Descriptive evidence on school leaders' prior professional experiences and instructional effectiveness

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Abstract

Many education policymakers and system leaders prioritize recruiting and developing effective school leaders as key mechanisms to improve school climate and student learning. Despite efforts to select and support successful school leaders, however, relatively little is understood about the prior professional experiences and skillsets that principals possess upon entry into their positions. In this descriptive paper, we use 14 years of administrative data on all educators in Oregon to trace the prior professional experiences and instructional effectiveness of those who become school leaders. We highlight that many principals in Oregon acquire educational leadership experience outside the assistant principal role and outside of the school district in which they serve as principals. We also find that when future school leaders were teachers, they improved student achievement at modestly higher rates than their peers. Insight into these topics has the potential to inform the pre-service training, recruitment and professional development of school leaders.

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1 Introduction

School system administrators charge principals with promoting student learning, supporting teacher development, creating a healthy school climate, and a host of other critical tasks. Researchers, advocates and policymakers alike regularly argue that recruiting high-potential principal candidates and equipping them with appropriate skills can be critical to school improvement efforts (e.g., Gates et al., 2019a; Darling-Hammond et al., 2022). Unfortunately, the evidence base on the particular skills necessary to be successful in the principalship is thin—particularly research supporting credibly causal interpretation (Liebowitz and Porter, 2019). Despite this uncertainty, observers frequently theorize that principals' prior experiences in leading adults or in teaching are likely to influence how effective they are in their role as a school leader (e.g., Browne-Ferrigno and Muth, 2016; Grissom et al., 2021; Hitt and Player, 2018). Principal training programs may play an important role in the development of these skills (e.g., Anderson et al., 2022; Corcoran et al., 2012; Fuller et al., 2016; Grissom et al., 2019b); however, formal pre-service training is just one dimension of the professional experiences principals have before beginning their roles.

For system leaders interested in selecting and developing more effective school leaders, it is valuable to understand the prior on-the-job professional experiences and instructional effectiveness of those who become assistant principals (APs) and principals. The traditionally assumed path to the principalship is from classroom teacher to AP to principal (Folsom et al., 2015; Bastian and Henry, 2015). While the majority of principals do have previous experience as APs (Goldring et al., 2021), this pathway may differ across school systems. For example, in some state and local contexts half (or fewer) of all principals have experience as an AP (Austin et al., 2019). To further complicate the typical path to the principalship, there exist many other school- and system-based roles (e.g., instructional coach, curriculum coordinator, assistant superintendent, etc.) that educators might assume before becoming principals. These positions may allow future principals to accumulate experience leading adults and managing operations, and these experiences may, in turn, have important implications for their later effectiveness as school leaders. In addition to learning more about principals' prior professional roles, it may be helpful to know more about principals' skills in their role as classroom teachers, as these skillsets may be relevant to their ability to lead instructional improvement efforts (Bastian and Henry, 2015; Hitt and Player, 2018; Goldhaber et al., 2019). Thus, both the prior positions held and the prior instructional effectiveness of school leaders may have implications for the development of current school leaders and the preparation and recruitment of future ones.

We use comprehensive student and staff data from the U.S. state of Oregon, covering 14 years, to study the professional pathways educators take into school leadership roles and their prior instructional effectiveness. Most other quantitative studies on school leadership have focused on different moments in the career trajectory than ours. A small, but growing, body of work examines the effects of university-based (Grissom et al., 2019b) and alternative principal preservice preparation programs (Clark et al., 2009; Corcoran et al., 2012; Gates et al., 2019b). Other work examines the effects of principal turnover (Grissom and Bartanen, 2019), the sorting of principals to particular schools or communities (Grissom et al., 2019a; Loeb et al., 2010), and

the labor market and turnover behaviors for practicing principals (Béteille et al., 2012; Boyce and Bowers, 2016; Pendola and Fuller, 2020). Still others have evaluated comprehensive efforts to reform the identification, recruitment, selection, coaching and evaluation of principals (Gates et al., 2019a). We respond to the call from Perrone and co-authors (2022) and advance the above-cited work by providing new information about school leaders' prior on-the-job experiences—including those beyond the assistant principalship—that may be relevant to future recruitment and ongoing development efforts. Additionally, we share insights from a state context typically under-studied in the U.S. educator labor market literature.

To preview our results, we find that—while the assistant principalship is a frequent stepping stone into the principalship—educators pursue various pathways to the principal's office. Importantly, many principals acquire school- or district-based leadership experiences outside the AP role. Further, nearly half of new principals assume their role in a different district than the one in which they were previously employed. AP role "skipping" patterns are most pronounced at the elementary level, which employ fewer APs. The highest-performing schools tend to hire more principals from out of district than schools with lower performance levels, as measured by test scores. Out-of-district entry and AP "skipping" patterns are consistent across most other school characteristics, including the school's location in an urban or rural locale. School leaders who have prior teaching experience in tested grades and subjects raise student achievement at modestly higher rates than peer teachers who do not enter school leadership. Together, these facts have implications for the kind of knowledge base and skill sets principals can be anticipated to have upon assuming their positions. In turn, this may inform the supports provided to current and future school leaders.

In the following section, we review the evidence base on school leaders' prior professional experiences in order to motivate our research questions. Then, we describe our data, sample and analytic approach. Next, we present our results for each research question and conclude with a discussion of the limitations of our study and its policy and research implications.

2 School Leaders' Prior Professional Experiences

A large literature documents the potential for on-the-job learning to improve professional productivity. This is true both for workers generally (e.g., Heckman et al., 2002), and educators specifically. For instance, there are substantial returns to experience for teachers on both student test scores and attendance rates (e.g., Atteberry et al., 2016; Ladd and Sorensen, 2017; Harris and Sass, 2011; Papay and Kraft, 2015). However, these studies tend to focus on the benefits of prior professional experiences, *within the same functional position*. In this paper, we consider prior experiences school leaders acquire from *different* professional roles in education.

Most managerial and leadership positions require some prior field experience in roles over which the manager will have supervisory responsibility. Implicit in these requirements is the assumption that there are on-the-job learning benefits derived from these prior roles that will improve managers' ability to supervise employees and lead their organizations. Mumford and co-authors (2000) argue that as workers ascend organizational hierarchies into positions with more lead-

ership responsibilities, the skills they have built in prior roles within the field are foundational for building managerial and leadership skills in their new positions. In examples ranging from military leaders (Horvath et al., 1999) to teacher mentors (Couse and Russo, 2006), case-study research documents benefits from insights gained and skills acquired in leaders' roles at lower-rungs of organizational hierarchies. The same is true in the case of principals, where observers frequently theorize that their prior experiences in leading adults or in teaching are likely to influence how effective they are in their role as a school leader (Browne-Ferrigno and Muth, 2016; Grissom et al., 2021; Hitt and Player, 2018).

As teachers, principals may hone instructional skills that improve their ability to lead other teachers in improvement activities. School principals may draw on these instructional skills as they support teachers by assisting with unit or lesson planning, providing direct feedback on pedagogy, or by modeling instructional strategies (Blase and Blase, 1999). These activities might take place in the context of the formal evaluation process or in informal skill development and coaching (Liebowitz, 2022), but all rely on instructional knowledge and skill. To the extent that principals conduct activities similar to those of instructional coaches or peers (Kraft et al., 2018; Blazar and Kraft, 2015; Papay et al., 2020), prior teaching experience may increase their ability to support teacher development.

Independent from *actual* instructional skills, prior (successful) teaching experience may imbue principals with a *perceived* set of skills and empathy with their teachers' experiences. In this way, instructional expertise can lend principals with the teaching "legitimacy" (Hitt and Player, 2018, p. 99) necessary to lead instructional improvement efforts, including investing faculty in broader strategic improvement plans. Separate from the particular skills or credibility a principal might acquire as a teacher, it is possible that instructional effectiveness captures some unobserved, fixed trait of an individual that makes an effective teacher also more effective as a principal (Goldhaber et al., 2019). Independently, prior experience as a teacher may acquaint principals with the operational and cultural contexts to best support teachers to improve their efficacy and well-being. In fact, Goldhaber and co-authors (2019) find that educators who are more effective at improving students' test scores as teachers appear to be more effective at improving test scores when they become principals, compared to those who were less effective at improving test scores as teachers.

Assistant principals are charged with many of the same tasks as principals; thus, experiences and skills acquired in this position are also often theorized to benefit future principals. These might include formally evaluating teachers, recruiting and hiring faculty and staff, improving schoolwide culture, managing operations, developing school strategy and more (Goldring et al., 2021). Bastian and Henry (2015) draw on Bandura's (1977) self-efficacy framework to argue that environments in which APs experience greater self-efficacy help them be more effective in future principal roles. Some tentative empirical conclusions suggest that skills in organizational management (e.g., Grissom and Loeb, 2011) and instructional leadership (e.g., Robinson et al., 2008) that could be developed as an AP may be central to principals' efficacy. Empirically, APs who work in schools with stronger student achievement (adjusting for prior achievement) go on to lead schools with stronger prior-achievement-adjusted student test scores (Grissom et al.,

2020; Bastian and Henry, 2015). The authors of these studies interpret these results to imply that APs who have the opportunity to observe and contribute to strong leadership practices carry some of these same skills into their future principal positions.

We are not the first to consider ways in which prior work environments influence principals' leadership skills in their current role. For instance, Bastian and Henry (2015) argue that the assistant principalship serves as "an *apprenticeship* to learn and practice effective school leadership behaviors" (p. 606, emphasis in original). The general assumption of this and related research is that educators will progress from a teaching role to a middle leadership role to the principal's office, and that they will gain relevant knowledge and skills in each of these two roles. In the United States, the step in between teaching and the principalship is generally conceived of as the assistant principalship (Folsom et al., 2015). Indeed, in Bastian and Henry's sample of 981 first-year North Carolina principals, 94 percent had served as an assistant principal in the North Carolina public school system.

While it is true that in some U.S. contexts, the standard pathway from teacher to AP to principal is the norm, this is not true for all states or districts. National surveys indicate that the majority of principals do have previous experience as APs (Goldring et al., 2021; Fuller et al., 2018). However, these national trends mask state and local variation as in some contexts only half of principals have experience as an AP, whereas in others nearly all do (Austin et al., 2019; Turnbull et al., 2016). For example, in Georgia, North Carolina and Texas most principals have previous experience as APs, but in Massachusetts, Missouri and Washington many principals ascend to the role without ever serving as an AP (Austin et al., 2019). In fact, there are a wide variety of other educational leadership roles that teachers might move into prior to the principalship. In other parts of the Global North, teacher-leadership roles are more common than mid-tier administrative roles (Montecinos et al., 2022). Alternatively, some educators might skip all prior formal leadership positions and enter the principalship directly from the classroom. Even in situations where principals do have AP experience, their move into the principalship may be preceded by employment in drastically different roles. For instance, in Davis et al.'s (2017) sample of Texas principals, over 91 percent entered the principalship from a school-based position. As we will show, this is far from a universal pattern.

Related to the particular positions principals have held, it may also be relevant to know whether they enter their role in a school- or district-context with which they are familiar or not. The decision to seek the principalship may originate from active recruitment efforts either within- or from outside a district (Farley-Ripple et al., 2012). In some contexts, internally-hired principals are more likely to possess historically marginalized identities, serve in urban schools and turn over less frequently (Pendola and Fuller, 2022). There are potential benefits (and drawbacks) to internal and external hires. On the one hand, it is possible that within-school or within-district hires benefit from localized knowledge; however, it may also be the case that external hires may bring new knowledge, innovative strategies or fresh relationships, particularly into school contexts which have faced recent struggles. Bastian and Henry (2015) document that three-quarters of first-time principals in North Carolina worked in the same school district in which they became a principal. However, North Carolina—as with many of the Southern U.S.

states that dominate the principal-labor-market literature—is organized in county-wide school districts, covering enormous geographic areas. Thus, it remains uncertain whether such patterns hold across the United States.

The varied paths that school principals take into their role may differ by the school contexts into which they enter the principalship. For instance, these patterns of entry to the principalship might be expected to differ across grade levels (Papa et al., 2002; Fuller et al., 2018) or in certain geographic areas (Pendola and Fuller, 2022; Yang et al., 2021; Lee and Mao, 2020). There may also be differences in schools with different levels of socio-economic privilege or with different levels of prior school performance (Gates et al., 2019a). To the extent that pathways into the principalship differ across these observable school and community characteristics, such insights might inform differentiated recruitment and preparation supports.

Though policymakers and advocacy organizations highlight the untapped potential of developing "pipelines" of effective leaders into the principalship (Gates et al., 2019a; Turnbull et al., 2016; Darling-Hammond et al., 2022), researchers continue to call for a better understanding of the school leader labor market in order to improve preparation, recruitment and development efforts (Perrone et al., 2022). Motivated by this call, we ask the following research questions:

1. What professional experiences do educators have prior to becoming school principals and how much does this differ across school and district contexts?
2. Were educators who become school leaders differentially effective at improving student test score outcomes when they were teachers?

3 Method

3.1 Data

We draw our data from the full student and staff administrative records of the Oregon Department of Education (ODE) from the 2006–07 through the 2019–20 school years. The staff records include information on all positions educators held in Oregon public schools and districts, their FTE in these positions, their demographic details, and their years of experience. The student data contain demographic information, course-taking patterns, attendance rates, and test score outcomes through 2018–19. We standardize students' end-of-year state-mandated assessments to have a mean of zero and standard deviation of one within each grade-year combination. For the 2013–14 school year and onwards, the data include a set of linking identifiers between students, classes and teachers. We provide additional information on our data, measures and analytic sample in Appendix B.

Given recent scholarship around the different labor market conditions experienced by rural schools and principals (Pendola and Fuller, 2022; Lee and Mao, 2020; Yang et al., 2021; Pijanowski and Brady, 2009) and efforts at the federal level to encourage Grow Your Own programs for rural school leaders (Office of Elementary & Secondary Education, 2020), we supplement our primary data by assigning each school in our dataset its four-type locale classification (city, suburban, town and rural) from the NCES Common Core of Data, accessed via the Urban

Institute's Education Data Portal (2022).

3.2 Sample

Each year we observe around 1,200 school principals. In total across the 14 years of our study, we observe 3,245 unique principals and 2,167 APs. Our estimates of teacher effectiveness draw on 1,922,546 student-subject-year observations from 2013–14 to 2018–19. In Table 1, we present demographic and professional experience characteristics of individuals who ever serve as principals (Panel A) and assistant principals (Panel B) over our full panel of 14 years. Like many states, Oregon's school leaders are predominantly White, Non-Hispanic (89 percent of principals, 85 percent of APs), which (like many states) is in contrast with Oregon's student body which is only just over half White, Non-Hispanic in the most recent year of our data. The average principal is 48 years old and has a total of 19 to 20 years of experience. Oregon's assistant principals are, on average, somewhat younger (44 years old) and have less experience (15 to 16 years) than principals. Table 1 also highlights that the majority of APs in Oregon work in secondary settings and that most elementary schools do not have an AP.

As detailed in Appendix Table A1, we are able to estimate teacher effects for just under 9,000 unique teachers in mathematics and English Language Arts (ELA) in grades 4-8 between 2013–14 and 2018–19. 143 of these teachers ever become principals and 166 ever become APs. This sample of school leaders with prior teacher effects is drawn from the more recent years of our data. As a consequence (and in parallel to overall trends in the state), this sub-sample is more female, younger and with less experience in education than our full sample of school leaders.

3.3 Analytic Methods

We examine our first question about school leaders' professional pathways through a series of displays that rely on simple counts and proportions of educators' prior positions. We explain how we aggregate the several dozen professional educator positions defined in state data into eight distinct categories in Appendix B.

To further explore how these pathways differ in the heterogeneous school contexts across the state, we disaggregate these frequencies and proportions by educator and school characteristics. We take rolling averages of the three prior years' combined ELA and math test scores as well as the proportion of students receiving free- or reduced-price lunch (FRPL). Using these three-year averages, we classify schools into quartiles of prior performance and family income (as proxied by FRPL).

Our observations are left-censored as we do not observe educators' experiences prior to the 2006–07 school year. While we have a record of their total years of experience in education, we are unable to observe the positions they held prior to the start of our panel. Additionally, we are unable to observe prior positions for educators who enter Oregon public schools from private schools, out of state, or internationally. Nevertheless, there is substantial turnover in the principalship, which permits us to observe the prior position of most principals in our panel.

For the cohort of school leaders serving as principals in 2019–20, we observe minimally one position prior to assuming their current principalship for 80 percent.

Our second question requires us to estimate teacher effects on student outcomes. A wide variety of such approaches exist (Koedel et al., 2015). While a full exploration of these nuances falls outside our scope, we highlight the attention researchers have recently paid to the perils of relying on unadjusted variation in teacher effects using fixed effects estimation strategies, which are biased upwards as a result of yearly estimation error (Bitler et al., 2021). To address these issues, we draw on an approach similar to Cohodes et al. (2021) in which we estimate teacher effects via restricted maximum likelihood estimation. Formally, we fit:

$$\begin{aligned} Y_{it} =& \Gamma_g + \Pi_t + \alpha(f(Y_{i(t-1)})) + \mathbf{X}_{it}\gamma + \bar{Y}_{i(c,t-1)} + \bar{\mathbf{X}}_{i(c,t)}\theta + \\ & (\sigma_{s(i,t)} + \tau_{j(i,t)} + \epsilon_{it}), \end{aligned} \tag{1}$$

in which we regress student i's test score Y in year t on fixed effects of grade (Γ_g) and year (Π_t). We include a cubic function of students' prior-year outcomes in math, ELA and attendance ($f(Y_{i(t-1)})$) as well as vectors of student demographic characteristics ($\mathbf{X}_{it}$) and the average of these characteristics taken at the classroom level ($\bar{Y}_{i(c,t-1)}$ and $\bar{\mathbf{X}}_{i(c,t)}$, respectively). The demographic characteristics include indicators for a student's gender, age, race, family-income status (FRPL), English proficiency status, receipt of special education services, receipt of Section 504 services, participation in Indian or migrant education programs, and prior grade repetition. We allow for a three-level error structure where $\sigma_{s(i,t)}$ indexes students' school s, $\tau_{j(i,t)}$ indexes their teacher j, and ϵ_{it} is an idiosyncratic student-level error term.

We partition out the teacher-specific component of the residual in our maximum likelihood estimates and interpret that as the teacher effect on student outcomes, purged of annual measurement error. Our primary results are derived from models in which we nest students within grade- and year-fixed effects, allow for random school- and teacher-disturbances, and adjust for classroom characteristics.[1] This strategy is essentially identical to *post-hoc* Empirical-Bayes-shrunken estimates in which we would calculate the teacher effect variance via a fixed effects approach and then correct for estimation error using the ratio of estimated true teacher effects to observed within-teacher variance. In our application, we take the posterior conditional mean of the student-level residuals for each teacher and interpret this as our "teacher effect." We prefer our true Empirical Bayes estimator in this application because the over-correction inherent in *post-hoc* adjustments risks understanding any selection effects due to over-shrinking the estimated teacher effects that we then use as outcomes to answer our second research question.

We then conduct a simple educator-level bivariate regression to compare the effects on student test-score outcomes of teachers who become school leaders with those who do not, adjusting our standard errors to ensure that they are robust to potential heteroskedasticity in our data.

[1] We fit additional models in which we allow for a four-level error structure, including the random effect of classroom ($\kappa_{c(i,j,t)}$). These estimates are correlated with our primary teacher effects at 0.98 and 0.99 in math and ELA, respectively. Our results for selection into the principalship remain unsurprisingly, therefore, unchanged.

Our counterfactuals in each instance are all educators with teacher effects in this subject area who do not become a school leader (principal or AP).

4 Results

4.1 What professional experiences do educators have prior to becoming school principals?

We find that principals accrue most of their overall professional experience within the state of Oregon. The bulk of principals' total experience in education when first assuming the principalship—including all roles prior to their first spell as principal—comes from their work in the Oregon public school system (Appendix Figure A1). However, when we compare their years of experience in district to their total years of experience, we observe that a substantial proportion of their overall experience comes from employment outside their current school district.

Educators frequently move to different schools and districts around Oregon when assuming school leadership positions. In Figure 1, we present the proportion of school leaders who enter their new role as principal (Panel A) or AP (Panel B) after having worked the prior year in the same school or district. Over 70 percent of new principals assume their role in a different school than the one in which they were previously employed; 45 percent move to a new district. Given that there exist few AP roles at the elementary level, it is perhaps unsurprising that principals are rarely hired from within the same school at the elementary level (see Appendix Figure A2, Panel A). However, the proportion of principals hired at the elementary level from within the same district is roughly comparable to the proportion of principals hired from within-district at the high-school level. More surprisingly, perhaps, we observe relatively little variation in the rates of within-district or school hiring by the school's urbanicity (Panel B). In fact, across geographic locale, prior-test-performance, and levels of family income, we observe very little variation in the rate of within-school hiring. In Panel C, we note that schools with prior-test-performance in the top-performing quartile are more likely to hire from outside the district than those in the other quartiles. However, schools with the smallest proportion of low-family-income students are more likely to hire from within-district.[2] Assistant principals (Figure 1, Panel B) are equally as likely as principals to be hired from outside of the school or district in which they were previously working.

While many educators enter the principalship from an assistant principal position or directly from teaching, sizeable proportions do so via other routes. In Figure 2, we present an alluvial flow of the pathways that the 1,172 principals who were serving in this role in 2019–20 took into their current position over the 14 years for which we are able to observe their experience. The most common pathway into the principalship entails moving from teacher to assistant principal

[2] All differences we discuss in the text are statistically significant at conventional levels. Auxiliary regressions in which we introduce these characteristics sequentially demonstrate that—adjusting for family-income—high-performing schools are more likely to hire from outside the district and vice-versa. Additionally, when we estimate auxiliary regressions adjusting for teachers' years of experience, age, education, gender and ethno-racial identity, our original estimates of out-of-district hiring practices hold.

to principal. Another common path involves moving from a classroom teaching position directly into the principal's office. Still others, however, take meandering roles in and out of district- and school-support roles (see Appendix B for detailed descriptions of the roles these categories include). During the time our data cover, Oregon required all administrators to obtain a "Continuing" administrator license within five years of receiving their "Initial" license which also permitted them to serve in district-level roles, facilitating these transitions between school- and district-leadership. However, Oregon has since re-designed its administrative licensure program to permit school-building-level leaders to hold a "Principal" license, which is permanent, but is not sufficient to work in a school-district role. Therefore, these meandering pathways may become less common in the future.

A large proportion of schools in Oregon, particularly small schools and those at the elementary level, do not have assistant principals; thus the pathway to the principalship must necessarily include alternate routes. In Figure 3, we categorize the roles that principals held immediately prior to their first-time entry into the principalship. We are first able to determine this in 2007. Of the total entrants into the principalship over these 13 years (n=1,694), only 48 percent enter immediately from the assistant principalship. An additional 19.1 percent enter the principal's office directly after a year of full-time teaching. Importantly, we highlight the under-documented phenomenon that almost one-third (32.5 percent) of principals enter their role from a position in which they had responsibilities outside that of a classroom teacher or AP. In Appendix Figure A3, we present the demographic and professional experience characteristics of those who enter the principalship directly from an AP role compared to those who do not. Principals with prior AP experience have similar racial/ethnic, age and years-of-experience profiles. However, elementary principals are much less likely to have prior AP experience and, relatedly, male principals (who are overrepresented in middle- and high-schools) are much more likely to have AP experience.

The phenomenon of "skipping" the assistant principal's role into the principalship is most evident at the elementary level, but is nevertheless a real phenomenon at other grade levels. In Figure A4, we disaggregate the positions held by individuals prior to entry into the principalship by school level (Panel A), urbanicity of the school location (Panel B), quartile of prior test performance of the school (Panel C), and family-income level quartile (Panel D). It is more common for individuals to enter the principalship from a position other than an AP for the elementary grades, nevertheless, this phenomenon does occur at other levels. This AP role "skipping" does not appear to differ across urbanicity, prior-performance or FRPL-level of the school. As we describe in Appendix B, we are able to observe all roles that have any FTE or compensation attached to them; however, it is possible that some teachers have uncompensated informal leadership roles that we do not observe.

To further explore grade-level differences in the "typical" pattern of moving from teacher to assistant principal to principal, we present in Figure 4 the pathway into the principalship for those principals whom we observe with prior experience as teachers or APs. We document several interesting patterns. First, educators with higher-grade level experience (and especially high-school experience) are much more likely to move into leadership roles at lower grade levels

than the converse. Second, we observe large proportions of teachers moving directly into the principalship with no spells as APs, particularly at the elementary level. Oregon's administrative licensure covers grades K–12, which presumably facilitates the cross-grade-level moves we observe.

As further evidence that the phenomenon of role "skipping" does not appear to be a geographic phenomenon, we present in Figure 5 evidence on the geographic dispersion of Oregon's principals.[3] We map schools for principals in our most recent year of data by whether the principal has prior AP experience (triangle), does not (circle), was in their position prior to 2007/08 (square), or entered from outside the Oregon public school system (diamond). Consistent with the results we present in Figure A4 Panel B, we observe no particular geographic patterns in the likelihood that principals have AP experience. In particular, there is no systematic dispersion of prior-AP experience across urban, suburban, town and rural regions of Oregon.

4.2 Are teachers who become school leaders differentially effective at improving student test score outcomes?

Consistent with many prior studies, we estimate the standard deviation of our teacher effects to be between 0.11 and 0.16 standard deviations (*SD*s) in magnitude in language arts and mathematics, respectively. We present our restricted maximum likelihood estimates of the magnitude of teacher effects in Appendix Table A1.

We find that teachers who become school leaders are modestly more instructionally effective—as measured by improved student test scores—than teachers who do not enter school leadership roles.[4] In Table 2, we document the relative effectiveness of individuals who become school (and other) leaders and for whom we observe at least one measure of their effectiveness at increasing student test-score outcomes. The point estimate in Column 1 indicates that teachers who become principals improved their students' math scores by 0.04 *SD* units more than those who we do not observe as either a principal or AP. In language arts, we estimate that future principals had students who improved by 0.01 *SD* units compared to their peer teachers' students, though these results are estimated imprecisely.[5] Our estimates for assistant principals (Columns 2 and

[3]Readers familiar with Oregon's geography will note the dense concentration of schools in the Portland metropolitan area and along the North-South I-5 corridor. These are the areas in which the majority of the state's population lives.

[4]Our results for this research question differ from earlier versions of this paper which we circulated publicly. In particular, we estimated positive coefficients on effectiveness measures for teachers who became principals of 0.015 (0.012) and 0.005 (0.009) in math and language arts, respectively. Similarly, we estimated positive coefficients for APs of 0.020 (0.013) and 0.015 (0.009). We interpreted these coefficients as small in magnitude and statistically indistinguishable from zero. This version of the paper updates our previous findings with an additional year of data and applies additional data cleaning steps to refine how we treat individuals who were part-time teachers and who served as principals across multiple schools. When we fit our same models to the updated data, our coefficients on principals and APs (but not other leaders) increase by 0.01–0.02 *SD* units and are now significant at conventional levels for principals in math and APs in Language Arts. While our interpretation of the results has updated, the substantive meaning of these magnitudes remains roughly equivalent across both sets of results. We believe transparency in the evolution of our findings as the collected evidence evolves is an asset of our research procedures.

[5]An alternative approach to describing the relative effectiveness of school leaders is to compare them with non-school leaders using the magnitude of the teacher-level value-added standard deviation as the scale. This is equivalent to dividing the coefficients in Table 2 by the standard deviations in Appendix Table A1. The appeal of this approach is that it compares individuals to the average teacher. Such an approach would increase the

5) are of roughly the same magnitude (0.02–0.03 *SDs*), though statistically indistinguishable from zero in the case of math.

To understand the extent to which the relationship between educators' relative effectiveness and their entry into school leadership may be explained by observable characteristics, we re-estimate our primary results with additional teacher-demographic characteristics included in our models. In Appendix Table A2, we report that, after adjusting for teachers' years of experience, age, education, gender and ethno-racial identity, none of our estimates of the prior value-added scores of those who enter into school leadership differ by more than five-thousandths (0.005) of a standard deviation. We estimate other types of school- and district-leaders' (e.g., Instructional Coordinator, Teacher on Special Assignment, etc.) effectiveness even more precisely, given the larger pool of this category of educators, and we are able to rule out all but the smallest differences in their average effectiveness compared to their peer teachers who do not take on leadership roles.

5 Discussion and Conclusion

Oregon is, of course, imperfectly generalizable to other contexts. The combination of rural and remote settings with a handful of mid- to large-sized school districts is a particular feature of the state, as is the exceedingly small proportion of Black students and educators. That said, many other states have similar student and school leader demographics.[6] As an additional limitation, all analyses relying on teacher effectiveness estimates generalize to only a fraction of the school leadership workforce (those who previously taught mathematics or ELA in grades 4–8). Finally, important questions remain about the extent of principals' contributions to the variability of student learning gains in schools.[7]

Nevertheless, our findings may inform the training, recruitment and ongoing development of school leaders. To start, we document that future school leaders were slightly more effective than their peers at increasing academic achievement when they were teachers.[8] To the extent that improving student academic outcomes serves as a reasonable proxy for instructional skill, there may be value in recruiting more effective teachers into the principalship. However, more research extending Goldhaber et al. (2019) is necessary before pursuing such policies. In fact, prioritizing the recruitment of more effective teachers into school leadership roles could lead to unanticipated consequences if such an approach were to draw the strongest teachers out of the

magnitude of the coefficients in Table 2: principals are 0.213 and 0.141 teacher-level standard deviation units more effective than their non-principal peers. However, we argue that this obscures the key substantive interpretation: school leaders improved student test scores by a modest amount more than their non-leader peers—an amount that has relatively minimal *practical* educational significance.

[6] In fact, we test the results of this study to different student inference populations using the Generalizer Software (Tipton and Miller, 2021) and find that Oregon has very high generalizability to 18 states and the District of Columbia and high or medium generalizability to all other states. The generalizability score uses the following variables: school size, percent eligible for free/reduced price lunch, percent female, urbanicity, percent white, percent black, school count, percent English learners, percent Hispanic, mean family income, and percent Spanish-speaking.

[7] Contrast, for example Branch et al. (2012) and Dhuey and Smith (2014) with Grissom et al. (2015a), Chiang et al (2016) and Bartanen et al. (2022).

[8] We draw on Kraft's (2020) benchmarks to make our qualitative interpretation about the magnitude of these test-score-gain differences.

classroom, with only a small benefit realized in the form of more effective leadership.

Rather, we consider the most policy-relevant element of this finding to be its implications for the initial training and development of school leaders. In particular, while there may be positive selection into school leadership, it is small and variation exists. Thus, we believe our findings highlight the importance of attending to the instructional toolkits of school leaders—whether measured (Goldhaber et al., 2019; Papay et al., 2020) or perceived (Hitt and Player, 2018; Blase and Blase, 1999). Pre-service training and ongoing professional development to improve instructional coaching skills for school leaders might benefit from reviews of fundamental instructional activities (e.g., lesson planning, formative assessment, classroom culture). Once school leaders demonstrate sound understanding of instructional practice, training activities can focus on how to best structure adult learning opportunities for teachers. Elementary school principals spend more time on instructional activities than those at other levels (Sebastian et al., 2017). Given that we document that secondary APs often move into elementary principalships, pre-service training and ongoing professional development focused on instructional leadership may be particularly important for those moving in this direction across grade bands.

We also highlight that principals in Oregon enter their roles from multiple positions other than the assistant principalship. Our results indicate that Oregon mirrors states like Massachusetts, Missouri and Washington (but contrasts with states like Georgia, North Carolina and Texas) in that many school leaders move into the principalship without ever serving as an assistant principal (Austin et al., 2019). These patterns are suggestive of the types of on-the-job learning opportunities which principals may (and may not) have experienced prior to assuming their role. While there is a growing national focus on training APs for their transition to the principalship (Goldring et al., 2021; Darling-Hammond et al., 2022), our findings suggest the need to provide different types of early-career supports for those entering the principalship from roles other than the assistant principal. For instance, those coming through pathways other than the AP may not gain access to the same degree of mentorship available to those who do (Barnett et al., 2017; Bastian and Henry, 2015; Grissom et al., 2020). Similarly, they may not have the opportunity to develop building-based skills such as organizational management and student discipline practices (Goldring et al., 2021). This type of knowledge may be particularly critical in schools that have substantial operational and organizational management needs. Daily schedules tend to be more fragmented for school leaders at the elementary level (Goldring et al., 2008), and principals at the elementary- and middle-grade levels report engaging in more frequent short-range planning activities (Grissom et al., 2015b). Thus, time-management supports may be particularly relevant at the elementary and middle levels and particularly for those without prior administrative experience at this level.

On the other hand, some principals without AP experience may bring other types of leadership and management knowledge and skills that could be of particular value to share across the profession. Our mapping of trajectories into the principalship demonstrates the array of experiences accumulated prior to entering the job, which may be important sources of skills and knowledge. Given the wide array of skills required of the principal (Grissom et al., 2021), it seems likely that those in the position draw on some skills best acquired outside the classroom

or even the assistant principal's office. We encourage future research into the types of roles and associated skillsets brought by principals with non-teaching, non-AP experiences, and into the extent to which these skills support improved school outcomes.

Across different types of communities, Oregon principals and APs frequently enter their role with little experience working in the local school- or district context. Counter to common perceptions—and consistent with recent results in Wisconsin from Yang et al. (2021)—principals of rural schools are just as likely to enter their position from a job outside the local community. Our study, thus, adds complexity to earlier findings (Bastian and Henry, 2015). Depending on school and community needs, this phenomenon may or may not set school leaders up for success in their new positions. Direct exploration of that question is outside the scope of the current study. However, our findings highlight the need for the differentiated induction supports school leaders may require, depending on their familiarity with their new school. In particular, for the 45 percent of principals entering from outside the district, induction activities focused on connecting with families, students and educators in the community may be critical. Further, creating operational supports that allow school leaders to rely on those with existing knowledge about, for example, local budgeting or scheduling procedures may create a smoother entry for new principals. In contrast, for those entering from within the school or district, opportunities to observe external school leadership practices or to receive leadership coaching to shift incoming leaders' existing relationships to match those of their new role may be of value.

Finally, though we document surprising consistency in the previous work experience patterns across geographies, prior school performance and levels of family income, we note differences in high-performing schools that may bear further exploration. In particular, the highest-performing schools tend to recruit more principals from outside the district compared to all other schools. It is possible that these schools are perceived as the most attractive or prestigious assignments, and so receive multiple applications from around the state. Alternatively, these schools may accrue status benefits from recruiting beyond their local communities. To the extent that these phenomena occur, it may create unequal distribution of leadership skills and opportunities; thus such practices bear further scrutiny by policymakers and researchers.

In sum, our work adds to a small research base focused on the prior professional experiences of those entering the principalship. Our results highlight potential opportunities to build principals' instructional, operational and strategic skills. In addition to our statewide findings, we also shed light on how pathways into the principalship are similar and different across contexts. Finally, our results inform other researchers by detailing principals' prior professional experiences and providing a foundation for future work on the implications of these experiences for their future productivity.

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Tables and Figures

Statistic	All Leaders		w/ Tchr. Effects	
	Mean	SD	Mean	SD
Panel A. Principals				
Pct. Female	0.51		0.64	
Pct. Am. Indian/AK	0.01		0.00	
Pct. Asian-PI	0.02		0.01	
Pct. Black	0.02		0.01	
Pct. Hispanic/Latino	0.05		0.08	
Pct. White, Non-Hisp	0.89		0.90	
Pct. Multi-racial	0.02		0.01	
Pct. Race miss	0.05		0.00	
Age (yrs)	48.20	8.18	34.30	8.03
Tot Yrs Experience	19.28	8.72	5.91	7.00
Tot Yrs Experience (no 0s)	19.80	8.23	8.20	7.02
Elementary	0.49		0.61	
Middle	0.16		0.25	
High	0.17		0.05	
Other/Unknown	0.18		0.09	
Principal-year obs.	15,597			
Unique principals	3,245		143	
Panel B. Assistant Principals				
Pct. Female	0.44		0.59	
Pct. Am. Indian/AK	0.00		0.01	
Pct. Asian-PI	0.02		0.02	
Pct. Black	0.04		0.01	
Pct. Hispanic/Latino	0.08		0.07	
Pct. White, Non-Hisp	0.85		0.89	
Pct. Multi-racial	0.02		0.01	
Pct. Race miss	0.03		0.00	
Age (yrs)	44.45	8.24	32.66	7.38
Tot Yrs Experience	15.55	8.20	5.03	5.84
Tot Yrs Experience (no 0s)	15.94	7.92	7.73	5.62
Elementary	0.11		0.42	
Middle	0.28		0.42	
High	0.49		0.09	
Other/Unknown	0.12		0.08	
AP-year obs.	7,417			
Unique APs	2,167		166	

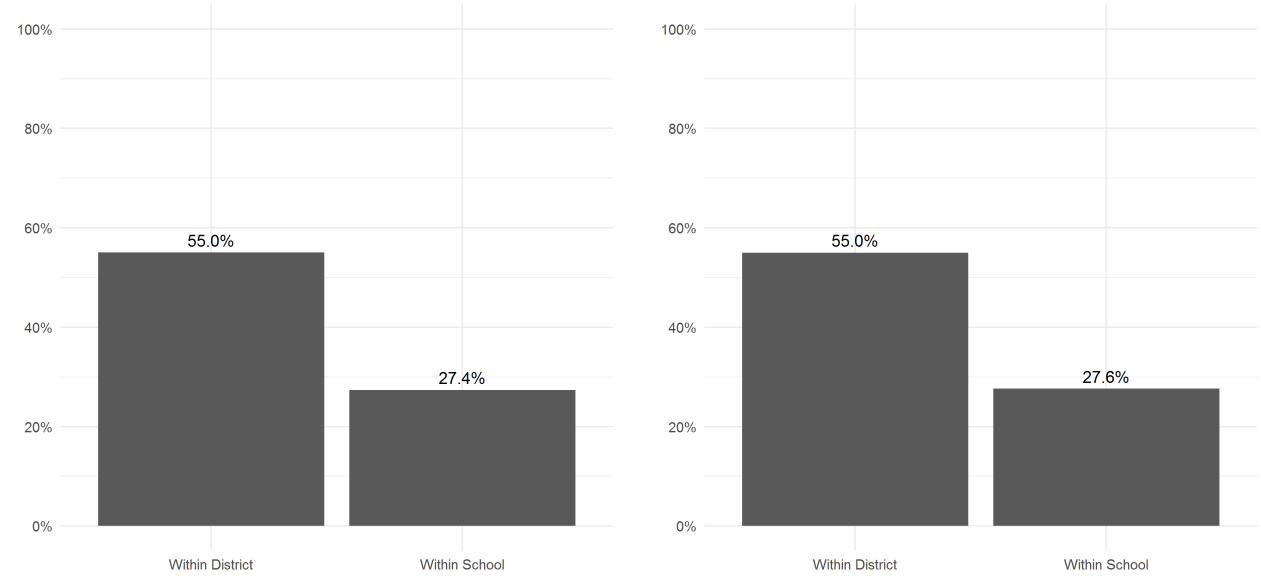
Notes: Cells report means and standard deviations. Means and *SD*s of time-varying statistics represent educator-year averages when in role of principal/AP. Race/ethnicity categories are non-overlapping, so differ slightly from public ODE reporting. See Appendix B for more details on measures and sample construction.

Table 1: Descriptive statistics on Oregon school leaders, 2006–07 through 2019–20

	Math			Language Arts		
	(1)	(2)	(3)	(4)	(5)	(6)
Principal	0.037*			0.013		
	(0.015)			(0.010)		
Asst. Principal		0.017			0.026**	
		(0.013)			(0.009)	
Other Leader			-0.001			-0.000
			(0.004)			(0.003)
Observations	8,544	8,555	8,593	8,718	8,718	8,769

Notes: $^{*}p$ <0.05; $^{**}p$ <0.01; $^{***}p$ <0.001. Cells present coefficients and heteroskedastic-robust standard errors in parentheses. Regressions estimated on all educators with teacher effects observed in 2013-14 through 2018-19 in positions observed in 2014-15 through 2019-20. One observation equals one educator. Other Leader category defined in Appendix B. Comparison group for principals is all educators with teacher effects, except APs who never serve as principals. Comparison group for APs is all educators with teacher effects, except principals who never serve as APs. Comparison group for Other Leaders is all educators with teacher effects except APs and principals. Observations vary across estimates as a result of differences in reference group and total number of teachers effects available by subject. Total n principals = 143. n APs = 166, n Other leaders = 2,852 Teacher effects estimated following Equation 1.

Table 2: Estimates of teacher effects for principals, assistant principals and other educational leaders



(a) Principals

(b) Assistant Principals

Figure 1: Proportion of Newly Hired School Leaders Employed in Prior Year in Same School or District, 2007–08 through 2019–20

Notes: n principals with prior observed position = 2,147. n APs with prior observed position = 1,666. This figure includes an additional 453 unique principals compared to Figure 3 because we can observe that those principals did (not) work in the same school or district in the prior year even if we do not observe their position.

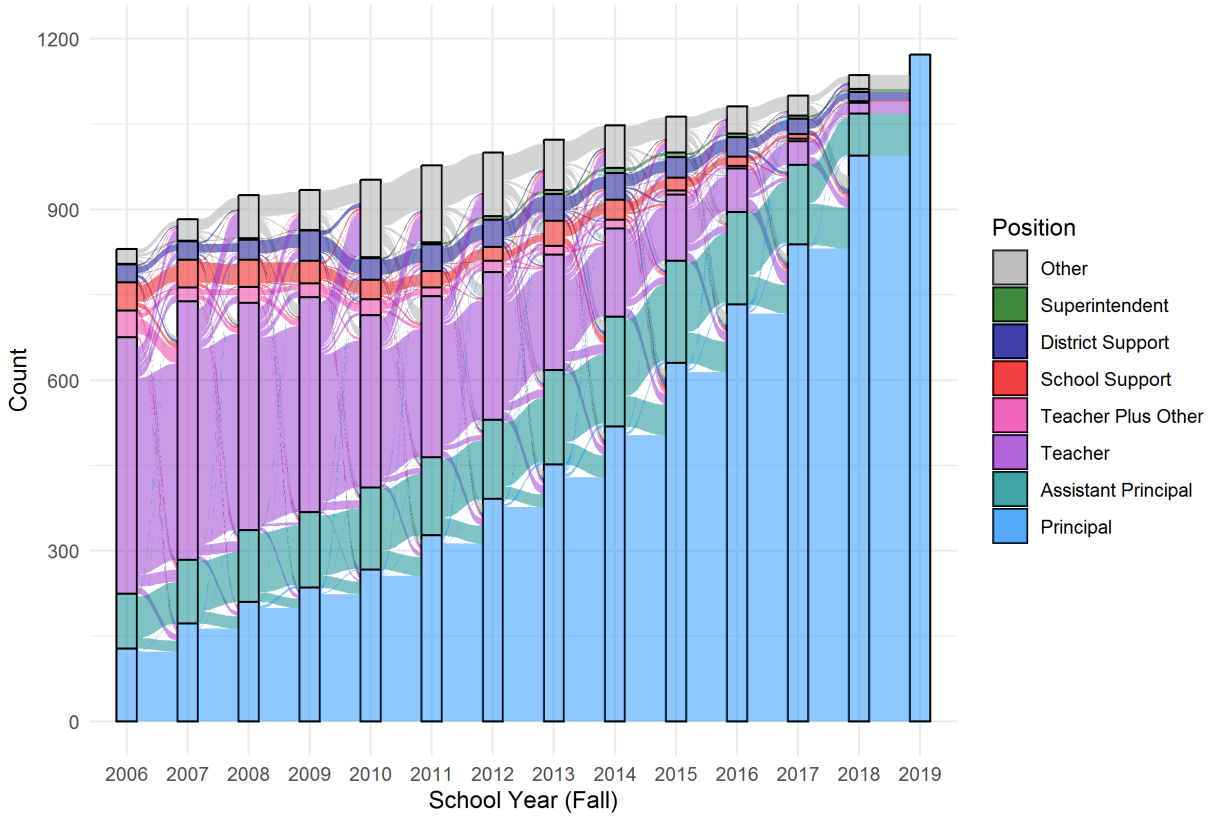


Figure 2: Prior educator roles for Oregon educators serving as principals in 2019–20

Notes: Figure presents all those who hold the principal position in 2019–20 (n=1,172), and every position we observe them holding in the Oregon education system between 2006–07 and 2019–20. The difference in bar height between 2006 and 2019 reflects entrants to the Oregon education system from outside the system. We do not observe prior positions for 19.5 percent (n=228) of all principals in 2019–20.

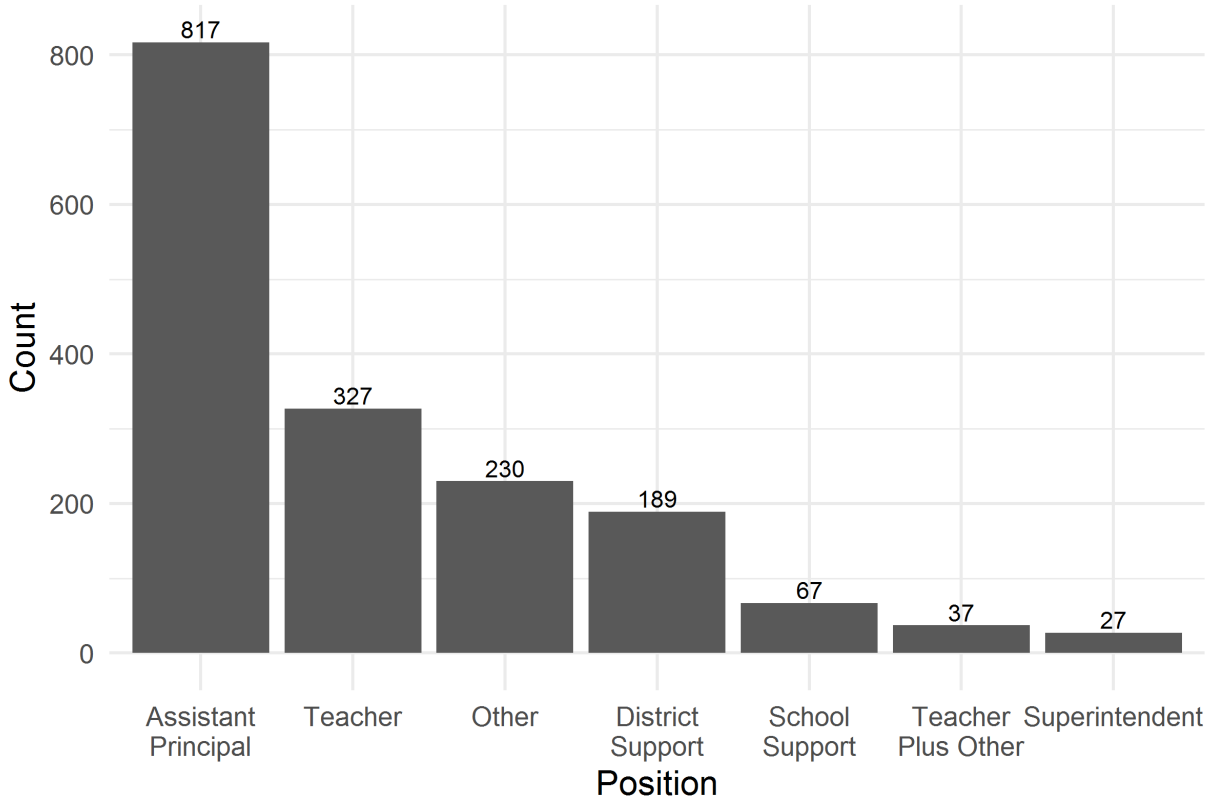


Figure 3: Immediate prior position for all principals 2007–08 through 2019–20

Notes: Figure displays all unique principals for whom we observe a prior position (n=1,694). Across all those whom we observe in the principalship (N=3,245), we do not observe prior positions for 47.8 percent (n=1,551). The majority of those for whom we do not observe prior positions started in or prior to the 2006-07 school year (n=1,098).

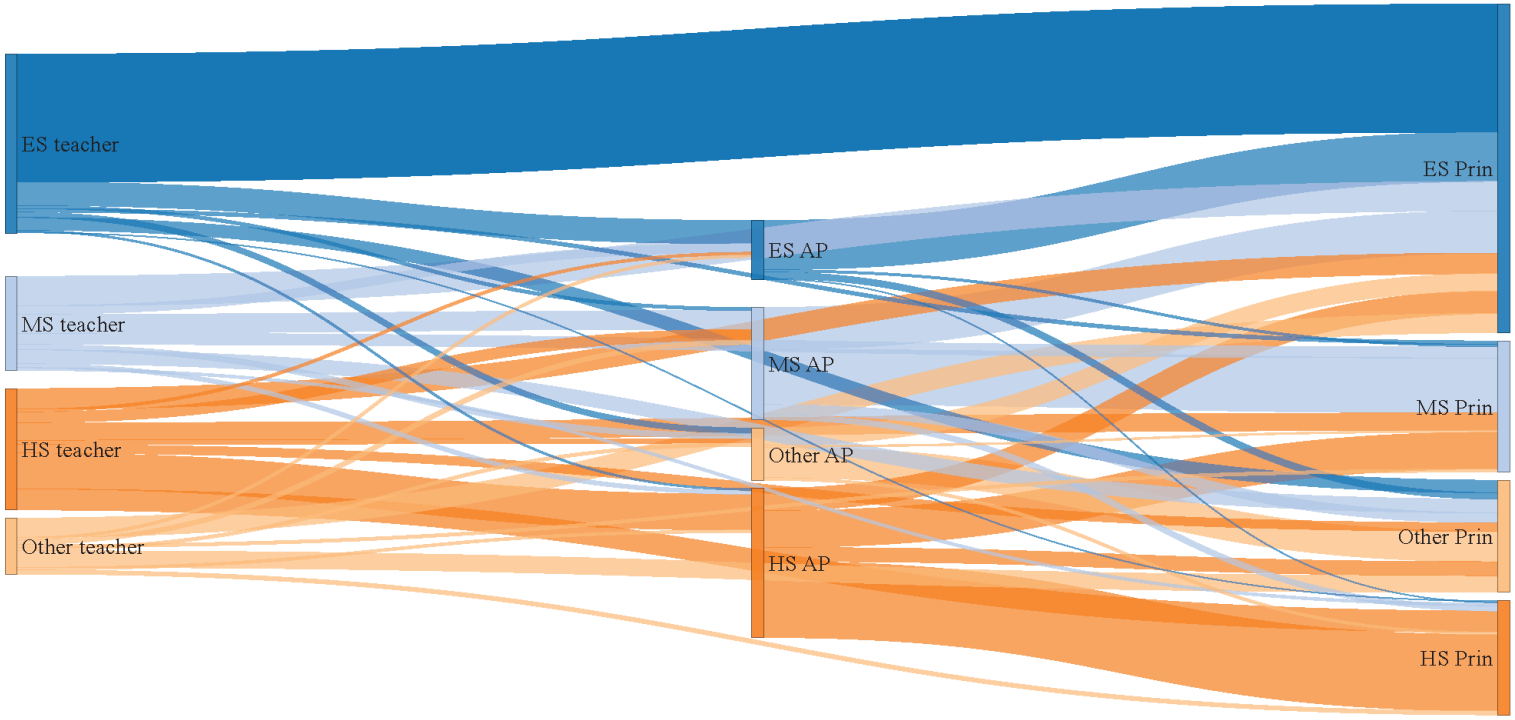


Figure 4: Pathway into principalship from teacher and assistant principalship, by grade level

Notes: Figure displays all unique principals whom we observe ever serving as a teacher or assistant principal (n=1,435).

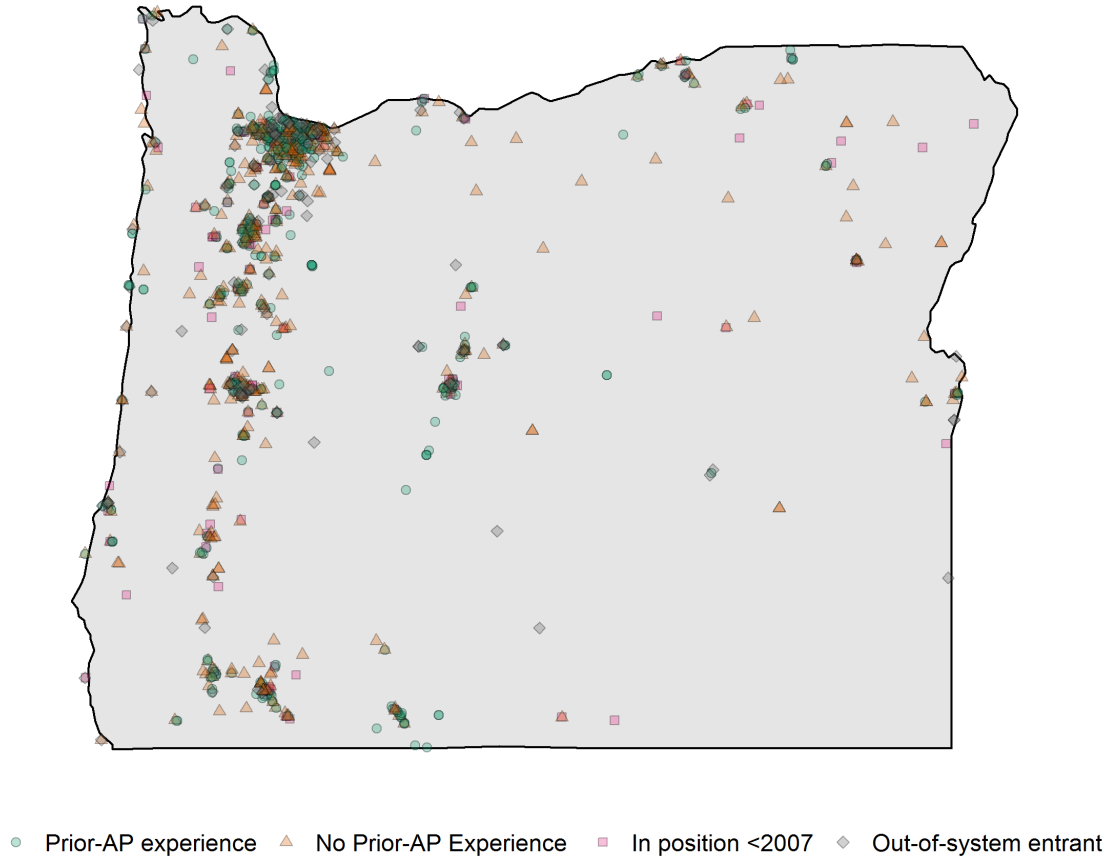


Figure 5: Geographic dispersion of prior-AP experience

Notes: Figure presents all those who hold the principal position in 2019–20 (n=1,172).

A Appendix Tables and Figures

	(1)	(2)	(3)	(4)
Teacher Intercepts (SD)	0.165	0.142	0.128	0.112
School Intercepts (SD)	0.096	0.084	0.074	0.069
Class Intercepts (SD)		0.126		0.104
Residual (SD)	0.492	0.479	0.529	0.520
School random effects	✓	✓	✓	✓
Teacher random effects	✓	✓	✓	✓
Class random effects		✓		✓
N (Student-years)	967,510	967,510	955,036	955,036
N (Unique Teachers)	8,890	8,890	9,015	9,015

Notes: Cells report standard deviation of teacher effects. All models include grade and year fixed effects. All models adjust for cubic polynomials of students' prior achievement and attendance, gender, age, race, disability status, 504 plan designation, participation in migrant or Indian education program, indicators for missing values and the class averages of the preceding characteristics. Teacher effects estimated following Equation 1.

Table A1: Restricted maximum likelihood estimates of teacher effects on Oregon State Assessments

	Math			Language Arts		
	(1)	(2)	(3)	(4)	(5)	(6)
Principal	0.038*			0.014		
	(0.015)			(0.010)		
Asst. Principal		0.022			0.029**	
		(0.013)			(0.009)	
Other Leader			0.001			0.002
			(0.004)			(0.003)
Max. Exper.	0.003***	0.003***	0.003***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
<BA	-0.038	-0.040	-0.032	0.038	0.036	0.042
	(0.031)	(0.031)	(0.031)	(0.028)	(0.028)	(0.028)
BA	-0.012	-0.013	-0.015	-0.001	-0.001	-0.000
	(0.023)	(0.022)	(0.023)	(0.021)	(0.020)	(0.020)
BA+	-0.024	-0.025	-0.027	-0.002	-0.002	-0.002
	(0.023)	(0.023)	(0.023)	(0.021)	(0.020)	(0.020)
Masters	-0.023	-0.023	-0.026	-0.003	-0.003	-0.003
	(0.022)	(0.022)	(0.023)	(0.020)	(0.020)	(0.020)
Doctorate	-0.051	-0.062	-0.068	-0.017	-0.030	-0.028
	(0.038)	(0.037)	(0.038)	(0.031)	(0.028)	(0.028)
Female	0.008*	0.009*	0.008*	0.018***	0.018***	0.019***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Race Missing	-0.031	-0.031	-0.031	-0.073***	-0.073***	-0.072***
	(0.088)	(0.088)	(0.088)	(0.019)	(0.019)	(0.019)
Black	-0.013	-0.014	-0.011	-0.008	-0.007	-0.007
	(0.021)	(0.021)	(0.021)	(0.014)	(0.014)	(0.014)
Hispanic/Latino	0.012	0.012	0.013	0.002	0.002	0.003
	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)
Multi-racial	-0.011	-0.013	-0.011	-0.010	-0.011	-0.010
	(0.012)	(0.012)	(0.012)	(0.008)	(0.008)	(0.008)
Max. Age	-0.001*	-0.000*	-0.001*	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	8,535	8,546	8,584	8,709	8,709	8,760

Notes: $^{*}p$ <0.05; $^{**}p$ <0.01; $^{***}p$ <0.001. Cells present coefficients and heteroskedastic-robust standard errors in parentheses. Regressions estimated on all educators with teacher effects observed in 2013-14 through 2018-19 in positions observed in 2014-15 through 2019-20. One observation equals one educator. Other Leader category defined in Appendix B. Comparison group for principals is all educators with teacher effects, except APs who never serve as principals. Comparison group for APs is all educators with teacher effects, except principals who never serve as APs. Comparison group for Other Leaders is all educators with teacher effects except APs and principals. Observations vary across estimates as a result of differences in reference group and total number of teachers effects available by subject. Total n principals = 143. n APs = 166, n Other leaders = 2,852 Teacher effects estimated following Equation 1.

Table A2: Estimates of teacher effects for principals, assistant principals and other educational leaders

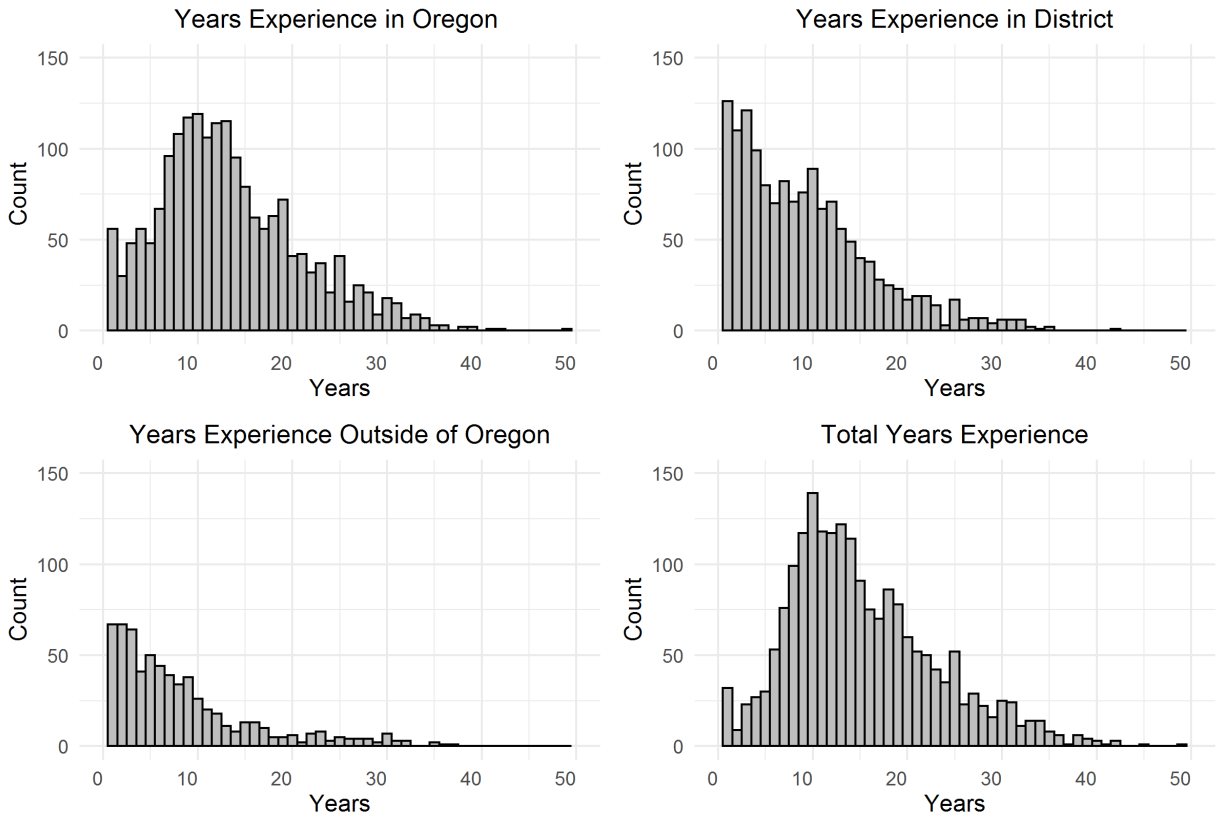
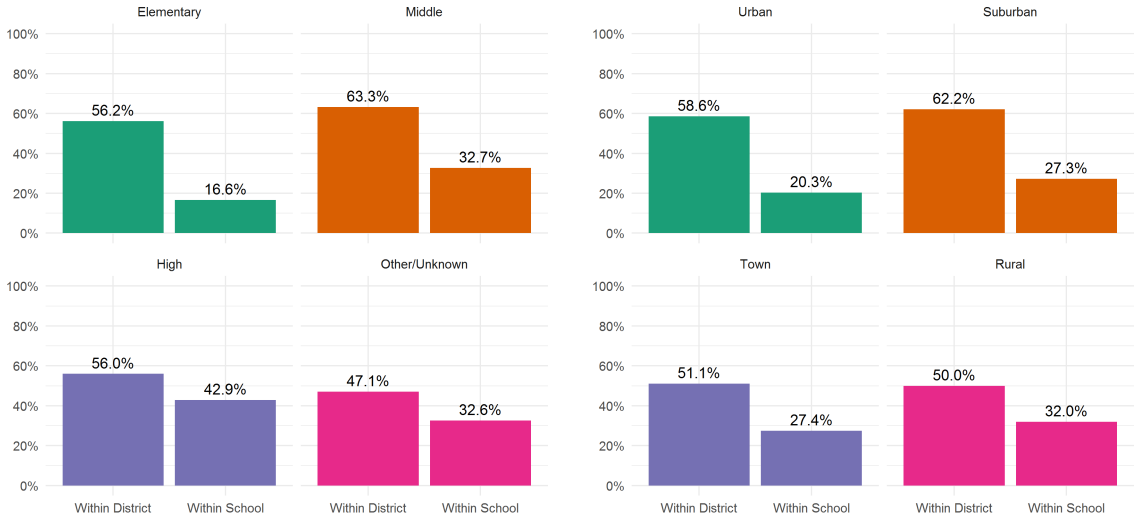


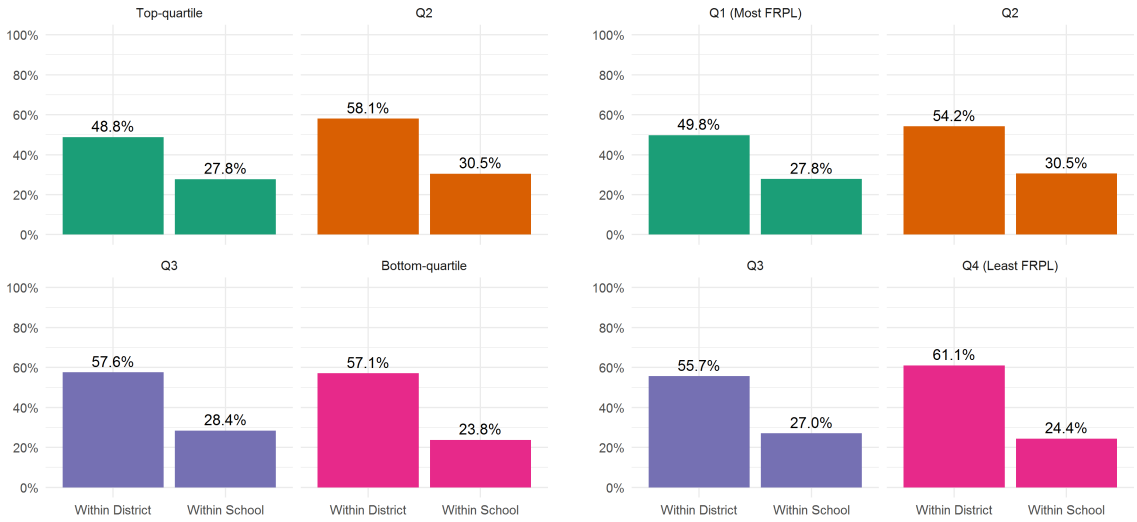
Figure A1: Years of experience in public education when first assuming principalship for Oregon principals, 2007–08 through 2019–20

Notes: 7.8 percent of principals are coded as having 0 years of prior experience when first assuming the principalship even after correcting for those for whom we can observe full experience. Some of these values may reflect principals with experience outside of the education sector, but we interpret it largely as inaccurate data. Those values are omitted in this figure.



(a) by grade level

(b) by urbanicity



(c) by test performance

(d) by FRPL

Figure A2: Immediate prior position for all principals 2007–08 through 2019–20, by school characteristics

Notes: n principals with observed in/out district entry = 2,147. A small number of schools have missing urbanicity, test performance, or FRPL quartile resulting in the exclusion of 122, 299 and 260 observations from panels B–D, respectively.

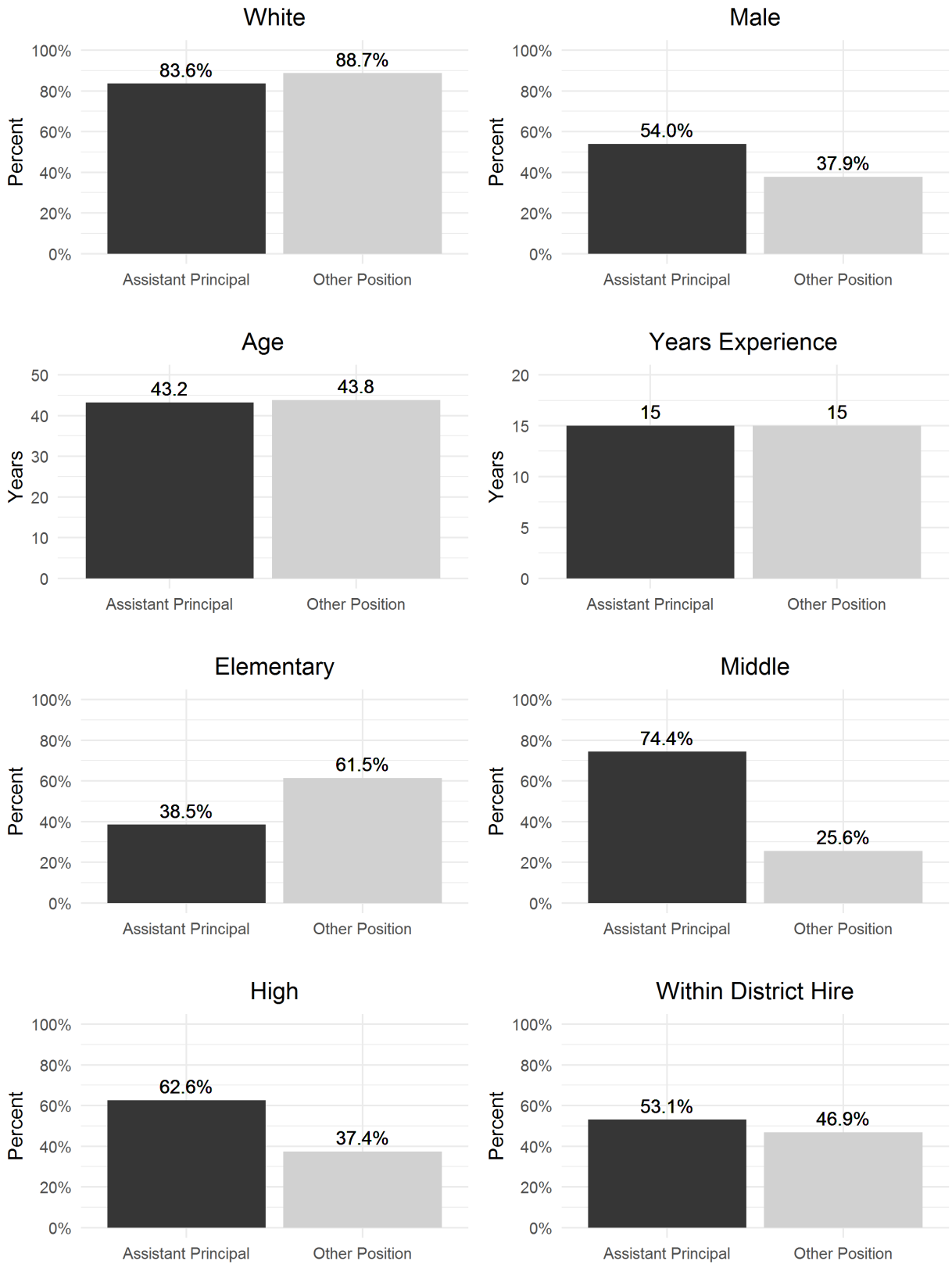
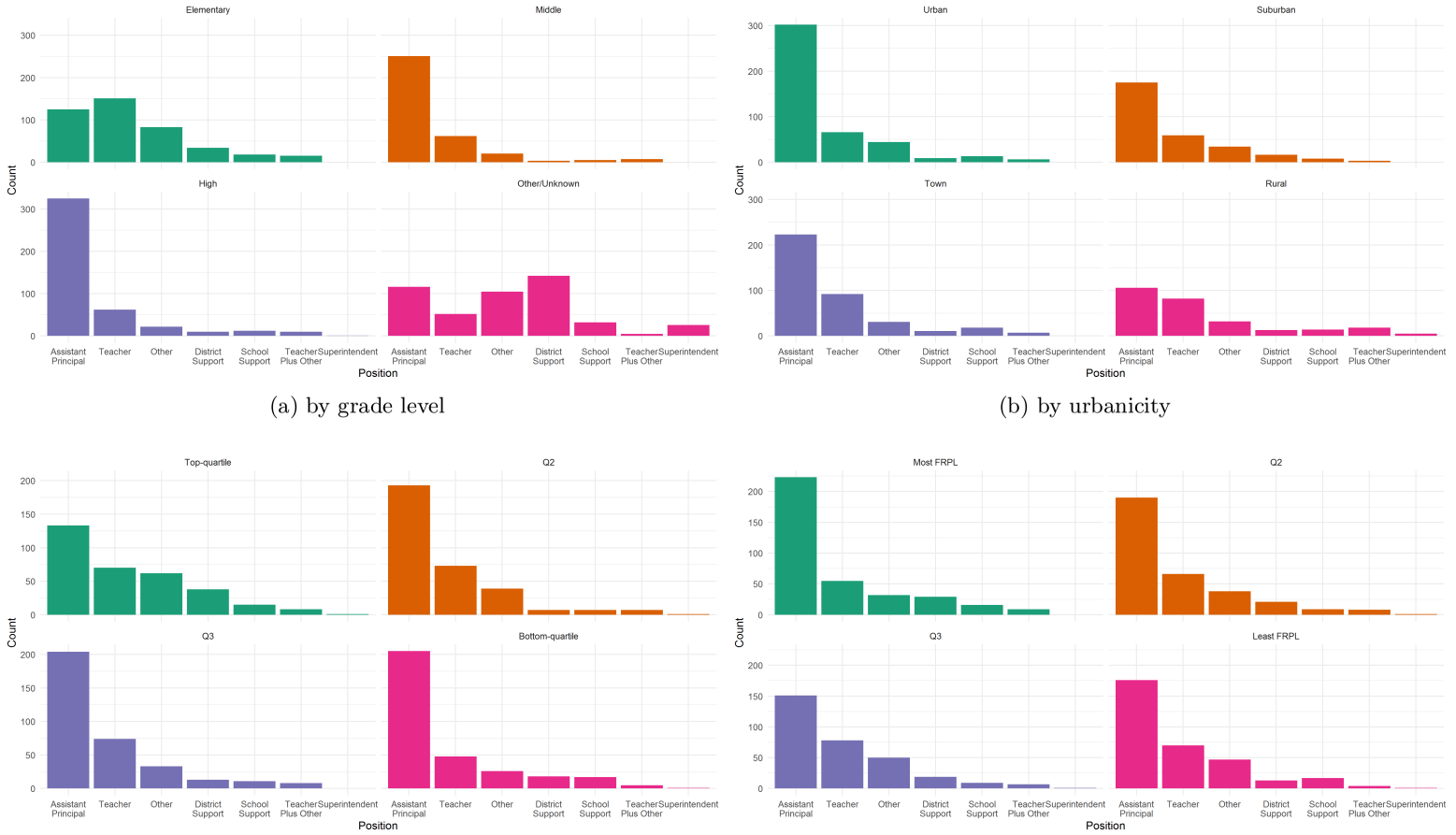


Figure A3: Demographic and professional experience differences of principals by prior position, 2007–08 through 2019–20

Notes: White, Male, Age and Years Experience graphs present the proportion or mean value of principals with prior AP or Other Position experience. Remaining graphs present the comparative proportion of prior AP or Other Leadership roles for principals working at different grade-band levels or who were within-district hires. n principals with prior position = 1,694.



(a) by grade level

(b) by urbanicity

(c) by test performance

(d) by FRPL

Figure A4: Immediate prior position for all principals 2007–08 through 2019–20, by school characteristics

Notes: Figure displays all unique principals for whom we observe a prior position (n=1,694). A small number of schools have missing urbanicity, test performance, or FRPL quartile resulting in the exclusion of 307, 377 and 354 observations from panels B–D, respectively.

B Data Appendix

B.1 Staff Data

We draw on staff data from the 2006–07 through 2019–20 school years from the Oregon Department of Education (ODE) administrative records. Our sample of ever-principals includes 3,330 individuals; for 3,245 of these individuals, we are able to confidently assign them as a principal of record to a given school in a particular year. Due to the dynamic nature of state-level data collection, however, there are limitations in what data we are able to use across years. We first describe how we construct the dataset we use to examine the prior positions held by those who ultimately become principals. Then, we describe how the data structure shapes our analysis.

We only observe positions held by educator staff from 2006-07 onward. Therefore, we are unable to observe the positions held prior to assuming the principalship for those we observe as principals in 2006–07. While we do have data on their total years of experience, we do not know what positions they held prior to appearing in our data. We also observe a number of principals entering the data from outside the Oregon education system for whom we do not have data on their prior positions. This includes those who enter from private education settings, out of state, or internationally. Again, we do have reported data on their years of experience, but not on prior positions held. In our analyses, they appear as having no position prior, and entering directly into the principalship. Therefore, we are unable to include them in analyses of prior positions (Figure 3, Figure A4, and Figure A3).

In Figure 1 and Figure A1, our sample includes only the principal's first year in their position and those who were not principals in 2006, for a total of 2,147 principal observations. In Figure A1, we remove all "0" values for those with zero total years of experience. We do this because with the exception of the rare possible case of principals entering the position with experience outside the education sector, it is not possible for an individual to become a principal with no prior experience. We, therefore, assume these educators have inaccurately coded professional experiences. This removes 168 observations for total years of experience. For consistency and scale alignment, we also remove those with zero years of experience from the other three panels. This removes 285 observations with zero years of experience in Oregon, 688 observations with zero years in district experience, and 1,513 observations with zero years of experience outside of Oregon.

Of the 3,245 ever-principals in our dataset, there are 1,098 for whom we do not observe their prior position because we first observe them in 2006–07 and an additional 453 principals who we do not observe in their prior position because they enter from outside the Oregon public school system. This sample of 1,694 principals is the one on which we analyze prior professional experience (Figure 3. An additional 259 principals do not figure in Figure 4) because their prior positions were not as Teachers or Assistant Principals.

There are a total of 38 position types in the Oregon staff database. We collapse these 38 distinct positions into seven broader categories: "Superintendent", "District Support", "School Support", "Teacher", "Teacher Plus", "Assistant Principal", and "Principal." Superintendent, Assistant Principal, and Principal positions are all stand-alone categories. The category of "District Support" includes the following seven (7) job titles: Assistant Superintendent, Instructional Coordinator/Supervisor, District Support, Special Education Administrator/Director, Special Education Administrative, Special Education Administrative Support Staff, and Special Education Other Services, Non-Licensed. The category of "School Support"—which we distinguish from District Support by either being based in particular schools or providing direct services to students in schools—includes the following twenty-one (21) job titles: Head Teacher, Psychologist, Guidance Counselor, Nurse, Paraprofessional, School Support, Student Support, Li-

brary/Media Support, Special Education Audiologist, Special Education Pathologist, Special Education Interpreter, Special Education Psychologist, Special Education Occupational Therapist, Special Education Physical Therapist, Special Education Recreational/Therapeutic Specialist, Special Education Social Worker, Special Education Medical and Nursing Staff, Special Education Counselor, Special Education Orientation and Mobility Specialist, Special Education Paraprofessional, and Special Education Other Services, Licensed. The "Teacher" category includes the following four (4) job titles: Teacher, Library/Media Specialist, Special Education Teacher, and Special Education Physical Education Teacher. The "Other" category includes the following three (3) job titles: Other Licensed Staff, Other, and Other, Non-Licensed Staff. The "Teacher Plus" category includes any educator who holds two distinct roles, one of them as a teacher, and the other in any additional role, except for "Other" as this category includes classified roles such as crossing-guard duty or athletic coach.

A further complication in our data is that some future principals hold multiple roles in each year, either within the same school or across schools. Of the 17,471 principal-year observations in which we observe principals actively serving in a role, 18 percent are ones in which principals serve in multiple roles or across multiple schools. We assign individuals to the position and school in which they hold the highest FTE. In the case of ties, we take a random first position. Thus, we do not exclude any educators during this step, but we do exclude positions.

ODE did not collect racial/ethnic data on staff until 2010–11; therefore we only report those characteristics for that year onward. We create a stable race/ethnicity variable that takes the final, non-missing reported race/ethnicity for each educator observation and imputes that as their stable race/ethnicity across all their observations. In ODE data, the category "Hispanic/Latino" is used in addition to other racial/ethnic identifiers, not as a stand-alone identifier. We approach the construction of our race/ethnicity categories in the following way for both staff and student data. If an individual is categorized as "Hispanic/Latino," we assign them a value of one for Hispanic and zeroes for all other racial/ethnic categories, even if they have multiple race/ethnicity categories in the original ODE data. We then create categories of White, Non-Hispanic (where only one race/ethnicity was selected and that was White), Asian/Pacific Islander for those who either selected only Asian, those who selected only Pacific Islander, or those who selected both. We assign the racial group Black to those who selected one race/ethnicity and that was Black, the group American Indian-Alaska Native for those who selected one race/ethnicity and it was American Indian/Alaska Native, and a multi-racial category for those who selected combinations other than the preceding. This leaves a total of six race/ethnicity categories (White, non-Hispanic, Hispanic, Asian/Pacific Islander, Black, American Indian-Alaska Native, and Multi-Racial). Five percent of our principals observations have missing race/ethnicity data.

For gender, we construct a similar stable gender variable that uses their last reported, non-missing binary gender identification.

B.2 Student, Course and Assessment Data

We draw student demographic, course-taking and assessment data from the 2006–07 through the 2018–19 school years from the same ODE records. The primary function of the student data in our analyses is for the purpose of calculating teacher effects, though we also use school-level averages to construct quartiles of family-income levels and prior school performance. In order calculate teacher effects, we must be able to identify students' classroom both to link them to a teacher of record and to identify peers who may contribute to their learning experiences. Oregon did not have a full census link between students, courses and teachers until the 2013–14 school year. As such, we restrict our sample for teacher effect analyses to the 2013-14 school-year onward.

Oregon experienced an important change in assessment regimes from the Oregon Assessment of Knowledge and Skills (OAKS) to the Smarter Balanced Assessment Consortium (SBAC) test in 2014-15. Oregon pioneered the use of computer-based testing for its statewide assessment and accountability system in the early 2000s. The OAKS assessment was unique in that it served both benchmarking and summative purposes. During the majority of the OAKS era, all students could be tested up to three times during the year at locally determined points in time. As a result, in our data which includes all instances in which a student took a state assessment, we observe that during the OAKS era (2006–07 through 2013–14), only between 48.1 and 71.8 percent of all ELA and Mathematics assessments ultimately counted as a student's best score.[9] Educators frequently re-administered the OAKS to students at all initial proficiency scores to offer students additional opportunities to demonstrate mastery and to improve school- and district-level averages that contribute to accountability ratings. In 2012, the state formally banned re-testing students once they earned a score corresponding to the level of "Exceeds" but still permitted re-testing students across all other levels. These practices compromise the analyst's ability to conduct cross-school comparisons. We standardize results within year to permit the comparison of outcomes across years. However, the unique assessment practices which permitted students to test at various times throughout the year, with varying and locally determined frequencies, mean that strong assumptions are required in order to interpret model-based teacher effects as the causal contributions of a given teacher to a student's test score gains. To take advantage of the full range of the panel possible, we present results on teacher effects that include one year of the OAKS assessment and four years of SBAC. We re-estimate our models dropping 2013-14 and return substantively identical results. For our teacher effect analyses, we focus on students' scores in mathematics and language arts in grades 4–8, as these are the subjects and grades that permit us to calculate yearly teacher effects.

We assign students to courses and teachers of record based on the following procedures. We begin by focusing on self-contained grade level and subject-area Language Arts and Mathematics courses.[10] Our approach excludes courses such as English as a Second Language and Reading from being included as courses of record for the Language Arts assessment. Additionally, students who only have a course code for an advanced math course (e.g., 02072 or 52072: Geometry) and do not have an additional course code for Grade 8 Mathematics (52038) do not contribute to our estimates. However, students who only have an Algebra I course code do, either as a single- (02052 or 52052) or a two-part (02053 or 02054) course. We also exclude multiple reported sections of the same student-teacher-course code combination. We include all students when we standardize our test score outcomes, but we exclude students who transfer schools or teachers mid-year. When students enroll in multiple courses, we assign them to their primary grade-level self-contained or subject classroom for value-added calculation purposes (e.g, Grade 4 or 7^{th} grade math). After these corrections, we still are left with 23,790 math and 11,848 ELA course-student-year combinations for which we have irresolvable conflicts preventing us from assigning them to a particular classroom and teacher. For example, they are assigned both to Grade 6 (52036) and Grade 7 math (52037). We exclude these student-course-teacher observations (these represent less than 1.5 percent of all course-student-year observations).

In addition to the above student-course-teacher match exclusions, we restrict our teacher effect analyses to teachers with at least 6 students, students whose test scores fall within ± 5 SDs, and students who are enrolled in a teacher's class for at least 110 days of the school year.

[9] In contrast, in the first year of the SBAC assessment (2014-15) 98.5 percent of all scores were the final score and from 2015 onward 99.9 percent of scores are students' best score.

[10] Specifically, we select restrict our analysis to students in the following Oregon ODE course codes: 01010, 01034, 01035, 01036, 01037, 02002, 02036, 02037, 02038, 02039, 02051, 02052, 02053, 02054, 02135, 23007, 23008, 23009, 23010, 23011, 23012, 23041, 1007, 51034, 51035, 51036, 51037, 52002, 52003, 52036, 52037, 52038, 52039, 52051, 52052, 52061, 52132, 73034, 73035, 73036, 73037, 73038, 73039, and 73041.

After these restrictions, we are left with the student-subject year samples we report in Appendix Table A1: 967,510 and 955,036 observations in math and language arts, respectively.

To examine heterogeneity, we construct three-year averages of schools' average math and ELA performance as well as their FRPL membership. We then assign schools to quartiles of prior performance and FRPL membership. We exclude schools from these calculations that have fewer than 10 qualifying students. We also have a small number of schools with missing urbanicity locales from the NCES data. We document these in the notes to Figure A2 and Figure A4.