Making Connections

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Factors related to teacher mobility and attrition in Colorado, Missouri, and South Dakota

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Key findings

In Colorado, Missouri, and South Dakota between 2015/16 and 2016/17:

- Teachers who moved to different schools (movers) were more likely than those who stayed (stayers) to be a special education teacher, to have been teaching in the same school for fewer years, or to be younger.
- Movers were more likely than stayers to be in a school with a low accountability rating or one that paid a lower average teacher salary.
- Teachers who left the state public school system or took a nonteaching position (leavers) were more likely than stayers to be older, to work less than half time, to have been teaching in the same district for fewer years, or to earn a lower salary.
- Leavers were more likely than stayers to be in a school that had a low accountability rating, paid a lower average teacher salary, or had a higher proportion of racial/ethnic minority students.

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This report is available on the Regional Educational Laboratory website at http://ies.ed.gov/ncee/edlabs.

Summary

This study responds to the shared concerns expressed by Educator Pipeline Research Alliance members from Colorado, Missouri, and South Dakota about teacher shortages, particularly in rural settings, and their interest in better understanding the factors that contribute to teacher mobility and attrition. The study used administrative data provided by the state education agencies in the three states to address the following research question:

- From 2015/16 to 2016/17, to what extent were characteristics of teachers, schools, and districts in Colorado, Missouri, and South Dakota related to the likelihood of teachers moving to a different school and taking a nonteaching position or leaving the state public school system altogether?

The study found that:

- Teachers who moved to different schools (movers) were more likely than those who stayed (stayers) to be a special education teacher, to have been teaching in the same school for fewer years, or to be younger.
- Movers were more likely than stayers to be in a school with a low accountability rating or one that paid a lower average teacher salary.
- Teachers who left the state public school system or took a nonteaching position (leavers) were more likely than stayers to be older, to work less than half time, to have been teaching in the same district for fewer years, or to earn a lower salary.
- Leavers were more likely than stayers to be in a school that had a low accountability rating, paid a lower average teacher salary, or had a higher proportion of racial/ethnic minority students.

The findings echo those of national studies, providing region- and state-specific information that decisionmakers can use to inform the development of policies and practices that support teacher recruitment and retention. The study also presents an approach that may be replicated or extended to examine the effectiveness of policies and practices designed to improve teacher retention.

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Why this study?

Educator Pipeline Research Alliance members from Colorado, Missouri, and South Dakota expressed a shared concern about teacher shortages and an interest in better understanding the factors that contribute to teacher mobility and attrition. In Colorado and South Dakota, for example, concerns about teacher mobility and attrition—particularly in rural districts—have prompted state action. Colorado's House Bill 17–1003 of May 2017 yielded a strategic plan that focused on the challenges associated with teacher recruitment and retention in rural districts (Cole, 2017). The South Dakota Department of Education's 2015 report for the Governor's Blue Ribbon Task Force on Teachers and Students also identified the need to better understand the factors affecting the teacher workforce (South Dakota Department of Education, 2015).

While teacher mobility and attrition (see box 1 for definitions of key terms) may result in positive outcomes, such as better matching of teachers to positions and replacement of ineffective teachers with more effective ones, they are also associated with negative consequences for students and schools, especially for schools in which attrition and mobility rates are consistently high (Atteberry, Loeb, & Wyckoff, 2016; Ronfeldt, Loeb, & Wyckoff, 2013). Because these schools are commonly in districts with a high proportion of low-performing schools and in economically disadvantaged areas, the outcome is an inequitable distribution of experienced teachers. High attrition and mobility can also compromise efforts to maintain a supportive and collegial work environment (Ingersoll & Merrill, 2012; Podgursky, Ehlert, Lindsay, & Wan, 2016; Sutcher, Darling-Hammond, & Carver-Thomas, 2016). And schools and districts that need to allocate additional resources for teacher recruitment and professional development because of teacher mobility and attrition also incur substantial financial costs (Atteberry et al., 2016; Borman & Dowling, 2008; National Commission on Teaching and America's Future, 2003; Podgursky et al., 2016).

While existing research paints a basic, national-level picture of teacher mobility and attrition, it also suggests that there is substantial variation across regions, states, and districts (Sutcher et al., 2016). A brief literature review with information about teacher shortages; teacher mobility and attrition; and factors associated with teacher retention, mobility, and attrition is presented in appendix A.

This report is the second resulting from a study of teacher retention, mobility, and attrition conducted with Educator Pipeline Research Alliance members. The first report describes rates of teacher retention, mobility, and attrition in rural and nonrural settings in Colorado, Missouri, Nebraska, and South Dakota (Meyer, Espel, Weston-Sementelli, & Serdiouk, 2019). This second report, based on combined data from Colorado, Missouri, and South Dakota, provides information on the characteristics of teachers and schools that are related to teacher mobility and attrition (see box 2 and appendix B for information on data and methods). State and district administrators may use the findings to identify groups of teachers who are most at risk of moving or leaving and to inform the development of supports or incentives to improve teacher recruitment and retention. The report also presents a model for how to use state education agency administrative data to examine factors associated with teacher mobility and attrition. The model may be adopted or adapted to understand factors associated with these phenomena within states. Findings from analyses identifying state-specific factors that may be associated with mobility and attrition are in appendixes D–F.

Box 1. Key terms

Classroom teacher. A staff member assigned the professional activities of instructing students in grades preK–12 in self-contained classes or courses. The definition excludes classroom interventionists, student teachers, teacher aides, paraprofessionals, librarians, psychologists, and speech pathologists.

Classroom teaching assignment. The grade level(s) or subject area(s) to which a classroom teacher is assigned. A teacher may have more than one teaching assignment.

Leaver. A classroom teacher who takes a nonteaching position or leaves a state public school system. Because this study includes data provided by three states that do not use a common teacher identifier, tracking teacher movement across study states was not possible. Therefore, teachers are classified as leavers if they move to a nonteaching position, leave the state public school system, or leave the profession. For example, a classroom teacher who becomes a principal is considered a leaver because he or she has left a classroom teaching position. Teachers who move to private schools or to schools in another state or who quit teaching are all considered leavers.

Mover. A classroom teacher who transfers to a classroom teaching position in a different school within a state public school system.

Nonteaching position. A leadership position or other type of school-based employment that does not involve classroom teaching.

Stayer. A classroom teacher who remains in a classroom teaching position in the same school.

Teacher attrition. Refers to classroom teachers who take a nonteaching position or leave a state public school system for any reason (leavers).

Teacher mobility. Refers to classroom teachers who move to a classroom teaching position in a different public school or district in the same state public school system for any reason (movers).

Teacher retention. Refers to classroom teachers who remain in a classroom teaching position in the same school (stayers).

What the study examined

The Regional Educational Laboratory Central study team used administrative data from Colorado, Missouri, and South Dakota to address the following question:

- From 2015/16 to 2016/17, to what extent were characteristics of teachers, schools, and districts in Colorado, Missouri, and South Dakota related to the likelihood of teachers moving to a different school and taking a nonteaching position or leaving the state public school system altogether?

Box 2. Data and methods

The study used administrative data provided by state education agencies in Colorado, Missouri, and South Dakota covering all teachers during 2011/12–2016/17. The data included employment position (the professional role of an individual in a state public school system, defined as either a classroom teaching position or a nonteaching position); district, school, and classroom teaching assignments; age; salary; gender; race/ethnicity; and highest educational degree.

School and district data were also obtained from state education agencies and supplemented with data from the National Center for Education Statistics Elementary/Secondary Information System (U.S. Department of Education, n.d.). These data included information about school and district locale (urban, suburban, town, or rural), school and district enrollment, school grade span, school median annual teacher salary, and school state accountability designation (a designation given to the lowest performing schools based on the state's accountability system). For each school the data also included proportion of students who scored proficient or better on the state English language arts assessment, proportion of racial/ethnic minority students, proportion of students who were eligible for the national school lunch program, and proportion of students who were English learner students.

Teachers' primary assignments to districts, schools, and teaching or nonteaching positions for each year were used to determine their status as stayers, movers, and leavers from 2015/16 to 2016/17. For teachers with multiple assignments, the one in which they spent the most time was considered the primary assignment. Nebraska was excluded from this report because it was not possible to determine primary grade-level and subject-area assignments for teachers with multiple assignments. Data for prior academic years were used to determine the number of years that teachers had been teaching in the same school and district.

For the analysis presented in the main report, the data for the three states were combined. Appendixes D–F report on analyses for each state. Multinomial logistic regression models were used to identify whether characteristics of teachers, schools, and districts were related to the likelihood of teachers being movers or leavers rather than stayers. Although district characteristics were examined, they were excluded from the models because all district characteristics except enrollment were highly correlated with school characteristics, and district enrollment was not a significant predictor. A threshold of at least 30 percent relative risk was used to identify the characteristics that were most strongly associated with the likelihood of moving or leaving. See appendix B for additional information about data and methodology.

What the study found

This study examined the relationship between teacher and school characteristics and the likelihood that teachers were movers or leavers rather than stayers from 2015/16 to 2016/17. Although district characteristics were also examined, they were excluded from the models because all district characteristics except enrollment were highly correlated with school characteristics, and district enrollment was not a statistically significant predictor (see appendix B). All analyses estimate the contribution of each characteristic—beyond all others explored—to teachers' likelihood of leaving or moving. Statistically significant associations are summarized in the tables. Characteristics associated with moving are presented first, followed by characteristics associated with leaving. A threshold of 30 percent relative risk was used to identify the characteristics that were most strongly associated with the likelihood of moving or leaving. More information about these analyses is presented

in appendixes C–F. The characteristics most strongly associated with likelihood of moving and leaving are listed first.

Nearly 20 percent of teachers moved from (8 percent) or left (10 percent) classroom teaching positions

Between 2015/16 and 2016/17, 8 percent of teachers in Colorado, Missouri, and South Dakota were movers, 10 percent were leavers, and 82 percent were stayers (see table B3 in appendix B). These proportions were calculated for the analytic sample used in this report to contextualize the main findings. Additional information about rates of stayers, movers, and leavers can be found in a prior report from this study (Meyer et al., 2019), which included data for four states: Colorado, Missouri, Nebraska, and South Dakota.

Special education teachers, teachers who had been teaching in the same school for fewer years, and younger teachers were more likely than teachers without these characteristics to be movers rather than stayers

Among the teacher characteristics examined, primary subject-area assignment, years teaching in the same school, and age were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table 1). Special education teachers were 72 percent more likely to be movers than were other teachers. Teachers who had been teaching in the same school for fewer than four years were 58 percent more likely to be movers than were teachers who had been teaching in the same school for four or more years. Teachers younger than 32 were 42 percent more likely to be movers than were teachers age 49 or older.

Several other teacher characteristics were less strongly associated (relative risk below 30 percent) with the likelihood of moving rather than staying but were still statistically significant. Teachers who earned a lower salary, male teachers, teachers whose primary grade-level assignment was not elementary school, and teachers who had a master's degree or higher were more like to be movers (see table 1).

Teachers in schools identified for improvement and teachers in schools with lower average teacher salaries were more likely to be movers rather than stayers

Among the school characteristics examined, state accountability designation (see box 1) and average teacher salary were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table 2). Teachers in schools identified by state education agencies for improvement due to low student achievement were 49–51 percent more likely to be movers than were teachers in schools not identified for improvement. And teachers in schools with an average salary of less than $41,525 were 47 percent more likely to be movers than were teachers in schools with an average salary of $55,149 or higher.

Several other school characteristics were less strongly associated with the likelihood of moving rather than staying. Teachers in schools with a higher proportion of racial/ethnic minority students, a higher proportion of students eligible for the national school lunch program, or a higher proportion of English learner students were more likely to be movers (see table 2). Teachers in schools with lower academic performance were more likely to be movers. Teachers in elementary schools were more likely to be movers than were teachers in high schools. And teachers in schools that did not have a traditional elementary, middle, or high school configuration were also more likely to be movers,[1] as were teachers in nonrural schools.[2]

Table 1. Teacher characteristics associated with the likelihood of being a mover rather than a stayer between 2015/16 and 2016/17

Characteristic	Finding
Primary subject-area assignment	Special education teachers were 71.8 percent more likely to be movers than were other teachers.
Years teaching in the same school	Teachers with fewer years in the same school were more likely to be movers. • Teachers who had been teaching in the same school for fewer than four years were 57.8 percent more likely to be movers than were teachers who had been teaching in the same school for four or more years.
Age[a]	Younger teachers were more likely to be movers. The likelihood of a teacher being a mover rather than a stayer decreased with age. Compared with teachers age 49 or older: • Teachers younger than 32 were 41.6 percent more likely to be movers. • Teachers ages 32–39 were 30.5 percent more likely to be movers. • Teachers ages 40–48 were 14.1 percent more likely to be movers.
Salary[a]	Teachers with lower salaries were more likely to be movers. The likelihood of a teacher being a mover rather than a stayer decreased with higher salaries. Compared with teachers with a salary of $55,341 or higher: • Teachers with a salary of less than $37,898 were 28.3 percent more likely to be movers. • Teachers with a salary of $37,898–$44,519 were 19.1 percent more likely to be movers. • Teachers with a salary of $44,520–$55,340 were 14.4 percent more likely to be movers.
Gender	Male teachers were 13.2 percent more likely to be movers than were female teachers.
Primary grade-level assignment	Non–elementary school teachers were 11.8 percent more likely to be movers than were elementary school teachers.
Highest educational degree	Teachers with more education were more likely to be movers. Teachers with a master's degree or higher were 9.5 percent more likely to be movers than were teachers with less education.

Note: In this sample, 81.5 percent of teachers were stayers, 8.1 percent were movers, and 10.4 percent were leavers. Statistically significant associations are summarized in this table and ordered by strength of association, with 30 percent or higher relative risk used as the threshold to identify strong associations. See appendix C for full results.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Teachers who were older, teachers who worked less than half time, teachers who had been teaching for fewer years in the same district, and teachers who earned lower salaries were more likely than teachers without these characteristics to be leavers than stayers

Among the teacher characteristics examined, age, full-time equivalency, years teaching in the same district, and salary were most strongly associated with leaving rather than staying between 2015/16 and 2016/17 (table 3). Teachers age 49 or older were 63 percent more likely to be leavers than were teachers ages 40–48. Teachers who worked less than half time were 41 percent more likely to be leavers than were teachers who worked half time or more. Teachers who had been teaching in the same district for fewer than four years were 36 percent more likely to be leavers than were teachers who had been teaching in the same district for four or more years. And teachers with lower salaries were more likely to be leavers.

Several other teacher characteristics were less strongly associated with the likelihood of leaving rather than staying. Teachers whose primary grade-level assignment was not elementary school, teachers who had a master's degree or higher, teachers who had been teaching in

Table 2. School characteristics associated with the likelihood of being a mover rather than a stayer between 2015/16 and 2016/17

Characteristic	Finding
State accountability designation[a]	Teachers in schools identified by state education agencies for improvement were more likely to be movers. Compared with teachers in schools that were not identified for improvement: · Teachers in schools identified as priority schools were 51.3 percent more likely to be movers. · Teachers in schools identified as focus schools were 48.6 percent more likely to be movers.
Average teacher salary[b]	Teachers in schools with lower average salaries were more likely to be movers. Compared with teachers in schools with an average salary of $55,149 or higher: · Teachers in schools with an average salary of less than $41,525 were 47.0 percent more likely to be movers. · Teachers in schools with an average salary of $41,525–$47,727 were 34.0 percent more likely to be movers. · Teachers in schools with an average salary of $47,728–$55,148 were 21.5 percent more likely to be movers.
Student population[b]	Teachers in schools with a higher proportion of racial/ethnic minority students, students eligible for the national school lunch program, or English learner students were more likely to be movers. Teachers in schools in which racial/ethnic minority students accounted for at least 52 percent of enrollment: · Were 24.4 percent more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for 26–51 percent of enrollment. · Were 19.8 percent more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for 13–25 percent of enrollment. · Were 12.1 percent more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for less than 13 percent of enrollment. Teachers in schools in which English learner students accounted for 8 percent or more of enrollment: · Were 17.7 percent more likely to be movers than were teachers in schools in which English learner students accounted for less than 0.3 percent of enrollment. · Were 16.6 percent more likely to be movers than were teachers in schools in which English learner students accounted for 0.3–2.1 percent of enrollment. · Were 13.3 percent more likely to be movers than were teachers in schools in which English learner students accounted for 2.2–7.9 percent of enrollment. Teachers in schools in which 67 percent or more of students were eligible for the national school lunch program: · Were 16.7 percent more likely to be movers than were teachers in schools in which less than 24 percent of students were eligible. · Were 14.8 percent more likely to be movers than were teachers in schools in which 24–45 percent of students were eligible.
Academic performance[b]	Teachers in schools with the lowest academic performance were more likely to be movers. Compared with teachers in schools in which 70 percent or more of students scored proficient or better on the state English language arts assessment: · Teachers in schools in which less than 39 percent of students scored proficient or better on the state English language arts assessment were 18.9 percent more likely to be movers.
Grade span	Teachers in elementary schools were 17.5 percent more likely to be movers than were teachers in high schools. Compared with teachers in elementary schools: · Teachers in schools offering other grade spans were more likely to be movers. · Teachers in schools that did not offer a traditional elementary (grade preK–5), middle (grades 6–8), or high school (grades 9–12) configuration were 10.8 percent more likely to be movers.
Rurality	Compared with teachers in rural schools: · Teachers in nonrural schools were 10.5 percent more likely to be movers.

Note: In this sample, 81.5 percent of teachers were stayers, 8.1 percent were movers, and 10.4 percent were leavers. Statistically significant associations are summarized in this table and ordered by strength of association, with 30 percent or higher relative risk used as the threshold to identify strong associations. See appendix C for full results.

a. Focus schools are schools identified by state agencies as having the largest within-school gaps in student achievement or graduation rates; priority schools are schools identified by state agencies as being the lowest performing in terms of student achievement or graduation rates.

b. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table 3. Teacher characteristics associated with the likelihood of being a leaver rather than a stayer between 2015/16 and 2016/17

Characteristic	Finding
Age[a]	Older teachers were more likely to be leavers. Teachers age 49 or older: • Were 63.2 percent more likely to be leavers than were teachers ages 40–48. • Were 52.9 percent more likely to be leavers than were teachers ages 32–39. • Were 47.0 percent more likely to be leavers than were teachers younger than 32.
Full-time equivalency	Teachers who worked less than half time were 41.2 percent more likely to be leavers than were teachers who worked half time or more.
Years teaching in the same district	Teachers with fewer years in the same district were more likely to be leavers: • Teachers who had been teaching in the same district for fewer than four years were 35.9 percent more likely to be leavers than were teachers who had been teaching in the same district for four or more years.
Salary[a]	Teachers with lower salaries were more likely to be leavers. • Teachers with a salary of less than $37,898 were 34.5 percent more likely to be leavers than were teachers with a salary of $55,341 or higher.
Primary grade-level assignment	Teachers whose primary grade-level assignment was other than elementary school were 19.2 percent more likely to be leavers than were teachers in elementary schools.
Highest educational degree	Teachers with more education were more likely to be leavers: • Teachers with a master's degree or higher were 18.9 percent more likely to be leavers than were teachers with less than a master's degree.
Years teaching in the same school	Teachers with fewer years in the same school were more likely to be leavers: • Teachers who had been teaching in the same school for fewer than four years were 14.4 percent more likely to be leavers than were teachers who had been teaching in the same school for four or more years.
Primary subject-area assignment	Special education teachers were 10.7 percent more likely to be leavers than were other teachers.
Gender	Female teachers were 7.5 percent more likely to be leavers than were male teachers.

Note: In this sample, 81.5 percent of teachers were stayers, 8.1 percent were movers, and 10.4 percent were leavers. Statistically significant associations are summarized in this table and ordered by strength of association, with 30 percent or higher relative risk used as the threshold to identify strong associations. See appendix C for full results.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of state education agency data, supplemented with data from U.S. Department of Education (n.d.).

the same school for fewer than four years, special education teachers, and female teachers were more likely to be leavers than were teachers without these characteristics (see table 3).

Teachers in schools identified by state education agencies for improvement, teachers in schools with lower average teacher salaries, and teachers in schools with higher proportions of racial/ethnic minority students were more likely than teachers in schools without these characteristics to be leavers rather than stayers

Among the school characteristics examined, state accountability designation, average teacher salary, and proportion of racial/ethnic minority students were most strongly associated with leaving rather than staying (table 4). Teachers in schools identified by state education agencies for improvement were 23–36 percent more likely to be leavers than were teachers in schools not identified for improvement. Teachers in schools with an average salary of less than $41,525 were 35 percent more likely to be leavers than were teachers in schools with an average salary of $55,149 or higher. And teachers in schools with the highest proportions of racial/ethnic minority students were more likely to be leavers than were teachers in schools with the lowest proportions of racial/ethnic minority students.

Several other school characteristics were less strongly associated with the likelihood of leaving rather than staying. Teachers in schools with the highest proportions of students

Table 4. School characteristics associated with the likelihood of being a leaver rather than a stayer between 2015/16 and 2016/17

Characteristic	Finding
State accountability designation[a]	Teachers in schools identified by state education agencies for improvement were more likely to be leavers. Compared with teachers in schools that were not identified for improvement: · Teachers in schools identified as priority schools were 35.8 percent more likely to be leavers. · Teachers in schools identified as focus schools were 22.6 percent more likely to be leavers.
Average teacher salary	Teachers in schools with lower average salaries were more likely to be leavers. Compared with teachers in schools with an average teacher salary of $55,149 or higher: · Teachers in schools with an average salary of less than $41,525 were 34.5 percent more likely to be leavers. · Teachers in schools with an average salary of $41,525–$47,727 were 21.3 percent more likely to be leavers. · Teachers in schools with an average salary of $47,728–$55,148 were 11.1 percent more likely to be leavers.
Student population[b]	Teachers in schools with higher proportions of racial/ethnic minority students or students eligible for the national school lunch program were more likely to be leavers, as were teachers in schools with higher proportions of English learner students. Teachers in schools in which racial/ethnic minority students accounted for at least 52 percent of enrollment: · Were 31.8 percent more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for less than 13 percent of enrollment. · Were 20.0 percent more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for 26–51 percent of enrollment. · Were 16.6 percent more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for 13–25 percent of enrollment. Teachers in schools in which 67 percent or more of students were eligible for the national school lunch program: · Were 7.8 percent more likely to be leavers than were teachers in schools in which 24–45 percent of students were eligible. · Were 7.3 percent more likely to be leavers than were teachers in schools in which 46–66 percent of students were eligible for the national school lunch program. Teachers in schools in which English learner students accounted for 8 percent or more of enrollment: · Were 7.5 percent more likely to be leavers than were teachers in schools in which English learner students accounted for 2.2–7.9 percent of enrollment.
Enrollment[b]	Teachers in smaller schools were more likely to be leavers. Compared with teachers in schools with 808 students or more: · Teachers in schools with 344–512 students were 15.8 percent more likely to be leavers. · Teachers in schools with fewer than 344 students were 12.0 percent more likely to be leavers. · Teachers in schools with 513–807 students were 11.6 percent more likely to be leavers.
Rurality	Teachers in nonrural schools were 13.2 percent more likely to be leavers than were teachers in rural schools.
Grade span	Teachers in elementary schools: · Were 14.0 percent more likely to be leavers than were teachers in middle schools. · Were 11.2 percent more likely to be leavers than were teachers in high schools.
Academic performance[b]	Teachers in schools with higher academic performance were more likely to be leavers. Compared with teachers in schools in which 56–69 percent of students scored proficient or better on the state English language arts assessment: · Teachers in schools in which 70 percent or more of students scored proficient or better on the state English language arts assessment were 7.5 percent more likely to be leavers.

Note: In this sample, 81.5 percent of teachers were stayers, 8.1 percent were movers, and 10.4 percent were leavers. Statistically significant associations are summarized in this table and ordered by strength of association, with 30 percent or higher relative risk used as the threshold to identify strong associations. See appendix C for full results.

a. Focus schools are schools identified by state agencies as having the largest within-school gaps in student achievement or graduation rates; priority schools are schools identified by state agencies as being the lowest performing in terms of student achievement or graduation rates.

b. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of state education agency data, supplemented with data from U.S. Department of Education (n.d.).

eligible for the national school lunch program were more likely to be leavers than were teachers in schools with lower proportions of eligible students (see table 4). Teachers in schools with higher proportions of English learner students were more likely to be leavers than were teachers in schools with lower proportions of English learner students. In addition, compared with teachers in larger schools, teachers in smaller schools were more likely to be leavers. Teachers in nonrural schools were more likely to be leavers than were teachers in rural schools. Teachers in elementary schools were more likely to be leavers than were teachers in middle or high schools. And teachers in schools with higher academic performance were more likely to be leavers than were teachers in schools with lower academic performance.

Implications of the study findings

This study describes factors related to teacher mobility and attrition in Colorado, Missouri, and South Dakota from 2015/16 to 2016/17, providing region- and state-specific information about factors associated with moving and leaving that may help decisionmakers better design policy, practices, and research focused on attracting and keeping teachers. Findings based on combined data for the three states echo those of national studies, which suggest high mobility and attrition among special education teachers, inexperienced teachers, and teachers in schools with a state education agency designation for improvement (Podolsky, Kini, Bishop, & Darling-Hammond, 2016; Sutcher et al., 2016). Other factors most strongly associated with teachers moving or leaving were teacher age, years teaching in the same school and district, full-time teaching equivalency, individual and school-average teacher salary, school state accountability designation, and school proportion of racial/ethnic minority students.

Decisionmakers in Colorado, Missouri, and South Dakota may use information about the characteristics of teachers and schools most associated with moving and leaving to design policies or practices that seek to retain educators with the greatest risk of moving from or leaving their positions. For example, drawing on these findings, state and district administrators may choose to prioritize loan forgiveness, induction support, or other initiatives for new teachers, special education teachers, teachers placed in schools with low average teacher salaries, or teachers placed in schools with high proportions of racial/ethnic minority students.

The approach used in this study serves as a model for future research using state administrative data by illustrating typically available data and how they can be used to identify factors related to teacher mobility and attrition. Administrators and researchers in state education agencies and districts can replicate or adapt this study approach to continue to inform understanding about what causes teachers to move or leave. For example, state and district administrators could incorporate other data about the nature and extent of induction support or the quality of building leadership to examine how those factors relate to the probability of teachers staying, moving, or leaving. State and district administrators could also review existing data that could be used for such analyses (for example, existing teacher survey data about induction support or school climate survey data) and consider collecting new data on these topics.

A recent review of policies in 40 states (Espinoza, Saunders, Kini, & Darling-Hammond, 2018) identified six common policy strategies aimed at attracting, developing, and retaining a strong

teacher workforce: service scholarships and loan forgiveness, high-retention pathways into teaching, mentoring and induction for new teachers, preparation of high-quality school principals, competitive compensation, and recruitment strategies to expand the pool of qualified educators. While some research suggests promise for such policies and practices (for example, Podolsky, Kini, Darling-Hammond, & Bishop, 2019), the research base provides limited conclusions about the effectiveness of particular strategies. State and district administrators could adapt the approach used in this study to examine the effectiveness of state and district policies and practices by examining annual rates of retention, mobility, and attrition across multiple years and among teachers and schools targeted by particular incentives or supports.

In addition, state and district administrators could incorporate new data collection about factors affecting teachers' decisions to move or leave. Inadequate preparation, lack of support for new teachers, challenging working conditions, dissatisfaction with compensation, better career opportunities, and personal reasons have all been found to contribute to mobility and attrition (Podolsky et al., 2016). States and districts could collect survey data from teachers who move or leave to better understand what motivates decisions among particular types of teachers or among teachers in particular school settings. A more complete understanding of these factors could allow state education agencies and districts to develop policies that better support retention.

Limitations of the study

This study provides information about teacher and school characteristics that are related to teacher mobility and attrition, based on a comparison of two consecutive academic years. It therefore provides a snapshot of mobility and attrition at one point in time. There are many characteristics of teachers, schools, and districts that may affect teachers' decisions to stay in classroom teaching positions, move to other positions, or leave the profession altogether. It is likely that additional factors beyond the scope of this study could help explain the likelihood that teachers will become stayers, movers, or leavers. Furthermore, analyses are correlational and do not provide conclusive information about the causes of mobility and attrition. For example, young teachers may also have family obligations with young children at home. If childcare is not provided in or near their school settings, they may choose to move to new locations, which could drive the correlation between teacher age and teachers moving. This study could not account for all factors that may be related to teachers moving or leaving, and decisionmakers should take local contexts into account.

Moreover, employment status changes examined in these analyses do not distinguish between voluntary and involuntary changes because this information is not reliably tracked in state education agency data systems. This study included data only from public schools; teachers were not tracked into or out of private schools. Teachers were classified as leavers if they left the teaching profession altogether or if they left the state public school systems. Leavers also include teachers who may take a year off and return to teaching in a subsequent year, such as those who take maternity leave. In addition, the study was not able to track teachers across state lines because state education agencies do not use common teacher identifiers. Information about teacher salaries do not adjust for cost of living, which may vary substantially across and within study states. While these analyses do not provide a comprehensive or conclusive picture of factors related to teacher retention and mobility, they make use of relevant and available administrative data, providing a model for future analyses based on data currently maintained by state education agencies.

Appendix A. Literature review

To inform development of the study, the study team conducted a review of literature related to teacher shortages, teacher mobility and attrition, and factors associated with teacher retention, mobility, and attrition.

Teacher shortages and challenges

Over the past several decades, education leaders and researchers have focused on the issue of teacher shortages (Borman & Dowling, 2008; Malkus, Hoyer, & Sparks, 2015). Several recent studies have prompted continued concern. For example, analysis of data from the federal Higher Education Act Title II reporting system revealed a decrease in teacher preparation program enrollment in recent years, from more than 700,000 teacher candidates enrolled in 2008/09 to fewer than 450,000 in 2015/16 (U.S. Department of Education, 2018). In addition, analysis of national data from the Schools and Staffing Survey, Common Core of Data, and Digest of Education Statistics suggested an estimated national shortage of 64,000 teachers during the 2015/16 academic year, a number that is expected to increase fivefold by 2025 (Sutcher et al., 2016).

However, other national data appear to contradict, or at least mitigate, the notion of a worsening national teacher shortage. For example, public school principal reports of teacher vacancies from the Schools and Staffing Survey indicated that vacancies decreased between the 1999/2000 and 2011/12 academic years (Malkus et al., 2015). Recent projections, based on national data, have also suggested that the national supply of elementary and secondary teachers will grow by 14 percent through 2021, relative to predicted growth of 7 percent for total elementary and secondary student enrollment (Hussar & Bailey, 2013).

The literature is consistent in reporting that teacher shortages are more pronounced in particular content areas, types of districts and schools, and geographic areas. Analyses of national data have identified acute shortages among teachers of math, science, special education, foreign languages, and English for English learner students; teachers in high-poverty and high–racial/ethnic minority schools; and teachers in locations where wages, school resources, and working conditions are least attractive (Podolsky et al., 2016, Sutcher et al., 2016).

Analyses of shortages and the factors that influence them, including wages, working conditions, and attrition rates, also revealed substantial variation across U.S. geographic areas, regions, and states (Sutcher et al., 2016). For example, rural schools and districts face shortages in particular content areas, such as math and science, that are more acute than their counterparts in nonrural settings (Malkus et al., 2015; McClure & Reeves, 2004; Murphy, DeArmond, & Guin, 2003).

Teacher mobility and attrition, and their consequences

Teacher mobility and attrition are primary contributors to teacher shortages, and, as is the case with teacher shortages, rates of teacher mobility and attrition vary substantially across states and districts (Plecki, Elfers, Loeb, Zahir, & Knapp, 2005; Sutcher et al., 2016). Recent analyses of national data have suggested that 17 percent of new teachers leave

teaching within five years (Gray & Taie, 2015). In contrast to decisions made by teachers who choose to change positions or leave teaching, involuntary mobility and attrition may be caused by principals who assign teachers to new positions or who do not renew teachers' contracts. Mobility and attrition can yield positive effects for schools and students by better matching teacher strengths to particular positions or by replacing ineffective teachers with more effective teachers.

However, the movement of teachers out of positions is frequently associated with a range of negative consequences for schools and students. For example, correlational studies examining the movement of individual teachers out of teaching positions and schools have documented negative relationships with student achievement (Atteberry et al., 2016; Ronfeldt et al., 2013). High attrition and mobility have also been linked to substantial costs for districts and schools because of the need to invest in additional recruitment, hiring, and training activities (Barnes, Crowe, & Schaefer, 2006; Borman & Dowling, 2008). These negative consequences tend to be concentrated in schools in which attrition and mobility are consistently high. These schools are commonly in low-performing districts and economically disadvantaged areas, leading to inequitable distribution of experienced teachers and compromising efforts to maintain supportive and collegial work environments (Ingersoll & Merrill, 2012; Podgursky et al., 2016; Sutcher et al., 2016).

Teacher retention, mobility, and attrition, and the factors that contribute to them

A large body of research has examined teacher retention, mobility, and attrition, and their contributing factors. Many studies have focused on characterizing annual mobility and attrition, describing the extent to which teachers move out of schools and out of the teaching profession. For example, studies of national teacher survey data have shown that about 84 percent of teachers remain in the same schools from one year to the next, while 8 percent move to different schools and 8 percent leave the profession (Goldring, Taie, & Riddles, 2014; Keigher, 2010).

These studies have also explored differences between teachers with varying levels of experience, the extent to which teachers move within and across districts, and the factors contributing to teachers' decisions to stay or leave. Other studies have used longitudinal data to examine patterns of retention, mobility, and attrition, focusing on cohorts of teachers over multiple years (Gray & Taie, 2015; Ingersoll, 2001). Studies examining factors related to retention, mobility, and attrition have suggested that decisions to remain in teaching positions are complex and affected by a variety of factors: teachers' demographics, qualifications, and experience, for example, as well as characteristics of teacher preparation and induction, school organization and resources, and students and communities (Allensworth, Ponisciak, & Mazzeo, 2009; Borman & Dowling, 2008; Ingersoll, 2001; Podolsky et al., 2016). Several common factors associated with retention, mobility, and attrition have been identified across studies. For example, characteristics of teachers who were more likely to leave the profession included their being female, White, married, or parents, as well as their having specialized degrees in math or science or more years of experience. Characteristics of schools associated with higher teacher attrition included lack of collaboration among teachers; lack of administrative support; and high enrollment of poor, racial/ethnic minority, or low-achieving students (Borman & Dowling, 2008).

The need for local analyses of teacher retention, mobility, and attrition

Ongoing concern about teacher shortages and the negative consequences of teacher mobility and attrition suggest the need for information about the nature and extent of these issues. While research provides a satisfactory national-level picture of teacher retention, mobility, and attrition, the substantial variation and contributing factors across regions, states, and districts reveal the need for more localized analysis of these phenomena to guide policy decisions. Indeed, several studies examining these phenomena at the state and district levels have been undertaken in recent years (for example, Goff, Bradley, & Yang, 2018; Janulis, 2017; Lovett, 2016; Podgursky et al., 2016).

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 data from the Elementary/Secondary Information System maintained by the National Center for Education Statistics, which includes data from the Common Core of Data, a national data collection involving all U.S. states, districts, and schools (U.S. Department of Education, n.d.).

Data acquisition

Formal requests for data were submitted to state education agencies in late 2017. Memoranda of agreement for data sharing were subsequently established, and the agencies provided data in February and March 2018. In particular, they provided de-identified classroom teacher data that enabled linking teachers across years and to their schools and districts and that provided information about teacher characteristics and assignments. The study team worked closely with agency staff in early 2018 to acquire additional documentation and confirm understanding of the data provided. Data describing school and district characteristics in 2015/16 were downloaded from the Elementary/Secondary Information System in April 2018 (U.S. Department of Education, n.d.).

Data elements

All state education agencies provided teacher data based on agency-specific staff position codes for 2011/12–2016/17. They identified teachers as "a staff member assigned the professional activities of instructing students in grades preK–12 in self-contained classes or courses: excluding classroom interventionists, student teachers, teacher aides, paraprofessionals, librarians, psychologists, and speech pathologists." Agencies in all three states provided data for classroom teachers for all years.

State education agencies provided district, school, assignment, and demographic data for each educator in their public school system as of the beginning of each academic year, 2011/12–2016/17. All data files included multiple records for each educator in cases in which a teacher was assigned to more than one district, school, grade level, and/or subject area. Information about the amount of time associated with each district and school was also provided as full-time equivalent percentages in Colorado and South Dakota and as course minutes in Missouri. Information about teacher characteristics included birthdate, salary, gender, race/ethnicity, and highest educational degree (table B1).

School and district variables, derived from state education agency systems and the Elementary/Secondary Information System, included rurality, school proportion of students who scored proficient or better on the state English language arts assessment, school grade span, school and district enrollment, school proportion of students who are racial/ethnic minority students, school proportion of students eligible for the national school lunch program, school proportion of students who are English learner students, school average total annual teacher base salary, and state accountability designation. 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.

Table B1. Summary of teacher variables used in analyses

Variable	Description
Teacher ID	Unique teacher identifier; used to link teacher data across years within states.
Birthdate	Year, month, and day of birth; used to compute age as of the beginning of the 2015/16 school year (September 1, 2015).
Salary	Total annual base salary in dollars in 2015/16.
Gender	Male or female.
Race/ethnicity	Categorized as White or racial/ethnic minority (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, Hispanic, or multiple races/ethnicities).
Highest educational degree	Highest educational degree as of 2015/16; categorized as less than master's degree or master's degree or higher (includes doctoral and specialist degrees).
District, school position, and teaching assignment(s)	District identifier, school identifier, and codes corresponding to position (teaching or nonteaching), primary grade-level and primary subject-area assignment(s) for each year 2011/12–2016/17. Because of interest in parsimony, and due to missing subject-area data for non–high school teachers, grade level was collapsed into elementary, middle, high school, and other, and teachers were considered to be special education or not special education teachers.
Years in district and school	Full-time equivalent percentage (or minutes of assignment in Missouri) associated with years spent in district and school teaching assignments categorized as four or more years, or fewer than four years, as of 2015/16.

Source: Authors' compilation of information from state education agency data.

Data preparation

The study team used the following steps to prepare the data files for analysis.

Step 1: Identifying classroom teachers in South Dakota. The 2011/12–2015/16 data for Colorado and Missouri included only classroom teachers, and the 2016/17 data for unambiguously identified educators as either classroom teachers or leaders. However, the South Dakota state dataset contained multiple records indicating that some educators had both teaching and nonteaching positions over 2011/12–2016/17. When the South Dakota data listed multiple positions for an educator, full-time equivalency in each position was used to identify whether the majority of time was spent as a classroom teacher. Teachers' primary positions were identified as those in which they spent the most time—positions with the highest total full-time equivalent. When teachers had multiple positions in which they spent equal amounts of time, the study team deemed the primary positions to be indeterminate and did not identify them as classroom teachers. In South Dakota less than 1 percent had indeterminate primary positions (table B2).

Step 2: Identifying teacher characteristics. Teacher characteristics were identified using available data for 2015/16. If any data for 2015/16 were missing for a teacher, data for 2016/17 were used. Teacher age in years was calculated as of September 1, 2015, based on birthdates. Values for gender, race/ethnicity, and highest educational degree variables were recoded to use a common set of categories across states.

Step 3: Determining teachers' primary districts, schools, and assignments. Each teacher's beginning-of-year primary district, school, grade level, and special education teacher designation were identified, using the same approach as that to determine primary position, described in step 1 above. Primary assignments to grade levels and special education

Table B2. Analytic samples

Sample	Three states combined	Colorado	Missouri	South Dakota
Teachers in 2015/16 (*N*)	131,358	53,167	68,629	9,562
Teachers in 2015/16 with a primary position (%)	100.0	100.0	100.0	99.6
Teachers in 2015/16 with a primary district (%)	99.9	100.0	100.0	99.9
Teachers in 2015/16 with a primary school (%)	98.2	98.5	98.9	96.0
Teachers in 2015/16 who could be identified as stayers, movers, or leavers[a]				
Number	129,948	52,444	68,055	9,449
Percent	98.9	98.6	99.2	98.8
Teachers with complete explanatory and outcome data for the final model				
Number	114,850	47,192	58,970	8,688
Percent	87.4	88.8	85.9	90.9

a. Includes teachers for whom primary schools and districts could be identified in 2015/16 and 2016/17 (stayers and movers) as well as teachers for whom primary schools and districts could be identified in 2015/16 but for whom there were no records in 2016/17 (leavers).

Source: Authors' analysis of state education agency data, supplemented with data from U.S. Department of Education (n.d.).

teachers were identified using only the assignment data associated with teachers' primary schools.

Step 4: Calculating the number of years that teachers had been teaching in the same school and district. The number of years that teachers had been teaching in the same school and district was calculated as of the beginning of the 2015/16 academic year. Teachers were categorized as having been teaching in the same school or district for fewer than four years or for four or more years.

Step 5: Identifying teachers as stayers, movers, and leavers. School and district identifiers also provided the basis for identifying teachers as stayers, movers, and leavers. Teachers who had the same primary school identifiers at the beginning of both the 2015/16 and 2016/17 academic years were considered stayers. Conversely, teachers with different primary school identifiers across those two years were considered movers. Finally, individuals who were identified as teachers in 2015/16 but not in 2016/17 were considered leavers.

Step 6: Identifying characteristics of districts and schools. State education agencies provided school- and district-level data. Because some requested data elements were not available or were incomplete, they were supplemented with school- and district-level data maintained in the Elementary/Secondary Information System (U.S. Department of Education, n.d.). State education agency school and district identifiers were linked to National Center for Education Statistics school and district identifiers to facilitate this process. Identifiers for each teacher's primary school and district were used to link school and district data to educator-level records.

Samples

The sample for the three-state model included the teachers in Colorado, Missouri, and South Dakota for whom primary schools, districts, and classroom teaching assignments could be identified in 2015/16 and 2016/17. Multinomial logistic regression models, described below, included only teachers with complete explanatory and outcome data. The sample in

the final three-state model included 87.4 percent of all teachers in 2015/16 (see table B2). Characteristics of teachers and their schools in the sample overall and disaggregated by teacher classification as a stayer, mover, or leaver, are provided in tables B3 and B4. In this sample, 81.5 percent of teachers were stayers, 8.1 percent were movers, and 10.4 percent were leavers. This sample was disaggregated by state for state-specific models in Colorado, Missouri, and South Dakota (see appendixes D–F). In Colorado 79.4 percent of teachers were stayers, 8.2 percent were movers, and 12.4 percent were leavers. In Missouri 82.8 percent of teachers were stayers, 8.2 percent were movers, and 9.1 percent were leavers.[3] In South Dakota 84.1 percent of teachers were stayers, 7.1 percent were movers, and 8.9 percent were leavers.[4] Characteristics of teachers and their schools in each state disaggregated by teacher classifications as a stayer, mover, or leaver are provided in tables B5–B10.

Table B3. Combined Colorado, Missouri, and South Dakota teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Total	81.5	8.1	10.4	100.0
State				
Colorado	40.0	41.6	48.9	41.1
Missouri	52.2	51.8	44.6	51.3
South Dakota	7.8	6.6	6.4	7.6
Total	100.0	100.0	100.0	100.0
Age[a]				
Mean (years)	41.0	37.6	42.8	40.9
Younger than 32	22.7	34.9	27.0	24.1
32–39	27.7	28.8	22.6	27.3
40–48	26.0	20.6	14.9	24.4
49 or older	23.6	15.7	35.5	24.2
Total	100.0	100.0	100.0	100.0
Gender				
Male	23.2	23.9	21.3	23.1
Female	76.8	76.1	78.7	76.9
Total	100.0	100.0	100.0	100.0
Race/ethnicity				
Racial/ethnic minority	7.9	10.2	10.5	8.4
White	92.1	89.8	89.5	91.6
Total	100.0	100.0	100.0	100.0
Highest educational degree				
Master's degree or higher	56.4	48.7	54.6	55.6
Less than master's degree	43.6	51.3	45.4	44.4
Total	100.0	100.0	100.0	100.0
Salary[a]				
Mean ($)	48,471	43,839	45,832	47,514
Less than $37,898	23.0	32.4	30.0	24.5
$37,898–$44,519	24.4	29.2	23.8	24.8
$44,520–$55,340	25.6	22.9	22.9	25.1
$55,341 or higher	27.0	15.5	23.3	25.7
Total	100.0	100.0	100.0	100.0

(continued)

Table B3. Combined Colorado, Missouri, and South Dakota teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Years in the same school				
Fewer than four	47.9	73.7	62.0	51.5
Four or more	52.1	26.3	38.0	48.5
Total	100.0	100.0	100.0	100.0
Years in the same district				
Fewer than four	39.9	62.7	54.9	43.3
Four or more	60.1	37.3	45.1	56.7
Total	100.0	100.0	100.0	100.0
Full-time equivalency				
Less than .50	3.7	4.2	7.1	4.1
.50 or more	96.3	95.8	92.9	95.9
Total	100.0	100.0	100.0	100.0
Primary grade-level assignment				
Elementary school	41.6	40.6	41.3	41.5
Middle school	25.5	29.7	26.7	26.0
High school	28.5	22.9	25.5	27.7
Other	4.4	6.8	6.5	4.8
Total	100.0	100.0	100.0	100.0
Primary subject-area assignment				
Special education	8.0	14.2	10.0	8.7

Note: The number of teachers included in the analysis was 114,850. Teacher characteristics are reported as of 2015/16. Data elements described here were used in 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; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2011/12 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B4. Combined Colorado, Missouri, and South Dakota school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Schools				
Rurality				
Rural	24.5	24.0	21.5	24.1
Nonrural	75.5	76.0	78.5	75.9
Total	100.0	100.0	100.0	100.0
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]				
Mean	55.0	48.8	49.3	53.9
Less than 39 percent	23.1	34.4	33.4	25.1
39–55 percent	25.1	24.9	26.0	25.2
56–69 percent	25.7	22.4	21.2	25.0
70 percent or more	26.0	18.4	19.4	24.7
Total	100.0	100.0	100.0	100.0
Grade span				
Elementary school	34.4	33.7	34.8	34.3
Middle school	16.9	17.7	16.0	16.9
High school	25.2	18.6	21.9	24.3
Other	23.5	30.0	27.3	24.4
Total	100.0	100.0	100.0	100.0
Enrollment[a]				
Mean (number of students)	709	621	658	696
Fewer than 344 students	22.0	26.2	22.9	23.5
344–512 students	24.9	27.6	27.4	24.1
513–807 students	26.2	25.1	26.8	26.1
808 or more students	27.0	21.1	23.0	26.3
Total	100.0	100.0	100.0	100.0
Proportion of students who are racial/ethnic minority students[a]				
Mean	33.2	41.0	40.8	35.1
Less than 13 percent	25.5	24.9	19.5	24.9
13–25 percent	26.0	19.3	23.6	25.0
26–51 percent	26.5	20.7	24.5	25.1
52 percent or more	22.0	35.1	32.4	25.0
Total	100.0	100.0	100.0	100.0
Proportion of students who are eligible for the national school lunch program[a]				
Mean	46.0	55.7	51.5	47.4
Less than 24 percent	25.9	16.4	21.7	24.7
24–45 percent	26.6	20.8	22.8	25.8
46–66 percent	24.9	26.7	23.9	24.9
67 percent or more	22.5	36.1	31.6	24.6
Total	100.0	100.0	100.0	100.0

(continued)

Table B4. Combined Colorado, Missouri, and South Dakota school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Proportion of students who are English learner students[a]				
Mean	7.5	10.9	10.4	8.1
Less than 0.3 percent	23.6	23.5	20.2	23.2
0.3–2.1 percent	26.4	22.1	23.1	25.7
2.2–7.9 percent	25.9	21.2	24.3	25.3
8.0 percent or more	24.1	33.2	32.4	25.7
Total	100.0	100.0	100.0	100.0
Average teacher salary[a]				
Mean ($)	49,183	46,812	48,104	48,879
Less than $41,525	23.5	29.5	26.3	24.3
$41.425–$47,727	24.2	27.7	25.3	24.6
$47,728–$55,148	25.5	25.7	26.6	25.6
$55,149 or higher	26.7	17.1	21.8	25.5
Total	100.0	100.0	100.0	100.0
State accountability designation				
Focus school	3.8	8.6	6.4	4.4
Priority school	1.6	3.9	3.1	2.0
None	94.6	87.5	90.5	93.6
Total	100.0	100.0	100.0	100.0
Districts				
Enrollment[a]				
Mean (number of students)	20,325	21,708	24,578	20,882
Fewer than 2,270 students	23.6	24.8	21.5	23.5
2,271–9,500 students	24.0	25.0	23.7	24.1
9,501–24,496 students	26.6	24.8	23.2	26.1
24,497 or more students	25.7	25.4	31.5	26.3
Total	100.0	100.0	100.0	100.0

Note: The number of teachers included in the analysis was 114,850. School characteristics are reported as of 2015/16. Data elements described here were used in multinomial regression models. For continuous variables in which quartiles were used (academic performance, enrollment, proportion of students who are racial/ethnic minority students, proportion of students who are eligible for the national school lunch program, proportion of students who are English learner students, average teacher salary, and district enrollment), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B5. Colorado teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Age[a]				
Mean (years)	41.3	38.0	41.8	41.1
Younger than 32	22.1	32.9	28.6	23.8
32–39	26.9	29.7	24.5	26.8
40–48	26.4	21.8	16.0	24.7
49 or older	24.6	15.7	30.9	24.7
Total	100.0	100.0	100.0	100.0
Gender				
Male	24.4	23.2	20.5	23.8
Female	75.6	76.8	79.5	76.2
Total	100.0	100.0	100.0	100.0
Race/ethnicity				
Racial/ethnic minority	11.8	13.7	12.2	12.0
White	88.2	86.3	87.8	88.0
Total	100.0	100.0	100.0	100.0
Highest educational degree				
Master's degree or higher	55.2	50.0	53.3	54.5
Less than master's degree	44.8	50.0	46.7	45.5
Total	100.0	100.0	100.0	100.0
Salary[a]				
Mean ($)	51,419	46,030	46,725	50,394
Less than $37,898	17.2	23.4	26.6	18.9
$37,898–$44,519	22.0	29.9	24.5	23.0
$44,520–$55,340	25.3	26.4	23.8	25.2
$55,341 or higher	35.4	20.3	25.1	32.9
Total	100.0	100.0	100.0	100.0
Years in the same school				
Fewer than four	51.9	77.9	66.7	55.9
Four or more	48.1	22.1	33.3	44.1
Total	100.0	100.0	100.0	100.0
Years in the same district				
Fewer than four	43.4	68.4	59.2	47.5
Four or more	56.6	31.6	40.8	52.5
Total	100.0	100.0	100.0	100.0
Full-time equivalency				
Less than .50	1.5	1.9	4.2	1.8
.50 or more	98.5	98.1	95.8	98.2
Total	100.0	100.0	100.0	100.0
Primary grade-level assignment				
Elementary school	47.1	45.8	48.3	47.2
Middle school	21.4	25.5	21.7	21.8
High school	25.1	18.9	21.2	24.1
Other	6.3	9.8	8.8	6.9
Total	100.0	100.0	100.0	100.0

(continued)

Table B5. Colorado teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Primary subject-area assignment				
Special education	7.7	15.6	9.4	8.6

Note: The number of teachers included in the analysis was 47,192. Teacher characteristics are reported as of 2015/16. Data elements described here were used in 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 percent due to rounding.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2011/12 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B6. Colorado school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Schools				
Rurality				
Rural	13.5	11.0	11.7	13.1
Nonrural	86.5	89.0	88.3	86.9
Total	100.0	100.0	100.0	100.0
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]				
Mean	40.5	34.3	37.3	39.6
Less than 39 percent	48.1	62.9	55.3	50.2
39–55 percent	32.7	24.6	29.2	31.6
56–69 percent	13.6	9.8	11.4	13.0
70 percent or more	5.6	2.7	4.1	5.2
Total	100.0	100.0	100.0	100.0
Grade span				
Elementary school	35.5	33.7	34.9	35.3
Middle school	16.6	18.6	15.6	16.6
High school	23.1	16.3	18.7	22.0
Other	24.8	31.4	30.7	26.1
Total	100.0	100.0	100.0	100.0
Enrollment[a]				
Mean (number of students)	810	726	725	792
Fewer than 344 students	12.4	14.7	14.9	12.9
344–512 students	24.9	28.1	28.2	25.6
513–807 students	30.7	30.1	30.1	30.5
808 or more students	32.0	27.2	26.7	31.0
Total	100.0	100.0	100.0	100.0
Proportion of students who are racial/ethnic minority students[a]				
Mean	44.8	55.4	50.7	46.4
Less than 13 percent	2.3	1.4	2.1	2.2
13–25 percent	27.0	19.7	23.0	25.9
26–51 percent	36.2	26.1	30.9	34.7
52 percent or more	34.5	52.8	44.0	37.2
Total	100.0	100.0	100.0	100.0

(continued)

Table B6. Colorado school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Proportion of students who are eligible for the national school lunch program[a]				
Mean	41.6	53.0	48.0	43.3
Less than 24 percent	34.7	22.1	27.6	32.8
24–45 percent	24.6	18.1	21.5	23.7
46–66 percent	17.3	20.4	18.2	17.7
67 percent or more	23.4	39.5	32.8	25.9
Total	100.0	100.0	100.0	100.0
Proportion of students who are English learner students[a]				
Mean	14.2	20.6	17.7	15.2
Less than 0.3 percent	2.2	1.4	2.7	2.2
0.3–2.1 percent	16.4	11.1	13.0	15.5
2.2–7.9 percent	36.7	27.4	31.4	35.3
8.0 percent or more	44.7	60.0	53.0	47.0
Total	100.0	100.0	100.0	100.0
Average teacher salary[a]				
Mean ($)	52,078	49,158	49,620	51,533
Less than $41,525	12.7	18.6	19.3	14.0
$41.425–$47,727	18.4	22.0	20.6	19.0
$47,728–$55,148	34.3	36.0	34.6	34.4
$55,149 or higher	34.7	23.5	25.5	32.6
Total	100.0	100.0	100.0	100.0
State accountability designation				
Focus school	3.7	8.2	5.9	4.3
Priority school	1.1	4.1	1.7	1.4
None	95.2	87.7	92.4	94.3
Total	100.0	100.0	100.0	100.0
Districts				
Enrollment[a]				
Mean (number of students)	38,991	41,862	41,957	39,595
Fewer than 2,270 students	7.8	7.4	7.8	7.8
2,271–9,500 students	13.1	15.4	14.2	13.4
9,501–24,496 students	18.4	19.2	17.5	18.3
24,497 or more students	60.8	58.1	60.4	60.5
Total	100.0	100.0	100.0	100.0

Note: The number of teachers included in the analysis was 47,192. School characteristics are reported as of 2015/16. Data elements described here were used in multinomial regression models. For continuous variables in which quartiles were used (academic performance, enrollment, proportion of students who are racial/ethnic minority students, proportion of students who are eligible for the national school lunch program, proportion of students who are English learner students, average teacher salary, and district enrollment), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B7. Missouri teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Age[a]				
Mean (years)	40.5	37.2	43.7	40.5
Younger than 32	23.4	36.3	25.1	24.6
32–39	28.8	28.8	21.0	28.1
40–48	26.1	19.9	14.1	24.5
49 or older	21.7	14.9	39.8	22.8
Total	100.0	100.0	100.0	100.0
Gender				
Male	22.3	24.7	21.8	22.4
Female	77.7	75.3	78.2	77.6
Total	100.0	100.0	100.0	100.0
Race/ethnicity				
Racial/ethnic minority	5.7	8.3	9.3	6.2
White	94.3	91.7	90.7	93.8
Total	100.0	100.0	100.0	100.0
Highest educational degree				
Master's degree or higher	60.6	50.2	59.1	59.6
Less than master's degree	39.4	49.8	40.9	40.4
Total	100.0	100.0	100.0	100.0
Salary[a]				
Mean ($)	47,236	42,701	45,645	46,721
Less than $37,898	25.1	37.1	31.2	26.7
$37,898–$44,519	25.5	28.8	23.2	25.5
$44,520–$55,340	25.6	20.8	22.2	24.9
$55,341 or higher	23.8	13.3	23.4	22.9
Total	100.0	100.0	100.0	100.0
Years in the same school				
Fewer than four	45.1	70.7	57.2	48.3
Four or more	54.9	29.3	42.8	51.7
Total	100.0	100.0	100.0	100.0
Years in the same district				
Fewer than four	37.6	59.2	50.4	40.5
Four or more years	62.4	40.8	49.6	59.5
Total	100.0	100.0	100.0	100.0
Full-time equivalency				
Less than .50	6.0	6.5	11.0	6.5
.50 or more	94.0	93.5	89.0	93.5
Total	100.0	100.0	100.0	100.0
Primary grade-level assignment				
Elementary school	36.8	34.4	33.5	36.3
Middle school	29.8	34.9	33.3	30.5
High school	31.1	27.0	29.9	30.7
Other	2.3	3.6	3.3	2.5
Total	100.0	100.0	100.0	100.0

(continued)

Table B7. Missouri teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Primary subject-area assignment				
Special education	8.2	13.2	10.8	8.8

Note: The number of teachers included in the analysis was 58,970. Teacher characteristics are reported as of 2015/16. Data elements described here were used in 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; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2011/12 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B8. Missouri school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Schools				
Rurality				
Rural	29.7	32.1	28.8	29.8
Nonrural	70.3	67.9	71.2	70.2
Total	100.0	100.0	100.0	100.0
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]				
Mean	66.2	60.3	62.2	65.3
Less than 39 percent	5.4	12.1	11.1	6.5
39–55 percent	17.5	23.5	21.2	18.3
56–69 percent	33.6	32.5	30.9	33.3
70 percent or more	43.5	31.9	36.7	41.9
Total	100.0	100.0	100.0	100.0
Grade span				
Elementary school	33.1	31.9	34.0	33.1
Middle school	17.0	17.1	16.1	16.9
High school	26.1	20.8	24.3	25.5
Other	23.7	30.3	25.7	24.4
Total	100.0	100.0	100.0	100.0
Enrollment[a]				
Mean (number of students)	662	553	606	648
Fewer than 344 students	26.3	33.5	29.0	27.1
344–512 students	25.2	27.7	26.5	25.5
513–807 students	23.5	22.0	24.2	23.4
808 or more students	25.0	16.8	20.3	23.9
Total	100.0	100.0	100.0	100.0
Proportion of students who are racial/ethnic minority students[a]				
Mean	25.6	30.8	31.5	26.5
Less than 13 percent	42.0	42.8	37.3	41.7
13–25 percent	24.3	18.4	23.2	23.7
26–51 percent	19.8	16.7	17.8	19.3
52 percent or more	13.9	22.1	21.7	15.3
Total	100.0	100.0	100.0	100.0

(continued)

Table B8. Missouri school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Proportion of students who are eligible for the national school lunch program[a]				
Mean	50.6	59.1	56.5	51.8
Less than 24 percent	18.7	10.7	14.4	17.6
24–45 percent	25.6	21.5	22.0	24.9
46–66 percent	32.1	33.4	31.5	32.2
67 percent or more	23.6	34.4	32.1	25.3
Total	100.0	100.0	100.0	100.0
Proportion of students who are English learner students[a]				
Mean	3.1	3.6	3.6	3.2
Less than 0.3 percent	38.0	40.5	37.1	38.1
0.3–2.1 percent	32.5	29.5	32.2	32.2
2.2–7.9 percent	18.9	17.2	17.6	18.7
8.0 percent or more	10.6	12.8	13.1	11.0
Total	100.0	100.0	100.0	100.0
Average teacher salary[a]				
Mean ($)	48,016	45,614	47,343	47,759
Less than $41,525	28.3	35.6	30.3	29.1
$41.425–$47,727	25.9	29.9	28.5	26.5
$47,728–$55,148	21.1	20.4	20.2	21.0
$55,149 or higher	24.7	14.1	21.0	23.5
Total	100.0	100.0	100.0	100.0
State accountability designation				
Focus school	4.0	9.4	7.2	4.7
Priority school	1.9	3.8	4.2	2.3
None	94.1	86.8	88.6	93.0
Total	100.0	100.0	100.0	100.0
Districts				
Enrollment[a]				
Mean (number of students)	8,077	7,474	8,093	8,029
Fewer than 2,270 students	32.0	36.2	32.2	32.4
2,271–9,500 students	32.2	32.0	35.0	32.4
9,501–24,496 students	33.1	29.4	28.5	32.4
24,497 or more students	2.7	2.4	4.3	2.8
Total	100.0	100.0	100.0	100.0

Note: The number of teachers included in the analysis was 58,970. School characteristics are reported as of 2015/16. Data elements described here were used in multinomial regression models. For continuous variables in which quartiles were used (academic performance, enrollment, proportion of students who are racial/ethnic minority students, proportion of students eligible for the national school lunch program, proportion of students who are English learner students, average teacher salary, and district enrollment), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B9. South Dakota teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Age[a]				
Mean (years)	42.5	38.5	44.3	42.4
Younger than 32	21.7	36.6	28.3	23.3
32–39	24.2	23.6	18.6	23.7
40–48	22.6	18.7	12.1	21.4
49 or older	31.4	21.1	41.0	31.6
Total	100.0	100.0	100.0	100.0
Gender				
Male	23.3	22.6	24.2	23.3
Female	76.7	77.4	75.8	76.7
Total	100.0	100.0	100.0	100.0
Race/ethnicity				
Racial/ethnic minority	3.0	2.4	5.1	3.1
White	97.0	97.6	94.9	96.9
Total	100.0	100.0	100.0	100.0
Highest educational degree				
Master's degree or higher	34.0	28.3	32.7	33.5
Less than master's degree	66.0	71.7	67.3	66.5
Total	100.0	100.0	100.0	100.0
Salary[a]				
Mean ($)	41,611	38,978	40,319	41,310
Less than $37,898	38.0	52.4	46.9	39.8
$37,898–$44,519	30.1	27.3	23.1	29.3
$44,520–$55,340	27.1	18.0	21.0	25.9
$55,341 or higher	4.8	2.3	9.0	5.0
Total	100.0	100.0	100.0	100.0
Years in the same school				
Fewer than four	45.6	71.4	60.6	48.8
Four or more	54.4	28.6	39.4	51.2
Total	100.0	100.0	100.0	100.0
Years in the same district				
Fewer than four	36.8	53.8	52.3	39.3
Four or more	63.2	46.2	47.7	60.7
Total	100.0	100.0	100.0	100.0
Full-time equivalency				
Less than .50	0.5	1.0	2.1	0.7
.50 or more	99.5	99.0	97.9	99.3
Total	100.0	100.0	100.0	100.0
Primary grade-level assignment				
Elementary school	45.5	55.9	43.1	46.1
Middle school	17.7	15.1	18.8	17.6
High school	27.5	14.8	27.5	26.6
Other	9.3	14.1	10.5	9.7
Total	100.0	100.0	100.0	100.0

(continued)

Table B9. South Dakota teacher characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Primary subject-area assignment				
Special education	8.2	13.8	9.7	8.7

Note: The number of teachers included in the analysis was 8,688. Teacher characteristics are reported as of 2015/16. Data elements described here were used in 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; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2011/12 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table B10. South Dakota school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated)

Characteristic	Stayers	Movers	Leavers	Total
Schools				
Rurality				
Rural	45.8	42.0	44.8	45.5
Nonrural	54.2	58.0	55.2	54.5
Total	100.0	100.0	100.0	100.0
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]				
Mean	54.9	49.5	51.5	54.2
Less than 39 percent	13.1	29.6	21.6	15.0
39–55 percent	36.8	37.7	34.8	36.7
56–69 percent	35.6	22.3	28.6	34.0
70 percent or more	14.4	10.4	15.1	14.2
Total	100.0	100.0	100.0	100.0
Grade span				
Elementary school	36.3	47.5	40.3	37.5
Middle school	18.4	16.9	18.6	18.3
High school	29.6	16.7	29.1	28.6
Other	15.7	18.9	12.1	15.6
Total	100.0	100.0	100.0	100.0
Enrollment[a]				
Mean (number of students)	507	488	497	505
Fewer than 344 students	41.8	41.0	40.5	41.7
344–512 students	22.5	23.4	27.0	22.9
513–807 students	21.4	18.5	19.5	21.0
808 or more students	14.3	17.1	13.0	14.4
Total	100.0	100.0	100.0	100.0
Proportion of students who are racial/ethnic minority students[a]				
Mean	24.8	29.5	30.1	25.6
Less than 13 percent	33.9	32.5	28.2	33.3
13–25 percent	32.5	23.4	30.5	31.7
26–51 percent	21.2	18.4	23.0	21.1
52 percent or more	12.4	25.7	18.3	13.9
Total	100.0	100.0	100.0	100.0

(continued)

Table B10. South Dakota school and district characteristics in the analytic sample for the final model (percent, unless otherwise indicated) *(continued)*

Characteristic	Stayers	Movers	Leavers	Total
Proportion of students who are eligible for the national school lunch program[a]				
Mean	38.3	45.3	43.4	39.3
Less than 24 percent	29.5	25.9	27.1	29.0
24–45 percent	43.9	32.2	39.1	42.7
46–66 percent	15.6	14.1	14.8	15.4
67 percent or more	11.0	27.8	19.0	12.9
Total	100.0	100.0	100.0	100.0
Proportion of students who are English learner students[a]				
Mean	3.0	7.5	3.0	3.3
Less than 0.3 percent	36.5	29.4	35.8	35.9
0.3–2.1 percent	37.8	33.3	38.1	37.5
2.2–7.9 percent	16.8	13.7	17.0	16.6
8.0 percent or more	9.0	23.6	9.1	10.1
Total	100.0	100.0	100.0	100.0
Average teacher salary[a]				
Mean ($)	42,140	41,449	41,827	42,063
Less than $41,525	47.5	49.6	52.1	48.1
$41.425–$47,727	42.7	46.8	38.6	42.6
$47,728–$55,148	9.8	3.6	9.4	9.3
$55,149 or higher	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
State accountability designation				
Focus school	2.8	4.6	4.2	3.0
Priority school	2.3	2.8	6.8	2.7
None	94.9	92.7	89.1	94.3
Total	100.0	100.0	100.0	100.0
Districts				
Enrollment[a]				
Mean (number of students)	6,452	6,446	6,674	6,471
Fewer than 2,270 students	49.0	45.2	51.6	49.0
2,271–9,500 students	25.3	30.6	18.4	25.0
9,501–24,496 students	25.7	24.2	30.0	26.0
24,497 or more students	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0

Note: The number of teachers included in the analysis was 8,688. School characteristics are reported as of 2015/16. Data elements described here were used in multinomial regression models. For continuous variables in which quartiles were used (academic performance, enrollment, proportion of students who are racial/ethnic minority students, proportion of students who are eligible for the national school lunch program, proportion of students who are English learner students, average teacher salary, and district enrollment), means are also presented to aid interpretation. Percentages may not sum to 100 because of rounding.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category. In South Dakota no teachers were in the highest quartile for school average teacher salary or the largest category of district enrollment.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Analysis methods

Using IBM SPSS Statistics software, Version 21.0, the study team analyzed the combined data for Colorado, Missouri, and South Dakota. Rates of classroom teacher retention, mobility, and attrition were calculated to examine the proportions of classroom teachers who remained in a classroom teaching position in the same school, those who transferred to a classroom teaching position in a different school or district, and those who took a nonteaching position or left their state public school system. Data for 2015/16 and 2016/17 were used for these analyses, which involved the same approach as that to identify stayers, movers, and leavers (described in the "Data preparation" section above). Proportions of stayers, movers, and leavers were calculated by dividing the number of teachers in each group in 2016/17 by the total number of teachers in 2015/16. Each teacher was counted as one teacher in the analysis, regardless of full-time equivalency. Multinomial logistic regression models were conducted to identify the extent to which characteristics of teachers, schools, and districts were related to classroom teacher retention, mobility, and attrition. The dependent variable included three categories: stayers, movers, and leavers as identified in the "Data preparation" section above. Explanatory variables included teacher, school, and district characteristics. Multinomial logistic regression, which uses maximum likelihood estimation, was selected because of its capability to incorporate multiple types of employment status change as the dependent variable in a single model. This approach allows for examination of characteristics associated with mobility and attrition for all teachers, yielding easily interpretable coefficients (relative risk ratios) that represent the likelihood of being in one of two focal categories (movers and leavers) relative to a reference category (stayers).

Sample characteristics and model assumptions were examined prior to model building and identification of the final model. Preliminary relationships between explanatory variables and teacher retention, mobility, and attrition were examined using descriptive statistics. Correlations were calculated among continuous explanatory variables and cross-tabulations among categorical explanatory variables. 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. 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 report. In other words, the study prioritized school characteristics when school and district characteristics were highly correlated.

To aid interpretability and understanding of the shape of the relationship between continuous variables and relative risk ratios, quartiles were calculated for the continuous variables (teacher age, teacher salary, school proportion of students scoring proficient or better on the state English language arts assessment, school enrollment, school proportion of students who are racial/ethnic minority students, school proportion of students who are eligible for the national school lunch program, school proportion of students who are English learner students, and school average teacher salary). Teacher full-time equivalency was split into two categories, using .50 full-time equivalent to distinguish teachers who taught less than half time and those who taught more than half time in Colorado and South Dakota. Because time in assignment is recorded in minutes for Missouri teachers,

1,050 minutes was used as a cut-off representing half of the 2,100 minutes per week associated with full-time teaching in the state.

Explanatory variables were introduced into models hierarchically, beginning with teacher characteristics, then introducing school characteristics, and finally adding district characteristics. All models controlled for state and included an indicator of school rurality. Each model was tested against a null, or empty model, and found to be a better fit than an empty model. As models were nested, model fit indices also were examined to identify whether the addition of teacher, school, and district characteristics improved the explanatory value of the model. If the addition of variables did not yield improved model fit or statistically significant associations with outcomes, they were removed. Significance values of each of the explanatory variables were examined and used to remove explanatory variables that were not significantly related to the outcome. A liberal threshold ($p < .10$) and a stringent threshold ($p < .05$) were tested. The stringent threshold yielded a model with 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 below (table B11).

The main text presents findings for associations that were statistically significant in the final three-state model. 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 C. A threshold of at least 30 percent relative risk was used to determine the characteristics that were most strongly associated with likelihood of moving or leaving. Among continuous variables that were categorized into quartiles, if at least one quartile group exceeded the 30 percent threshold, the variable was described as one that was most strongly associated, and only the categories for which significant differences were found appear in tables in the body of the report.

The final analytic model was replicated using data for each state. Relative risk ratios from these state-specific models may be directly compared within states but not across states. State-specific findings are presented in appendixes D–F.

Table B11. Data elements included in hierarchical multinomial logistic regression models

Data element	Model 1 teacher characteristics	Model 2 teacher and school characteristics	Model 3 teacher, school, and district characteristics	Model 4 trimmed (cutoff $p < .10$)	Final model Model 5 trimmed (cutoff $p < .05$)
Teacher characteristics					
Colorado		✔	✔	✔	✔
Missouri	✔	✔	✔	✔	✔
South Dakota	✔	✔	✔	✔	✔
Age[a]	✔	✔	✔	✔	✔
Gender	✔	✔	✔	✔	✔
Racial/ethnic minority	✔	✔	✔	—	—
Master's degree or higher	✔	✔	✔	✔	✔
Salary[a]	✔	✔	✔	✔	✔
Fewer than four years in the same school	✔	✔	✔	✔	✔
Fewer than four years in the same district	✔	✔	✔	✔	✔
.50 or more full-time equivalent	✔	✔	✔	✔	✔
Primary grade level (elementary school, middle school, high school, other)	✔	✔	✔	✔	Elementary school only
Special education assignment	✔	✔	✔	✔	✔
School characteristics					
Rurality	✔	✔	✔	✔	✔
Proportion of students scoring proficient or better on the state English language arts assessment[a]	—	✔	✔	✔	✔
Grade span	—	✔	✔	✔	✔
Enrollment[a]	—	✔	✔	✔	✔
Proportion of students who are racial/ethnic minority students[a]	—	✔	✔	✔	✔
Proportion of students who are eligible for the national school lunch program[a]	—	✔	✔	✔	✔
Proportion of students who are English learner students[a]	—	✔	✔	✔	✔
Average teacher salary[a]	—	✔	✔	✔	✔
State accountability designation (focus or priority school)	—	✔	✔	✔	✔
District characteristics					
District enrollment[a]	—	—	✔	—	—

— was not examined in the specified model.

a. Continuous variables were transformed into quartiles.

Source: Authors' analysis of 2011/12 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

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

This appendix presents results from the final three-state multinomial logistic regression analysis model. The final model produces 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 in the three-state combined model. Teacher and school characteristics are presented separately.

Results from multinomial logistic regression models for Colorado, Missouri, and South Dakota combined and guidance for interpreting relative risk ratios

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

A value of one indicates that the explanatory variable is not associated with a difference in likelihood of participants being movers or leavers. A value greater than one indicates that the explanatory variable is associated with increased likelihood of being a mover or leaver, while a value less than one indicates that an explanatory variable is associated with a decreased likelihood. For each teacher 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 and allows the comparison of male and female teachers (see example 1 below). Two examples from the analysis results are provided below: one to demonstrate the interpretation of a relative risk ratio when the explanatory variable has two categories (for example, gender) and one to demonstrate the interpretation of a relative risk ratio when the explanatory variable has more than two categories (for example, age quartiles).

Example 1. Results show the relationship of gender to the likelihood of moving rather than staying and leaving rather than staying (table C1). When movers were examined relative to stayers, the relative risk ratio of 1.132 indicated that male teachers were 13.2 percent [(1.132 − 1.0) × 100] more likely to be movers than were female teachers, all other variables held constant. When leavers were examined relative to stayers, a relative risk ratio of 0.925 indicated that male teachers were 7.5 percent [(1.0 − 0.925) × 100] less likely to be leavers than were female teachers, with all other variables held constant.

Example 2. Results show the relationship of age to the likelihood of moving rather than staying and leaving rather than staying (see table C1). Teacher age was categorized into quartiles to aid interpretability of coefficients. The quartiles were younger than 32, ages

32–39, ages 40–48, and age 49 or older. As in example 1, a reference group is used as a basis for describing relative risk. In this case, the oldest group (49 or older) was the reference group. All other age groups were compared with the reference group. When examining the likelihood that teachers would be movers and not stayers, teachers younger than 32 had a relative risk ratio of 1.416. This indicates that teachers younger than 32 were 41.6 percent [(1.416 − 1.0) × 100] more likely to be movers compared with teachers age 49 or older.

Teachers ages 32–39 were 30.5 percent [(1.305 − 1.0) × 100] more likely to be movers than were teachers age 49 or older. Teachers ages 40–48 were 14.1 percent [(1.141 − 1.0) × 100] more likely to be movers than were teachers age 49 or older.

Table C1. Combined Colorado, Missouri, and South Dakota teacher characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
State		
Colorado	1.050	1.289***
Missouri	1.185*	1.108*
South Dakota	na	na
Age[a]		
Younger than 32	1.416***	0.530***
32–39	1.305***	0.471***
40–48	1.141***	0.368***
49 or older	na	na
Gender		
Male	1.132***	0.925**
Highest educational degree		
Master's degree or higher	1.095**	1.189***
Salary[a]		
Less than $37,898	1.283***	1.345***
$37,898–$44,519	1.191***	1.074
$44,520–$55,340	1.144**	1.047
$55,341 or higher	na	na
Years in the same school		
Fewer than four	1.578***	1.144***
Years in the same district		
Fewer than four	0.964	1.359***
Full-time equivalency		
Less than .50	1.067	1.412***
Primary grade-level assignment		
Elementary school	0.882***	0.808***
Primary subject-area assignment		
Special education	1.718***	1.107**

(continued)

Table C1. Combined Colorado, Missouri, and South Dakota teacher characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17 *(continued)*

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 114,850. This analysis controls for state. School-level characteristics were entered in the same model, and results for those characteristics are presented in table C2. The table does not list reference groups for the following dichotomous teacher characteristic categories: male versus female, master's degree or higher versus less than master's degree, fewer than four years in the same school versus four or more years in the same school, fewer than four years in the same district versus four or more years in the same district, less than .50 full-time equivalent versus .50 or more full-time equivalent, elementary school assignment versus all other grade-level assignments, and special education assignment versus all other subject-area assignments. This model was an improvement over the null model, –2 log likelihood = 105,295.813, $p < .001$.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Table C2. Combined Colorado, Missouri, and South Dakota school characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Rurality		
Rural	0.895**	0.868***
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]		
Less than 39 percent	1.189**	1.014
39–55 percent	1.064	0.987
56–69 percent	0.972	0.925*
70 percent or more	na	na
Grade span		
Elementary school	na	na
Middle school	1.045	0.860***
High school	0.825***	0.888**
Other	1.108**	0.989
Enrollment[a]		
Fewer than 344 students	1.050	1.120**
344–512 students	1.012	1.158***
513–807 students	0.935	1.116**
808 or more students	na	na
Proportion of students who are racial/ethnic minority students[a]		
Less than 13 percent	0.879*	0.682***
13–25 percent	0.802***	0.834***
26–51 percent	0.756***	0.800***
52 percent or more	na	na
Proportion of students who are eligible for the national school lunch program[a]		
Less than 24 percent	0.833**	0.926
24–45 percent	0.852***	0.922*
46–66 percent	0.935	0.927*
67 percent or more	na	na
Proportion of students who are English learner students[a]		
Less than 0.3 percent	0.823***	1.014
0.3–2.1 percent	0.834***	0.987
2.2–7.9 percent	0.867***	0.925*
8.0 percent or more	na	na
Average teacher salary[a]		
Less than $41,525	1.470***	1.345***
$41.525–$47,727	1.340***	1.213***
$47,728–$55,148	1.215***	1.111**
$55,149 or higher	na	na
State accountability designation		
Focus school	1.486***	1.226***
Priority school	1.513***	1.358***
None	na	na

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 114,850. This analysis controls for state. The table does not list a reference group for the dichotomous school characteristic rural versus nonrural. This model was an improvement over the null model, –2 log likelihood = 105,295.813, $p < .001$.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Appendix D. Results from multinomial logistic regression models for Colorado

State-specific analytic models were developed to document patterns of the relationships between teacher and school characteristics and the likelihood that teachers would be movers or leavers rather than stayers. This appendix presents results from the state-specific multinomial logistic regression analysis model for Colorado. A description of the Colorado sample is provided to contextualize the findings, followed by the findings from the model.

In 2015/16 the mean teacher age in Colorado was 41 years, 76 percent of teachers were female, 12 percent were racial/ethnic minorities, and 55 percent had a master's degree or higher. The mean salary was $50,394, 44 percent of teachers had been teaching in the same school for four or more years, 53 percent had been teaching in the same district for four or more years, and 98 percent worked half time or more. About 47 percent of teachers had a primary grade-level assignment of elementary school, 22 percent had a primary grade-level assignment of middle school, 24 percent had a primary grade-level assignment of high school, and 7 percent had a nontraditional grade assignment (see table B5 in appendix B).

In 2015/16, 87 percent of Colorado schools were nonrural. Approximately 40 percent of students scored proficient or better on the state English language arts assessment. About 35 percent were elementary schools, 17 percent were middle schools, 22 percent were high schools, and 26 percent had a nontraditional grade band. Average school enrollment was 792 students, and average district enrollment was 39,595 students. On average, 46 percent of students were racial/ethnic minority students, 43 percent were eligible for the national school lunch program, and 15 percent were English learner students. The mean teacher salary across schools was $51,533. About 6 percent of schools were identified by the Colorado Department of Education for focus or priority improvement due to low student achievement (see table B6 in appendix B).

In Colorado, special education teachers, teachers who had been teaching in the same school for fewer years, and teachers with lower salaries were more likely than teachers without these characteristics to be movers rather than stayers

Among the Colorado teacher characteristics examined, primary subject-area assignment, years teaching in the school, and salary were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table D1). Special education teachers were 104 percent more likely to be movers than were other teachers. Teachers who had been teaching in the same school for fewer than four years were 49 percent more likely to be movers than were teachers who had been teaching in the same school for four or more years. And compared with teachers with a salary of $55,341 or higher, teachers with lower salaries were more likely to be movers. The largest difference was for teachers with a salary of less than $37,898, who were 37 percent more likely to be movers than teachers with a salary of $55,341 or higher.

Other Colorado teacher characteristics were less strongly associated with the likelihood of moving rather than staying. Teachers who were younger than 49, teachers who had been teaching in the same district for fewer years, teachers whose primary grade-level assignment was not elementary school, and teachers who had a master's degree or higher were also more likely to be movers (see table D1).

Table D1. Colorado teacher characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Age[a]		
Younger than 32	1.215**	0.622***
32–39	1.273***	0.577***
40–48	1.181**	0.447***
49 or older	na	na
Gender		
Male	1.023	0.855***
Highest educational degree		
Master's degree or higher	1.122**	1.229***
Salary[a]		
Less than $37,898	1.372***	1.651***
$37,898–$44,519	1.267***	1.266***
$44,520–$55,340	1.237***	1.192***
$55,341 or higher	na	na
Years in the same school		
Fewer than four	1.490***	0.835**
Years in the same district		
Fewer than four	1.204***	0.705***
Full-time equivalency		
Less than .50	1.180	0.485***
Primary grade-level assignment		
Elementary school	0.871*	0.918
Primary subject-area assignment		
Special education	2.041***	1.115*

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 47,192. School-level characteristics were entered in the same model, and results for those characteristics are presented in table D2. The table does not list reference groups for the following dichotomous teacher characteristic categories: male versus female, master's degree or higher versus less than master's degree, fewer than four years in the same school versus four or more years in the same school, fewer than four years in the same district versus four or more years in the same district, less than .50 full-time equivalent versus .50 or more full-time equivalent, elementary school assignment versus all other grade-level assignments, and special education assignment versus all other subject-area assignments.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

In Colorado, teachers with lower salaries, older teachers, teachers who worked half time or more, and teachers who had been teaching in the same district for longer were more likely than teachers without these characteristics to be leavers rather than stayers

Among the Colorado teacher characteristics examined, salary, age, full-time equivalency, and years teaching in the same district were most strongly associated with teachers leaving rather than staying between 2015/16 and 2016/17 (see table D1). Compared with teachers with a salary $55,341 or higher, teachers with lower salaries were more likely to be leavers. The largest difference was for teachers with a salary of less than $37,898, who were 65 percent more likely to be leavers than those with a salary of $55,341 or higher.

Teachers age 49 or older were more likely to be leavers than were younger teachers. The largest difference was for teachers ages 40–48: teachers age 49 or older were 55 percent more likely to be leavers than were teachers ages 40–48. Teachers who worked half time or more were 52 percent more likely to be leavers than were teachers who worked less than half time. And teachers who had been teaching in the same district for four or more years were 30 percent more likely to be leavers than were teachers who had been teaching in the same district for fewer than four years.

Other Colorado teacher characteristics were less strongly associated with the likelihood of leaving rather than staying. Teachers who had a master's degree or higher, teachers who had been teaching in the same school for four or more years, female teachers, and special education teachers were also more likely to be leavers (see table D1).

In Colorado, teachers in schools identified by the Colorado Department of Education for improvement and teachers in schools with higher proportions of English learner students, lower academic achievement, lower average teacher salaries, or higher proportions of students eligible for the national school lunch program were more likely than teachers in schools without these characteristics to be movers rather than stayers

Among the Colorado school characteristics examined, state accountability designation, proportion of English learner students, proportion of students scoring proficient or better on the state English language arts assessment, average teacher salary, and proportion of students eligible for the national school lunch program were most strongly associated with teachers moving rather than staying between 2015/16 and 2016/17 (table D2). Teachers in schools identified by the Colorado Department of Education for priority improvement due to low student achievement were 152 percent more likely to be movers than were teachers in schools not identified for improvement. Teachers in schools identified by the Colorado Department of Education for focus improvement due to low student achievement were 52 percent more likely to be movers than were teachers in schools not identified for improvement.

Teachers in schools with a higher proportion of English learner students were also more likely to be movers rather than stayers (see table D2). The largest difference was for teachers in schools in which English learner students accounted for less than 0.3 percent of enrollment. Compared with that group, teachers in schools in which English learner students accounted for 8 percent or more of enrollment were 44 percent more likely to be movers. Compared with teachers in schools in which 70 percent or more of students scored proficient or better on the state English language arts assessment, teachers in schools in which a lower proportion of students scored proficient or better were more likely to be movers. The largest difference was for teachers in schools in which 56–69 percent of students scored proficient or better: those teachers were 41 percent more likely to be movers than were teachers in schools in which 70 percent or more of students scored proficient or better. The proportion of students eligible for the national school lunch program was also related to the likelihood of teachers being movers: a higher proportion of eligible students was associated with a greater likelihood of being a mover. The largest difference was for teachers in schools in which 67 percent or more of students were eligible: those teachers were 32 percent more likely to be movers than were teachers in schools in which less than 24 percent of students were eligible.

Table D2. Colorado school characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Rurality		
Rural	0.883*	0.784***
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]		
Less than 39 percent	1.342*	1.015
39–55 percent	1.257*	1.089
56–69 percent	1.409**	1.140
70 percent or more	na	na
Grade span		
Elementary school	na	na
Middle school	1.122	1.012
High school	0.835*	1.034
Other	1.216**	1.180***
Enrollment[a]		
Fewer than 344 student	1.041	1.161**
344–512 students	1.001	1.121*
513–807 students	0.941	1.063
808 or more students	na	na
Proportion of students who are racial/ethnic minority students[a]		
Less than 13 percent	0.891	1.010
13–25 percent	1.004	0.975
26–51 percent	0.829**	0.901*
52 percent or more	na	na
Proportion of students who are eligible for the national school lunch program[a]		
Less than 24 percent	0.685***	0.755***
24–45 percent	0.750***	0.796***
46–66 percent	0.937	0.839***
67 percent or more	na	na
Proportion of students who are English learner students[a]		
Less than 0.3 percent	0.560***	0.815
0.3–2.1 percent	0.774**	0.754***
2.2–7.9 percent	0.829***	0.865**
8.0 percent or more	na	na
Average teacher salary[a]		
Less than $41,525	1.319***	1.366***
$41.525–$47,727	1.219**	1.189***
$47,728–$55,148	1.168**	1.164***
$55,149 or higher	na	na
State accountability designation		
Focus school	1.517***	1.218**
Priority school	2.523***	1.207
None	na	na

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 47,192. The table does not list a reference group for the dichotomous school characteristic rural versus nonrural.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

Compared with teachers in schools with an average salary of $55,149 or higher, teachers in schools with a lower salary were more likely to be movers rather than stayers (see table D2). The largest difference was for teachers in schools with an average salary of less than $41,525, who were 32 percent more likely to be movers than were teachers in schools with an average salary of $55,149 or higher.

Other Colorado school characteristics were less strongly associated with the likelihood of moving rather than staying. Teachers in schools that did not have a traditional elementary, middle, or high school configuration were more likely to be movers than were teachers in elementary schools, while teachers in elementary schools were more likely to be movers than were teachers in high schools (see table D2). Teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for 26–51 percent of enrollment. And teachers in nonrural schools were also more likely to be movers.

In Colorado, teachers in schools with low average teacher salaries were more likely to be leavers rather than stayers

Among the Colorado school characteristics examined, average teacher salary was most strongly associated with teachers leaving rather than staying between 2015/16 and 2016/17 (see table D2). Compared with teachers in schools with an average salary of $55,149 or higher, teachers with lower salaries were more likely to be movers. The largest difference was for teachers in schools with an average salary of less than $41,525: those teachers were 37 percent more likely to be leavers than were teachers in schools with an average salary of $55,149 or higher.

Other Colorado school characteristics were less strongly associated with the likelihood of leaving rather than staying. Teachers in schools in which English learner students accounted for 8 percent or more of enrollment were more likely to be leavers than were teachers in schools in which English learner students accounted for 0.3–7.9 percent of enrollment (see table D2). Teachers in schools in which 67 percent or more of students were eligible for the national school lunch program were more likely to be leavers than were teachers in schools with a lower proportion of eligible students. Teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for 26–51 percent of enrollment. Teachers in schools identified by the Colorado Department of Education for focus improvement due to low student achievement were also more likely to be leavers than were teachers in schools not identified for improvement. Teachers in nonrural schools were more likely to be leavers than were teachers in rural schools. Teachers in schools that did not have a traditional elementary, middle, or high school configuration were more likely to be leavers than were teachers in elementary schools. And teachers in schools with fewer than 513 students were more likely to be leavers than were teachers in schools with 808 or more students.

Appendix E. Results from multinomial logistic regression models for Missouri

State-specific analytic models were developed to document patterns of the relationships between teacher and school characteristics and the likelihood that teachers would be movers or leavers rather than stayers. This appendix presents results from the state-specific multinomial logistic regression analysis model for Missouri. A description of the Missouri sample is provided to contextualize the findings, followed by the findings from the model.

In 2015/16 the mean teacher age in Missouri was 41 years, 78 percent of teachers were female, 6 percent were racial/ethnic minorities, and 60 percent had a master's degree or higher. The mean salary was $46,721, 52 percent of teachers had been teaching in the same school for four or more years, 60 percent had been teaching in the same district for four or more years, and 94 percent worked half time or more. About 36 percent of teachers had a primary grade-level assignment of elementary school, 31 percent had a primary grade-level assignment of middle school, 31 percent had a primary grade-level assignment of high school, and 3 percent had a nontraditional grade assignment (see table B7 in appendix B).

In 2015/16, 70 percent of Missouri schools were nonrural. Approximately 65 percent of students scored proficient or better on the state English language arts assessment. About 33 percent were elementary schools, 17 percent were middle schools, 26 percent were high schools, and 24 percent had a nontraditional grade band. Average school enrollment was 648 students, and average district enrollment was 8,029 students. On average, 27 percent of students were racial/ethnic minority students, 52 percent were eligible for the national school lunch program, and 3 percent were English learner students. The mean teacher salary across schools was $47,759. About 7 percent of schools were identified by the Missouri Department of Elementary and Secondary Education for focus or priority improvement due to low student achievement (see table B8 in appendix B).

In Missouri, teachers who had been teaching in the same school for fewer years, younger teachers, and special education teachers were more likely than teachers without these characteristics to be movers rather than stayers

Among the Missouri teacher characteristics examined, years teaching in the same school, age, and primary subject-area assignment were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table E1). Teachers who had been teaching in the same school for fewer than four years were 61 percent more likely to be movers than were teachers who had been teaching in the same school for four or more years. Younger teachers were more likely to be movers than were older teachers. The largest difference was for teachers younger than 32, who were 58 percent more likely to be movers than were teachers age 49 or older. And special education teachers were 46 percent more likely to be movers than were other teachers.

Other Missouri teacher characteristics were less strongly associated with the likelihood of moving rather than staying. Teachers who had been teaching in the same district for four or more years, male teachers, and teachers whose primary grade-level assignment was not elementary school were also more likely to be movers (see table E1).

Table E1. Missouri teacher characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Age[a]		
Younger than 32	1.584***	0.446***
32–39	1.351***	0.382***
40–48	1.117*	0.298***
49 or older	na	na
Gender		
Male	1.192***	1.002
Highest educational degree		
Master's degree or higher	1.048	1.127**
Salary[a]		
Less than $37,898	1.163	1.070
$37,898–$44,519	1.098	0.897
$44,520–$55,340	1.054	0.921
$55,341 or higher	na	na
Years in the same school		
Fewer than four	1.612***	0.932
Years in the same district		
Fewer than four	0.798**	0.580***
Full-time equivalency		
Less than .50	1.039	0.636***
Primary grade-level assignment		
Elementary school	0.819***	0.750***
Primary subject-area assignment		
Special education	1.463***	1.136*

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 58,970. School-level characteristics were entered in the same model, and results for those characteristics are presented in table E2. The table does not list reference groups for the following dichotomous teacher characteristic categories: male versus female, master's degree or higher versus less than master's degree, fewer than four years in the same school versus four or more years in the same school, fewer than four years in the same district versus four or more years in the same district, less than .50 full-time equivalent versus .50 or more full-time equivalent, elementary school assignment versus all other grade-level assignments, and special education assignment versus all other subject-area assignments.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

In Missouri, older teachers, teachers who had been teaching in the same district for longer, and teachers who worked half time or more were more likely than teachers without these characteristics to be leavers rather than stayers

Among the Missouri teacher characteristics examined, age, years teaching in the same district, and full-time equivalency were most strongly associated with leaving rather than staying between 2015/16 and 2016/17 (see table E1). Older age was associated with a greater likelihood of being a leaver. The largest difference was for teachers ages 40–48: teachers age 49 or older were 70 percent more likely to be movers than were teachers ages 40–48. Teachers who had been teaching in the same district for four or more years were 42 percent

more likely to be leavers than were teachers who had been teaching in the same district for fewer than four years. And teachers who worked half time or more were 36 percent more likely to be leavers than were teachers who worked less than half time.

Other Missouri teacher characteristics were less strongly associated with the likelihood of leaving rather than staying. Teachers whose primary grade-level assignment was not elementary school, special education teachers, and teachers who had a master's degree or higher were also more likely to be leavers (see table E1).

In Missouri, teachers in schools with lower average teacher salaries, teachers in schools identified by the Missouri Department of Elementary and Secondary Education for focus improvement, teachers in schools with lower academic achievement, and teachers in schools with higher proportions of racial/ethnic minority students were more likely than teachers in schools without these characteristics to be movers rather than stayers

Among the Missouri school characteristics examined, average teacher salary, state accountability designation, proportion of students scoring proficient or better on the state English language arts assessment, and proportion of racial/ethnic minority students were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table E2). Compared with teachers in schools with an average salary of $55,149 or higher, teachers in schools with lower salaries were more likely to be movers. The largest difference was for teachers in schools with an average salary of less than $41,525: those teachers were 69 percent more likely to be movers than were teachers in schools with an average salary of $55,149 or higher. Teachers in schools identified by the Missouri Department of Elementary and Secondary Education for focus improvement due to low student achievement were 50 percent more likely to be movers than were teachers in schools not identified for improvement.

Compared with teachers in schools in which 70 percent or more of students scored proficient or better on the state English language arts assessment, teachers in schools in which less than 56 percent of students scored proficient or better were more likely to be movers (see table E2). The largest difference was for teachers in schools in which less than 39 percent of students scored proficient or better: these teachers were 35 percent more likely to be movers than were teachers in schools in which 70 percent or more of students scored proficient or better. Finally, teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were more likely to be movers than were teachers in schools with a lower proportion of racial/ethnic minority students. The largest difference was for teachers in schools in which racial/ethnic minority students accounted for 13–25 percent of enrollment: teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were 33 percent more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for 13–25 percent of enrollment.

One other Missouri school characteristic was less strongly associated with the likelihood of moving rather than staying. Teachers in schools with fewer than 513 students were more likely to be movers than were teachers in schools with 808 or more students (see table E2).

Table E2. Missouri school characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Rurality		
Rural	0.975	1.023
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]		
Less than 39 percent	1.346**	1.455***
39–55 percent	1.146*	1.145*
56–69 percent	0.980	0.972
70 percent or more	na	na
Grade span		
Elementary school	na	na
Middle school	1.010	0.743***
High school	0.917	0.831**
Other	1.049	0.823***
Enrollment[a]		
Fewer than 344 students	1.248**	1.099
344–512 students	1.243***	1.162**
513–807 students	1.106	1.194**
808 or more students	na	na
Proportion of students who are racial/ethnic minority students[a]		
Less than 13 percent	0.705***	0.649***
13–25 percent	0.673***	0.813**
26–51 percent	0.722***	0.740***
52 percent or more	na	na
Proportion of students who are eligible for the national school lunch program[a]		
Less than 24 percent	0.971	1.003
24–45 percent	1.006	1.046
46–66 percent	1.001	1.035
67 percent or more	na	na
Proportion of students who are English learner students[a]		
Less than 0.3 percent	1.008	0.997
0.3–2.1 percent	1.023	1.062
2.2–7.9 percent	1.047	0.966
8.0 percent or more	na	na
Average teacher salary[a]		
Less than $41,525	1.688***	1.267**
$41.525–$47,727	1.487***	1.195**
$47,728–$55,148	1.327***	1.009
$55,149 or higher	na	na
State accountability designation		
Focus school	1.496***	1.097
Priority school	1.085	1.092
None	na	na

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 58,970. The table does not list a reference group for the dichotomous school characteristic rural versus nonrural.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

In Missouri, teachers in schools with lower academic performance and teachers in schools with higher proportions of racial/ethnic minority students were more likely than teachers in schools without these characteristics to be leavers rather than stayers

Among the Missouri school characteristics examined, academic performance and proportion of racial/ethnic minority students were most strongly associated with leaving rather than staying between 2015/16 and 2016/17 (see table E2). Compared with teachers in schools in which 70 percent of students scored proficient or better on the state English language arts assessment, teachers in schools in which less than 56 percent of students scored proficient or better were more likely to be leavers. The largest difference was for teachers in schools in which less than 39 percent of students scored proficient or better: those teachers were 46 percent more likely to be leavers than were teachers in schools in which 70 percent or more of students scored proficient or better. And teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were more likely to be leavers than were teachers in schools with a lower proportion of racial/ethnic minority students. The largest difference was for teachers in schools in which racial/ethnic minority students accounted for less than 13 percent of enrollment: teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment were 35 percent more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for less than 13 percent of enrollment.

Other Missouri school characteristics were less strongly associated with the likelihood of leaving. Teachers in schools with an average salary of less than $47,728 were more likely than teachers in schools with average salaries of $55,149 or higher to be leavers (see table E2). Teachers in elementary schools were more likely to be leavers than were teachers in middle schools, high schools, or schools that did not have a traditional elementary, middle, or high school configuration. And teachers in schools with 344–807 students were more likely to be leavers than were teachers in schools with 808 or more students.

Appendix F. Results from multinomial logistic regression models for South Dakota

State-specific analytic models were developed to document patterns of the relationships between teacher and school characteristics and the likelihood that teachers would be movers or leavers rather than stayers. This appendix presents results from the state-specific multinomial logistic regression analysis model for South Dakota. A description of the South Dakota sample is provided to contextualize the findings, followed by the findings from the model.

In 2015/16 the mean age of South Dakota teachers was 42 years, 77 percent of teachers were female, 3 percent were racial/ethnic minorities, and 34 percent had a master's degree or higher. The mean salary was $41,310, 51 percent of teachers had been teaching in the same school for four or more years, 61 percent had been teaching in the same district for four or more years, and 99 percent of teachers taught half time or more. About 46 percent of teachers had a primary grade-level assignment of elementary school, 18 percent had a primary grade-level assignment of middle school, 27 percent had a primary grade-level assignment of high school, and 10 percent had a nontraditional grade-level assignment (see table B9 in appendix B).

In 2015/16, 46 percent of South Dakota schools were rural. Approximately 54 percent of students scored proficient or better on the state English language arts assessment. About 38 percent of schools were elementary schools, 18 percent were middle schools, 29 percent were high schools, and 16 percent had a nontraditional grade band. Average school enrollment was 505 students, and average district enrollment was 6,471 students. On average, 26 percent of students were racial/ethnic minority students, 39 percent were eligible for the national school lunch program, and 3 percent were English learner students. The mean teacher salary across schools was $42,063. About 6 percent of schools were identified by the South Dakota Department of Education for focus or priority improvement due to low student achievement (see table B10 in appendix B).

In South Dakota, special education teachers, teachers who had been teaching in the same district for longer, teachers who had been teaching in the same school for fewer years, teachers who worked less than half time, younger teachers, and male teachers were more likely than teachers without these characteristics to be movers rather than stayers

Among the South Dakota teacher characteristics examined, primary subject-area assignment, years of teaching in the same district and in the same school, full-time equivalency, age, and gender were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table F1). Special education teachers were 128 percent more likely to be movers than were other teachers. Teachers who had been teaching in the same district for four or more years were 68 percent more likely to be movers than were teachers who had been teaching in the same district for fewer than four years. Teachers who had been teaching in the same school for fewer than four years were 65 percent more likely to be movers than were teachers who had been teaching in the same school for four or more years. Teachers who worked less than half time were 62 percent more likely to be movers than were teachers who worked half time or more. Teachers who were younger than 32 were 49 percent more likely to be movers than were teachers age 49 or older. And male teachers were 30 percent more likely to be movers than were female teachers. No other teacher characteristics were associated with moving in South Dakota.

Table F1. South Dakota teacher characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Age[a]		
Younger than 32	1.486*	0.586***
32–39	1.045	0.476***
40–48	1.074	0.384***
49 or older	na	na
Gender		
Male	1.304*	1.045
Highest educational degree		
Master's degree or higher	1.087	1.002
Salary[a]		
Less than $37,898	1.677	0.533**
$37,898–$44,519	1.466	0.468***
$44,520–$55,340	1.080	0.473***
$55,341 or higher	na	na
Years in the same school		
Fewer than four	1.653***	0.804
Years in the same district		
Fewer than four	0.318***	0.562***
Full-time equivalency		
Less than .50	1.617*	0.266***
Primary grade-level assignment		
Elementary school	1.478	0.561**
Primary subject-area assignment		
Special education	2.275***	0.849

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 8,688. School-level characteristics were entered in the same model, and results for those characteristics are presented in table F2. The table does not list reference groups for the following dichotomous teacher characteristic categories: male versus female, master's degree or higher versus less than master's degree, fewer than four years in the same school versus four or more years in the same school, fewer than four years in the same district versus four or more years in the same district, less than .50 full-time equivalent versus .50 or more full-time equivalent, elementary school assignment versus all other grade-level assignments, and special education assignment versus all other subject-area assignments.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

In South Dakota, teachers who worked half time or more, older teachers, teachers with higher salaries, teachers who did not teach in elementary schools, and teachers who had been teaching in the same district for longer were more likely than teachers without these characteristics to be leavers rather than stayers

Among the South Dakota teacher characteristics examined, full-time equivalency, age, salary, primary grade-level assignment, and years teaching in the same district were most strongly associated with leaving rather than staying between 2015/16 and 2016/17 (see table F1). Teachers who worked half time or more were 73 percent more likely to be leavers than were teachers who worked less than half time. In addition, being older was associated with

greater likelihood of being a leaver. The largest difference was for teachers ages 40–48: teachers age 49 or older were 62 percent more likely to be leavers than were teachers ages 40–48. Teacher salary was also related to the likelihood of being a leaver: a salary of $55,341 or higher was associated with higher likelihood of leaving. The largest differences were for teachers with a salary of $44,520–$55,340 and those with a salary of $37,898–$44,519. Compared with teachers with a salary in these ranges, teachers with a salary of $55,341 or higher were 53 percent more likely to leave teaching. Teachers whose primary grade-level assignment was not elementary school were 44 percent more likely to be leavers than were teachers whose primary grade-level assignment was elementary school. Teachers who had been teaching in the same district for four or more years were 44 percent more likely to be leavers than were teachers who had been teaching in the same district for fewer than four years. No other teacher characteristics were associated with leaving in South Dakota.

In South Dakota, teachers in schools with lower average teacher salaries, lower academic performance, lower proportions of racial/ethnic minority students, higher enrollment, higher proportions of students eligible for the national school lunch program, or higher proportions of English learner students, as well as teachers in nonrural schools and teachers in elementary schools, were more likely than teachers in schools without these characteristics to be movers rather than stayers

Among the South Dakota school characteristics examined, average teacher salary, academic performance, proportion of racial/ethnic minority students, enrollment, proportion of English learner students, proportion of students eligible for the national school lunch program, rurality, and grade span were most strongly associated with moving rather than staying between 2015/16 and 2016/17 (table F2). Teachers in schools with an average teacher salary of less than $47,728 were more likely to be movers rather than stayers. The largest difference was for teachers in schools with an average salary of less than $41,525: those teachers were 176 percent more likely to be movers than were teachers in schools with an average salary of $47,728 or higher. Teachers in schools in which less than 39 percent of students scored proficient or better on the state English language arts assessment were 93 percent more likely to be movers than were teachers in schools in which 70 percent or more of students scored proficient or better. Teachers in schools in which racial/ethnic minority students accounted for less than 13 percent of enrollment were 92 percent more likely to be movers than were teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment.

Teachers in schools with 808 or more students were 59 percent more likely to be movers than were teachers in schools with 344–807 students and 44 percent more likely to be movers than were teachers in schools with fewer than 344 students (see table F2). Teachers in schools in which 67 percent or more of students were eligible for the national school lunch program were more likely to be movers than were teachers in schools with a lower proportion of eligible students. The largest difference was for teachers in schools in which 46–66 percent of students were eligible: teachers in schools in which 67 percent or more of students were eligible were 59 percent more likely to be movers than were teachers in schools in which 46–66 percent of students were eligible. Teachers in schools in which English learner students accounted for 8 percent or more of enrollment were also more likely to be movers than were teachers in schools with a lower proportion of English learner students. The largest difference was for teachers in schools in which English learner students accounted for 2.2–7.9 percent of enrollment: teachers in schools in which English learner students accounted for 8 percent or more of enrollment were 52 percent more likely

Table F2. South Dakota school characteristics related to the likelihood of moving and leaving rather than staying between 2015/16 and 2016/17

Characteristic	Risk of moving rather than staying	Risk of leaving rather than staying
Rurality		
Rural	0.595***	0.775*
Academic performance (proportion of students scoring proficient or better on the state English language arts assessment)[a]		
Less than 39 percent	1.926**	0.991
39–55 percent	1.366	0.852
56–69 percent	0.865	0.770*
70 percent or more	na	na
Grade span		
Elementary school	na	na
Middle school	1.004	0.624*
High school	0.596*	0.562**
Other	1.015	0.693*
Enrollment[a]		
Fewer than 344 students	0.562**	1.015
344–512 students	0.407***	1.092
513–807 students	0.408***	0.800
808 or more students	na	na
Proportion of students who are racial/ethnic minority students[a]		
Less than 13 percent	1.922**	1.159
13–25 percent	1.364	1.359
26–51 percent	1.448	1.688*
52 percent or more	na	na
Proportion of students who are eligible for the national school lunch program[a]		
Less than 24 percent	0.575*	0.648
24–45 percent	0.497**	0.560*
46–66 percent	0.408***	0.517**
67 percent or more	na	na
Proportion of students who are English learner students[a]		
Less than 0.3 percent	0.538***	1.115
0.3–2.1 percent	0.570***	1.077
2.2–7.9 percent	0.476***	0.825
8.0 percent or more	na	na
Average teacher salary[a]		
Less than $41,525	2.761***	1.370
$41.525–$47,727	2.075**	1.018
$47,728 or higher	na	na
State accountability designation		
Focus school	0.779	1.244
Priority school	0.763	2.613***
None	na	na

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

na is not applicable because this is the reference group.

Note: The number of teachers included in the analysis was 8,688. The table does not list a reference group for the dichotomous school characteristic rural versus nonrural.

a. Categories were created using quartiles; approximately 25 percent of teachers across the three states combined fall within each category.

Source: Authors' analysis of 2015/16 and 2016/17 state education agency data, supplemented with data from U.S. Department of Education (n.d.).

to be leavers than were teachers in schools in which English learner students accounted for 2.2–7.9 percent of enrollment. Teachers in nonrural schools were 40 percent more likely to be movers than were teachers in rural schools. And teachers in elementary schools were 40 percent more likely to be movers than were teachers in high schools. No other school characteristics were associated with the likelihood of moving in South Dakota.

In South Dakota, teachers in schools identified by the South Dakota Department of Education for priority improvement, teachers in schools with a moderate proportion of racial/ethnic minority students, teachers in schools with higher proportions of students eligible for the national school lunch program, and teachers in elementary schools were more likely than teachers in schools without these characteristics to be leavers rather than stayers

Among the South Dakota school characteristics examined, school accountability designation, proportion of racial/ethnic minority students, proportion of students eligible for the national school lunch program, and grade span were most strongly associated with leaving rather than staying between 2015/16 and 2016/17 (see table F2). Teachers in schools designated by the South Dakota Department of Education for priority improvement were 161 percent more likely to be leavers than were teachers in schools not designated for improvement. Teachers in schools in which racial/ethnic minority students accounted for 26–51 percent of enrollment were 69 percent more likely to be leavers than were teachers in schools in which racial/ethnic minority students accounted for 52 percent or more of enrollment. Teachers in schools in which 67 percent or more of students were eligible for the national school lunch program were more likely to be movers than were teachers in schools in which 24–66 percent of students were eligible. The largest difference was for teachers in schools in which 46–66 percent of students were eligible: teachers in schools in which 67 percent or more of students were eligible were 48 percent more likely to be leavers than were teachers in schools in which 46–66 percent of students were eligible. And teachers in elementary schools were 44 percent more likely to be leavers than were teachers in high schools, 38 percent more likely than were teachers in middle schools, and 31 percent more likely than were teachers in schools that did not have a traditional elementary, middle, or high school configuration.

Two other South Dakota school characteristics were less strongly associated with the likelihood of leaving. Teachers in schools in which 70 percent or more of students scored proficient or better on the state English language arts were more likely to be leavers than were teachers in schools in which 56–69 percent of students scored proficient or better (see table F2). And teachers in nonrural schools were more likely to be leavers than were teachers in rural schools.

Notes

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1. Approximately 70 percent of teachers in schools that did not offer a traditional configuration were in preK–8 schools; others were in schools serving grades 6–12, preK–12, and preK/kindergarten.
2. A prior report with related findings (Meyer et al., 2019) suggested that the proportions of stayers, movers, and leavers were similar across rural and nonrural teachers. While those findings may appear to contradict the findings in the current report, they are based on a different sample and use a different analytic approach. The analytic sample in this report excludes teachers from Nebraska as well as those with missing data on variables used in the logistic regression models. Furthermore, the analyses in the current report are correlational and control for all other factors in each model, including explanatory factors that may account for variance in the likelihood of a teacher being a stayer, mover, or leaver.
3. Percentages do not sum to 100 due to rounding.
4. Percentages do not sum to 100 due to rounding.

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