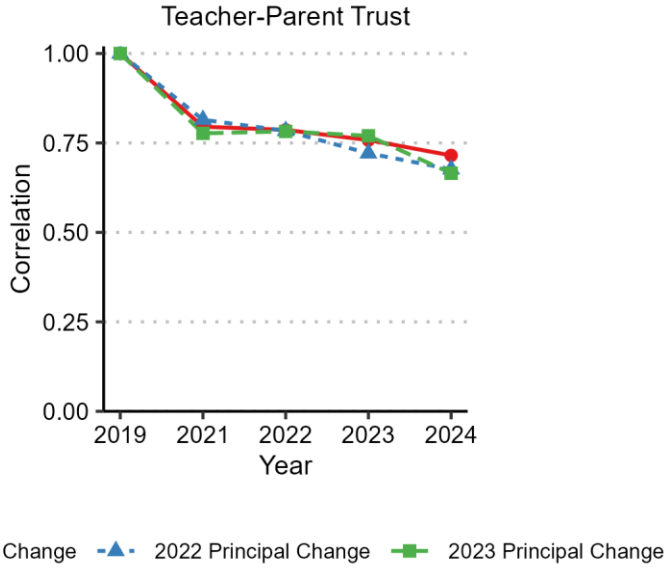
	Teacher-Principal Trust	Instructional Leadership	Factor 1	Factor 2
Teacher-Principal Trust	--			
Instructional Leadership	0.71	--		
Factor 1	0.59	0.82	--	
Factor 2	0.35	0.46	0.12	--

Figure 1. Correlations of Teacher-Principal Trust and Instructional Leadership for Three Groups of Schools with Distinct Principal Turnover Profiles.



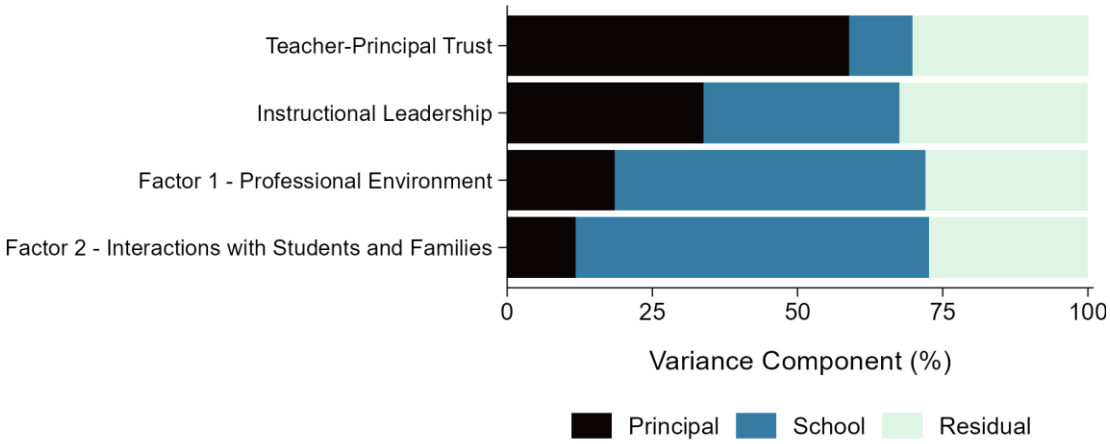
Notes: The red line is for schools with no principal change from 2019 to 2024, the blue line is for schools that experienced a principal change in 2022 only, and the green line is for schools with a principal change in 2023 only. Each point represents the correlation with 2019, with years shown on the horizontal axis.

Figure 2. Correlations of Teacher-Parent Trust for Three Groups of Schools with Distinct Principal Turnover Profiles.



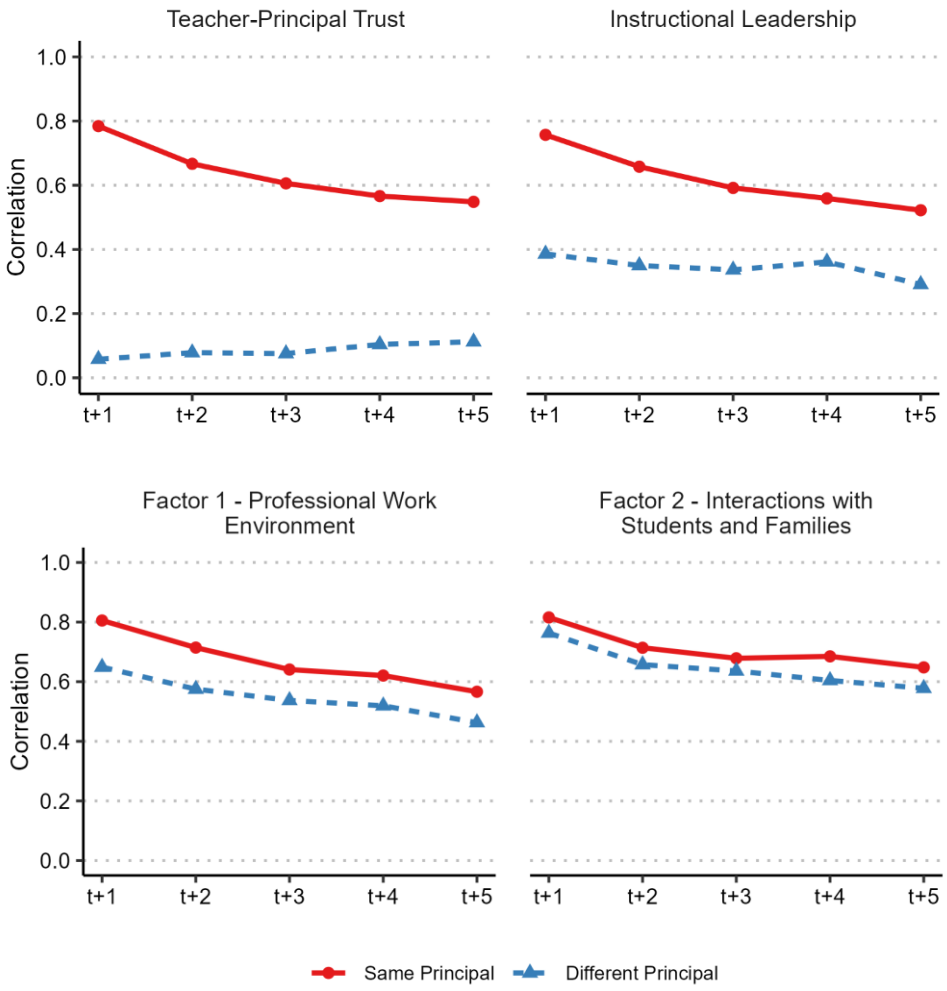
Notes: See notes to Figure 1.

Figure 3. Basic Variance Decompositions.



Notes: The stacked bars display the shares of the variance descriptively attributable to the principal (black), the school (blue), and the residual based on estimation of simple random effects models (equation 9). Of the 20 Measures, we analyze instructional leadership and teacher-principal trust separately and aggregate the remaining 18 Measures into two indices using the factor structure in Table 3. Appendix Figure A2 reports results from our variance decompositions separately for each of the 18 individual working-condition Measures that comprise the indices.

Figure 4. Correlations in Schools with the Same and Different Principals Over Time.



Notes: The figures plot correlations of residualized teacher working conditions for schools led by the same principal versus different principals generated from equations (6) and (7). Correlations are weighted by the number of teachers in each school and are computed between year t and $t+k$ for the same school. Residualized measures are obtained using equation 2, which adjusts for school-level student demographics and enrollment, district median income, and year fixed effects. Of the 20 measures, we plot instructional leadership and teacher-principal trust separately and aggregate the remaining 18 Measures into two indices using the factor structure in Table 3. Appendix Figure A3 reports results separately for each of the 18 individual working-condition Measures that comprise the indices.

Appendix A

Supplementary Tables & Figures

Appendix Table A1. 5E Survey Sample Size and Coverage.

Year (Spring)	5E Schools	5E schools as a share of all schools listed in the CCD	Number of students in 5E Schools	Students in 5E schools as a share of total Illinois CCD enrollment	Number of teachers in 5E schools	Teacher survey response rate (percent; conditional on school sampling)	Estimated number of teacher respondents (6×7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2024	3484	0.81	1682094	0.91	165292	78.54	129826
2023	3524	0.80	1725630	0.93	167527	77.13	129220
2022	3393	0.77	1690866	0.90	164157	75.29	123588
2021	3433	0.78	1708043	0.91	164101	76.21	125067
2019	3506	0.80	1806947	0.91	159169	81.68	130009

Notes: CCD refers to the Common Core of Data. The 5E Survey was not administered in 2020 due to the COVID-19 pandemic. Teacher response rates are calculated as teacher-weighted averages of school-level response rates, and the estimated number of teachers surveyed equals the number of teachers multiplied by the response rate. When CCD enrollment data are missing, we impute values using an adjoining year where available; otherwise, we use the number of eligible 5E student respondents, with an adjustment in elementary schools since the survey begins in fourth grade. Schools that participated in the 5E survey but had data suppressed because of small sample sizes are treated as not included in the 5E Survey sample; e.g., they are excluded from column (2), etc.

Appendix Table A2. Replication of Table 4 in the Main Text for Each Individual Working-Condition Measure in the Indices.

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Classroom Disruptions							
1	2552	423	0.700	0.708	-0.008	0.753	0.000
4	1483	1434	0.489	0.372	0.117	0.000	0.286
5	1205	1654	0.450	0.360	0.089	0.005	0.250
Pooled							0.186
Panel B: Collaborative Practices							
1	7600	1346	0.717	0.636	0.082	0.000	0.253
2	6298	2548	0.612	0.540	0.073	0.000	0.239
3	3513	2304	0.557	0.504	0.053	0.006	0.204
4	1506	1456	0.572	0.472	0.100	0.000	0.279
5	1221	1678	0.545	0.435	0.111	0.000	0.294
Pooled							0.245
Panel C: Collective Responsibility							
1	7756	1374	0.767	0.646	0.121	0.000	0.336
2	6414	2594	0.700	0.581	0.119	0.000	0.333
3	3571	2355	0.638	0.531	0.107	0.000	0.316
4	1532	1484	0.639	0.540	0.099	0.000	0.304
5	1243	1715	0.594	0.476	0.119	0.000	0.333
Pooled							0.329
Panel D: Teacher Influence							
1	7666	1363	0.848	0.740	0.108	0.000	0.300
2	6343	2568	0.772	0.667	0.105	0.000	0.296
3	3532	2323	0.725	0.644	0.081	0.000	0.260
4	1516	1464	0.694	0.598	0.097	0.000	0.284
5	1232	1687	0.632	0.554	0.078	0.001	0.256
Pooled							0.288
Panel E: Teacher Innovation							
1	7694	1365	0.771	0.678	0.093	0.000	0.293
2	6373	2574	0.695	0.604	0.090	0.000	0.288
3	3550	2331	0.635	0.574	0.061	0.000	0.237
4	1521	1469	0.625	0.554	0.071	0.003	0.256
5	1236	1696	0.591	0.511	0.080	0.002	0.271
Pooled							0.278
Panel F: Program Coherence							
1	7737	1371	0.809	0.675	0.134	0.000	0.348
2	6402	2588	0.731	0.593	0.138	0.000	0.353
3	3567	2349	0.665	0.544	0.121	0.000	0.331
4	1526	1480	0.642	0.545	0.096	0.000	0.295
5	1241	1710	0.568	0.476	0.092	0.001	0.289
Pooled							0.340
Panel G: Parent Influence on Decision Making in Schools							
1	7671	1362	0.768	0.633	0.134	0.000	0.330
2	6345	2569	0.682	0.557	0.125	0.000	0.319
3	3533	2325	0.600	0.518	0.082	0.000	0.257
4	1515	1466	0.606	0.479	0.127	0.000	0.321
5	1233	1689	0.529	0.442	0.087	0.002	0.266
Pooled							0.311

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel H: Parent Involvement in School							
1	7580	1338	0.845	0.821	0.023	0.010	0.135
2	6276	2541	0.807	0.762	0.044	0.000	0.186
3	3504	2296	0.773	0.760	0.014	0.222	0.103
4	1500	1453	0.768	0.730	0.038	0.019	0.172
5	1219	1673	0.731	0.724	0.007	0.681	0.075
Pooled							0.149
Panel I: Student Responsibility							
1	7473	1313	0.716	0.710	0.006	0.689	0.061
2	6188	2502	0.616	0.613	0.003	0.864	0.040
3	3451	2269	0.603	0.599	0.004	0.799	0.052
4	1484	1436	0.626	0.547	0.080	0.001	0.223
5	1207	1655	0.547	0.535	0.012	0.650	0.087
Pooled							0.081
Panel J: Quality Professional Development							
1	7734	1374	0.710	0.520	0.190	0.000	0.420
2	6397	2589	0.592	0.437	0.155	0.000	0.379
3	3564	2348	0.528	0.390	0.138	0.000	0.358
4	1526	1481	0.523	0.411	0.112	0.000	0.323
5	1240	1710	0.468	0.369	0.100	0.001	0.304
Pooled							0.384
Panel K: Reflective Dialogue							
1	7760	1377	0.688	0.553	0.134	0.000	0.342
2	6419	2596	0.585	0.491	0.094	0.000	0.287
3	3575	2356	0.550	0.484	0.066	0.001	0.240
4	1532	1484	0.545	0.467	0.078	0.004	0.260
5	1243	1715	0.515	0.445	0.070	0.014	0.248
Pooled							0.298
Panel L: School Commitment							
1	7750	1375	0.790	0.607	0.183	0.000	0.403
2	6411	2590	0.682	0.512	0.169	0.000	0.387
3	3570	2354	0.636	0.499	0.137	0.000	0.348
4	1531	1484	0.607	0.489	0.118	0.000	0.324
5	1244	1715	0.584	0.457	0.126	0.000	0.335
Pooled							0.379
Panel M: Quality of Student Discussion							
1	7471	1312	0.669	0.620	0.050	0.005	0.208
2	6190	2501	0.569	0.548	0.021	0.203	0.134
3	3451	2269	0.542	0.511	0.031	0.116	0.163
4	1483	1437	0.554	0.489	0.064	0.017	0.237
5	1207	1654	0.502	0.460	0.042	0.146	0.192
Pooled							0.182
Panel N: Socialization of New Teachers							
1	7701	1367	0.791	0.730	0.062	0.000	0.239
2	6380	2578	0.711	0.630	0.081	0.000	0.275
3	3554	2333	0.626	0.549	0.077	0.000	0.267
4	1521	1469	0.570	0.531	0.039	0.129	0.190
5	1237	1697	0.466	0.429	0.037	0.219	0.185
Pooled							0.250

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel O: Teacher-Parent Trust							
1	7678	1353	0.808	0.776	0.033	0.003	0.156
2	6355	2574	0.741	0.689	0.052	0.000	0.196
3	3543	2335	0.695	0.662	0.032	0.025	0.155
4	1517	1473	0.689	0.649	0.040	0.047	0.173
5	1233	1696	0.647	0.623	0.024	0.292	0.133
Pooled							0.169
Panel P: Teacher-Teacher Trust							
1	7684	1364	0.755	0.685	0.070	0.000	0.255
2	6361	2572	0.669	0.597	0.072	0.000	0.259
3	3545	2330	0.596	0.535	0.061	0.001	0.239
4	1519	1468	0.559	0.492	0.067	0.011	0.251
5	1236	1693	0.508	0.458	0.050	0.081	0.216
Pooled							0.251
Panel Q: Teacher Safety							
1	7745	1375	0.619	0.644	-0.024	0.164	0.000
2	6410	2591	0.307	0.444	-0.137	0.000	0.000
3	3570	2353	0.372	0.399	-0.027	0.233	0.000
4	1530	1484	0.705	0.606	0.099	0.000	0.276
5	1244	1714	0.681	0.586	0.095	0.000	0.270
Pooled							0.000
Panel R: Expectations for Postsecondary Education							
1	1340	255	0.916	0.884	0.032	0.012	0.143
2	1093	480	0.884	0.848	0.036	0.008	0.151
3	623	415	0.836	0.848	-0.012	0.506	0.000
4	267	262	0.825	0.825	0.000	0.995	0.010
5	206	303	0.804	0.768	0.036	0.297	0.151
Pooled							0.122

Notes: See notes to Table 4 in the main text. In cases where $\text{diff}_k < 0$ we report the value of SD_k as 0.

Appendix Table A3. Replication of Table 4 in the Main Text Using Teacher Turnover as an Additional Control Variable in the Residualization Procedure.

K	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	5086	924	0.784	0.039	0.745	0.000	0.838
2	4371	1652	0.663	0.061	0.602	0.000	0.753
3	1869	1062	0.626	0.036	0.590	0.000	0.746
4	1529	1479	0.567	0.093	0.474	0.000	0.668
Pooled							0.778
Panel B: Instructional Leadership							
1	5082	925	0.758	0.383	0.375	0.000	0.584
2	4362	1649	0.660	0.358	0.302	0.000	0.524
3	1868	1058	0.614	0.386	0.228	0.000	0.455
4	1524	1474	0.558	0.357	0.201	0.000	0.427
Pooled							0.529
Panel C: Factor 1 - Professional Work Environment							
1	5095	925	0.810	0.636	0.174	0.000	0.286
2	4380	1654	0.712	0.588	0.123	0.000	0.241
3	1873	1062	0.658	0.590	0.068	0.004	0.179
4	1531	1479	0.615	0.515	0.100	0.000	0.217
Pooled							0.250
Panel D: Factor 2 - Interactions with Students and Families							
1	5095	925	0.801	0.744	0.057	0.000	0.158
2	4380	1654	0.689	0.642	0.047	0.004	0.143
3	1873	1062	0.703	0.675	0.028	0.172	0.110
4	1531	1479	0.680	0.591	0.089	0.000	0.198
Pooled							0.152

Notes: Residualized outcomes are constructed using an alternative version of the residualization procedure that includes teacher turnover as an additional control variable. We measure turnover in year *t* as the fraction of teachers in the school in year *t* who are not at the same school in year *t+1*, inclusive of movers and leavers. Because turnover is forward-looking, we limit the sample to observations through 2023. The maximum value of *k* in the restricted sample is 4. As noted in the text, teacher turnover is a textbook example of a "bad control," but include these results for completeness. All other notes follow Table 4 in the main text.

Appendix Table A4. Replication of Table 4 in the Main Text Using an Alternative Residualization Procedure that Includes the Use of School-by-Principal Fixed Effects in Equation (1).

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	7975	1443	0.798	0.107	0.691	0.000	0.828
2	6591	2717	0.690	0.120	0.570	0.000	0.752
3	3668	2461	0.638	0.117	0.521	0.000	0.719
4	1570	1544	0.605	0.157	0.448	0.000	0.666
5	1273	1795	0.589	0.170	0.419	0.000	0.644
Pooled							0.764
Panel B: Instructional Leadership							
1	7963	1442	0.782	0.451	0.330	0.000	0.577
2	6577	2713	0.709	0.412	0.297	0.000	0.547
3	3663	2455	0.655	0.400	0.255	0.000	0.507
4	1563	1538	0.640	0.434	0.206	0.000	0.455
5	1269	1789	0.595	0.378	0.218	0.000	0.468
Pooled							0.541
Panel C: Factor 1 - Professional Work Environment							
1	7989	1445	0.839	0.740	0.099	0.000	0.237
2	6603	2721	0.764	0.667	0.097	0.000	0.234
3	3675	2463	0.703	0.633	0.069	0.000	0.198
4	1573	1544	0.687	0.627	0.060	0.003	0.185
5	1273	1796	0.632	0.575	0.057	0.014	0.180
Pooled							0.223
Panel D: Factor 2 - Interactions with Students and Families							
1	7989	1445	0.879	0.854	0.025	0.000	0.120
2	6603	2721	0.82	0.784	0.036	0.000	0.143
3	3675	2463	0.795	0.771	0.024	0.016	0.118
4	1573	1544	0.806	0.760	0.047	0.001	0.164
5	1273	1796	0.769	0.732	0.037	0.022	0.145
Pooled							0.132

Notes: Residualized outcomes are constructed using an alternative version of the residualization procedure that identifies the residualization parameters using within school-by-principal variation only. All other notes follow Table 4 in the main text.

Appendix Table A5. Replication of Table 4 in the Main Text Using an Alternative Residualization Procedure that Includes Lagged Outcomes from 2019 for a Selected Sample of Schools that Experienced a Principal Change in 2021.

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	1760	327	0.761	0.087	0.674	0.000	0.809
2	955	422	0.630	0.069	0.561	0.000	0.738
3	400	285	0.487	0.146	0.342	0.000	0.576
Pooled							0.761
Panel B: Instructional Leadership							
1	1751	325	0.701	0.277	0.424	0.000	0.594
2	951	420	0.569	0.245	0.324	0.000	0.519
3	398	283	0.412	0.253	0.158	0.022	0.363
Pooled							0.547
Panel C: Factor 1 - Professional Work Environment							
1	1761	327	0.699	0.553	0.146	0.000	0.215
2	956	422	0.569	0.429	0.139	0.001	0.210
3	401	285	0.408	0.370	0.038	0.566	0.109
Pooled							0.203
Panel D: Factor 2 - Interactions with Students and Families							
1	1761	327	0.677	0.602	0.075	0.036	0.140
2	956	422	0.546	0.425	0.121	0.007	0.178
3	401	285	0.395	0.316	0.079	0.247	0.144
Pooled							0.153

Notes: Residualized outcomes are constructed using an alternative version of the residualization procedure that includes 2019 teacher working conditions as lagged outcomes in schools that experience a principal change in 2021. From 2021 onward, we compare correlations across schools that do and do not experience another principal change. The maximum value of k in the restricted sample is 3. All other notes follow Table 4 in the main text.

Appendix Table A6. Replication of Table 4 in the Main Text Using Elementary Schools Only.

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	4933	805	0.762	0.019	0.743	0.000	0.854
2	4126	1557	0.655	0.065	0.590	0.000	0.761
3	2318	1427	0.594	0.107	0.487	0.000	0.691
4	993	922	0.533	0.125	0.408	0.000	0.632
5	823	1065	0.522	0.105	0.417	0.000	0.639
Pooled							0.770
Panel B: Instructional Leadership							
1	4926	804	0.743	0.339	0.404	0.000	0.622
2	4115	1555	0.653	0.310	0.343	0.000	0.573
3	2313	1424	0.606	0.327	0.279	0.000	0.516
4	989	919	0.570	0.320	0.250	0.000	0.489
5	821	1061	0.524	0.264	0.260	0.000	0.499
Pooled							0.572
Panel C: Factor 1 - Professional Work Environment							
1	4937	806	0.796	0.618	0.178	0.000	0.305
2	4132	1559	0.711	0.536	0.175	0.000	0.303
3	2320	1428	0.644	0.522	0.122	0.000	0.253
4	995	922	0.619	0.495	0.124	0.000	0.255
5	823	1065	0.566	0.445	0.120	0.000	0.251
Pooled							0.289
Panel D: Factor 2 - Interactions with Students and Families							
1	4937	806	0.797	0.701	0.095	0.000	0.214
2	4132	1559	0.697	0.604	0.093	0.000	0.211
3	2320	1428	0.665	0.596	0.069	0.001	0.182
4	995	922	0.674	0.571	0.103	0.000	0.223
5	823	1065	0.648	0.554	0.095	0.001	0.213
Pooled							0.209

Notes: The sample is restricted to elementary schools. All other notes follow Table 4 in the main text.

Appendix Table A7. Replication of Table 4 in the Main Text Using Middle and High Schools Only.

k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	2770	563	0.811	0.090	0.721	0.000	0.814
2	2262	1026	0.679	0.083	0.595	0.000	0.740
3	1243	923	0.620	0.027	0.593	0.000	0.738
4	538	562	0.605	0.063	0.542	0.000	0.706
5	421	651	0.578	0.104	0.473	0.000	0.660
Pooled							0.762
Panel B: Instructional Leadership							
1	2765	564	0.778	0.436	0.342	0.000	0.550
2	2259	1025	0.667	0.392	0.275	0.000	0.493
3	1243	920	0.585	0.335	0.250	0.000	0.470
4	536	560	0.540	0.399	0.142	0.003	0.354
5	419	649	0.514	0.308	0.206	0.000	0.427
Pooled							0.500
Panel C: Factor 1 - Professional Work Environment							
1	2777	564	0.823	0.687	0.136	0.000	0.240
2	2267	1028	0.727	0.625	0.103	0.000	0.208
3	1247	923	0.642	0.555	0.087	0.002	0.192
4	538	562	0.615	0.552	0.063	0.113	0.163
5	421	651	0.561	0.478	0.083	0.070	0.187
Pooled							0.214
Panel D: Factor 2 - Interactions with Students and Families							
1	2777	564	0.832	0.789	0.043	0.006	0.134
2	2267	1028	0.731	0.682	0.049	0.009	0.142
3	1247	923	0.686	0.649	0.037	0.124	0.124
4	538	562	0.679	0.605	0.074	0.037	0.175
5	421	651	0.624	0.566	0.057	0.157	0.154
Pooled							0.139

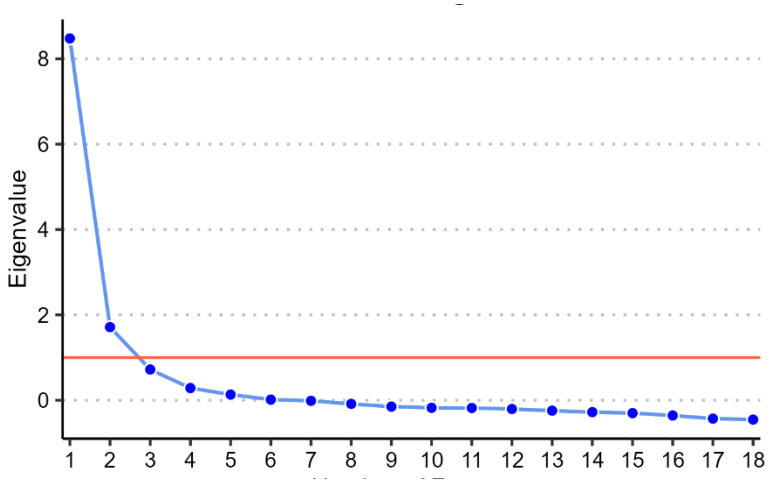
Notes: The sample is restricted to middle and high schools. All other notes follow Table 4 in the main text.

Appendix Table A8. Replication of Table 4 in the Main Text Using a Restricted Post-COVID Sample from 2022 to 2024.

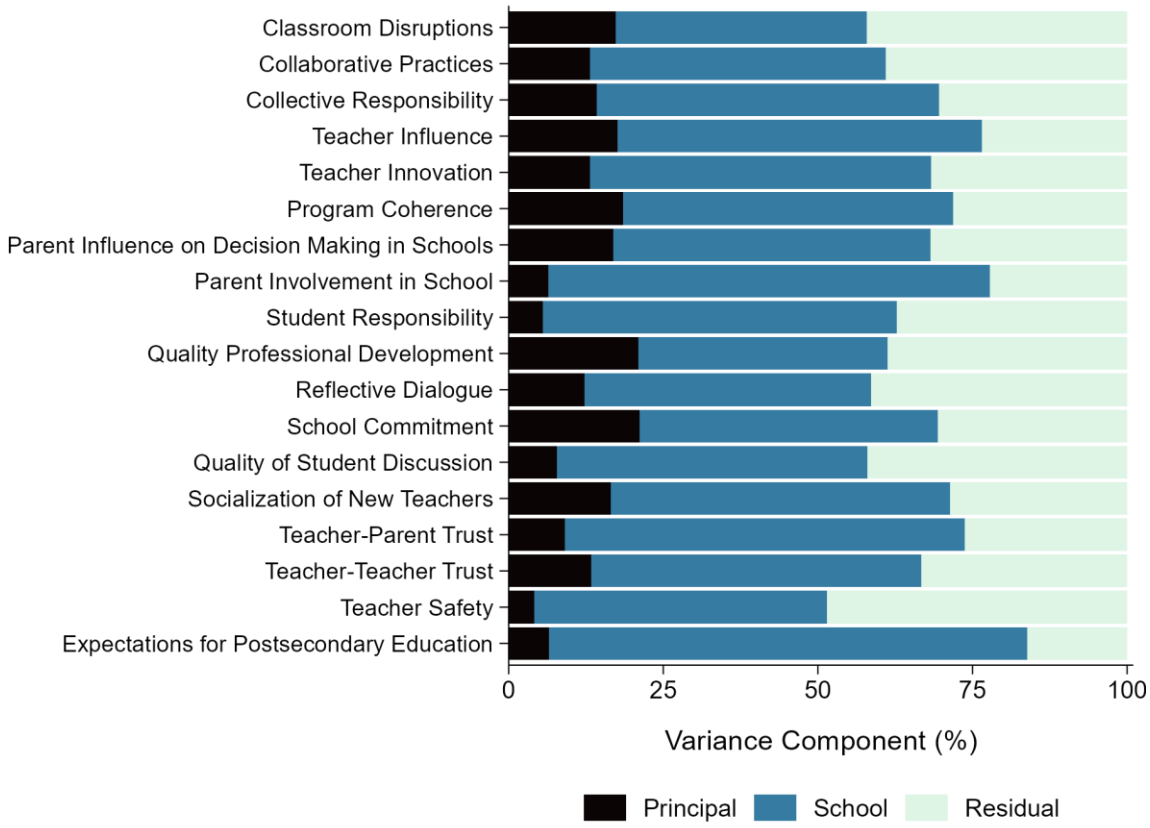
k	N_k^{same}	N_k^{diff}	r_k^{same}	r_k^{diff}	diff_k	p-value	SD_k
Panel A: Teacher-Principal Trust							
1	5154	979	0.783	0.068	0.714	0.000	0.823
2	2029	936	0.669	0.094	0.575	0.000	0.738
Pooled							0.800
Panel B: Instructional Leadership							
1	5144	979	0.757	0.378	0.380	0.000	0.596
2	2025	936	0.651	0.331	0.319	0.000	0.547
Pooled							0.583
Panel C: Factor 1 - Professional Work Environment							
1	5160	981	0.805	0.645	0.160	0.000	0.278
2	2031	938	0.712	0.551	0.161	0.000	0.279
Pooled							0.278
Panel D: Factor 2 - Interactions with Students and Families							
1	5160	981	0.828	0.754	0.075	0.000	0.190
2	2031	938	0.737	0.668	0.069	0.001	0.183
Pooled							0.188

Notes: The sample is restricted to the post-COVID period from 2022 to 2024. The maximum value of k in the restricted sample is 2. All other notes follow Table 4 in the main text.

Appendix Figure A1. Scree Plot of Eigenvalues to Inform the Factor Analysis.

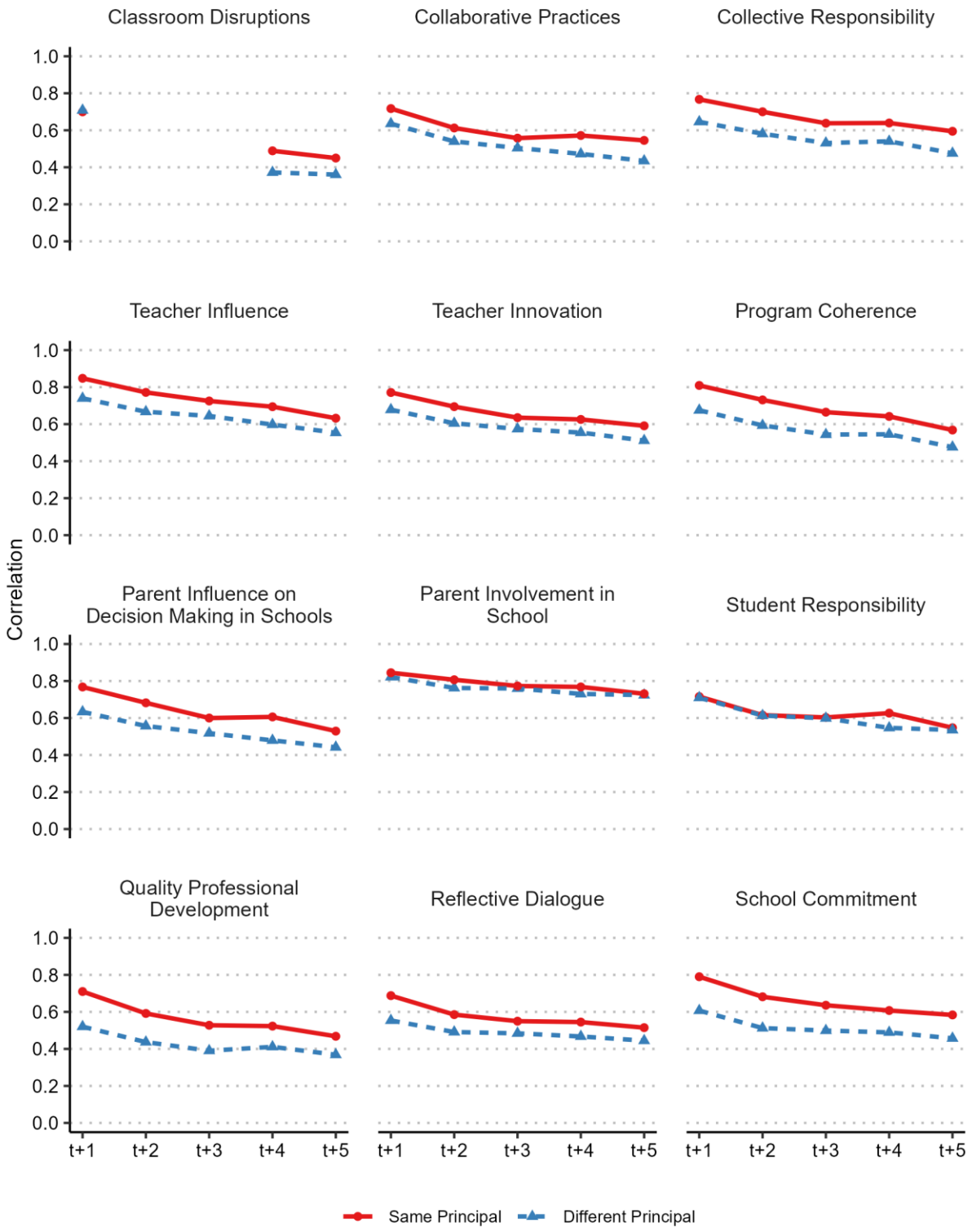


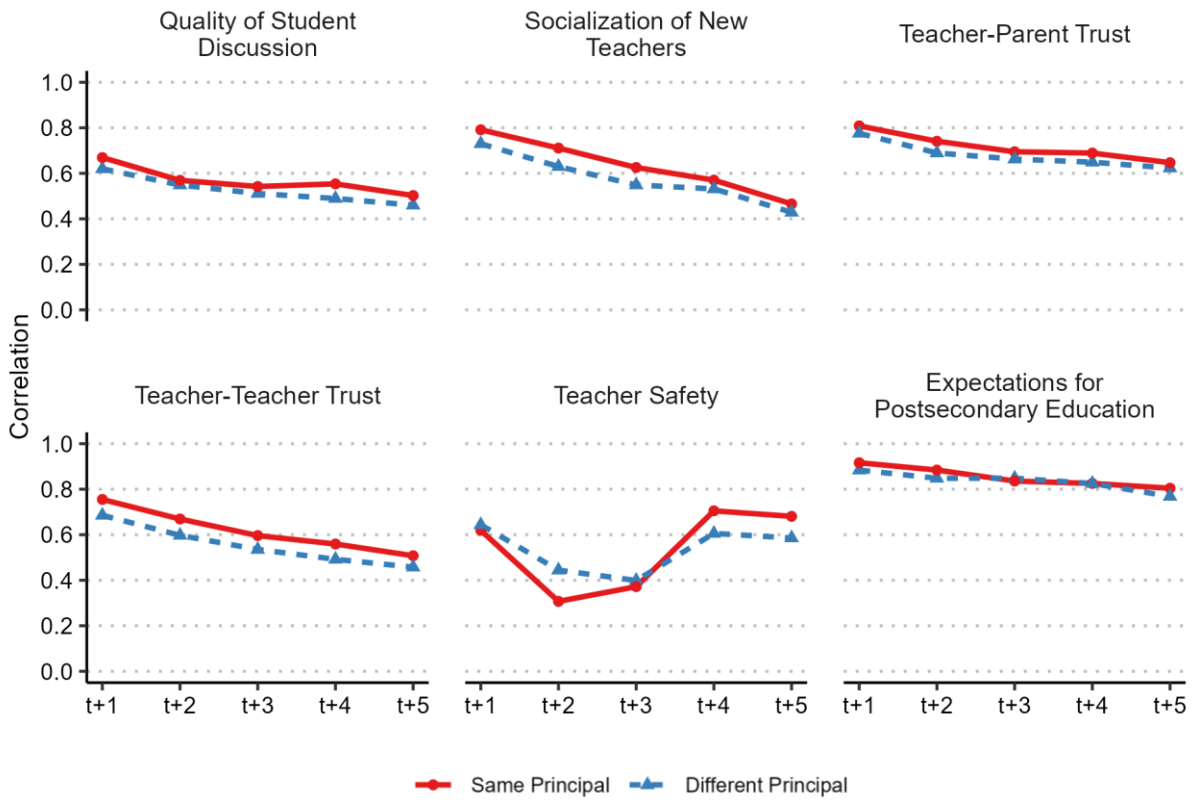
Appendix Figure A2. Replication of Figure 3 in the Main Text for Each Individual Working-Condition Measure in the Indices.



Notes: See notes to Figure 3 in the main text.

Appendix Figure A3. Replication of Figure 4 in the Main Text for Each Individual Working-Condition Measure in the Indices





Notes: See notes to Figure 4 in the main text.

Appendix B

Appendix Table B1. Individual Survey Questions in each 5E Survey Measure.

Survey Measure	Survey Question
Teacher-Principal Trust	To what extent do you feel respected by your principal?
	Please indicate the extent to which you disagree or agree with the following: The principal has confidence in the expertise of the teachers
	Please indicate the extent to which you disagree or agree with the following: I trust the principal at his or her word.
	Please indicate the extent to which you disagree or agree with the following: It's OK in this school to discuss feelings, worries, and frustrations with the principal.
	Please indicate the extent to which you disagree or agree with the following: The principal takes a personal interest in the professional development of teachers.
	Please indicate the extent to which you disagree or agree with the following: The principal looks out for the personal welfare of the faculty members.
	Please indicate the extent to which you disagree or agree with the following: The principal places the needs of children ahead of personal and political interests.
	Please indicate the extent to which you disagree or agree with the following: The principal at this school is an effective manager who makes the school run smoothly.
Instructional Leadership	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team makes clear to the staff the leadership's expectations for meeting instructional goals.
	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team communicates a clear vision for our school.
	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team presses teachers to implement what they have learned in professional development.
	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team knows what's going on in my classroom.
	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team provides me with useful feedback to improve my teaching.
	Please indicate the extent to which you disagree or agree with the following: A member of the school leadership team has provided me with the support I need to improve my teaching.
Level of Classroom Disruptions	How many of the students in your class regularly refuse to respond when addressed?
	How many of the students in your class regularly use inappropriate language during class?
	How many of the students in your class regularly threaten you verbally?
	How many of the students in your class regularly do off-task things (e.g., play games, text, talk on cell phone) during instructional time?
	How many of the students in your class regularly create serious behavior problems in your class?
Collaborative Practices	This school year, how often have you observed another teacher's class to offer feedback?
	This school year, how often have you observed another teacher's class to get ideas for your own instruction?
	This school year, how often have you gone over student assessment data with other teachers to make instructional decisions?

	This school year, how often have you worked with other teachers to develop materials or activities for particular classes?
	This school year, how often have you worked on instructional strategies with other teachers?
Collective Responsibility	How many teachers in this school take responsibility for improving the school?
	How many teachers in this school feel responsible to help each other do their best?
	How many teachers in this school feel responsible that all students learn?
	How many teachers in this school feel responsible for helping students develop self-control?
	How many teachers in this school feel responsible when students in this school fail?
Teacher Influence	How much influence do teachers have over: Planning how discretionary school funds should be used.
	How much influence do teachers have over: Determining which books and other instructional materials are used in classrooms.
	How much influence do teachers have over: Establishing the curriculum and instructional program.
	How much influence do teachers have over: Determining the content of in-service programs.
	How much influence do teachers have over: Setting standards for student behavior.
Teacher Innovation	How many teachers in this school are really trying to improve their teaching?
	How many teachers in this school are willing to take risks to make the school better?
	How many teachers in this school are eager to try new ideas?
	Please indicate the extent to which you disagree or agree with the following: In this school, teachers are continually learning and seeking new ideas.
Program Coherence	To what extent do you disagree or agree with the following: Once we start a new program in this school, we follow up to make sure that it's working.
	To what extent do you disagree or agree with the following: Curriculum, instruction, and learning materials are well coordinated across different grade levels at this school.
	To what extent do you disagree or agree with the following: There is consistency in curriculum, instruction, and learning materials among teachers in the same grade level at this school.
	To what extent do you disagree or agree with the following: We have so many different programs in this school/center that I can't keep track of them all.
	To what extent do you disagree or agree with the following: Many special programs come and go at this school.
Parent Influence on Decision Making in School	To what extent does this school involve parents/guardians in the development of programs aimed at improving students' academic outcomes?
	To what extent does this school involve parents/guardians in commenting on school curricula?
	To what extent does this school include parent leaders from all backgrounds in school improvement efforts?
	To what extent does this school develop formal networks to link all families with each other (e.g., sharing parent directories, providing a website for parents/guardians to connect with one another, etc.)?
	To what extent does this school encourage more involved parents/guardians to reach out to less involved parents/guardians?
Parent Involvement in School	For the students you teach this year, how many of their parents/guardians attended parent-teacher conferences when you requested them?
	For the students you teach this year, how many of their parents/guardians volunteered time to support the school (e.g., volunteer in classrooms, help with school-wide events, etc.)?
	For the students you teach this year, how many of their parents/guardians contacted you about their child's performance?
	For the students you teach this year, how many of their parents/guardians responded to your suggestions for helping their child?
Student Responsibility	How many of the students in your {specific} class come to class on time?
	How many of the students in your {specific} class attend class regularly?

	How many of the students in your {specific} class come to class prepared with the appropriate supplies and books?
	How many of the students in your {specific} class regularly pay attention in class?
	How many of the students in your {specific} class actively participate in class activities?
	How many of the students in your {specific} class always turn in their homework?
Quality Professional Development	Please indicate the extent to which you disagree or agree with the following: Overall, my professional development experiences this year have been sustained and coherently focused, rather than short-term and unrelated.
	Please indicate the extent to which you disagree or agree with the following: Overall, my professional development experiences this year have included enough time to think carefully about, try, and evaluate new ideas.
	Please indicate the extent to which you disagree or agree with the following: Overall, my professional development experiences this year have been closely connected to my school's improvement plan.
	Please indicate the extent to which you disagree or agree with the following: Overall, my professional development experiences this year have included opportunities to work productively with colleagues in my school.
	Please indicate the extent to which you disagree or agree with the following: Overall, my professional development experiences this year have included opportunities to work productively with teachers from other schools.
Reflective Dialogue	Please indicate the extent to which you disagree or agree with the following: Teachers talk about instruction in the teachers' lounge, faculty meetings, etc.
	Please indicate the extent to which you disagree or agree with the following: Teachers in this school share and discuss student work with other teachers.
School Commitment	Please indicate the extent to which you disagree or agree with the following: I usually look forward to each working day at this school.
	Please indicate the extent to which you disagree or agree with the following: I wouldn't want to work in any other school.
	Please indicate the extent to which you disagree or agree with the following: I feel loyal to this school.
	Please indicate the extent to which you disagree or agree with the following: I would recommend this school to parents seeking a place for their child.
Quality of Student Discussions	In discussions that occur in your {specific} class, how often does the following occur? Students build on each other's ideas during discussion.
	In discussions that occur in your {specific} class, how often does the following occur? Students use data and text references to support their ideas.
	In discussions that occur in your {specific} class, how often does the following occur? Students show each other respect.
	In discussions that occur in your {specific} class, how often does the following occur? Students provide constructive feedback to their peers and to me.
	In discussions that occur in your {specific} class, how often does the following occur? Most students participate in the discussion at some point.
Socialization of New Teachers	Please indicate the extent to which you disagree or agree with the following: Experienced teachers invite new teachers into their classes to observe, give feedback, etc.
	Please indicate the extent to which you disagree or agree with the following: A conscious effort is made by faculty to make new teachers feel welcome here.
	How many teachers are assigned a mentor teacher when they first begin working at this school?
Teacher-Parent Trust	How many teachers in this school feel good about parents' support for their work?
	For the students you teach this year, how many of their parents/guardians support your teaching efforts?
	For the students you teach this year, how many of their parents/guardians do their best to help their children learn?

	To what extent do you feel respected by the parents of your students?
	Please indicate the extent to which you disagree or agree with the following: Teachers and parents at this school think of each other as partners in educating children.
	Please indicate the extent to which you disagree or agree with the following: Staff at this school work hard to build trusting relationships with parents.
Teacher-Teacher Trust	To what extent do you feel respected by other teachers at this school?
	Please indicate the extent to which you disagree or agree with the following: Teachers in this school trust each other.
	Please indicate the extent to which you disagree or agree with the following: It's OK in this school to discuss feelings, worries, and frustrations with other teachers.
	Please indicate the extent to which you disagree or agree with the following: Teachers respect other teachers who take the lead in school improvement efforts.
	Please indicate the extent to which you disagree or agree with the following: Teachers at this school respect those colleagues who are experts at their craft.
Teacher Safety	To what extent is the following a problem at your school: Physical conflicts among students
	To what extent is the following a problem at your school: Robbery or theft
	To what extent is the following a problem at your school: Gang activity
	To what extent is the following a problem at your school: Disorder in classrooms
	To what extent is the following a problem at your school: Disorder in hallways
	To what extent is the following a problem at your school: Student disrespect of teachers
	To what extent is the following a problem at your school: Threats of violence toward teachers
Expectations for Postsecondary Education	Please indicate the extent to which you disagree or agree with the following: Teachers expect most students in this school to go to college.
	Please indicate the extent to which you disagree or agree with the following: Teachers at this school help students plan for college outside of class time.
	Please indicate the extent to which you disagree or agree with the following: The curriculum at this school is focused on helping students get ready for college.
	Please indicate the extent to which you disagree or agree with the following: Most of the students in this school are planning to go to college.
	Please indicate the extent to which you disagree or agree with the following: Teachers in this school feel that it is a part of their job to prepare students to succeed in college.

Notes: Individual survey questions are those used on the 2023 5E Survey.