Retention, Mobility, and Attrition among School and District Leaders in Colorado, Missouri, and South Dakota

Appendix A. Literature review

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See https://go.usa.gov/xfHH7 for the full report.

Appendix A. Literature review

To inform development of the study, the study team conducted a review of the literature associated with education leadership, the mobility and attrition of school and district leaders, and factors associated with leader retention, mobility, and attrition.

The importance of effective leadership for school success

Literature spanning several decades supports the notion that effective leadership is important for school success (see, for example, Grissom & Loeb, 2011). In particular, research examining the characteristics and behavior of principals has identified associations with school outcomes, such as student achievement, student engagement, and teacher retention (see, for example, Seashore Louis et al., 2010; Snodgrass Rangel, 2018). There is uncertainty about what aspects of principal preparation, skills, and behavior result in the best outcomes for schools and students (Osborne-Lampkin et al., 2015). Yet there is broad consensus about the importance of effective school leadership and its indirect influence on school outcomes through, for example, the creation of conditions that allow teachers to improve their instructional practice; the efficient allocation of people, money, time, and programs; and the establishment of a school culture that promotes high expectations, professional practice, and opportunities for collaboration (Murphy et al., 2006).

A smaller body of research has explored the influence of district leadership on school outcomes. For example, using qualitative and quantitative methods to examine longitudinal data for nine states, one study suggested that district policies and practices contributed to better school outcomes through greater efficacy and confidence of principals in their ability to bring about school improvement and enact effective policies and practices associated with instruction (Seashore Louis et al., 2010). Findings suggested that district policies and practices supported school leader efficacy by ensuring that educators had access to relevant professional development and that higher-performing districts tended to be led by staff who communicated a strong belief in the capacity of teachers and principals to improve the quality of teaching and learning.

Mobility and attrition among school and district leaders and related consequences

National data suggest that about four of five principals stay in their position from year to year. Among principals in public schools in 2015/16, about 82 percent remained at the same school the following year, 6 percent moved

to a different school, 10 percent no longer served as principals, and 2 percent left their school but their occupational status was unknown (Goldring & Taie, 2018). Between 2015/16 and 2016/17 rates of principal retention were lower in schools with higher percentages of students eligible for the national school lunch program and in rural schools. However, state education agencies do not systematically collect information about the prevalence of district leader mobility and attrition, and the few available state-level studies have suggested higher rates of mobility and attrition for district leaders than for school leaders, corresponding to the typically shorter duration of district leadership positions (Chingos et al., 2014; Johnson et al., 2011).

Changing or leaving a leadership position may be voluntary (for example, motivated by a decision to change careers) or involuntary (for example, caused by reassignment or nonrenewal of employment contracts). Whether voluntary or involuntary, mobility and attrition can have positive effects for schools and students if they result in a better matching of leader strengths to positions or settings or in the replacement of ineffective leaders with more effective ones. However, research has suggested that leadership change—particularly at the school level—is also associated with negative outcomes for schools. A recent review of this research, which consists mostly of descriptive and correlational studies, highlighted negative associations between rates of principal mobility and attrition and various school and student outcomes (Snodgrass Rangel, 2018). Studies conducted in large urban districts, for example, found that a principal's departure from a school was associated with lower student achievement and higher teacher turnover, which was in turn associated with lower student achievement (see, for example, Ronfeldt et al., 2013). Furthermore, negative associations between principal turnover and student achievement were most pronounced in low-performing schools and in schools with high concentrations of new teachers and economically disadvantaged students (Béteille et al., 2011; Burkhauser et al., 2012).

Fewer studies have examined the association between district leader mobility and attrition and school outcomes, and those studies have tended to find inconsistent and weak associations. For example, a study of the association between mobility and attrition among superintendents in Texas and school achievement found initial negative associations, followed by positive long-term associations (Hill, 2005). A study using administrative data for two states found that superintendents accounted for a small fraction (0.3 percent) of the differences in student achievement and that superintendent longevity of tenure was not associated with student achievement (Chingos et al., 2014).

Because the research examining the association between school and district leader retention, mobility, and attrition and school and student outcomes has tended to be descriptive and correlational, it cannot establish causality. For example, an association between leadership change and reduced student achievement might reflect a direct negative effect of leadership change on achievement, or the reduction in student achievement might be explained by other factors such as challenges in recruiting or retaining effective teachers. In that case, a lack of effective teachers might contribute to both leadership change and low student achievement.

Other studies have focused on two types of costs associated with mobility and attrition among education leaders: the financial costs of replacing leaders, and the costs to progress resulting from leaders leaving their position before they fully implement improvement plans. A recent study of the costs associated with hiring high school principals in six South Carolina districts, for example, determined that the average cost of replacing a principal, including recruitment and training, was about $24,000 (Tran et al., 2018). Principals may need an average of five years to establish a vision, strengthen teaching staff, and fully implement policies and practices that improve school performance (Seashore Louis et al., 2010). Principal mobility and attrition may therefore compromise the extent to which education leaders are able to effect positive change.

Factors associated with school leader retention, mobility, and attrition

Building on the widely expressed belief that retaining effective principals can contribute to school success, researchers have sought to identify factors associated with principal retention, mobility, and attrition. A recent review of this literature based on findings from descriptive and correlational studies identified a range of factors associated with principal mobility and attrition (Snodgrass Rangel, 2018). The factors most consistently associated with principal mobility and attrition were school performance, school conditions (for example, frequency of disciplinary incidents and staff cohesiveness), certain student demographics (for example, race/ethnicity and special education status), accountability policies (for example, policies that introduce sanctions for low-performing schools), and principals' perceptions of challenges associated with hiring and firing teachers. The factors less consistently associated with principal mobility and attrition included principal characteristics (for example, race/ethnicity, experience, and education), school grade levels, school poverty levels, and school locale/urbanicity.

The need for local analyses of the retention, mobility, and attrition of school and district leaders

While a large body of research has focused on teacher retention, mobility, and attrition, less research has focused on school leaders, and even less on district leaders. Findings from the descriptive and correlational studies discussed above suggest that a range of negative consequences are potentially associated with school leader mobility and attrition. Those findings, combined with the financial costs and compromises to multiyear improvement processes associated with changes in school leadership, suggest that more attention to leader retention, mobility, and attrition is warranted.

While federally collected data provide a national-level picture of school leader retention, mobility, and attrition, region-specific and state-specific data are not consistently available. Findings indicating that factors influencing principal mobility and attrition vary by state suggest that information at the regional and state levels might help inform where best to direct resources to encourage leader retention. Furthermore, the finding that factors associated with principal retention, mobility, and attrition varied by the locale in which the research was conducted (Snodgrass Rangel, 2018) indicates the need for more localized analysis of these phenomena to guide policy decisions. For example, principal mobility rates were higher for urban districts in North Carolina but lower for urban districts in Utah.

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Appendix B. Data and methodology

The study used administrative data provided by state education agencies in Colorado, Missouri, and South Dakota. These data were supplemented with publicly available data from state education agency websites and data from the Elementary/Secondary Information System, which includes data from the Common Core of Data, a national data collection involving all states, districts, and schools (https://nces.ed.gov/ccd/elsi/).

Data acquisition

Formal requests for data were submitted to state education agencies in early 2019, and the agencies provided data between March and July 2019. State agencies provided de-identified data on educators that enabled linking them across years and to their schools and districts and that provided information about educator characteristics and assignments. Through close collaboration with agency staff during the first half of 2019, the study team acquired additional documentation and confirmed its understanding of the data provided. Data describing the rurality of districts and schools in 2015/16 and 2017/18 were downloaded from the Elementary/Secondary Information System in August 2019 (https://nces.ed.gov/ccd/elsi/). School-level rurality was stable from 2015/16 to 2017/18, with changes in designation in fewer than 3 percent of schools: 1.8 percent of schools changed from rural to nonrural and 0.3 percent changed from nonrural to rural (table B1).

Table B1. Percentage of schools and districts in Colorado, Missouri, and South Dakota that changed rurality designation from 2015/16 to 2017/18

Data element	Changes in rurality	
	Rural to nonrural	Nonrural to rural
Schools	1.8	0.3
Districts	0.7	1.0

Source: Authors' analysis of data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

Data elements

All state education agencies provided educator data based on agency-specific staff position codes for 2011/12 to 2018/19. Educator position codes were used to classify educators into four common position categories: school or district leaders, education specialists, teachers, or other. Because capacity to fulfill the data request within the specified timeline varied, some state education agencies provided data for a subset of requested years or a subset of requested data elements. State education agencies in Missouri and South Dakota provided data on district, school, position, and educator characteristics for all educators in their public school systems as of the beginning of each academic year, 2011/12 to 2018/19. Colorado data included the same information only for individuals who were designated as school or district leaders as of the beginning of each academic year, 2015/16 to 2018/19. Some state data files allowed for less disaggregation than others. For example, Colorado and South Dakota data files allowed for identification of principals and assistant principals in each year, whereas the Missouri data files allowed for identification of school leaders (a designation that included both principals and assistant principals) only for 2011/12 to 2014/15 (table B2). These data were used to calculate years as a school leader as well as years as a school leader in the same school.

Table B2. Availability of data on educator position codes in Colorado, Missouri, and South Dakota, by state and date range, 2011/12 to 2018/19

State	Data availability	
	2011/12 to 2014/15	2015/16 to 2018/19
Colorado	All educator position codes only for those with a school or district leader position in any year.	School and district leader position codes only for those with a school or district leader position in any year.
Missouri	School leader (no distinction between assistant principals and principals) and teacher position codes for those with any educator position in any year.	School or district leader and teacher position codes for those with any educator position in any year (for this time period, the distinction between assistant principals and principals was available).
South Dakota	All educator position codes for those with any educator position in any year.	All educator position codes for those with any educator position in any year.

Source: Authors' analysis of state education agency data from 2011/12 through 2018/19.

All data files included multiple records for each educator who was assigned to more than one district, school, or position. Information about the amount of time associated with each district, school, and position was also provided as full-time equivalency percentages. Information about education leader characteristics included birthdate, gender, race/ethnicity, highest education degree, and salary.

School and district data were also obtained from state education agencies and supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/). These data included information about school and district rurality, school and district enrollment, school grade span, school and district average annual teacher salary, schools identified by the state education agency as needing priority or comprehensive improvement support (a state accountability designation given to the lowest-performing schools based on a state's accountability system), percentage of students who scored proficient or better on the state English language arts assessment, percentage of racial/ethnic minority students, percentage of students eligible for the national school lunch program, and percentage of English learner students. Rural schools and districts were identified based on the National Center for Education Statistics locale framework (Geverdt, 2015), using 2010 Census data, including those in a Census-defined rural territory with a school locale code of 41 (rural fringe), 42 (rural distant), or 43 (rural remote). Schools and districts in other locales were designated as nonrural.

Data preparation

The study team took the following steps to prepare the data files for analysis for two separate samples. The one-year analysis sample identified school and district leaders as stayers, movers, or leavers from 2017/18 to 2018/19. The three-year analysis sample identified leaders as stayers, movers, or leavers from 2015/16 to 2018/19.

Step 1: Identifying school and district leaders in Missouri and South Dakota. The 2015/16 to 2018/19 data for Colorado included only school and district leaders. However, the Missouri and South Dakota datasets contained multiple records indicating that some educators had positions as a school or district leader, education specialist, teacher, or other educator position from 2011/12 to 2018/19. When these data listed multiple positions for an educator, the study team used full-time equivalency in each position to identify whether a majority of the educator's time was spent as a school or district leader. Primary positions were identified as those in which an educator spent the most time—positions with the highest total full-time equivalency. For educators who had multiple primary positions in which they spent equal amounts of time, the primary position was deemed to be indeterminate, and those educators were not identified as having a primary position. To ensure that educators served primarily in a leadership role, only educators with a total full-time equivalency percentage of 60 percent or higher as a school or district leader were considered eligible for the analytic sample across all states for each academic year. In the three-state analysis samples, fewer than 3 percent of school and district leaders were identified as being ineligible by the full-time equivalency criterion. In individual state samples, 1–9 percent of school and district leaders were identified as ineligible according to this criterion (table B3).

Table B3. Preliminary and analytic samples for descriptive analyses of school and district leader retention, mobility, and attrition in Colorado, Missouri, and South Dakota in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

Sample	2017/18 (one-year analyses: 2017/18 to 2018/19)				2015/16 (three-year analyses: 2015/16 to 2018/19)			
	Three states combined	Colorado[a]	Missouri	South Dakota	Three states combined	Colorado[a]	Missouri	South Dakota
Educators	—	—	75,669	11,369	—	—	74,628	11,385
Leaders (educators with a primary position of school or district leader)	8,715	3,897	4,213	605	8,367	3,680	4,093	594
Leaders with at least a .60 full-time equivalency and with primary school or district assignment[b]	8,468	3,885	4,020	563	8,125	3,671	3,912	542
Percent of all leaders	97.2	99.7	95.4	93.1	97.1	99.8	95.6	91.2
Leaders who could be identified as stayers, movers, or leavers (primary samples to address research questions 1 and 2)	7,994	3,704	3,779	511	7,661	3,518	3,658	485
Percent of all leaders	91.7	95.0	89.7	84.5	91.6	95.6	89.4	81.6
Leaders who could be identified according to subcategories of stayers, movers, or leavers with additional detail[c]	7,953	3,691	3,754	508	7,558	3,493	3,593	472
Percent of all leaders	91.3	94.7	89.1	84.0	90.3	94.9	87.8	79.5

— is not available.

a. Educator data files for Colorado included only educators who were designated as a school or district leader as of the beginning of each academic year from 2015/16 to 2018/19.

b. Included leaders for whom primary school assignment (for school leaders) or district assignment (for district leaders) could be identified in 2017/18 and 2018/19 (for one-year analyses) and in 2015/16 and 2018/19 (for three-year analyses). This group included stayers and movers as well as those for whom the primary school or district assignment could be identified in either 2015/16 or 2017/18 but for whom there were no records in 2018/19 (leavers).

c. Included school and district leaders for whom subcategories of stayers, movers, and leavers could be identified (for example, principal stayers who remained in a principal position or became an assistant principal).

Source: Authors' analysis of administrative data provided by the state education agencies.

Step 2: Identifying school and district leader characteristics. School and district leader characteristics were identified using data available as of fall 2017 for the one-year analyses and as of fall 2015 for the three-year analyses. A leader's age was calculated as of September 1, 2017, for the one-year analyses and September 1, 2015, for the three-year analyses, based on birthdates. Values for gender, race/ethnicity, and highest education degree variables were recoded to use a common set of categories across states.

Step 3: Determining school and district leaders' primary districts, schools, and leader types. Each education leader's beginning-of-year primary district, school, and leader type were identified using the same approach as that used to determine primary position (see step 1 above). Primary assignments to leader type were identified using only the assignment data associated with a leader's primary school for principals and assistant principals or primary district for superintendents and assistant superintendents.

Step 4: Calculating the number of years that principals had been a leader. For analyses examining factors associated with principal retention, mobility, and attrition, the number of years that a principal had been a school leader was calculated as of fall 2017 and as of fall 2015. The number of consecutive years that a principal had been a leader in the same school was also calculated as of fall 2017 and as of fall 2015. Because the number of years of available data varied by state, principals were categorized as having been a leader for fewer than four years or four or more years.

Step 5: Identifying school and district leaders as a stayer, mover, or leaver. School and district identifiers also provided the basis for identifying leaders as a stayer, mover, and leaver in both one-year analyses (from 2017/18

to 2018/19) and three-year analyses (from 2015/16 to 2018/19). For example, a school leader who had the same primary school identifier at the beginning of both the 2017/18 and 2018/19 academic years was considered a stayer in the one-year analyses. Similarly, a school leader who had the same primary school identifier at the beginning of both 2015/16 and 2018/19 was considered a stayer in the three-year analyses. An educator who remained a school leader for two consecutive years but had a different primary school identifier in 2017/18 and 2018/19 was considered a mover in the one-year analyses. An educator who was identified as a school leader in 2015/16, 2016/17, and 2017/18 and as another type of educator (district leader, teacher, education specialist, or other) at the beginning of the 2018/19 academic year or who was not in the state education system at that time was considered a leaver in the three-year analyses. Stayer, mover, or leaver status was indeterminant if a primary school was indeterminant for a school leader or if a primary district was indeterminant for a district leader in the baseline year (2015/16 for the one-year analyses and 2017/18 for the three-year analyses) or in 2018/19.

Step 6: Identifying characteristics of schools and districts. Characteristics of schools and districts were identified in 2017/18 for the one-year analyses and in 2015/16 for the three-year analyses. State education agencies provided school- and district-level data. Because some requested data elements were not available or were incomplete, these data were supplemented with publicly available data from state education agency websites and school- and district-level data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/). State education agency identifiers for schools and districts were linked to National Center for Education Statistics school and district identifiers to facilitate this process. Identifiers for each leader's primary school and district were used to link school and district data to educator-level records. When school and district data were unavailable for a particular year, data from the prior year were used to complete the dataset to the extent possible.

Samples

The total number of school and district leaders for the three states combined was 8,715 in the sample for the one-year analyses and 8,367 in the sample for the three-year analyses. For the three states combined and for both samples, 97 percent of leaders had at least a .60 full-time equivalency, and 92 percent had at least a .60 full-time equivalency as well as a primary school or district assignment. These leaders were eligible for inclusion in the descriptive analysis of stayers, movers, and leavers (see table B3).

The samples for regression analyses examining factors associated with principal retention, mobility, and attrition included eligible principals in Colorado, Missouri, and South Dakota whose primary school district and position could be identified in 2017/18 and 2018/19 (for one-year analyses) and in 2015/16 and 2018/19 (for three-year analyses). These analyses included only principals with complete explanatory and outcome data. The sample in the final three-state models included 97 percent of all principals in 2017/18 who had a primary school assignment, primary district assignment, and an administrator full-time equivalency of at least .60, and 88 percent of all principals in 2015/16 who had a primary school assignment, primary district assignment, and an administrator full-time equivalency of at least .60 (table B4).

Table B4. Analytic samples for analysis of factors associated with principal retention, mobility, and attrition in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

Sample	2017/18 (one-year analyses: 2017/18 to 2018/19)				2015/16 (three-year analyses: 2015/16 to 2018/19)			
	Three states combined	Colorado	Missouri	South Dakota	Three states combined	Colorado	Missouri	South Dakota
Principals eligible for inclusion in the analysis[a]								
Number	3,820	1,638	1,886	296	3,682	1,603	1,819	260
Principals with complete explanatory and outcome data for the final model (sample to address research question 3)								
Number	3,718	1,621	1,824	273	3,222	1,578	1,385	259
Percent	97.3	99.0	96.7	92.2	87.5	98.4	76.1	99.6

a. Includes principals who had at least a .60 full-time equivalency; who could be identified as a stayer, mover, or leaver; and for whom a primary school and district assignment could be identified in 2017/18 and 2018/19 (for one-year analyses) or in 2015/16 and 2018/19 (for three-year analyses).
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19, supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

The extent of missing data for individual, school, and district characteristics was assessed for all educators in 2017/18 (one-year analyses) and 2015/16 (three-year analyses) who had an identified primary position of principal; who were identified as a stayer, mover, or leaver; and who had a primary school and district assignment. Data on the characteristics of principals were missing for no more than 1 percent of principals. Missing data were more prevalent for school and district characteristics (table B5). No single characteristic was missing school or district data for more than 12 percent of principals. Only principals with complete explanatory and outcome data were included in the final model used to address research question 3.

Table B5. Missing data for principals eligible for inclusion in the analysis of factors associated with principal retention, mobility, and attrition in the one-year and three-year periods ending in 2017/18, by school and district characteristic (percent, unless otherwise indicated)

Data element	School characteristics		District characteristics	
	2017/18 (one-year analyses)	2015/16 (three-year analyses)	2017/18 (one-year analyses)	2015/16 (three-year analyses)
Number of principals eligible for inclusion in the analysis[a]	3,820	3,682	3,820	3,682
Percent of principals for whom data were missing				
Enrollment	1.0	0.3	1.9	0.0
Percent of racial/ethnic minority students	0.6	0.0	na	na
Percent of students eligible for the national school lunch program	0.6	0.4	1.6	0.8
Average teacher salary	0.6	0.1	0.6	0.0
Percent of English learner students	1.0	0.3	11.5	10.7
Rurality	0.6	0.0	0.6	0.0
Grade span	0.6	0.0	na	na
School state accountability designation/identified for improvement (focus/targeted or priority/comprehensive school)	0.6	0.0	na	na
Percent of students scoring proficient or better on the state English language arts assessment	na	na	1.6	1.5

na is not applicable and denotes data elements that were not included in analyses of factors associated with principal retention, mobility, and attrition (see the section in this appendix on analysis methods).
a. Includes principals who could be identified as a stayer, mover, or leaver and whose primary school and district assignment could be identified in 2017/18 and 2018/19 (for one-year analyses) and in 2015/16 and 2018/19 (for three-year analyses).
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19, supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

The characteristics of principals and their schools in the analytic samples overall and disaggregated by principals' classification as a stayer, mover, or leaver are shown in tables B6 and B7. In the one-year analyses 81 percent of principals were stayers, 6 percent were movers, and 13 percent were leavers. In the three-year analyses 55 percent of principals were stayers, 13 percent were movers, and 32 percent were leavers.

Table B6. Characteristics of principals in the analytic samples for the final models in the one-year and three-year periods ending in 2018/19, by stayer, mover, and leaver status (percent, unless otherwise indicated)

Characteristic	2017/18 (one-year analyses: 2017/18 to 2018/19)				2015/16 (three-year analyses: 2015/16 to 2018/19)			
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
Retention, mobility, and attrition (three states combined)	81.3	5.7	13.0	100.0	54.8	13.3	31.9	100.0
State								
Colorado	42.5	41.7	51.6	43.6	46.7	50.1	52.4	49.0
Missouri	50.2	49.8	41.4	49.1	45.1	41.0	40.2	43.0
South Dakota	7.3	8.5	7.0	7.3	8.2	8.9	7.4	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Age[a]								
Mean (years)	45.6	44.6	48.8	46.0	45.3	43.0	48.5	46.0
Younger than 40	20.7	29.4	16.4	20.6	22.4	35.2	17.2	22.5
40–44	29.3	26.1	18.2	27.7	30.0	28.4	19.6	26.4
45–51	26.3	21.8	21.9	25.5	26.0	22.8	19.4	23.5
52 or older	23.7	22.7	43.5	26.2	21.6	13.5	43.8	27.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Salary[a]								
Mean ($)	92,949	92,125	92,185	92,803	92,354	89,767	92,204	91,962
Less than $75,084	21.2	22.3	22.6	21.5	18.7	18.2	19.0	18.7
$75,085–$88,668	22.4	18.5	21.7	22.1	26.7	28.4	25.9	26.7
$88,669–$105,999	29.9	33.2	27.7	29.8	30.5	37.3	30.1	31.3
$106,000 or higher	26.4	26.1	28.0	26.6	24.1	16.1	25.0	23.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gender								
Male	43.9	51.7	46.2	44.7	43.7	49.9	42.2	44.0
Female	56.1	48.3	53.8	55.3	56.3	50.1	57.8	56.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Race/ethnicity								
Racial/ethnic minority	11.2	16.1	16.4	12.1	10.4	18.2	15.5	13.0
White	88.8	83.9	83.6	87.9	89.6	81.8	84.5	87.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: n = 3,718 principals for the one-year analyses and 3,222 principals for the three-year analyses. Principal characteristics were reported as of 2015/16 and 2017/18. Data elements described here were used in the final multinomial regression models. For continuous variables in which quartiles were used (age and salary), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.
a. Categories were created using quartiles as of 2017/18, based on the sample used for the one-year analyses, meaning that approximately 25 percent of leaders across the three states combined fell within each category.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19, supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

Table B7. School and district characteristics in the analytic samples for the final models in the one-year and three-year periods ending in 2018/19, by stayer, mover, and leaver status (percent, unless otherwise indicated)

Characteristic	2017/18 (one-year analyses: 2017/18 to 2018/19)				2015/16 (three-year analyses: 2015/16 to 2018/19)			
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
School enrollment[a]								
Mean (number of students)	508	461	489	503	541	506	527	532
Fewer than 154 students	8.6	12.4	11.9	9.2	5.5	6.3	8.4	6.5
154–331 students	27.7	24.3	26.7	27.4	24.0	22.1	23.4	23.6
332–507 students	31.0	32.4	28.5	30.7	33.8	32.9	31.2	32.8
508 or more students	32.8	31.0	32.9	32.7	36.7	38.7	37.1	37.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
School percentage of racial/ethnic minority students[a]								
Mean	32.8	39.1	40.5	34.1	33.4	42.1	40.1	36.7
Less than 5.8 percent	18.3	18.5	17.2	18.2	11.5	12.4	11.8	11.7
5.8–19.7 percent	25.6	19.0	18.2	24.3	29.9	20.3	23.9	26.7
19.8–46.7 percent	29.6	23.7	28.2	29.1	32.4	28.2	29.4	30.9
46.8 percent or higher	26.5	38.9	36.4	28.5	26.2	39.2	35.0	30.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
School average teacher salary[a]								
Mean ($)	49,212	49,606	47,722	49,041	48,877	48,518	47,067	48,252
Less than $39,139	13.4	17.5	18.8	14.4	13.4	16.1	18.9	15.5
$39,139–$45,953	26.3	20.9	27.1	26.1	26.4	24.7	27.5	26.5
$45,954–$53,589	29.3	29.9	30.2	29.5	31.6	32.2	30.5	31.3
$53,590 or higher	31.0	31.8	23.8	30.1	28.6	27.0	23.2	26.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
School grade span								
Elementary school	28.0	30.8	23.4	27.6	31.1	31.0	24.2	28.9
Middle school	13.6	17.1	13.9	13.8	14.1	14.2	16.3	14.8
High school	17.0	17.5	19.9	17.4	17.1	13.3	21.2	17.9
Other	41.3	34.6	42.9	41.2	37.7	41.5	38.3	38.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
School state accountability designation/identified for improvement								
Priority/comprehensive school supports	3.1	8.5	4.6	3.6	1.4	6.1	3.5	2.7
No priority/comprehensive school supports	96.9	91.5	95.4	96.4	98.6	93.9	96.5	97.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
District enrollment[a]								
Mean (number of students)	18,717	20,428	22,280	19,275	19,839	24,247	22,555	21,292
Fewer than 220 students	2.1	2.5	2.9	2.2	0.7	0.2	1.8	1.0
220–479 students	7.3	7.8	9.2	7.6	3.7	4.4	4.3	4.0
480–1,339 students	14.4	16.7	13.8	14.4	10.9	10.3	14.0	11.8
1,340 or more students	76.2	73.0	74.0	75.7	84.7	85.1	79.9	83.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
District percentage of students eligible for the national school lunch program[a]								
Mean	44.7	48.7	50.6	45.7	42.8	47.1	49.1	45.4
Less than 29.0 percent	24.6	17.1	16.4	23.1	26.7	21.4	18.1	23.3
29.0–47.7 percent	31.9	28.9	28.2	31.3	29.8	27.3	26.8	28.5
47.8–63.0 percent	16.8	22.7	18.0	17.3	20.3	22.4	21.7	21.0
63.1 percent or higher	26.7	31.3	37.5	28.3	23.2	28.9	33.4	27.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
District percentage of English learner students[a]								
Mean	8.8	10.9	12.3	9.4	8.0	10.3	10.7	9.1
Less than 0.54 percent	18.8	21.0	19.6	19.0	12.4	14.0	10.8	12.1
0.54–1.82 percent	23.9	18.6	20.8	23.2	16.3	12.4	14.8	15.3
1.83–6.35 percent	29.9	26.7	25.4	29.2	30.2	21.9	25.5	27.6
6.36 percent or higher	27.4	33.8	34.2	28.6	41.1	51.7	48.9	45.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Characteristic	2017/18 (one-year analyses: 2017/18 to 2018/19)				2015/16 (three-year analyses: 2015/16 to 2018/19)			
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
District academic performance (percentage of students scoring proficient or better on the state English language arts assessment)[a]								
Mean	47.5	44.2	43.4	46.8	52.2	47.5	47.3	50.0
Less than 39.1 percent	20.7	31.8	32.5	22.8	27.3	36.8	37.9	31.9
39.1–47.0 percent	25.2	24.2	27.1	25.4	11.4	12.4	13.9	12.4
47.1–55.0 percent	28.7	28.4	26.3	28.4	17.0	18.9	14.9	16.6
55.1 percent or higher	25.4	15.6	14.1	23.4	44.3	31.9	33.3	39.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: *n* = 3,718 principals for the one-year analyses and 3,222 principals for the three-year analyses. School characteristics were reported as of 2015/16 and 2017/18. Data elements in this table were used in multinomial logistic regression models. For continuous variables in which quartiles were used (school enrollment, school percentage of racial/ethnic minority students, school average teacher salary, district enrollment, district percentage of students eligible for the national school lunch program, district percentage of English learner students, and district academic performance), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.

a. Categories were created using quartiles, meaning that approximately 25 percent of leaders across the three states combined fell within each category.

Source: Authors' analysis of state education agency data from 2015/16 through 2018/19, supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

Analysis methods

The study team analyzed the combined and state-specific data for Colorado, Missouri, and South Dakota using IBM SPSS Statistics software, version 24.0. Rates of school and district leader retention, mobility, and attrition were calculated to examine the percentages of leaders who remained in a leadership position in the same school or district; who transferred to a leadership position in a different school or district; and who moved from a school leadership position to a district leadership position or vice versa, took a nonleadership position, or left the state public school system. Data for 2017/18 and 2018/19 were used for one-year analyses, and data for 2015/16 and 2018/19 were used for three-year analyses. Separate analyses were conducted for each of four leader types: principals, assistant principals, superintendents, and assistant superintendents. Percentages of stayers, movers, and leavers for the one-year analyses were calculated by dividing the number of leaders in each group in fall 2018 by the total number of leaders in fall 2017. Percentages of stayers, movers, and leavers for three-year analyses were calculated by dividing the number of leaders in each group in fall 2018 by the total number of leaders in fall 2015. Percentages were disaggregated by state.

Multinomial logistic regression models were conducted to identify which characteristics of principals, schools, and districts were associated with principal mobility and attrition. The dependent variable included three categories: stayers, movers, and leavers. Explanatory variables included principal, school, and district characteristics. Multinomial logistic regression, which uses maximum likelihood estimation, was selected because of its ability to incorporate multiple types of employment status change as the dependent variable in a single model. This approach enabled examination of characteristics associated with mobility and attrition for all principals, yielding easily interpretable coefficients (relative risk ratios) that represent the likelihood of being in one of two focal categories (movers or leavers) relative to a reference category (stayers).

Sample characteristics and model assumptions were examined before building the model and identifying the final model. Preliminary associations between explanatory variables and principal retention, mobility, and attrition were examined using descriptive statistics. Correlations were calculated among continuous explanatory variables, and cross-tabulations were calculated among categorical explanatory variables. Variables with a correlation greater than .90 were flagged for closer examination. Multicollinearity diagnostics were used to ensure that only data elements with limited multicollinearity were included in the models, thus improving the precision of coefficient estimates. Diagnostics were conducted using linear regression models, with all characteristics of interest included as independent variables and principals' stayer, mover, or leaver status included as dependent variables. Characteristics with a variance inflation factor of 10.0 or greater were excluded.

As expected, some school characteristics and district characteristics were closely aligned. For example, the racial/ethnic composition of a school often reflected that of its district. In these cases district elements were not included in any model and were excluded from the findings presented in the main report. In other words, the study prioritized school characteristics when school and district characteristics were highly correlated. For school performance or for district performance (percentage of students in the district scoring proficient or better on the state English language arts assessment), district-level data were included in the model and school-level data were excluded. Colorado did not administer a state assessment in high schools during 2017/18, and including school-level values would have required excluding all high schools in Colorado for complete case analysis.

To aid interpretability and understanding of the shape of the association between continuous variables and relative risk ratios, quartiles were calculated for the continuous variables (principal age, principal salary, school and district enrollment, school percentage of racial/ethnic minority students, school and district percentage of students eligible for the national school lunch program, school and district average teacher salary, school and district percentage of English learner students, and district percentage of students scoring proficient or better on the state English language arts assessment).

Explanatory variables were introduced into models hierarchically. First, all principal characteristics were introduced into the model and tested against a null, or empty, model (described below). Then, principal characteristics that were not significantly associated with the outcome at a liberal threshold of $p < .10$ were removed. Next, school characteristics were added to the model and tested against a null model and the model with principal characteristics only. School characteristics that were not associated with the outcome at $p < .10$ were removed. Finally, district characteristics were added to the model, and district characteristics that were not associated with the outcome at $p < .10$ were removed. This model was also tested against a null model and the model with principal and school characteristics. Finally, stringent thresholds were tested, removing characteristics that were not associated with the outcome at $p < .05$. That model had the best fit relative to all other models and was thus retained as the final, parsimonious model. Explanatory variables included in each model are listed in table B8.

Model fit criteria were examined against a null, or empty, model and in nested models. Chi-square tests for likelihood ratio tests were used. Chi-square coefficients for the significant likelihood ratio tests indicated that the model with characteristics was a better fit than a null model. The nested models were considered to be improved if the deviance decreased and if McFadden's pseudo-R^2 increased, suggesting improved explanatory value of the model. All models controlled for state.

The main report presents findings for the three associations with the largest absolute value of the relative risk ratios in the final three-state model for movers and leavers for the one-year and three-year analyses. The reported coefficients are exponentiated log odds ratios generated by the statistical program and can be interpreted as the relative risk ratio. For a description of how to interpret relative risk ratios, see appendix D. Among continuous variables that were categorized into quartiles, the variable was described as one that was most strongly associated if at least one quartile group was significantly associated with the outcome. Only the categories for which significant differences were found appear in tables 1 and 2 in the main report.

Table B8. Data elements included in hierarchical multinomial logistic regression models for principals in the one-year and three-year periods ending in 2018/19

Data element	All principal, school, and district characteristics considered	One-year period (2017/18 to 2018/19)		Three-year period (2015/16 to 2018/19)	
		Trimmed model (cutoff $p < .10$)	Final trimmed model (cutoff $p < .05$)	Trimmed model (cutoff $p < .10$)	Final trimmed model (cutoff $p < .05$)[b]
Principal characteristic					
State	x	x	x	x	x
Age[a]	x	x	x	x	x
Salary[a]	x			x	x
Gender	x	x	x	x	x
Racial/ethnic minority	x	x		x	x
Master's degree or higher	x				
Years as a leader in the same school	x				
Years as a school leader	x				
School characteristic					
Enrollment[a]	x			x	x
Percentage of racial/ethnic minority students[a]	x	x	x		
Percentage of students eligible for the national school lunch program[a]	x				
Average teacher salary[a]	x	x	x	x	x
Percentage of English learner students[a]	x				
Rurality	x				
Grade span	x			x	x
State accountability designation (focus/targeted or priority/comprehensive school)	x	x		x (priority/ comprehensive only)	x (priority/ comprehensive only)
District characteristic					
Enrollment[a]	x	x		x	x
Percentage of students eligible for the national school lunch program[a]	x	x	x	x	x
Average teacher salary[a]	x				
Percentage of English learner students[a]	x			x	x
Percentage of students scoring proficient or better on the state English language arts assessment[a]	x	x	x	x	x
Rurality	x				

Note: Blank cells indicate that a data element was not examined in the specified model.

a. Continuous variables were transformed into quartiles, meaning that approximately 25 percent of principals across the three states combined fell within each variable category.

b. The final trimmed model for the three-year period was the same as the trimmed model (all variables in the trimmed model were significant).

Source: Authors' analysis of state education agency data from 2015/16 through 2018/19, supplemented with data from the Elementary/Secondary Information System (https://nces.ed.gov/ccd/elsi/).

Reference

Geverdt, D. E. (2015). *Education Demographic and Geographic Estimates Program (EDGE): Locale boundaries user's manual* (NCES No. 2016-012). National Center for Education Statistics Working Paper. U.S. Department of Education. https://eric.ed.gov/?id=ED577162.

Appendix C. Additional descriptive analysis results

This appendix presents the data used to create figures 1–3 in the main report, along with further disaggregation of school and district leader retention, mobility, and attrition rates by state and by position changes within categories of stayers, movers, and leavers. Counts and percentages of school leaders who were stayers, movers, and leavers in each time period are presented first (tables C1 and C2). Next, detailed information is provided about position changes within categories of school leader stayers, movers, and leavers (tables C3–C5). Counts and percentages of district leader stayers, movers, and leavers in each time period are presented next (tables C6 and C7). Subcategories of movers are not presented because all district leader movers changed districts. The final tables present detailed information about position changes within categories of district leader stayers and leavers (tables C8 and C9).

Table C1. Percentage of principal stayers, movers, and leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

State	One-year period (2017/18 to 2018/19)				Three-year period (2015/16 to 2018/19)			
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
Three states combined	79.9	6.1	14.0	100.0	53.7	13.1	33.3	100.0
Colorado	78.2	5.4	16.4	100.0	51.4	13.5	35.1	100.0
Missouri	82.3	5.7	11.9	100.0	56.1	12.4	31.5	100.0
South Dakota	73.5	12.9	13.6	100.0	50.5	15.0	34.5	100.0

Note: *n* = 3,865 principals (1,654 in Colorado, 1,909 in Missouri, and 302 in South Dakota) for the one-year analyses and 3,774 principals (1,631 in Colorado, 1,856 in Missouri, and 287 in South Dakota) for the three year analyses. Percentages may not sum to 100 because of rounding. The sample included all principals whose primary school and district assignments could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C2. Percentage of assistant principal stayers, movers, and leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

State	One-year period (2017/18 to 2018/19)				Three-year period (2015/16 to 2018/19)			
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
Three states combined	76.9	11.7	11.4	100.0	50.6	24.3	25.1	100.0
Colorado	73.5	13.1	13.3	100.0	45.5	26.2	28.3	100.0
Missouri	80.8	10.3	9.0	100.0	55.6	22.9	21.5	100.0
South Dakota	85.1	4.6	10.3	100.0	71.1	12.0	16.9	100.0

Note: *n* = 2,783 assistant principals (1,546 in Colorado, 1,150 in Missouri, and 87 in South Dakota) for the one-year analyses and 2,578 assistant principals (1,399 in Colorado, 1,096 in Missouri, and 83 in South Dakota) for the three year analyses. Percentages may not sum to 100 because of rounding. The sample included all assistant principals whose primary school and district assignments could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C3. Detailed information about principals and assistant principals who were stayers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

	One-year period (2017/18 to 2018/19)				Three-year period (2015/16 to 2018/19)			
	Principal stayers		Assistant principal stayers		Principal stayers		Assistant principal stayers	
State and statistic	Remained principal	Became assistant principal	Remained assistant principal	Became principal	Remained principal	Became assistant principal	Remained assistant principal	Became principal
Three states combined								
Number	3,080	7	2,032	108	2,013	12	1,094	211
Percent	99.8	0.2	95.0	5.0	99.4	0.6	83.8	16.2
Colorado								
Number	1,289	4	1,069	68	833	5	523	114
Percent	99.7	0.3	94.0	6.0	99.4	0.6	82.1	17.9
Missouri								
Number	1,569	3	891	38	1,035	7	524	85
Percent	99.8	0.2	95.9	4.1	99.3	0.7	86.0	14.0
South Dakota								
Number	222	0	72	2	145	0	47	12
Percent	100.0	0.0	97.3	2.7	100.0	0.0	79.7	20.3

Note: Percentages may not sum to 100 because of rounding. The sample included all principals and assistant principals whose primary school and district assignments could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C4. Detailed information about principals and assistant principals who were movers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

	One-year period (2017/18 to 2018/19)				Three-year period (2015/16 to 2018/19)			
	Principal movers		Assistant principal movers		Principal movers		Assistant principal movers	
State and statistic	Same district	Different district	Same district	Different district	Same district	Different district	Same district	Different district
Three states combined								
Number	123	114	234	91	224	269	399	228
Percent	51.9	48.1	72.0	28.0	45.4	54.6	63.6	36.4
Colorado								
Number	48	41	145	58	117	103	235	131
Percent	53.9	46.1	71.4	28.6	53.2	46.8	64.2	35.8
Missouri								
Number	48	61	86	32	83	147	155	96
Percent	44.0	56.0	72.9	27.1	36.1	63.9	61.8	38.2
South Dakota								
Number	27	12	3	1	24	19	9	1
Percent	69.2	30.8	75.0	25.0	55.8	44.2	90.0	10.0

Note: Percentages may not sum to 100 because of rounding. The sample included all principals and assistant principals whose primary school and district assignments could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C5. Detailed information about principals and assistant principals who were leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

| State and statistic | One-year period (2017/18 to 2018/19) | | | | | | Three-year period (2015/16 to 2018/19) | | | | | |
| | Principal leavers | | | Assistant principal leavers | | | Principal leavers | | | Assistant principal leavers | | |
	To school non-leader position	To district position	Left the state public school system	To school non-leader position	To district position	Left the state public school system	To school non-leader position	To district position	Left the state public school system	To school non-leader position	To district position	Left the state public school system
Three states combined												
Number	33	70	438	27	4	287	82	183	991	55	13	578
Percent	6.1	12.9	81.0	8.5	1.3	90.3	6.5	14.6	78.9	8.5	2.0	89.5
Colorado												
Number	—	—	—	—	—	—	—	—	—	—	—	—
Percent	—	—	—	—	—	—	—	—	—	—	—	—
Missouri												
Number	30	34	164	26	2	75	80	116	388	52	9	175
Percent	13.2	14.9	71.9	25.2	1.9	72.8	13.7	19.9	66.4	22.0	3.8	74.2
South Dakota												
Number	3	7	31	1	0	8	2	19	78	3	1	10
Percent	7.3	17.1	75.6	11.1	0.0	88.9	2.0	19.2	78.8	21.4	7.1	71.4

— is not available because educator data files for Colorado included only educators who were designated as a school or district leader as of the beginning of each academic year from 2015/16 to 2018/19.
Note: Percentages may not sum to 100 because of rounding. The sample included all principals and assistant principals whose primary school and district assignments could be identified. Colorado educators in nonleadership positions could not be identified in 2018/19.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C6. Percentages of superintendent stayers, movers, and leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

| State | One-year period (2017/18 to 2018/19) | | | | Three-year period (2015/16 to 2018/19) | | | |
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
Three states combined	82.3	3.0	14.7	100.0	56.1	10.4	33.5	100.0
Colorado	74.7	4.2	21.1	100.0	52.1	9.5	38.5	100.0
Missouri	84.3	2.8	12.9	100.0	56.9	10.6	32.5	100.0
South Dakota	84.7	2.5	12.7	100.0	59.1	10.9	30.0	100.0

Note: *n* = 756 superintendents (166 in Colorado, 472 in Missouri, and 118 in South Dakota) for the one-year analyses and 741 superintendents (169 in Colorado, 462 in Missouri, and 110 in South Dakota) for the three-year analyses. Percentages may not sum to 100 because of rounding. The sample included all superintendents whose primary district assignment could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C7. Percentages of assistant superintendent stayers, movers, and leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

| State | One-year period (2017/18 to 2018/19) | | | | Three-year period (2015/16 to 2018/19) | | | |
	Stayers	Movers	Leavers	Total	Stayers	Movers	Leavers	Total
Three states combined	78.5	3.1	18.5	100.0	55.3	4.6	40.1	100.0
Colorado	74.0	1.8	24.3	100.0	51.4	2.8	45.8	100.0
Missouri	84.7	4.8	10.5	100.0	61.5	6.6	32.0	100.0
South Dakota	75.0	0.0	25.0	100.0	0.0	20.0	80.0	100.0

Note: *n* = 590 assistant superintendents (338 in Colorado, 248 in Missouri, and 4 in South Dakota) for the one-year analyses and 568 assistant superintendents (319 in Colorado, 244 in Missouri, and 5 in South Dakota) for the three-year analyses. Percentages may not sum to 100 because of rounding. The sample included all assistant superintendents whose primary district assignment could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C8. Detailed information about superintendents and assistant superintendents who were stayers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

| State and statistic | One-year period (2017/18 to 2018/19) | | | | Three-year period (2015/16 to 2018/19) | | | |
| | Superintendent stayers | | Assistant superintendent stayers | | Superintendent stayers | | Assistant superintendent stayers | |
	Remained superintendent	Became assistant superintendent	Remained assistant superintendent	Became superintendent	Remained superintendent	Became assistant superintendent	Remained assistant superintendent	Became superintendent
Three states combined								
Number	619	3	452	11	414	2	293	21
Percent	99.5	0.5	97.6	2.4	99.5	0.5	93.3	6.7
Colorado								
Number	124	0	246	4	88	0	159	5
Percent	100.0	0.0	98.4	1.6	100.0	0.0	97.0	3.0
Missouri								
Number	395	3	203	7	261	2	134	16
Percent	99.2	0.8	96.7	3.3	99.2	0.8	89.3	10.7
South Dakota								
Number	100	0	3	0	65	0	0	0
Percent	100.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0

Note: Percentages may not sum to 100 because of rounding. The sample included all superintendents and assistant superintendents whose primary district assignment could be identified.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table C9. Detailed information about superintendents and assistant superintendents who were leavers in the one-year and three-year periods ending in 2018/19, by three states combined and individual states

| State and statistic | One-year period (2017/18 to 2018/19) | | | | | | Three-year period (2015/16 to 2018/19) | | | | | |
| | Superintendent leavers | | | Assistant superintendent leavers | | | Superintendent leavers | | | Assistant superintendent leavers | | |
	To school position, same district	To school position, different district	Left the state public school system	To school position, same district	To school position, different district	Left the state public school system	To school position, same district	To school position, different district	Left the state public school system	To school position, same district	To school position, different district	Left the state public school system
Three states combined												
Number	10	5	96	6	10	98	0	15	233	8	7	213
Percent	9.0	4.6	86.5	5.5	9.0	89.9	0.0	6.0	94.0	3.5	3.1	93.4
Colorado												
Number	—	—	—	—	—	—	—	—	—	—	—	—
Percent	—	—	—	—	—	—	—	—	—	—	—	—
Missouri												
Number	6	0	53	2	6	24	0	8	142	1	3	74
Percent	9.8	0.0	86.9	7.7	9.8	92.3	0.0	5.3	94.7	1.3	3.8	94.9
South Dakota												
Number	2	0	10	0	2	1	0	4	29	2	0	2
Percent	13.3	0.0	66.7	0.0	13.3	100.0	0.0	12.1	87.9	50.0	0.0	50.0

— is not available because educator data files for Colorado included only educators who were designated as a school or district leader as of the beginning of each academic year from 2015/16 to 2018/19.
Note: Percentages may not sum to 100 because of rounding. The sample included all superintendents and assistant superintendents whose primary district assignment could be identified. Colorado educators in nonleadership positions could not be identified in 2018/19.
Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Appendix D. Results from multinomial logistic regression models

This appendix presents results from the final three-state multinomial logistic regression analysis models. The final models produced relative risk ratios. Guidance on interpreting relative risk ratios is presented first. Then, relative risk ratios and coefficient significance are presented for the risk of moving rather than staying and the risk of leaving rather than staying for principals in the three-state combined models (examining one-year and three-year retention, mobility, and attrition). Principal and school characteristics are presented separately.

Guidance for interpreting relative risk ratios

This section provides information about how to interpret the relative risk ratios that were produced by the analytic models and reported throughout the findings. For the analyses in this study relative risk ratios demonstrate the likelihood that principals with a particular characteristic would be movers rather than stayers or leavers rather than stayers compared with principals without that characteristic, after all other explanatory variables in the model are controlled for. For example, the analytic model tests whether gender is associated with principal mobility and attrition and presents a relative risk ratio showing the extent to which being male is associated with being a mover or being a leaver above and beyond the associations accounted for by all other factors in the model. The relative risk is presented relative to the risk of being a stayer.

A value of 1 indicates that the explanatory variable is not associated with a difference in likelihood of principals being movers or leavers. A value greater than 1 indicates that the explanatory variable is associated with increased likelihood of principals being movers or leavers, while a value of less than 1 indicates that an explanatory variable is associated with a decreased likelihood. For each principal characteristic examined, a reference group is used as a basis for describing relative risk, allowing more interpretable relative risk ratios. For example, female is the reference group for gender for comparisons of male and female principals (see example 1 below). Two examples from the analysis results are provided below: one to demonstrate the interpretation of a relative risk ratio when an explanatory variable has two categories (for example, gender) and one to demonstrate the interpretation of a relative risk ratio when an explanatory variable has more than two categories (for example, age quartiles).

Example 1. Results show the association between gender and the likelihood of moving rather than staying and leaving rather than staying (table D1). For movers relative to stayers from 2017/18 to 2018/19, the relative risk ratio of 1.387 indicates that male principals were 38.7 percent $[(1.387 - 1.0) \times 100]$ more likely to be a mover than were female principals, with all other variables held constant. For leavers relative to stayers, the relative risk ratio of 1.247 indicates that male principals were 24.7 percent $[(1.247 - 1.0) \times 100]$ more likely to be a leaver than were female principals, with all other variables held constant.

Example 2. Results show the association between age and the likelihood of moving rather than staying and leaving rather than staying (see table D1). Principal age was categorized into quartiles to aid the interpretability of coefficients. The quartiles were younger than age 40, ages 40–44, ages 45–51, and age 52 or older. The reference group for describing relative risk was the oldest group (age 52 or older). All other age groups were compared with the reference group. For the likelihood that principals would be movers and not stayers from 2015/16 to 2018/19, principals younger than age 40 had a relative risk ratio of 2.441, indicating that they were 144.1 percent $[(2.441 - 1.0) \times 100]$ more likely to be a mover than were principals age 52 or older. In contrast, for the likelihood that principals would be leavers and not stayers from 2015/16 to 2018/19, principals younger than age 40 had a relative risk ratio of 0.386, indicating that they were 61.4 percent $[-(0.386 - 1.0) \times 100]$ less likely to be a leaver than were principals age 52 or older.

Results from multinomial logistic regression models for Colorado, Missouri, and South Dakota combined

Table D1. Principal characteristics associated with the likelihood of moving and leaving rather than staying in the one-year and three-year periods ending in 2018/19

Characteristic	One-year period (2017/18 to 2018/19)		Three-year period (2015/16 to 2018/19)	
	Risk of moving rather than staying	Risk of leaving rather than staying	Risk of moving rather than staying	Risk of leaving rather than staying
State				
Colorado	0.469	1.067	0.785	1.348
Missouri	0.611	0.784	1.031	1.242
South Dakota	na	na	na	na
Age[a]				
Younger than 40	1.442	0.396***	2.441***	0.386***
40–44	0.912	0.346***	1.488*	0.338***
45–51	0.861	0.466***	1.421	0.369***
52 or older	na	na	na	na
Salary[a]				
Less than $75,084	—	—	0.995	0.598*
$75,085–$88,668	—	—	1.401	0.811
$88,669–$105,999	—	—	1.447*	0.882
$106,000 or higher	—	—	na	na
Gender				
Male	1.387*	1.247*	1.366**	0.928
Race/ethnicity				
Racial/ethnic minority	—	—	1.533*	1.279

* Significant at $p = .05$; ** significant at $p = .01$; *** significant at $p = .001$.

— indicates that the data element was not included in the final model either because it did not significantly relate to the likelihood that principals were stayers, movers, or leavers or because it did not improve the model fit. Analyses are described in appendix B.

na is not applicable because this was the reference group.

Note: $n = 3,718$ principals for the one-year analyses and 3,222 principals for the three-year analyses. These analyses controlled for state. School-level characteristics were entered in the same models, and results for those characteristics are presented in table C2 in appendix C. This table does not list reference groups for the following dichotomous principal characteristic categories: male or female and racial/ethnic minority or White. The one-year model was an improvement over the null model, –2 log likelihood = 2,638.97, $p < .001$, as was the three-year model, –2 log likelihood = 5,341.67, $p < .001$.

a. Categories were created using quartiles based on the sample of principals, schools, or districts in 2017/18.

Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.

Table D2. School and district characteristics related to the likelihood of principals moving and leaving rather than staying in the one-year and three-year periods ending in 2018/19

Characteristic	One-year period (2017/18-2018/19)		Three-year period (2015/16 to 2018/19)	
	Risk of moving rather than staying	Risk of leaving rather than staying	Risk of moving rather than staying	Risk of leaving rather than staying
School enrollment[a]				
Fewer than 154 students	—	—	1.008	1.042
154–331 students	—	—	0.636**	0.746*
332–507 students	—	—	0.764	0.912
508 or more students	—	—	na	na
School percentage of racial/ethnic minority students[a]				
Less than 5.8 percent	0.633	1.045	—	—
5.8–19.7 percent	0.530*	0.817	—	—
19.8–46.7 percent	0.592*	0.942	—	—
46.8 percent or higher	na	na	—	—
School average teacher salary [a]				
Less than $39,139	0.930	1.800***	1.309	2.383***
$39,139–$45,953	0.566*	1.317	0.846	1.541**
$45,954–$53,589	0.751	1.247	0.901	1.185
$53,590 or more	na	na	na	na
School grade span				
Elementary school	—	—	na	na
Middle school	—	—	0.920	1.575**
High school	—	—	0.668*	1.528**
Other	—	—	1.170	1.387**
School state accountability designation/identified for improvement				
Priority/comprehensive school supports	—	—	2.971**	1.891*
District enrollment[a]				
Fewer than 220 students	—	—	0.228	2.219
220–479 students	—	—	1.128	1.197
480–1,338 students	—	—	1.036	1.541**
1,339 or more students	—	—	na	na
District percentage of students eligible for the national school lunch program[a]				
Less than 29.0 percent	1.004	0.622*	1.220	0.595**
29.0–47.7 percent	1.345	0.734	1.124	0.760
47.8–63.0 percent	1.862**	0.830	1.578*	0.929
63.1 percent or higher	na	na	na	na
District percentage of English learner students[a]				
Less than 0.54 percent	—	—	1.190	0.846
0.54–1.82 percent	—	—	0.704	1.018
1.83–6.35 percent	—	—	0.658*	0.909
6.36 percent or higher	—	—	na	na
District academic performance (percentage of students scoring proficient or better on the state English language arts assessment)[a]				
Less than 39.1 percent	2.109*	1.642*	1.997**	1.268
39.1–47.0 percent	1.405	1.268	1.761*	1.394
47.1–55.0 percent	1.463	1.346	1.736**	1.107
55.1 percent or higher	na	na	na	na

* Significant at p = .05; ** significant at p = .01; *** significant at p = .001.

— indicates that data element was not included in the final model either because it did not significantly relate to the likelihood that principals were stayers, movers, or leavers or because it did not improve the model fit. Analyses are described in appendix B.

na is not applicable because this is the reference group.

Note: n = 3,718 principals for the one-year analyses and 3,222 principals for the three-year analyses. These analyses controlled for state. School-level characteristics were entered in the same models, and results for those characteristics are presented in table C2 in appendix C. This table does not list reference groups for the following dichotomous school characteristic category: schools identified for priority improvement support versus those not identified for priority improvement support. The one-year model was an improvement over the null model, −2 log likelihood = 2,638.97, p < .001, as was the three-year model, −2 log likelihood = 5,341.67, p < .001.

a. Categories were created using quartiles based on the sample of principals, schools, or districts in 2017/18.

Source: Authors' analysis of state education agency data from 2015/16 through 2018/19.