

Review of Educational Research

<http://rer.aera.net>

Teacher Attrition and Retention: A Meta-Analytic and Narrative Review of the Research

Geoffrey D. Borman and N. Maritza Dowling

REVIEW OF EDUCATIONAL RESEARCH 2008; 78; 367 originally published online
Aug 28, 2008;

DOI: 10.3102/0034654308321455

The online version of this article can be found at:
<http://rer.sagepub.com/cgi/content/abstract/78/3/367>

Published on behalf of



<http://www.aera.net>

By



<http://www.sagepublications.com>

Additional services and information for *Review of Educational Research* can be found at:

Email Alerts: <http://rer.aera.net/cgi/alerts>

Subscriptions: <http://rer.aera.net/subscriptions>

Reprints: <http://www.aera.net/reprints>

Permissions: <http://www.aera.net/permissions>

Teacher Attrition and Retention: A Meta-Analytic and Narrative Review of the Research

Geoffrey D. Borman and N. Maritza Dowling
University of Wisconsin–Madison

This comprehensive meta-analysis on teacher career trajectories, consisting of 34 studies of 63 attrition moderators, seeks to understand why teaching attrition occurs, or what factors moderate attrition outcomes. Personal characteristics of teachers are important predictors of turnover. Attributes of teachers' schools, including organizational characteristics, student body composition, and resources (instructional spending and teacher salaries), are also key moderators. The evidence suggests that attrition from teaching is (a) not necessarily "healthy" turnover, (b) influenced by various personal and professional factors that change across teachers' career paths, (c) more strongly moderated by characteristics of teachers' work conditions than previously noted in the literature, and (d) a problem that can be addressed through policies and initiatives. Though researchers have utilized a number of national and state databases and have applied economic labor theory to questions related to teacher attrition, the authors argue that better longitudinal data on teacher career paths and more nuanced theories are needed.

KEYWORDS: meta-analysis, faculty careers, teacher research, educational policy.

This study involved a comprehensive meta-analysis of all quantitative studies related to teachers' career trajectories and attrition from or retention in the field. Our analyses focused on those primary studies that measured two teacher career persistence outcomes: attrition or retention. Rather than quantifying typical national attrition rates, which has been the subject of prior work by Ingersoll (2001a) and others, our goal was to understand why attrition occurs or, more formally, what factors moderate attrition outcomes. Personal characteristics of teachers, including their backgrounds and qualifications to perform their jobs, and the characteristics of their workplaces, including the "raw products" with which they work (i.e., students), the organizational characteristics of their working environments, and the resources available to perform their jobs served as our key moderators of persistence outcomes. Studies that we reviewed operationalized attrition in varying ways. For instance, some reported voluntary quits, retirements, and transfers to other schools as separate outcomes. In these cases, we synthesized only those outcomes for voluntary quits and excluded the results for the retirement and

transfer groups. Specifically, the key outcome that we considered in this review is attrition from teaching in the form of voluntary quits.

The Importance of Teachers

According to the work of Hanushek (1992), the difference between being taught by a highly capable and a less than capable teacher can translate into a full grade level of achievement in a single school year. Beyond these potential short-term benefits, the research of Sanders and Rivers (1996) indicated that teacher effects can be enduring and cumulative, whether they advance student achievement or leave children behind. As Sanders and Rivers demonstrated, after 2 years, the performance of fifth-grade students was still affected by the quality of their third-grade teacher. Furthermore, students whose initial achievement levels were comparable can have vastly different academic outcomes as a result of the sequence of teachers to whom they are assigned. Indeed, evidence of the strong effects of teachers on student achievement can be traced back to the classic Coleman report, which concluded that teacher characteristics tended to explain more variance in student achievement than any other school resource (Coleman et al., 1966).

Not only are teachers central to promoting student learning, their compensation represents a substantial portion of the national investment in public education. In the typical school district, teacher salaries account for at least half of the expenditures (Guthrie & Rothstein, 1999; Speakman et al., 1996). The resource demands associated with employing teachers and the strong empirical evidence linking teacher quality to improved achievement are compelling reasons to focus on policies related to teachers as key levers to improve efficiency, equity, and productivity in public education.

During the past two decades, the education research literature and policy landscape have been replete with recommendations for reforming the preparation of teachers, enhancing in-service professional development, improving teacher recruitment and retention, and improving teacher quality. From reports in the 1980s by organizations such as the National Commission on Excellence in Education (1983), the Holmes Group (1986), and the Carnegie Forum on Education and the Economy (1986), which primarily focused on the reform of teacher preparation programs, to the recent federal education legislation, *No Child Left Behind*, prominent national efforts to reform education in the United States have emphasized the importance of placing a high-quality teacher in every classroom.

Perspectives on Teacher Labor Markets and the Role of Attrition

A significant part of this discussion has revolved around the issues of teacher labor markets and the supply and demand of elementary and secondary school teachers. Along with the growing concerns regarding teacher quality, this discussion took root during the 1980s and was initiated in response to two clear demographic trends: projected increases in student enrollments with the echo of the post-World War II baby boom and anticipated increases in the number of retirements among an aging teaching force (Darling-Hammond, 1984; Grissmer & Kirby, 1987; Murnane, Singer, & Willett, 1989; National Academy of Sciences, 1987). This research suggested impending shortfalls of teachers that would, in turn, force many of the nation's school systems to lower standards to fill the increasing numbers of teaching openings, inevitably resulting in a less qualified teaching

force and lower school performance. This literature, along with an increasing number of national and local policy initiatives, focused considerable attention on the problem of staffing classrooms with qualified teachers (National Commission on Teaching and America's Future, 1997).

Throughout the 1980s and much of the 1990s, the prevailing policy response to these staffing problems was fairly predictable. Efforts were directed primarily toward innovative methods of increasing the supply of qualified teachers. Initiatives, such as Teach for America, which was developed by an undergraduate named Wendy Kopp in her Princeton dormitory room, attempted to attract talented students from disciplines and fields other than education to enter the teaching force (Kopp, 2001). Other efforts have attempted to recruit new teachers from among early retirees, women who have raised children and who wish to enter or return to the work force, and others interested in midcareer job changes. For instance, the federally funded Troops-to-Teachers program was designed to assist retiring and separating military veterans to become teachers in their next careers. Finally, in concert with these initiatives and others, a wider array of alternative licensing programs emerged to allow college graduates without formal education training to obtain emergency alternative credentials that would allow them to immediately begin teaching.

In addition to efforts to improve the supply of teachers, an increasing amount of research and policy rhetoric has addressed the issue of teacher attrition from the profession and has explored factors that may help retain a greater proportion of the existing teaching force. Using national data on teachers from the Teacher Follow-up Survey, Ingersoll (2001a, 2001b) reported that, in comparison to turnover rates of approximately 12.0% in the mid-1990s in the field of nursing—which, like teaching, is a predominantly female occupation that has experienced staffing problems—teaching has a somewhat higher attrition rate: 15.0% in 1988–1989, 13.2% in 1991–1992, and 14.3% in 1994–1995. In all of these cases, Ingersoll noted that roughly half of the attrition among teachers was because of actually leaving the workforce and the other half was associated with teachers moving from one school to another.

Also, though Ingersoll (2001a, 2001b) noted that the number of teachers retiring from the profession steadily increased across the 1990s, he found that the number of retirees in any given year was smaller than the number of teachers leaving the profession for other reasons. This finding has important policy implications because it does not highlight the graying and retirement of the teacher work force as the central problem related to teacher shortages, which was a prominent theme in earlier research. Instead, Ingersoll's work suggests that the larger problem is related to nonretirement turnover and that policy efforts may be productively directed toward retaining the substantial number of teachers who are leaving the profession for other reasons.

These findings have been disputed by Harris and Adams (2007), who recently analyzed national data from the Current Population Survey. The authors noted that it is surely true that turnover is an important problem facing certain schools and subject areas, but their results suggested that aggregate teacher turnover was similar to the rates of turnover in three comparison professions: nursing, accounting, and social work. Their analyses also revealed that teacher turnover is relatively high among older teachers, reflecting the fact that they retire considerably earlier than do other professionals. Harris and Adams hypothesized that the high number

of early retirements is in part because of the relatively high ratio of pensions to salaries in teaching, which therefore makes pension participation a more salient factor in labor market decisions. Similarly, earlier analyses of the Schools and Staffing Survey data by Grissmer and Kirby (1997) showed that the incidence of teacher turnover followed a *U*-shaped distribution, with the highest attrition occurring early and later in teachers' careers. As a result, these authors, like Harris and Adams, also gave greater weight to the importance of teacher retirements than did Ingersoll (2001a, 2001b).

Even if early retirements are a large part of the problem, other cases of voluntary attrition are prevalent and seem to represent a significant expense that the nation's school systems must bear. According to a recent report published by the Alliance for Excellent Education (2005), the Department of Labor estimated that attrition costs an employer 30% of the departing employee's salary. Based on this projection and an estimated 1999–2000 average teacher salary of \$41,820, the Alliance for Excellent Education indicated that each case of teacher attrition costs a school system \$12,546. With 173,439 nonretirees leaving the profession during 1999–2000, the total cost of replacing public school teachers who dropped out of the profession was nearly \$2.2 billion for the year. Attrition and its associated costs to the system have rarely been addressed by formal policies and interventions. Understanding who typically leaves the profession and why they chose to do so could help policy makers invest in initiatives that target the teachers most at risk for quitting and that help ameliorate the conditions that appear most salient in teachers' quit decisions.

Beyond the stage of one's career, over the last two decades researchers have examined numerous other factors associated with attrition, including individual characteristics of teachers, compensation policies, and attributes of the places in which teachers work—schools. Though no formal quantitative meta-analysis of this work has been performed, there are some general concepts and beliefs that have emerged from prior narrative reviews of this literature. A recent narrative review of this literature by Guarino, Santibanez, and Daley (2006) was particularly helpful in summarizing some of the prominent themes. These authors examined literature related to teacher entry, mobility, and attrition patterns and found that teachers exhibited preferences for higher salaries, better working conditions, and greater intrinsic rewards. Their work suggested that teachers will tend to move to other teaching positions or jobs or activities outside of teaching that offer these characteristics.

Descriptive analyses of the type of teachers who leave the profession have suggested that math and science teachers tend to leave the profession at higher rates than do teachers of other subjects (Arnold, Choy, & Bobbitt, 1993; Grissmer & Kirby, 1992). Because teaching is a decidedly female occupation, one's gender, one's marital status, and the composition of one's family have been examined by various researchers (Marso & Pigge, 1997; Stinebrickner, 1998, 2002). Driven by concerns that the most qualified and talented teachers may be leaving the profession to go into other occupations, other research on teacher characteristics has focused on various qualifications of teachers, including the level of education they attained, the test scores they achieved, and the years of experience they had accumulated (Adams, 1996; Hanushek, Kain, & Rivkin, 2004; Johnson & Birkeland, 2003; Stinebrickner, 1998, 2002).

In addition to the characteristics of teachers, a growing number of studies have explored the ways in which schools may play a role in teacher attrition. Guarino et al. (2006) pointed out that urban schools and schools with high percentages of minority students were difficult to staff and that teachers tended to leave these schools when more attractive opportunities presented themselves. It is also evident, though, that factors that are amenable to change through policy can have an impact on teachers' decisions to migrate to other schools or quit teaching. Specifically, Guarino et al. noted some findings that supported the notion that the implementation of school-based mentoring and induction programs—particularly those related to collegial support—may help lower rates of turnover among beginning teachers. Also, schools that provided teachers with more autonomy and administrative support appeared to have lower levels of teacher attrition and migration.

Conceptualizing the Review

There are several key findings that have currency within the literature on teacher attrition and retention that helped frame the effort. First, the issue of teacher quality continues to be of central importance in discussions of school reform and improvement. Therefore, questions regarding the qualifications, and the potential quality, of those who are lost to attrition were of considerable importance. Second, though key demographic characteristics, including gender, age, and race/ethnicity, have often been used as covariates in models that focus on other predictors of attrition, there is a substantive interest and policy relevance in understanding these general characteristics of teachers who leave the profession. Third, various researchers have found inequities in the distribution of teacher quality across schools of varying minority and poverty concentrations (Borman & Kimball, 2005; Ferguson, 1998; Kain & Singleton, 1996). These findings raise questions concerning how the school context and the demographics of students may shape teachers' decisions about where they work and how efforts can be developed to attract high-quality teachers to high-need schools.

Fourth, research related to improving the retention of teachers has suggested that one powerful incentive is higher teacher pay, which reduces the probability that teachers leave the profession, particularly once differences in alternative earnings opportunities are taken into account (Dolton & van der Klaauw, 1995, 1999; Murnane & Olsen, 1989, 1990). Therefore, we examined how teacher compensation and other forms of school and classroom resources may be related to teachers' career persistence. Finally, though Ingersoll (2001a) pointed out that less is known regarding the relationships between attrition and the organizational characteristics of schools, we attempted to locate literature that documented the roles that various attributes of school organization and culture can play in teacher retention.

Method

Literature Search Method

Broad searches of the literature on teacher career trajectories and correlates of attrition and retention were conducted using several search strategies. First, the following computerized reference databases were searched, focusing on articles or research reports published from 1980 to 2005: Education Resources Information Clearinghouse; PsychINFO; JSTOR; The Scholarly Journal Archive; Social

Sciences Full Text; Academic Search; and Education Full Text. We searched these databases for all publications that contained at least one of several terms related to teachers and their career paths (i.e., *teacher career change*, *teacher career development*, *teacher career paths*, *teacher retention*, *teacher attrition*, *teacher turnover*, and *teacher attitudes*). A second method applied general World Wide Web searches, using search engines such as Google, for references to research or any other published or unpublished studies or compilations of data. Through the method of citation chasing, we also collected all related material cited in recent narrative reviews of this literature, including those published by Guarino et al. (2006), Johnson, Berg, and Donaldson (2005), and Wilson, Floden, and Ferrini-Mundi (2001). Finally, we reviewed the reference sections of all retrieved articles in an attempt to identify any additional reports. After completing this series of search methods, we found no other available quantitative studies of teachers' career paths.

Inclusion Criteria

The search strategies and exhaustive citation chasing produced more than 150 unique references to studies. We examined abstracts of the studies to ascertain whether they included any report of teacher retention or attrition data. If an abstract or study did not suggest these data were reported, the study was excluded from further consideration. More than 90 of the studies were selected and retrieved and further organized into one or more of the following seven major topic areas:

1. characteristics of individuals who enter and remain in the teaching profession;
2. characteristics of individuals who leave the teaching profession;
3. characteristics of schools and districts related to teacher attrition and retention;
4. compensation policies, teacher attrition, and retention;
5. preservice policies that affect teacher recruitment and retention;
6. in-service policies that affect teacher retention; and
7. other general descriptive articles addressing issues related to teacher career trajectories.

All bibliographic references were entered into an EndNote file. We developed an Access database with descriptive information for each reference. The descriptive information included (a) the relevant topic or topics addressed by the study; (b) the study design, data, and sample description, including participant recruitment; (c) independent variables; (d) outcome variables; and (e) main research questions.

In the second stage, we focused on the subset of studies that provided quantitative information on teacher retention and attrition. This subset included an array of statistical approaches to data analysis, ranging from retention and attrition results presented as proportions and means to more sophisticated approaches including, for example, discriminant function analyses and logistic, probabilistic, or predictive models of teacher retention and/or attrition. From these studies, we further chose those that allowed us to estimate the odds of attrition from teaching and how

the odds varied according to a number of teacher-related characteristics and school- and student-related characteristics commonly associated with teacher attrition and/or retention in the research literature. Teacher-related characteristics, or moderators based on teacher characteristics, included gender, age, marital status, school level (elementary, middle, high) taught, education level, teaching experience, certification type, ability or achievement, subject taught, and salary. School variables, or moderators based on school characteristics, included location, sector (public or private), enrollment, various types of teacher support provided, and school student population characteristics, including poverty level, racial composition, socioeconomic status, and school average achievement levels.

More specifically, we deemed studies eligible for further consideration based on the following criteria:

- the study provided sufficient data on teacher attrition or retention from which effect sizes could be computed;
- the study reported teacher attrition by individual and/or school-related characteristics from which an effect could be determined;
- the statistical analysis employed provided attrition probabilities in the form of counts, proportions, or logged odds;
- the sample or data provided were not duplicated in another study accepted for inclusion; and
- the sample used in the evaluation was composed of teachers from a elementary, middle, or high school in the United States.

Many studies reviewed did not meet these eligibility requirements. This was in large part because of insufficient information for calculating effect sizes. The most common reasons for excluding studies were a data analysis design that did not allow the computation of attrition probabilities and failure to provide a standard deviation or information about the sample sizes by the moderator variables of interest (e.g., gender, race, educational background, and school poverty level). A substantial number of studies were based on samples or data that were reported in other studies accepted for inclusion, so they were eliminated. In the end, 34 studies met all requirements and were selected for analysis.

The characteristics of the 34 studies included in the meta-analysis are summarized in Table 1. Each of these studies, which are listed alphabetically in the table by the first author's surname and within author by year of publication, contributed at least one independent sample of teachers for analysis of attrition by the various moderator variables. As the table reveals, most studies examined multiple moderators of attrition outcomes across the five categories of teacher demographics, teacher qualifications, school organizational characteristics, school resources, and school student body characteristics. Also, as noted in Table 1, 19 of the 34 studies reported teacher attrition outcomes as logged odds ratios derived from multivariate models, and the remaining 15 studies reported proportions and means.

Moderator Variables

In addition to collecting the quantitative data necessary for calculating the effect sizes (e.g., proportions, odds ratios, means and standard deviations, and sample

TABLE 1
Characteristics of the 34 studies included in the meta-analysis

Authors	Year	<i>n</i> of teachers	<i>n</i> of effect sizes reported	Moderators studied					School student body characteristics	Outcome reported
				Teacher demographics	Teacher qualifications	School organizational characteristics	School resources	School student body characteristics		
Adams	1996	2,327	6	Age, gender, race/ethnicity	Training					Logged odds-ratio
Allred and Smith	1984	233	5	Gender	Experience, specialty, training					Proportion
Arnold, Choy, and Bobbitt	1993	2,151,619	19	Gender, race/ethnicity, marital status	Experience, training, specialty	Sector, location				Logged odds ratio
Beaudin	1993	3,060	4	Gender, race/ethnicity	Training					Proportion
Boyd, Lankford, Loeb, and Wyckoff	2005a	359,942	7	Race/ethnicity	Ability, experience	Location				Logged odds ratio
Boyd, Lankford, Loeb, and Wyckoff	2005b	Population of certified New York public school teachers from 1995 to 2004	5	Race/ethnicity	Ability					Proportion
Brewer	1996	5,458	2							Logged odds ratio
Chapman and Hutcheson	1982	690	1		Training				Salary	Proportion
Clewell and Villegas	2001	2,593	2	Race/ethnicity	Specialty					Proportion
Dworkin	1980	3,063	2	Age, race/ethnicity	Experience					Proportion

(continued)

TABLE 1 (continued)

Authors	Year	<i>n</i> of teachers	<i>n</i> of effect sizes reported	Moderators studied					Outcome reported
				Teacher demographics	Teacher qualifications	School organizational characteristics	School resources	School student body characteristics	
Eller, Doerfler, and Meier	2000	Teachers in all Texas school districts with more than 1,000 students from 1994 to 1998	6		Experience	Bureaucracy	Average class size, salary	Achievement level, socioeconomic composition	Logged odds ratio
Grissmer and Kirby	1992	Full-time teachers in Indiana, 1965 to 1987 (approx. 52,000)	4	Gender	Training, specialty				Proportion
Griz and Theobald	1996	9,756	17	Age	Specialty, training		Salary, school expenditure for support per teacher, school expenditure for teaching materials, teacher aide	Socioeconomic composition, racial/ethnic composition	Logged odds ratio
Hall, Pearson, and Carroll	1992	189	3			Administrative support, opportunities for advancement			Proportion, mean and standard deviation
Hanushek, Kain, and Rivkin	2004	378,790	11		Experience		Salary	Achievement level, racial/ethnic composition, socioeconomic composition	Logged odds ratio
Henke, Chen, Geis, and Knepper	2000	11,200	1	Gender					Proportion

(continued)

TABLE 1 (continued)

Authors	Year	n of teachers	n of effect sizes reported	Moderators studied						Outcome reported
				Teacher demographics	Teacher qualifications	School organizational characteristics	School resources	School student body characteristics		
Imazeki	2005	1,175	11	Age, race/ethnicity	Specialty, training	Location	Instructional spending, per pupil spending, salary	Racial/ethnic composition, socioeconomic composition	Logged odds ratio	
Ingersoll	2001a	6,733	7	Age, gender	Specialty	Administrative support, school size	Teacher aide	Racial/ethnic composition, socioeconomic composition	Logged odds ratio (multilevel model)	
Ingersoll and Alsalam	1997	53,347	6	Gender, race/ethnicity		Administrative support, location, sector	Salary		Logged odds ratio (multilevel model)	
Johnson and Birkeland	2003	50	2	Gender	Training				Proportion	
Kirby	1999	98,951	1		Experience				Logged odds ratio	
Loeb, Darling-Hammond, and Luczak	2005	1,071	7	Age, race/ethnicity	Experience, training			Racial/ethnic composition, socioeconomic composition	Logged odds ratio	
Marso and Pigge	1997	551	3	Gender	Ability, specialty, training				Proportion	
Mont and Rees	1996	525	8	Age, gender	Experience	School size	Average class size, salary	Achievement level, socioeconomic composition	Logged odds ratio (discrete hazard model)	
Rees	1991	49,396	6	Age, gender	Experience		Average class size, salary	Achievement level	Logged odds ratio	
Rickman and Parker	1990	636	3	Gender	Ability				Logged odds ratio	

(continued)

TABLE 1 (continued)

Authors	Year	<i>n</i> of teachers	<i>n</i> of effect sizes reported	Moderators studied					Outcome reported
				Teacher demographics	Teacher qualifications	School organizational characteristics	School resources	School student body characteristics	
Schlechty and Vance	1981	32,167	3	Gender	Ability				Proportion
Shen	1997	3,612	5	Gender, race/ethnicity	Ability, specialty, training	School mentoring program for beginning teachers	Salary	Achievement level, racial/ethnic composition, socioeconomic composition	Proportion
Shin	1995	786	12	Gender, race/ethnicity	Ability, specialty, training	Location, sector, school size	Salary	Socioeconomic composition	Proportion
Smith and Ingersoll	2004	3,235	14	Age, gender, race/ethnicity	Ability, specialty	Regular supportive communication with administrators, school mentoring program for beginning teachers, collaboration and teacher network, location, sector, school size	Salary, teacher aide	Socioeconomic composition	Logged odds ratio
Stinebrickner	1998	341	13	Gender, marital status	Ability, specialty, training	Sector	Salary, student-teacher ratio	Socioeconomic composition	Logged odds ratio (proportional hazard model)
Stinebrickner	1999	341	10	Gender, marital status	Ability, specialty, training	Sector	Salary, student-teacher ratio	Socioeconomic composition	Logged odds ratio
Stinebrickner	2002	1,450	6	Having a new child, marital status, number of children	Ability, specialty		Salary		Logged odds ratio (proportional hazard model)
Whitener et al.	1997	5,075	6	Age	Training			Racial/ethnic composition	Proportion

sizes), we coded a number of moderators of the effect sizes reported in the studies. As summarized by Table 1, nearly all studies reported attrition outcomes for multiple moderators and yielded multiple effect size estimates, which we reported at the level of the outcome rather than at the level of the study. We organized and conceptualized the moderators of attrition within five categories: teacher demographic characteristics; teacher qualifications; school organizational characteristics; school resources; and school student body characteristics.

Teacher demographic characteristics. Teacher demographic variables helped us to examine potential differences in attrition related to the demographic and background characteristics of teachers. As revealed by Table 1, the moderator variables included the following:

- gender;
- teacher race;
- age;
- marital status;
- whether or not the individual was having a child;
- number of children.

Across the 34 studies included in the meta-analysis, 19 contrasted the attrition of male and female teachers, and 12 studies compared the relative attrition of White and non-White, minority teachers. Studies operationalized age as a moderator of attrition in various ways. Four studies compared attrition of teachers who were 30 years or younger at entry into the profession to teachers who were 31 years or older. Three studies used age as a continuous variable predicting the likelihood of attrition, three studies contrasted teachers who were older than or younger than a particular age (e.g., 35, 39, 50), and two contrasted those whose age fell within particular ranges (i.e., 20 to 24 vs. 25 to 29, and 30 or older vs. 25 to 29). Finally, four studies considered marital status as a possible moderator of attrition, and a study by Stinebrickner (2002) examined whether having a child was associated with attrition and the extent to which the number of children in the teacher's family moderated attrition outcomes.

Teacher qualifications. Table 1 also lists the studies that included four general categories of teachers' professional qualifications as moderators of attrition. Specifically, the moderator variables we identified in our review included the following:

- teacher training;
- experience;
- teacher ability or achievement;
- teaching specialty area.

A total of 13 studies compared attrition rates of teachers with a graduate degree to those for teachers with an undergraduate degree or less. Three studies (Stinebrickner, 1998, 1999, 2002) specifically examined the relative attrition rates

of teachers with a bachelor's degree in science or math versus those with a degree in another area. Three studies examined teacher training and its relation to attrition by comparing the attrition rates of teachers holding a regular teaching certificate to those for teachers without a certificate. Four studies compared the attrition of teachers with less than 5 years of experience to the rates for teachers with 5 or more years of experience. Years of experience was also measured as a continuous variable in five studies and was used as a predictor of the probability of attrition.

Table 1 also lists a number of studies that investigated the relationship between teachers' performances on various standardized aptitude and achievement tests and attrition outcomes. Specifically, one study by Marso and Pigge (1997) compared the attrition outcomes of teachers with a "high" score on the ACT and Comprehensive Test of Basic Skills (CTBS) tests to those with a "low" score on the ACT and CTBS tests. A score of 21 or higher was considered a high ACT score, and a score of 180 or higher was considered a high CTBS score. Three studies by Stinebrickner (1998, 1999, 2002) also used scores on the math and verbal sections of the Scholastic Aptitude Test (SAT) as continuous predictors of teacher attrition.

The specialty area in which teachers received their training was also the subject of a number of studies. Six studies compared attrition for teachers trained in math or science to teachers having other subject specialties. Another six studies contrasted the attrition rates of trained special education teachers to those for teachers of other secondary-level courses. High school science teachers were compared to elementary teachers in one study (Grissmer & Kirby, 1992), and 14 studies contrasted attrition rates for high school teachers and elementary school teachers.

School organizational characteristics. Many studies examined implications for teacher turnover rates related to school-to-school differences in their organizational conditions. As noted in Table 1, we identified the following moderator variables among the 34 studies reviewed:

- school location;
- school sector;
- school size;
- administrative support;
- school mentoring program for beginning teachers;
- collaboration and teacher network;
- regular supportive communication with administrators;
- opportunities for advancement;
- bureaucracy.

Six studies contrasted the attrition rates of teachers working in schools located in an urban or suburban area to those of teachers working in schools located in rural areas. Six additional studies examined the attrition rates of teachers working in public schools relative to those for teachers working in private schools. Also, four studies included school size as a moderator of teacher turnover, with two studies, by Shin (1995) and Smith and Ingersoll (2004), contrasting large schools of more than 1,000 students to schools with smaller enrollments and two studies of the

relationship between attrition and continuous measures of school enrollment by Ingersoll (2001a) and Mont and Rees (1996).

Researchers studied attrition outcomes associated with several other school organizational characteristics that had to do with the general climate and level of support in the workplace. Three studies used a measure of level of administrative support, which was a 5-point Likert-type scale, for predicting the probability of attrition. Administrative support was generally defined as the school's effectiveness in assisting teachers with issues such as student discipline, instructional methods, curriculum, and adjusting to the school environment. Two studies, by Shen (1997) and Smith and Ingersoll (2004), examined the relationship between the percentage of beginning teachers who were provided with a mentoring program, from either the same field or from a different field, and teacher attrition. Smith and Ingersoll also used the percentage of teachers participating in school-based induction activities, including collaborative and networking opportunities, as a predictor of the likelihood of attrition from teaching as a profession. More specifically, these collaboration and teacher network activities included seminars or classes for beginning teachers, common planning time with other teachers in the subject area, and participation in a network of teachers. The moderating effects of regular supportive communication with administrators were studied as the percentage of teachers reporting regular or supportive communications with the school's principal, other administrators, or department chairs. In one other case, a study by Hall, Pearson, and Carroll (1992) considered the relationship between attrition and teachers' perceptions of the "opportunities for advancement" provided by the teaching profession. Finally, one study, by Eller, Doerfler, and Meier (2000), examined the association between the number of bureaucrats per 100 students and the likelihood of attrition from teaching.

School resources. Also documented in Table 1 are the studies of teacher turnover that compared differences in teachers' salaries and school-to-school differences in the resources provided to facilitate instruction. The moderator variables of primary interest included the following:

- average class size;
- student-teacher ratio;
- school expenditure for support per teacher;
- school expenditure for teaching materials;
- teacher aide or classroom assistants;
- instructional spending;
- per-pupil spending;
- teacher salary.

Three studies examined how average class size was associated with the probability of leaving the teaching profession, and two others investigated the relation between average student-teacher ratio and attrition. Two studies, by Smith and Ingersoll (2004) and Shin (1995), compared the association of "large" (1,000 students or more) school enrollment to "smaller" school enrollment with teacher

turnover. Two additional studies, by Ingersoll (2001a) and Mont and Rees (1996), used school enrollment as a continuous predictor of attrition.

A study by Gritz and Theobald (1996) looked specifically at the relationships between school expenditures allocated for support per teacher, teaching materials, and classroom assistants and attrition. Another study, by Imazeki (2005), investigated how instructional spending and per-pupil spending were associated with teacher attrition rates. Finally, 14 studies noted in Table 1 incorporated teacher salary as a predictor of teacher turnover. For example, 6 studies analyzed the relationship between teachers' annual salary and attrition for teachers with 0 to 5 years of experience in the teaching profession. Another 5 studies looked at the same relationship for a sample of teachers with tenure or with 6 to 30 years of experience. In addition, a study by Shin (1995) compared the attrition rates of teachers with "high" salaries (more than \$10,000 in 1972) to those of teachers with "low" salaries (less than \$8,500 in 1972). The same study also compared attrition rates of teachers receiving a "medium" salary (\$8,501 to \$9,999 in 1972) to those of teachers in the low-salary category. Finally, using a 5-point Likert-type scale, one study examined the relationship between teachers' reported satisfaction with their salaries and attrition outcomes.

School student body characteristics. The final category of moderators listed in Table 1 includes three general categories: (a) the schools' socioeconomic composition; (b) student achievement levels; and (c) the racial/ethnic composition of the schools. Three studies, by Stinebrickner (1998, 1999) and Shin (1995), compared attrition rates for teachers working in schools in which the majority of students (more than 50%) were classified as "low" socioeconomic status to those of teachers working in schools with student populations of a higher socioeconomic class. Stinebrickner (1998, 1999) also contrasted attrition rates of teachers working in largely "middle-class" schools to others. Nine other studies operationalized school socioeconomic composition using a continuous measure of the percentage of students in the school eligible for the federal free or reduced-price lunch program.

Three studies identified schools with higher test scores and contrasted their attrition rates to those for schools with lower test scores. A continuous variable indicating the percentage of students with poor achievement performances was used to predict teacher turnover in two studies by Boyd, Lankford, Loeb, and Wyckoff (2005a, 2005b). Also, two studies, by Hanushek et al. (2004) and Eller et al. (2000), examined the relationship between district average Texas Assessment of Academic Skills (TAAS) math and reading outcomes and teacher attrition.

As noted in Table 1, the relationship between the percentage of minority students (i.e., African American, Asian, Native American, or Latino) enrolled at the school and teacher attrition outcomes was the topic of six studies. Three additional studies compared attrition outcomes of teachers working in schools with predominantly (i.e., more than 50%) minority student bodies composed of African American students, Latino students, and a combination of African American and Latino students to those of teachers working in schools with lesser minority enrollments. Finally, one study, by Shin (1995), measured the relation between school racial/ethnic diversity and teacher attrition.

Results

Because the outcome of interest was dichotomous, that is, attrition from the teaching profession or quitting teaching versus remaining in the teaching profession, logged odds ratio effect sizes were calculated. The odds ratio is an effect size statistic that typically compares two groups in terms of the relative odds of a given status or event (Fleiss, 1994; Lipsey & Wilson, 2001). In the case of attrition, national data suggest that approximately 7% of teachers leave the profession each year (Ingersoll, 2003). Therefore, for a group of 100 teachers, the odds that a teacher will leave the profession in a given year are about 7 to 93. This is often expressed by the ratio of the number of times that the event of interest occurs to the number of times that it does not. This ratio from the previous example is $7 \div 93$, or .08. Alternatively, the odds of an event can be defined as,

$$\text{Odds} = p \div (1 - p),$$

where p is the probability of an event, such as teacher attrition. Thus, if the probability of attrition is .07, then $.07 \div (1 - .07)$ also gives the odds as .08.

The odds ratio is an appropriate summary statistic for dichotomous outcomes that are reported in a variety of ways but that most frequently take the form of relative frequencies or proportions. An odds ratio generally compares the relative odds of two groups. For instance, if the odds of attrition for female teachers are .22, or 2 to 9, and the odds for male teachers are .11, or 1 to 9, the ratio of these two odds is $.22 \div .11$, or 2. The odds ratio of 2 for this hypothetical comparison suggests that the odds of teacher attrition among women are 2 times greater than the odds for men.

Unfortunately, the odds ratio has some properties that make it inappropriate for statistical analysis. It is centered around 1 rather than 0, with 1 indicating that an event or outcome is equally likely in both groups. An odds ratio greater than 1 implies that the event is more likely in the first group, and values between 0 and 1 imply that the event is less likely in the first group. Because of this asymmetrical distributional form, an odds ratio such as 0.5 is actually of the same magnitude as an odds ratio of 2—which is the inverse of 0.5—but in the opposite direction. To address this problem, all statistical analyses are performed on the natural log of the odds ratio. One of the main advantages of the log odds ratio is that it is easier to derive inferences for than the odds ratio directly. In large samples, the sampling distribution of the log odds ratio is approximately normal, with a mean of 0 and standard deviation of 1.83.

Computation of Logged Odds Ratio Effect Sizes

Differences in the nature of the outcome data reported across the 34 studies necessitated the use of two primary methods for computing effect sizes. Despite differences in the formulas for computing the effect sizes, the methods were algebraically equivalent and yielded consistent estimates of the logged odds ratio effect size. First, many studies reported probabilistic models in which attrition was the outcome reported as a logged odds ratio and predicted by various teacher and school characteristics. The modeled predictors across these studies were relatively consistent, and all models included teacher's gender, race/ethnicity, and some

indicator of age or experience level. In these cases, we used the coefficients for the modeled teacher and school characteristics, which are interpreted as the logged odds ratio of the likelihood of attrition, directly as the logged odds ratio effect size.

Second, many other studies reported proportions or frequency counts of persons in contrasting groups with the outcome of attrition. When studies provided proportions, the effect size was computed based on the following formula,

$$ES_{LOR} = \log_e (p_1 (1 - p_2) \div p_2 (1 - p_1)),$$

where p_1 is the proportion of individuals in Group 1 (e.g., men) who experienced attrition and p_2 is the proportion of people in Group 2 (e.g., women) who experienced attrition. When frequency counts were reported, the following formula was employed,

$$ES_{LOR} = \log_e (ad \div bc),$$

where a is the frequency of individuals in Group 1 (e.g., men) who experienced attrition, b is the frequency of individuals in Group 1 who did not experience attrition, c is the count of individuals in Group 2 (e.g., women) who left teaching, and d is the count of individuals in Group 2 who did not leave teaching.

As Lipsey and Wilson (2001) pointed out, the logged odds ratio effect size can also be expressed in a form that is more similar to that of the common standardized mean difference effect size, known as Cohen's d or Hedges's g . Specifically, the logged odds ratio can be calculated as the difference between the logit for each group,

$$ES_{LOR} = \log_e (p_1 \div (1 - p_1)) - \log_e (p_2 \div (1 - p_2)),$$

where p_1 is the proportion of individuals in Group 1 (e.g., men) who experienced attrition and p_2 is the proportion of people in Group 2 (e.g., women) who experienced attrition. As this formula suggests, the logged odds ratio effect size can be interpreted directly as the difference between the log transformed odds of attrition in each group.

Though the logged odds ratio is the preferred measure for meta-analysis of dichotomous outcomes (Fleiss, 1994; Lipsey & Wilson, 2001), its interpretation is not intuitive. Positive values greater than zero imply a positive association, values equal to zero suggest no relationship, and logged odds ratios less than zero indicate a negative relationship. However, a more explicit understanding of the meaning of the effect size may be obtained by converting the logged odds ratio to a simple odds ratio. We performed all statistical analyses using the logged odds ratio but then took the antilogarithms to convert the mean effect sizes for each of the moderators studied to an odds ratio. The formula for this conversion is,

$$ES_{OR} = e^{ES_{LOR}}$$

where e is the base of the natural logarithm, or approximately 2.72, and ES_{LOR} is a logged odds ratio.

Computation of Standard Errors and Weights

The 34 studies included in this meta-analysis had varying sample sizes, with some studies using large, nationally representative samples of teachers and others using small samples of teachers from a specific locale. The logged odds ratio effect sizes derived from studies that employed larger samples have less sampling error than effect sizes from studies that used smaller samples. Therefore, the former are more reliable and precise estimates of attrition than the latter, and effect sizes generated from larger samples should be weighted more heavily in our analyses than those from smaller samples.

We conducted all analyses of the logged odds ratio effect sizes using weights, which were equal to the inverse of the sampling error variance of the effect sizes, such that the contribution of each effect size was proportionate to its reliability. For those studies that applied probabilistic models that reported coefficients for the modeled teacher and school characteristics predicting attrition, we constructed weights using the reported standard errors for the appropriate coefficient from the models and the formula,

$$w = \frac{1}{se^2}$$

where se is the standard error for the coefficient.

For studies reporting proportions of individuals experiencing attrition, the standard error was calculated as the square root of,

$$p(1-p)(1 \div n_1 + 1 \div n_2),$$

where p is the weighted mean of the proportion experiencing attrition in Group 1 and Group 2, specifically,

$$p = (n_1 \times p_1 + n_2 \times p_2) \div (n_1 + n_2),$$

and n_1 is the number of individuals in Group 1 and n_2 is the number of individuals in Group 2. Standard errors for the studies that reported frequency counts were computed as,

$$se = \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}}$$

where a , b , c , and d are the cell frequencies from a 2×2 contingency table. Finally, after using the above formulas to compute standard errors for the logged odds ratio effect sizes from studies reporting proportions and frequency counts, we used the formula reported above for the weight, which was the inverse of the standard error squared.

Teacher Demographic Characteristics and Attrition

The first set of tabulated results is presented in Table 2. This table identifies each of the teacher demographic variables that we identified as a moderator of effect size, the number of studies in which the moderator's relation to attrition was observed, the effect size expressed as an odds ratio, the value for the logged odds ratio used in the statistical analyses, a 95% confidence interval for the logged odds ratio, and the z test statistic, which tests the null hypothesis that the logged odds ratio effect size is equal to zero.

Gender, the first moderator presented in Table 2, was identified in more studies of teacher attrition (19) than any other teacher or school characteristic. The 19 studies of gender as a moderator of attrition suggest that the differences between men and women are statistically significant ($z = -2369967.00, p < .01$) and that the odds of men leaving teaching are approximately three fourths those for women. Alternatively, by taking the inverse of the odds ratio of 0.77, the result suggests that the odds of women leaving the profession are 1.30 times those for men. The effect size for teacher race/ethnicity was also statistically significant ($z = 917152.76, p < .01$), indicating that White teachers are 1.36 times more likely to leave teaching than non-White minority teachers.

Moderator variables that measured a teacher's age took on a variety of forms. First, a simple continuous measure of the teacher's age in years revealed that older teachers were less likely to leave teaching than were younger teachers ($z = -8.06, p < .01$). The effect of a 1-year difference was slight, but if one assumed a linear relationship between age and attrition, the odds of attrition for a teacher 5 years younger would be 5.32 times greater than those for the older teacher. Even when considering the four studies that investigated the relationship between age at entry into teaching and attrition, the evidence suggested that teachers who began their careers at 31 or older were less likely to leave the profession than teachers who began teaching at 30 or younger ($z = -7.97, p < .01$). Single studies compared the relative odds of attrition of several other age groups. Two studies, which compared teachers who were 26 or older to teachers 25 or younger and those who were 40 or older to teachers 39 or younger, revealed the same trend—older teachers were less likely than younger teachers to leave teaching. However, when comparing 20- to 24-year-old teachers to those 25 to 29 years of age, one study suggested that younger teachers were slightly less likely to experience attrition. Finally, another study suggested a potential threshold at which older teachers are more likely to leave teaching than their younger counterparts. The odds of teachers 51 years or older leaving teaching were nearly 2.5 times those for teachers 50 years old or younger.

Three characteristics of teachers' families have been the topic of study. First, four studies of teachers' marital status and attrition suggested that the odds of married teachers leaving the profession were 1.40 times greater than those for non-married teachers. Though this difference was not of considerable practical significance, it was statistically significant ($z = 2.40, p < .05$). Second, the event of having a new child was associated with odds of attrition 6.69 times greater relative to the odds for teachers not having a new child ($z = 7.92, p < .01$). Finally, the number of children in the teacher's family was not associated with any difference for the attrition outcome.

TABLE 2
Teacher demographic characteristics as moderators of effect size

Moderator variable	n of studies	n of effect sizes	Effect size			95% CI		z
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
Gender (<i>male</i> = 1)	19	19	0.77	-0.26	0.00 ^a	-0.26	-0.26 ^b	-2369967.00**
Teacher race (<i>White</i> = 1, <i>minority</i> = 0)	13	13	1.36	0.31	0.00 ^c	0.31	0.31 ^d	917152.76**
Teacher age								
Years	4	4	0.94	-0.06	0.01	-0.08	-0.05	-8.06**
26 or older = 1, 25 or younger = 0	1	1	0.70	-0.35	—	—	—	—
40 or older = 1, 39 or younger = 0	1	1	0.70	-0.36	—	—	—	—
51 or older = 1, 50 or younger = 0	1	1	2.48	0.91	—	—	—	—
20 to 24 = 1, 25 to 29 = 0	1	1	0.95	-0.05	—	—	—	—
30 or older = 1, 25 to 29 = 0	1	1	0.75	-0.29	—	—	—	—
Age at entry (31 or older = 1, 30 or younger = 0)	4	4	0.73	-0.31	0.05	-0.89	-0.23	-7.97**
Teacher marital status (<i>married</i> = 1)	4	4	1.40	0.34	0.14	0.06	0.61	2.40*
Having a new child (<i>child</i> = 1)	1	2	6.69	1.90	0.24	1.43	2.37	7.92**
Number of children	1	2	0.91	-0.09	0.16	-0.40	0.23	-0.54

Note. CI = confidence interval.

a. SE = 0.0000001105.

b. The CI ranges from -0.2618957488 to -0.2618953156.

c. SE = 0.0000003363.

d. The CI ranges from 0.3084672608 to 0.3084685792.

p* < .05. *p* < .01.

Teacher Qualifications and Attrition

The results for those moderator variables related to teacher qualifications are summarized in Table 3. In 13 studies, researchers compared the relative attrition of teachers with a graduate degree and teachers without a graduate degree. The evidence from these studies suggested that the odds of teachers with a graduate degree leaving teaching were somewhat greater than those for teachers without a graduate degree ($z = -672.12, p < .01$). As the next tabulated result suggests, a science or math undergraduate degree was associated with odds of attrition approximately twice those for teachers with other undergraduate degrees ($z = 3.93, p < .01$). On the other hand, though, teachers holding a traditional or regular teaching certification had a lower odds of leaving teaching relative to those with no certification ($z = -532.34, p < .01$). By taking the inverse of the odds ratio of 0.38, the result suggested that teachers without a certificate had odds of leaving the profession that were 2.63 greater than those for teachers with a certificate.

With regard to teacher experience level, the odds of attrition among teachers with 5 or 6 years of teaching experience were 1.57 greater than those for teachers during the first 5 years of their careers ($z = 213062.19, p < .01$). Also, with each additional year of experience, the odds of attrition increased slightly ($z = 3.83, p < .01$). For instance, a difference of 5 years of experience was associated with odds of attrition for the more experienced teacher that were 5.10 times greater than those for the less experienced teacher.

Table 3 also lists attrition outcomes for four measures of teacher ability or achievement. First, teachers with high scores on the CTBS or the ACT national college admission and placement examination were more likely to leave teaching than were teachers with lower scores ($z = 12.10, p < .01$), but the magnitude of this difference was slight. In three other cases, differences in teachers' outcomes on the SAT math, verbal, and combined math and verbal sections were not associated with statistically significant attrition effect sizes. Similarly, teachers who failed certification tests on the first attempt or who scored in the bottom 25% had attrition rates that were statistically equivalent to those who achieved better performances on the tests.

Differences in attrition based on teachers' specialty area are listed at the bottom of Table 3. Secondary teachers had higher odds of attrition relative to special education teachers ($z = 129706.81, p < .01$), but the effect size of 1.02 was very slight. Compared to science and math teachers, the odds of attrition for teachers of any other secondary-level subject were 1.12 greater ($z = -72952.62, p < .01$). When secondary science teachers were compared to elementary-school teachers, though, their odds of attrition were nearly 1.5 times greater ($z = 5.44, p < .01$). Comparing the odds of attrition for all elementary teachers to those for all secondary teachers, the final outcome in Table 3, which was gleaned from 14 separate studies, suggested that elementary teachers were only 1.02 times more likely to leave the profession, but this difference was of statistical significance ($z = -79049.05, p < .01$).

School Organizational Characteristics and Attrition

Table 4 documents the role that differences in school organization can play in teacher attrition outcomes. Referring to the nine tabulated moderators, the first suggested that the odds of attrition for teachers from urban and suburban schools were

TABLE 3
Teacher qualifications as moderators of effect size

Moderator variable	<i>n</i> of studies	<i>n</i> of effect sizes	Effect size			95% CI		<i>z</i>
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
Teacher training								
Graduate degree vs. non-graduate degree	13	13	1.12	0.11	0.00 ^a	0.11	0.11 ^b	672.12 ^{**}
Undergraduate science or math degree vs. other	2	2	1.99	0.69	0.18	0.34	1.03	3.93 ^{**}
Certification (<i>traditional or regular certification = 1, no certificate = 0</i>)	3	3	0.38	-0.98	0.00 ^c	-0.99	-0.98	-532.34 ^{**}
Teacher experience								
5 or 6 years or more = 1, first 5 years = 0	4	4	1.57	0.45	0.00 ^d	0.45	0.45 ^e	2039901.10 ^{**}
Years of teaching experience	5	5	1.02	0.02	0.01	0.01	0.04	3.83 ^{**}
Teacher ability or achievement								
Score on CTBS/ACT (<i>high = 1, low = 0</i>)	1	2	1.02	0.02	0.00 ^f	0.02	0.02 ^g	12.10 ^{**}
Score on SAT verbal and math	3	3	1.04	0.04	0.04	-0.04	0.12	0.91

(continued)

TABLE 3 (continued)

Moderator variable	n of studies	n of effect sizes	Effect size			95% CI		z
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
Score on SAT math	3	3	1.09	0.09	0.06	-0.03	0.21	1.45
Score on SAT verbal	3	3	0.99	-0.01	0.18	-0.12	0.11	-0.11
Outcome on certification test (scored in bottom 25% or failed on first attempt = 1)	2	2	1.01	0.01	0.01	-0.01	0.03	0.76
Teaching specialty area	6	6	1.02	0.02	0.00 ^b	0.02	0.02 ⁱ	129706.81**
Secondary = 1, special education = 0	6	6	0.89	-0.12	0.00 ⁱ	-0.12	-0.12 ^k	-658433.70**
Science or math = 1, other secondary level = 0	1	3	1.42	0.35	0.06	0.22	0.47	5.44**
Secondary = 1, elementary level = 0	14	14	0.98	-0.02	0.00 ⁱ	-0.02	-0.02 ^m	-203113.00**

Note. CI = confidence interval; CTBS = Comprehensive Test of Basic Skills.

- a. SE = 0.0001684540.
- b. The CI ranges from 0.1128909605 to 0.1135512866.
- c. SE = 0.0029634269.
- d. SE = 0.000002223.
- e. The CI ranges from 0.4533840382 to 0.4533849094.
- f. SE = 0.0015525133.
- g. The CI ranges from 0.0157411708 to 0.0218268987.
- h. SE = 0.0000001715.
- i. The CI ranges from 0.0222405916 to 0.0222412638.
- j. SE = 0.0000001823.
- k. The CI ranges from -0.1200437396 to -0.1200430249.
- l. SE = 0.0000001049.
- m. The CI ranges from -0.0212999871 to -0.0212995761.

p < .05. *p < .01.

only slightly greater than those for teachers from rural locations (1.13), but this effect size was statistically significant ($z = 176316.27, p < .01$). Second, two studies contrasted large schools of 1,000 or more students to smaller schools and revealed that the odds of attrition from smaller schools were 1.08 times higher than those for attrition from larger schools ($z = -52.06, p < .01$). Another two studies assessed the relationship between a continuous measure of school enrollment and attrition rates, and these studies also suggested higher rates of attrition of smaller schools ($z = -2.51, p < .05$). Third, six studies suggested that teachers in private schools experienced odds of attrition that were 2.27 times those of teachers from public schools ($z = -3354113.00, p < .01$). Fourth, three studies that operationalized administrative support using a 5-point Likert-type scale revealed a reduction in the odds of attrition associated with more positive ratings of support ($z = -2.09, p < .05$). The fifth moderator, the percentage of beginning teachers participating in a school mentoring program, was also a statistically significant predictor of attrition ($z = -2917.82, p < .01$), with greater participation in the programs associated with a reduced likelihood of attrition. Sixth, a greater reported prevalence of school-based teacher networks and opportunities for collaboration was related to lower attrition rates ($z = -3.33, p < .01$). The outcomes for the final three moderators indicated that regular and supportive communication with administrators and better opportunities for advancement were associated with lesser attrition rates and that higher levels of bureaucracy were related to greater attrition rates, but each of these outcomes was based on only one study.

School Resources and Attrition

Table 5 provides information regarding education expenditures, teacher salaries, and other school resources as moderators of attrition odds ratios. School expenditures for teacher support and expenditures for teaching materials exhibited no statistically reliable relation to attrition outcomes. In each case, though, these results come from only one study and four independent estimates of the effect size. Additional resources in the form of teacher aides or classroom assistants were associated with considerably higher odds of attrition ($z = 2.33, p < .05$). One study examined the relation between instructional spending and attrition and per-pupil spending and the odds of attrition. In the case of spending on instructional needs, additional funds reduced the likelihood of attrition ($z = -3.87, p < .01$). A difference of \$500 per pupil in instructional spending was associated with odds of attrition for teachers in the lesser funded schools that are 5.38 times greater than those for teachers from the better funded schools. Overall increases in per-pupil spending, though, were associated with higher odds of teacher attrition ($z = 4.78, p < .01$). The outcomes for schools' average class sizes ($z = 1.82$) and student-teacher ratios ($z = 1.22$) revealed no statistically significant differences for either moderator.

At the bottom of Table 5 are the results for 14 studies that included teacher salary as a moderator of teacher turnover. In both cases, for teachers with 0 to 5 years of experience in the teaching profession and those teachers with tenure or 6 to 30 years of experience, higher salaries correlated with reduced odds of attrition. For those teachers later in their careers, the relationship between salary and attrition was strongest, with an odds ratio of 0.66 ($z = -3.44, p < .01$), but teachers with 0 to 5 years experience also experienced reduced odds of turnover associated with

TABLE 4

School organizational characteristics as moderators of effect size

Moderator variable	n of studies	n of effect sizes	Odds ratio	Effect size		95% CI		z
				Logged odds ratio	SE	Lower bound	Upper bound	
School location (<i>urban or suburban</i> = 1, <i>rural</i> = 0)	6	6	1.13	0.12	0.00 ^a	0.12	0.12 ^b	627215.60**
School sector (<i>public</i> = 1, <i>private</i> = 0)	6	6	0.44	-0.82	0.00 ^c	-0.82	-0.82 ^d	-3354113.00**
School size <i>Large</i> = 1, <i>small</i> = 0 ^e	2	2	0.93	-0.07	0.00 ^f	-0.07	-0.06	-52.06**
Enrollment	2	2	0.97	-0.03	0.97	-0.06	-0.01	-2.51*
Administrative support	3	3	0.79	-0.23	0.11	-0.44	-0.01	-2.07*
School mentoring program for beginning teachers	2	2	0.55	-0.60	0.00 ^g	-0.60	-0.60	-2917.82**
Collaboration and teacher network	1	2	0.63	-0.46	0.14	-0.73	-0.19	-3.33**
Regular supportive communication with administrators	1	1	0.87	-0.14	—	—	—	—
Opportunities for advancement	1	1	0.42	-0.87	—	—	—	—
Bureaucracy	1	1	2.30	0.83	—	—	—	—

Note. CI = confidence interval.

a. SE = 0.0000001945.

b. The CI ranges from 0.1219996187 to 0.1220003812.

c. SE = 0.0000002452.

d. The CI ranges from -0.8225504471 to -0.8225494857.

e. A "large" school had an enrollment of 1,000 or more students.

f. SE = 0.0013636184.

g. SE = 0.0002047464.

p* < .05. *p* < .01.

TABLE 5
School resources as moderators of effect size

Moderator variable	<i>n</i> of studies	<i>n</i> of effect sizes	Effect size			95% CI		<i>z</i>
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
School expenditure for support per teacher ^a	1	4	0.96	-0.04	0.19	-0.40	0.33	-0.19
School expenditure for teaching materials ^b	1	4	0.29	-1.25	1.32	-3.84	1.34	-0.95
Teacher aide or classroom assistant	3	6	0.98	-0.02	0.01	-0.03	0.00	-1.94
Instructional spending (in \$100 units)	1	2	0.93	-0.07	0.02	-0.10	-0.03	-3.87**
Per-pupil spending (in \$100 units)	1	2	1.05	0.05	0.01	0.03	0.07	4.78**
Average class size	3	3	1.00	0.00	0.00 ^c	-0.00	0.01	1.82
Student-teacher ratio	2	2	1.01	0.01	0.01	-0.01	0.02	1.22
Teacher salary								
0 to 5 years of experience	6	6	0.98	-0.02	0.01	-0.03	0.00	-2.76**
6 to 30 years of experience (or tenured)	5	5	0.66	-0.41	0.12	-0.64	-0.18	-3.44**
<i>High salary</i> = 1, <i>low salary</i> = 0	1	1	0.54	-0.61	—	—	—	—
<i>Medium salary</i> = 1, <i>low salary</i> = 0	1	1	0.73	-0.31	—	—	—	—
Teacher satisfaction with salary	1	1	0.34	-1.07	—	—	—	—

Note. CI = confidence interval.

a. Expenditures per teacher in the budgetary program for support activities divided by 10,000.

b. Expenditures expressed as a percentage of total expenditures for regular education, special education, and vocational education.

c. *SE* = 0.0011108902.

p* < .05. *p* < .01.

higher salaries ($z = -2.76, p < .01$). Three other outcomes were associated with teacher salaries, but in each case the moderator was the subject of only a single study. One study comparing the attrition rates of teachers with “high” salaries (more than \$10,000 in 1972) to those of teachers with “low” salaries (less than \$8,500 in 1972) revealed that lower paid teachers had an odds of attrition 1.85 times greater than their higher paid counterparts. The same study compared attrition rates of teachers receiving a “medium” salary (\$8,501 to \$9,999 in 1972) to those of teachers in the low-salary category and suggested that lower paid teachers had odds of attrition 1.37 times greater than those for higher paid teachers. Finally, one study used a 5-point Likert-type scale of teachers’ reported satisfaction with their salaries and showed that a 1-unit increase in satisfaction was related to a decrease of 2.94 for the odds ratio of attrition

School Student Body Characteristics and Attrition

The demographic characteristics of schools’ student populations have been the subject of research in a number of studies. In Table 6, the key moderator variables are organized according to three general categories: indicators of the schools’ socioeconomic composition, variables measuring the average student achievement level, and moderators relating to the schools’ racial/ethnic composition. Three studies indicated odds of attrition 1.05 times greater in predominantly low-SES schools relative to schools in which low-SES students were not in the majority ($z = 27.37, p < .01$). Similarly, the results from eight studies suggested that schools with higher percentages of students qualifying for free or reduced-price meals had higher odds of teacher turnover ($z = 3.19, p < .01$). In one study, researchers found that the odds of attrition in schools composed of 20% or more free-lunch-eligible students were 1.73 times greater than the odds for schools with less than 20% free-lunch eligibility.

The evidence related to school-average achievement levels and teacher attrition was consistent. Schools that had high or above-average achievement scores had lower odds of attrition among their teachers than did schools with lower achievement scores ($z = 3.72, p < .01$). Also, higher percentages of students with poor achievement performances were associated with increased odds of attrition ($z = 8.88, p < .01$). As suggested by two studies, higher district-average outcomes on the TAAS were related to a reduced likelihood of attrition ($z = -80.05, p < .01$).

Finally, at the bottom of Table 6 are the outcomes for various indicators of schools’ racial/ethnic composition. In five cases, studies examined differences in attrition rates between predominantly nonminority schools and those schools with a majority African American, Latino, or African American and Latino population. In these cases, the odds of attrition among teachers in predominantly minority schools were up to 3 times greater than those for majority-White schools. One study also suggested that the odds of teachers leaving the profession from schools with diverse student populations were more than 3 times greater than the odds for teachers from schools with more homogeneous racial/ethnic compositions. In seven studies, a continuous measure of the percentage of minority students indicated that schools with higher percentages of minorities suffered higher odds of teacher attrition than did schools with fewer minority students ($z = 5.53, p < .01$).

TABLE 6
School student body characteristics as moderators of effect size

Moderator variable	n of studies	n of effect sizes	Effect size			95% CI		z
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
School socioeconomic composition								
Majority in low socioeconomic class	3	3	1.05	0.05	0.00 ^a	0.05	0.06	27.37**
Majority in middle socioeconomic class	2	2	1.25	0.22	0.26	-0.29	0.73	0.83
Percentage with free lunch eligibility	8	8	1.01	0.01	0.00 ^b	0.00	0.01	3.19**
Free lunch eligibility (20% or more = 1, less than 20% = 0)	1	1	1.00	0.00	—	—	—	—
Student achievement level								
High or above average	2	2	0.75	-0.29	0.08	-0.44	-0.14	-3.72**
Percentage of students with poor performances	2	2	1.36	0.31	0.04	0.24	0.38	8.88**
District average TAAS math or reading scores	2	2	0.78	-0.25	0.00 ^c	-0.26	-0.25	-80.05**
School racial/ethnic composition								
Percentage of minority students	7	7	1.03	0.03	0.01	0.02	0.03	5.53**

(continued)

TABLE 6 (continued)

Moderator variable	n of studies	n of effect sizes	Effect size			95% CI		z
			Odds ratio	Logged odds ratio	SE	Lower bound	Upper bound	
Majority Black or Latino (50% or more = 1, less than 50% = 0)	2	2	1.12	0.11	0.00 ^d	0.11	0.11 ^e	738337.68**
Majority Black or Latino (50% or more = 1, less than 5% = 0)	1	1	1.11	0.10	—	—	—	—
Majority Black (>50%)	1	1	2.64	0.97	—	—	—	—
Majority Latino (> 50%)	1	1	2.08	0.73	—	—	—	—
Majority Black or Latino (>50%)	1	1	3.19	1.16	—	—	—	—
Percentage Black or Latino (5% to 19% = 1, <5% = 0)	1	1	1.06	0.06	—	—	—	—
Student diversity	1	1	3.10	1.13	—	—	—	—

Note. CI = confidence interval; TAAS = Texas Assessment of Academic Skills.

a. SE = 0.0019621382.

b. SE = 0.0021115095.

c. SE = 0.0031453873.

d. SE = 0.0000001444.

e. The CI ranges from 0.1065997170 to 0.1066002830.

** $p < .01$.

Discussion

The goal of this synthesis was to understand why attrition occurs or, more formally, what factors moderate attrition outcomes. Personal characteristics of teachers, including their backgrounds and qualifications, are important predictors of teacher turnover. Specifically, the odds of attrition are higher among teachers who are female, White, young, and married and who have a child. Regarding teachers' qualifications, the odds of attrition are greater among those who have no graduate degree, have specialized degrees in math or science, have regular certifications, have more years of experience, and score relatively lower on some standardized tests. The characteristics of the schools in which teachers work are also important moderators of attrition, with higher attrition in urban and suburban schools, private schools, elementary schools, and schools with a lack of collaboration, teacher networking, and administrative support. Those schools with high enrollments of poor, minority, and low-achieving students also suffer high attrition rates. Finally, with respect to resources, higher attrition is associated with lower levels of instructional spending and lower teacher salaries but higher overall per-pupil spending levels. This formal meta-analysis of 34 quantitative studies related to teacher attrition and retention revealed four major themes that help frame one's interpretation of the overall body of evidence and that might help inform future research in this area.

First, the attrition from the profession of teaching is not necessarily "healthy" attrition. Past research has tended to frame the issue of teacher attrition as a problematic and highly negative outcome. However, to a great extent, whether attrition is bad or not depends on the relative competence of those who are leaving and staying. If those who are leaving the schools are the worst teachers, then attrition may be deemed as a healthy and potentially beneficial outcome. Of course, this is because healthy and productive organizations typically retain the most effective employees and turn over the least effective ones.

The evidence from this review is somewhat mixed regarding whether or not teacher attrition is healthy. Teachers with presumably better training, who have earned a graduate degree, are somewhat more likely than those with lesser training to leave teaching. However, those who have earned certifications tend to stay in teaching somewhat more often than those without a teaching certificate. There is evidence from one study suggesting that higher achieving teachers are the ones who are more likely to leave, but this finding is not one that has been consistent across other efforts to study attrition, which have typically found no statistically significant relationship between teacher test scores and attrition. The schools do seem to lose more experienced teachers and teachers with high-demand science and math degrees. On balance, then, there is somewhat more evidence suggesting that it is the more talented rather than the less talented teachers—those who are better trained, more experienced, and more highly skilled—who tend to be lost to turnover with greater frequency. However, this finding is equivocal because the evidence is somewhat mixed and because these various teacher qualifications are imperfect indicators of teacher quality.

Second, attrition appears to be influenced by a number of personal and professional factors that are prone to change across the life span and career path. Kirby

and Grissmer (1991) noted that theory related to human capital offers some insight into this problem. Applying the human capital model to attrition, a teacher's decision to leave the profession is based on a careful weighing of the costs and benefits. Attrition tends to be higher during the early stages of a teacher's career because the teacher has accumulated less specific capital, or knowledge that is specific to the occupation and that is nontransferable. Teacher attrition tends to diminish later in the career as a teacher builds a greater amount of specific capital. As a result, attrition in the early stages of a teacher's careers is especially problematic. Specifically, Ingersoll (2003) estimated that during the first 5 years of their careers, 45% of teachers leave the profession.

Kirby and Grissmer (1991) also suggested that the decision to accept and keep a teaching job depends on life cycle factors related to one's existing family status and changes in one's family status. Similarly, Wayne (2000) maintained that individuals are more likely to leave teaching for family and personal reasons than because they are dissatisfied with their job. Indeed, important family-related decisions, such as whether to have a child, tend to be faced by many teachers early in their careers. Teachers who have children are far more likely than those teachers who do not have children to leave the profession. Notwithstanding, there is also some evidence to suggest that teachers who leave the profession to have a child or to pursue other ventures often return to teaching. These temporary leavers represent significant numbers nationally, with one recent estimate suggesting that one fourth of the teachers hired each year are people who, though not currently teaching, have some prior teaching experience (Wayne, 2000).

Beyond personal and family factors that can affect new teachers' career decisions, another reason new teachers leave is that teaching, as a profession, has been slow to develop a systematic way to induct beginners gradually into a highly complex job. Unlike other developed countries, beginning teachers in the United States are typically given the most difficult assignments, are provided limited classroom resources compared to veteran teachers, receive little or no support, and are generally isolated behind classroom doors with little feedback or help (Gordon & Maxey, 2000; Moskowitz & Stephens, 1996). However, this meta-analysis suggests that when more formal organizational mechanisms are put in place to provide novice teachers with support networks and mentoring opportunities, these efforts are associated with decreased attrition rates.

Our results and previous summaries of the literature by authors such as Kirby and Grissmer (1991) also suggest that attrition rates are high early and later in teachers' careers and that this attrition pattern conforms to a *U*-shaped distribution. Our review indicates that researchers who attempt to model a simple linear relationship between years of experiences or teachers' age and attrition are very likely to misrepresent the true pattern that is represented by the data. Indeed, the results from our meta-analysis that summarize correlations between simple continuous measures of experience or age and attrition should be interpreted with considerable caution.

Decisions to leave the profession during the later stages of a career may be explained by factors that are distinct from those that are prominent during the earlier years of teaching. For instance, Harris and Adams (2007) found that teachers tend to retire considerably earlier than other professionals and hypothesized that this is in part because of the relatively high ratio of pensions to salaries in teaching,

which therefore makes pension participation a more significant factor in labor market decisions. Obviously, family-related decisions, including whether to have a child, are less relevant to teachers during the latter years of their careers. However, care of an aging parent or desire to spend time with grandchildren may be salient factors to those who leave teaching during the twilight of their careers. It is interesting that although higher salaries are associated with higher retention rates for teachers at all stages of their careers, the evidence reviewed suggests that higher salaries tend to be more important for retaining teachers who have been in the profession for 6 to 30 years than for teachers in the first 5 years of their careers.

Third, the characteristics of teachers' work conditions are more salient for predicting attrition than previously noted in the literature. The early literature of the 1970s and 1980s related to the career paths of teachers stressed the rapidly increasing number retirees from the baby boom generation, personal and family characteristics of teachers as predictors of voluntary attrition, and the draw of higher salaries for retaining more teachers. More recently, Ingersoll (2001a, 2001b) argued that organizational factors within a school, including lack of support from administrators, student discipline issues, and lack of input and decision-making power, cause teachers to leave the profession. However, much debate continues to characterize the field. Other researchers, including Harris and Adams (2007), have continued to provide evidence suggesting that early retirements are the key problem and have speculated that this problem is exacerbated by a pension and salary structure that rewards early retirements. Harrington (2001) blames specific shortages of math and science teachers on a dysfunctional labor market held hostage by poor allocation of resources, disincentives to productivity, and, ironically, inequity. Equal pay for all teachers, he argues, distorts the market for teachers in these technical subject areas.

The evidence reviewed in this meta-analysis suggests that there are a large number of characteristics of the environments in which teachers work that predict attrition. These characteristics include those noted prominently by Ingersoll (2001a, 2001b), including organizational features of schools. However, our results indicate that they also include salaries and instructional resources provided to teachers, other organizational attributes of schools, and, also important, the characteristics of schools' student bodies. Indeed, one of the more troubling contemporary problems related to equality of educational opportunity is staffing every classroom in high-poverty and high-minority schools with a highly qualified and talented teacher. The research evidence has continued to suggest that poor and minority students have less access to qualified teachers than do more affluent and nonminority children (Borman & Kimball, 2005; Ferguson, 1998; Kain & Singleton, 1996). A significant reason for these disparities is, in part, attributable to the fact that the greatest teacher attrition rates are found in those schools serving low-achieving, poor, and minority students.

Fourth, there are various conditions, such as higher salaries, teacher collaboration and networking, and administrative support, that are related to retention and that are quite amenable to change. Through the early and later stages of research on teacher attrition, the salary teachers receive has continued to be a highly salient predictor of attrition outcomes. This may be a factor that explains other relationships

as well, including the large disparities between attrition rates for private and public schools. For instance, according to the 1987–1988 Teacher Follow-up Survey, 4.5% of public school teachers stated salary as a main reason for leaving the profession. In the private schools, 9.1% of private school teachers stated salary as a main reason for leaving the profession (Bobbitt, Faupel, & Burns, 1991). In addition, Theobald (1990) found that salaries are positively related to decisions to continue teaching in the same district. Even previous research has suggested that salary provides a reason for teachers to change careers. According to Bloland and Selby's (1980) review of the literature, salary appears to be an important factor associated with the career changes of male educators, but not female educators. Obviously, increased salaries, and even incentives to teach in high-needs schools, are policy options that require additional educational expenditures. However, each of these options could curtail the high costs to school systems of recruiting and replacing teachers. Also, with respect to staffing high-needs schools, such policies could have very important consequences for advancing educational equality.

During the early years of teachers' careers, other proactive policy options centered around collaboration and mentoring appear to have particular benefits. Given the high rate of attrition during the first 5 years of teachers' careers, more proactive policies to ease this transition from teacher preparation programs to the real world of schools and classrooms are likely to hold promise. Discovering the ways in which preservice, internship, and professional development experiences can be structured to help teachers during the crucial first 5 years is a critical research, policy, and program development initiative for the future. In addition, defining the roles that administrators and more senior teachers can play in improving retention requires more research and development. From the evidence reviewed, it appears that initiatives that lessen the bureaucratic organization of schools and school systems and strategies that promote more genuine administrative support from school leaders and collegiality among teachers are strategies that may improve retention.

Limitations of the Existing Research Base and Future Directions

High-quality information on the labor market for teachers is vital to monitoring trends and addressing potential shortages in a productive and preemptive manner. A number of national data sets have provided good periodic evidence regarding these trends. These data have also allowed researchers to explore many of the moderators of attrition and retention reviewed here. Examples of widely utilized national data sets on teachers and their careers are noted in the appendix. The information provided by these data sources has been important for informing research on career trajectories. However, four significant limitations exist.

First, few data sources have provided long-term longitudinal data on teachers. Instead, typical national data sets measure attrition rates from one academic year to the next. Although informative, these data do not capture the dynamic trajectories of teachers' careers. Two waves of data collection through, for instance, the Teacher Follow-up Survey cannot tell us about the shape of teachers' growth trajectories on important outcomes, such as commitment to teaching, and cannot tell us the extent to which teachers leave and reenter the teaching force. We need truly longitudinal data with more than two time points to capture more nuanced pictures of teachers' career trajectories. As Singer and Willett (1996) argued, such a strategy for studying teacher career paths allows investigations of both the duration of

teacher employment itself and the growth and change in the attributes, behaviors, and attitudes of teachers.

Second, the literature on teacher attrition and retention has developed through a relatively uncoordinated array of data collection and analytical efforts that has focused on many elements of the problem and has, as such, not produced a very compelling body of cumulative evidence. The 34 studies reviewed in this meta-analysis have collected information regarding a total of 63 different characteristics related to teachers and the schools in which they teach. Together, these studies provide a rich and variegated literature. Though this breadth of research may be viewed as an asset, its limited depth with respect to a number of key moderators of attrition—most important, those that concern how policies and other initiatives can help improve retention—is a significant limitation. In this way, the research has only scratched the surface in many respects and has not produced a strong cumulative body of evidence and theory for informing future work.

We hope that this synthesis of the research evidence will help sharpen research questions and theory applied to teacher attrition and retention. For instance, our conceptualization of five important constellations of variables affecting attrition and retention (i.e., teacher demographic characteristics, teacher qualifications, school organizational characteristics, school resources, and school student body characteristics) should provide a more coherent framework for organizing future data-collection efforts and analytical models. Furthermore, the relatively large number of moderators that showed only weak associations to attrition provides researchers with empirical information that can help guide efforts to winnow down the number of predictors employed in future research. Our conclusion that teacher attrition rates and the reasons for attrition vary across the life span and career path points to the need for longitudinal analyses that are sensitive to differences emerging over time in teachers' career choices. We also hope that our observation of the importance of school organizational characteristics and the characteristics of teachers' work conditions as predictors of attrition and retention will inspire greater attention to these variables, which are both amenable to intervention and change.

As Guarino et al. (2006) noted, the conceptual framework most often applied to the study of teacher labor markets is directly derived from the economic labor market theory of supply and demand. With this conceptualization, demand for teachers is defined as the number of teaching positions offered at a particular level of compensation, and the supply of teachers is the number of qualified individuals willing to teach at a particular level of compensation. In this case, compensation includes not only salary, bonuses, and other forms of current and future earnings but also nonpecuniary rewards such as working conditions and personal satisfaction. Though we agree that this general theory provides a logical framework for studying teacher retention and attrition, our review suggests that researchers must apply it in a nuanced way that, most notably, takes into account that the perceived rewards of teaching and those of competing occupations and activities are likely to change across the career path of teachers and that—although monetary and material resources are important—many aspects of teachers' working conditions are of equal or greater importance within the education labor market.

Third, the information on national attrition rates is sporadic and has been subject to some inconsistencies over time because of differences in data collection and sampling methods. The investment in a yearly national data collection effort to collect this

basic information from schools and districts could be minimal because it does not represent a significant reporting burden and could even be added to existing surveys, including the National Center for Education Statistics Common Core of Data. Consistent yearly measures of teacher outcomes, including attrition, would provide other important indicators of the health of the education system, which disproportionately focuses its data-collection activities on students and schools.

Finally, despite some recognition of the problem of teacher attrition, there is little evidence to guide potential initiatives to help ameliorate it. Rigorous experimental studies of programs or policies to address attrition are nonexistent. Though there is some correlational research with some promise suggesting that mentoring programs for beginning teachers and teacher networking programs may be associated with reduced attrition rates, there is a strong need for randomized experiments or well-crafted quasi-experiments to provide more convincing evaluations of initiatives such as these. The weight of evidence suggesting that alterable characteristics of teachers' work environments play an important role in attrition underlines the critical need for well-designed interventions and evaluations of initiatives to help retain teachers, especially in those schools that are most in need of improvement.

APPENDIX

National data sources on teachers and teacher careers

Source	Description
Nation-wide Schools and Staffing Survey (SASS), National Center for Education Statistics (NCES)	Surveys concerning schools and school personnel conducted by the NCES. The SASS survey system emphasizes teacher demand and shortage, teacher and administrator characteristics, school programs, and general conditions in schools. SASS also collects data on many other topics, including principals' and teachers' perceptions of school climate and problems in their schools, teacher compensation, district hiring practices, and basic characteristics of the student population. SASS has four core components: the School Questionnaire, the Teacher Questionnaire, the Principal Questionnaire, and the School District Questionnaire, which was known as the Teacher Demand and Shortage Questionnaire until the 1999–2000 SASS administration. These questionnaires are sent to respondents in public, private, and Bureau of Indian Affairs or tribal schools. In 1999–2000, public charter schools were

(continued)

APPENDIX (continued)

Source	Description
	also included in the sample. For the 2003–2004 SASS, a sample of public charter schools was included in the sample as part of the public school questionnaire.
Survey of Teacher Demand and Shortage, NCES	Part of the general SASS system now known as the School District Questionnaire
School Questionnaire from the SASS system, NCES	Part of the general SASS system
Teacher Questionnaire from the SASS system, NCES	Part of the general SASS system
Principal Questionnaire from the SASS system, NCES	Part of the general SASS system
The Teacher Follow-up Survey (TFS), NCES	The TFS is designed to measure attrition from the teaching profession and teacher mobility. The TFS seeks to determine how many teachers remained at the same school, moved to another school, or left the profession in the year following the SASS administration. The TFS uses two questionnaires, one for teachers who left teaching since the previous SASS and another for those who are still currently teaching either in the same school as last year or in a different school. The topics for the Current Teacher Questionnaire include teaching status and assignments, ratings of various aspects of teaching, the time teachers spend on different aspects of the job, professional development over the past 2 years, and ratings of various strategies for retaining more teachers. The topics for the Former Teacher Questionnaire include employment status, ratings of various aspects of teaching and their current jobs, information on decisions to leave teaching, and ratings of various strategies for retaining more teachers.
Surveys of Recent College Graduates (SRCG)	The SRCG describes recent science and engineering graduates in 1995, 1997, and 1999. The SRCG surveys provide more

(continued)

APPENDIX (continued)

Source	Description
1993 Survey of College Graduates (SCG), National Science Foundation (NSF)	<p>than 12,000 observations on 20- to 30-year-old full-time workers who are recent science and engineering bachelor's degree graduates. The survey contains information about earnings, hours worked per week, geographic location, educational attainment, age, race, sex, date of college graduation, college major, fields of higher degrees earned, and parents' educational attainment. It also includes information about each individual's college grade point average.</p> <p>Data were collected by the NSF as part of the Scientists and Engineers Statistical Data System. The 1993 National SCG was a once-a-decade baseline survey in that it also covered the non-scientist and engineer population with a bachelor's or higher degree—about 29 million people.</p>
High School and Beyond Study (HS&B), NCES	<p>Second major longitudinal study after the National Longitudinal Study of 1972 (NLS-72) conducted by NCES. HS&B studied the high school students of 1980, attempting to collect the same types of data gathered in NLS-72. However, the second study differed from the first in two significant ways: It addressed many newer issues of the educational process, and it included a sophomore cohort as well as a senior cohort. Adding the sophomore cohort made it possible to study high school dropouts and analyze changes and processes during high school.</p>
National Education Longitudinal Study of 1988 (NELS:88), NCES	<p>NELS:88 was the third major longitudinal study sponsored by NCES. The purpose of the NELS:88 was to expand on the base of knowledge from the first two longitudinal surveys by following young adolescents from an earlier age (eighth grade) and updating information throughout the 1990s. In the base year, four cognitive tests (reading, science, history and government, and mathematics)</p>

(continued)

APPENDIX (continued)

Source	Description
Education Longitudinal Study of 2002 (ELS:2002), NCES	<p>were administered in addition to the student questionnaire, a parent questionnaire, a teacher questionnaire, and a school administrator questionnaire.</p> <p>ELS:2002 is the fourth in a series of NCES-sponsored secondary school-based longitudinal studies. ELS:2002 is designed to monitor the transition of a national sample of young people as they progress from 10th grade through high school and on to postsecondary education and/or the world of work. Under current plans, cohort members will be followed through 2014 so that later outcomes—including access to, and persistence in, higher education or success in the labor market—can be examined in terms of students' earlier aspirations, achievement, and high school experiences.</p>
Current Population Survey (CPS)	<p>CPS, conducted by the U.S. Bureau of Labor Statistics, is the least detailed data set but is useful because it covers the longest span of time. It contains monthly surveys of representative samples of the U.S. population throughout the past two decades. CPS merged outgoing rotation files assembled by the National Bureau of Economic Research and provides more than 400,000 observations on full-time workers, aged 20 to 39, between 1980 and 2001.</p>
Common Core of Data (CCD), NCES	<p>CCD is the primary NCES database on public elementary and secondary education in the United States. Produced annually, it is a comprehensive national statistical database of all public elementary and secondary schools and school districts, and it contains comparable data across all states. The CCD contains three categories of information: general descriptive information on schools and school districts, data on students and staff, and fiscal data.</p>

(continued)

APPENDIX (continued)

Source	Description
Alternative Certification: A National Study	The Center for Education Policy at the Stanford Research Institute (SRI) International was awarded a grant from the Carnegie Corporation of New York to conduct a comprehensive study of alternative teacher certification programs (2001 to 2005). The study was designed to identify normative standards for effective alternative certification programs; the SRI study explored the components of various alternative routes to teacher certification and their relative effectiveness in preparing teachers for the classroom. The goal of the study was to determine the key characteristics that render alternative certification programs more or less effective in terms of preparing teachers for the classrooms in which they will be working and to understand the contributions of the programs to both the quantity and quality of new teachers.

References

References marked with an asterisk indicate studies included in the meta-analysis.

- *Adams, G. J. (1996). Using a Cox regression model to examine voluntary teacher turnover. *Journal of Experimental Education*, 64, 267–285.
- Alliance for Excellent Education. (2005, August). *Tapping the potential: Retaining and developing high-quality new teachers*. Washington, DC: Author. Available from the Alliance for Excellent Education Web site, <http://www.all4ed.org/>
- *Allred, W. E., & Smith, R. B. (1984). Profile of Utah teachers leaving the teaching profession. *Rural Educator*, 5(3), 2–5.
- *Arnold, C. L., Choy, S. P., & Bobbitt, S. A. (1993). *Modeling teacher supply and demand, with commentary* (NCES 93-461). Washington, DC: National Center for Education Statistics.
- *Beaudin, B. Q. (1993). Teachers who interrupt their careers: Characteristics of those who return to the classroom. *Educational Evaluation and Policy Analysis*, 15, 51–64.
- Bloland, P., & Selby, T. (1980). Factors associated with career change among secondary school teachers: A review of the literature. *Educational Research Quarterly*, 5(3), 13–24.
- Bobbitt, S. A., Faupel, E., & Burns, S. (1991). *Characteristics of stayers, movers, and leavers: Results from the Teacher Follow-up Survey, 1988-1989* (NCES 91-128).

- Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.
- Borman, G. D., & Kimball, S. (2005). Teacher quality and educational equality: Do teachers with higher standards-based evaluation ratings close student achievement gaps? *Elementary School Journal, 106*, 3–20.
- *Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2005a). *The impact of assessment and accountability on teacher recruitment and retention: Are there unintended consequences?* Washington, DC: U.S. Department of Education.
- *Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2005b). Explaining the short careers of high-achieving teachers in schools with low-performing students. *American Economic Review, 95*(2), 166–171.
- *Brewer, D. J. (1996). Career paths and quit decisions: Evidence from teaching. *Journal of Labor Economics, 14*(2), 313–339.
- Carnegie Forum on Education and the Economy. (1986). *A nation prepared: Teachers for the 21st century*. New York: Carnegie Corporation.
- *Chapman, D. W., & Hutcheson, S. M. (1982). Attrition from teaching careers: A discriminant analysis. *American Educational Research Journal, 19*, 93–105.
- *Clewell, B. C., & Villegas, A. M. (2001). *Evaluation of the DeWitt Wallace-Reader's Digest Fund's Pathways to Teaching Careers Program*. Washington, DC: Urban Institute.
- Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., et al. (1966) *Equality of educational opportunity*. Washington, DC: Government Printing Office.
- Darling-Hammond, L. (1984). *Beyond the commission reports: The coming crisis in teaching*. Santa Monica, CA: RAND.
- Dolton, P. J., & van der Klaauw, W. (1995). Leaving teaching in the UK: A duration analysis. *Economic Journal, 105*, 431–444.
- Dolton, P. J., & van der Klaauw, W. (1999). The turnover of teachers: A competing risks explanation. *Review of Economics and Statistics, 81*, 543–552.
- *Dworkin, A. G. (1980). The changing demography of public school teachers: Some implications for faculty turnover in urban areas. *Sociology of Education, 53*(2), 65–73.
- *Eller, W. S., Doerfler, C. B., & Meier, K. J. (2000). *Teacher turnover in Texas: Problems and prospects. A report of the Texas Educational Excellence Project*. College Station: Texas A&M University.
- Ferguson, R. F. (1998). Can schools narrow the Black-White test score gap? In C. Jencks & M. Phillips (Eds.), *The Black-White test score gap* (pp. 318–374). Washington, DC: Brookings Institution.
- Fleiss, J. L. (1994). Measures of effect size for categorical data. In H. Cooper & L. V. Hedges, *The handbook of research synthesis* (pp. 245–260). New York: Russell Sage.
- Gordon, S. P., & Maxey, S. (2000). *How to help beginning teachers succeed* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.
- Grissmer, D. W., & Kirby, S. N. (1987). *Teacher attrition: The uphill climb to staff the nation's schools*. Santa Monica, CA: RAND.
- *Grissmer, D. W., & Kirby, S. N. (1992). *Patterns of attrition among Indiana teachers: 1965-1987* (R-4076-LE). Santa Monica, CA: RAND.
- Grissmer, D. W., & Kirby, S. N. (1997). Teacher turnover and teacher quality. *Teachers College Record, 99*, 45–56.

- *Gritz, R. M., & Theobald, N. D. (1996). The effects of school district spending priorities on length of stay in teaching. *Journal of Human Resources*, 31(3), 477–512.
- Guarino, C. M., Santibanez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, 76, 173–208.
- Guthrie, J., & Rothstein, R. (1999). Enabling “adequacy” to achieve reality: Translating adequacy into state school finance distribution arrangements. In J. Hansen & R. Chalk (Eds.), *Equity and adequacy in education finance: Issues and perspectives* (pp. 209–259). Washington, DC: National Academy Press.
- *Hall, B. W., Pearson, L. C., & Carroll, D. (1992). Teachers’ long-range teaching plans: A discriminant analysis. *Journal of Educational Research*, 85(4), 221–225.
- Hanushek, E. A. (1992). The trade-off between child quantity and quality. *Journal of Political Economy*, 100, 84–117.
- *Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Why public schools lose teachers. *Journal of Human Resources*, 39(2), 326–354.
- Harrington, P. E. (2001). Attracting new teachers requires changing old rules. *College Board Review*, 192, 6–11.
- Harris, D. N., & Adams, S. (2007). Understanding the level and causes of teacher turnover: A comparison with other professions. *Economics of Education Review*, 26, 325–337.
- Henke, R. R., Chen, X., Geis, S., & Knepper, P. (2000). *Progress through the teacher pipeline: 1992-93 college graduates and elementary/secondary teaching as of 1997* (NCES 2000-152). Washington, DC: National Center for Education Statistics.
- Holmes Group. (1986). *Tomorrow’s teachers: A report of the Holmes Group*. East Lansing, MI: Author.
- *Imazeki, J. (2005). Teacher salaries and teacher attrition. *Economics of Education Review*, 24, 431–449.
- *Ingersoll, R. M. (2001a). *Teacher turnover, teacher shortages, and the organization of schools* (No. R-01-1). Seattle: University of Washington, Center for the Study of Teaching and Policy.
- Ingersoll, R. (2001b). Teacher turnover and teacher shortages: An organizational analysis. *American Education Research Journal*, 38, 499–534.
- Ingersoll, R. M. (2003). *Is there really a teacher shortage?* Seattle: University of Washington, Center for the Study of Teaching and Policy.
- *Ingersoll, R. M., & Alsalam, N. (1997). *Teacher professionalization and teacher commitment: A multilevel analysis* (NCES 97-069). Washington, DC: National Center for Education Statistics.
- Johnson, S. M., Berg, J. H., & Donaldson, M. L. (2005). *Who stays in teaching and why: A review of the literature on teacher retention*. Boston: Harvard Graduate School of Education, Project on the Next Generation of Teachers.
- *Johnson, S. M., & Birkeland, S. E. (2003). Pursuing a “sense of success”: New teachers explain their career decisions. *American Educational Research Journal*, 40, 581–617.
- Kain, J. F., & Singleton, K. (1996, May-June). Equality of educational opportunity revisited. *New England Economic Review*, pp. 87–111.
- *Kirby, S. (1999). Supply and demand of minority teachers in Texas: Problems and prospects. *Educational Evaluation and Policy Analysis*, 21, 47–66.
- Kirby, S. N., & Grissmer, D. W. (1991). Sources of teacher supply: Some new evidence from Indiana. *Educational Evaluation and Policy Analysis*, 13, 256–268.

- Kopp, W. (2001). *One day, all children: The unlikely triumph of Teach for America and what I learned along the way*. New York: Public Affairs.
- Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.
- *Loeb, S., Darling-Hammond, L., & Luczak, J. (2005). How teaching conditions predict teacher turnover in California schools. *Peabody Journal of Education, 80*(3), 44–70.
- *Marso, R. N., & Pigge, F. L. (1997). A longitudinal study of persisting and nonpersisting teachers' academic and personal characteristics. *Journal of Experimental Education, 65*, 243–254.
- *Mont, D., & Rees, D. I. (1996). The influence of classroom characteristics on high school teacher turnover. *Economic Inquiry, 34*(1), 152–167.
- Moskowitz, J., & Stephens, M. (1996). *From students of teaching to teachers of students: Teacher induction around the Pacific Rim*. Washington, DC: Pelavin Associates.
- Murnane, R. J., & Olsen, R. J. (1989). The effects of salaries and opportunity costs on duration in teaching: Evidence from Michigan. *Review of Economics and Statistics, 71*, 347–352.
- Murnane, R. J., & Olsen, R. J. (1990). The effect of salaries and opportunity costs on length of stay in teaching: Evidence from North Carolina. *Journal of Human Resources, 25*, 106–124.
- National Academy of Sciences. (1987). *Toward understanding teacher supply and demand*. Washington, DC: National Academy Press.
- National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform*. Washington, DC: Government Printing Office.
- National Commission on Teaching and America's Future. (1997). *Doing what matters most: Investing in quality teaching*. New York: Author.
- Murnane, R. J., Singer, J. D., & Willett, J. B. (1989). The influences of salaries and "opportunity costs" on teachers' career choices: Evidence from North Carolina. *Harvard Educational Review, 59*, 325–346.
- *Rees, D. I. (1991). Grievance procedure strength and teacher quits. *Industrial and Labor Relations Review, 45*(1), 31–43.
- *Rickman, B. D., & Parker, C. D. (1990). Alternative wages and teacher mobility: A human capital approach. *Economics of Education Review, 9*(1), 73–79.
- Sanders, W., & Rivers, J. C. (1996, November). *Cumulative and residual effects of teachers on future student academic achievement*. Knoxville: University of Tennessee, Value-Added Research and Assessment Center.
- *Schlechty, P. C., & Vance, V. S. (1981). Do academically able teachers leave education? The North Carolina case. *Phi Delta Kappan, 63*(2), 106–112.
- *Shen, J. (1997). Teacher retention and attrition in public schools: Evidence from SASS91. *Journal of Educational Research, 91*(2), 81–88.
- *Shin, H. (1995). Estimating future teacher supply: Any policy implications for educational reform? *International Journal of Educational Reform, 4*(4), 422–433.
- Singer, J. D., & Willett, J. B. (1996). Methodological issues in the design of longitudinal research: Principles and recommendations for a quantitative study of teachers' careers. *Educational Evaluation and Policy Analysis, 18*(4), 265–283.
- *Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal, 41*, 681–714.

- Speakman, S. T., Cooper, B. S., Sampieri, R., May, J., Holsomback, H., & Glass, B. (1996). Bringing money into the classroom: A systemic resource allocation model applied to the New York City public schools. In L. Picus & J. Wattenberger (Eds.), *Where does the money go?* (pp. 106–131). Thousand Oaks, CA: Sage.
- *Stinebrickner, T. R. (1998). An empirical investigation of teacher attrition. *Economics of Education Review*, 17(2), 127–136.
- *Stinebrickner, T. R. (1999). Estimation of a duration model in the presence of missing data. *Review of Economics and Statistics*, 81(3), 529–542.
- *Stinebrickner, T. R. (2002). An analysis of occupational change and departure from the labor force: Evidence of the reasons that teachers leave. *Journal of Human Resources*, 37(1), 192–216.
- Theobald, N. D. (1990). An examination of the influence of personal, professional, and school district characteristics on public school teacher retention. *Economics of Education Review*, 9(3), 241–250.
- Wayne, A. J. (2000). Teacher supply and demand: Surprises from primary research. *Education Policy Analysis Archives*, 8(47). Available from the *Education Policy Analysis Archives* Web site, <http://epaa.asu.edu/epaa/v8n47.html>
- *Whitener, S. D., Gruber, K. J., Lynch, H., Tingos, K., Perona, M., & Fondelier, S. (1997). *Characteristics of stayers, movers, and leavers: Results from the Teacher Followup Survey: 1994-95* (NCES 97-450). Washington, DC: National Center for Education Statistics.
- Wilson, S. M., Floden, R. E., & Ferrini-Mundi, J. (2001, February). *Teacher preparation research: Current knowledge, gaps, and recommendations*. Seattle: University of Washington, Center for the Study of Teaching and Policy.

Authors

GEOFFREY D. BORMAN is a professor of educational leadership and policy analysis, educational policy studies, and educational psychology at the University of Wisconsin–Madison, 1161D Educational Sciences Building, 1025 W. Johnson St., Madison, WI 53706; e-mail: gborman@education.wisc.edu.

N. MARITZA DOWLING is an assistant scientist, Department of Biostatistics and Medical Informatics, University of Wisconsin–Madison, D4211 VAH, Madison, WI 53726; e-mail: nmdowlin@biostat.wisc.edu.