Modeling Teacher Attrition: Teacher Characteristics and Working Conditions

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This paper describes the literature on teacher attrition as either focusing on the working conditions faced by beginning teachers or highlighting variations in teachers' characteristics as causes for early teacher attrition. This study uses responses to the School and Staffing Survey (SASS) along with the Teacher Follow-Up Survey (TFS) to compare these contrasting views of early teacher attrition. Two logistic regression models were constructed and their relative efficacy in explaining teacher attrition were compared using three statistical techniques; model fit characteristics (e.g. pseudo-R^2, Akaike Information Criteria, Bayesian Information Criteria); a comparison of their classification effectiveness, and results from Davidson and MacKinnon's *J* test (1981). A final model was also constructed using the predictive elements of each of the previous models. Results suggest that the working conditions model better fits the observed data than the teacher characteristics model. The final model highlights the importance of teacher commitment and engagement in the profession in teachers' career decisions.

To Evelyn Cannady

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Chapter 1: Perspectives on Early Leaving

When teachers leave the profession, they do so with more than their belongings. They leave with the investment that colleagues, administrators, and school districts have made in them along with the resources required to recruit them to the school and support them through the year. They also walk out with the added professional experience garnered through the year(s) and the relationships developed with colleagues in the school. The true cost of exit is more than just these unrecoverable costs; when teachers leave, they leave other voids that the school must expend even further resources to fill.

These departures from teaching generate costs, both financial (Texas Center for Educational Research, 2000) and instructional (Johnson, Berg & Donaldson, 2005). In an attempt to estimate the financial burden associated with teacher turnover, let alone the effect on instruction, the National Commission on Teaching and America's Future (NCTAF) studied five school districts across the country and found that the costs across school districts range from $4,366 to $17,872 *per* teacher who leaves (NCTAF, 2003). NCTAF estimated 332,700 teachers left their teaching assignments from the 2003-4 to the 2004-5 school year; their estimate of the cost of this turnover exceeded 7 billion dollars (NCTAF, 2007).

The problem of teacher attrition is especially evident with beginning teachers. Early attrition is particularly problematic, because it requires schools to replace a teacher they have just recently hired. Statistics on teacher attrition indicate 20% of beginning teachers leave the profession within their first three years (Henke, Chen, & Gies, 2000) and nearly half leave within the first five years (Ingersoll, 2003). Moreover, national averages mask the even higher rates of early attrition among teachers in schools in urban and rural areas, which often are the least

equipped to deal with the additional impact on the budget and traditionally serve students with the greatest educational needs (Hanushek, Kain & Rivkin, 2004).

Research on early attrition offers a variety of explanatory theories, but, as is demonstrated in Chapter 2, these research studies can largely be categorized into one of two constellations. The term constellation is used to describe groupings of research studies while recognizing the variety of separate elements that comprise each grouping. The shared perspective the studies take on the explanation for early teacher attrition forms the constellations. For example, studies in the constellation I call "working conditions," the one most frequently discussed in the literature, takes the perspective that teachers leave the profession as a result of one, or a combination of several, factors in their working experience. Although there are a variety of theoretical frameworks within this constellation, one common theory derives from labor economics, which claims that teachers, like workers in other fields, are rational beings and make choices about their career decisions based on their preferences for "wages, working conditions and other unobservable factors" (Strunk & Robinson, 2006, p. 67). Another major theory within this same constellation comes from sociology, specifically the study of organizations. Research deriving from this theory seeks to determine how leaders within schools, considered organizations, can respond to issues of teacher attrition by promoting the retention of desired teachers within a school. The term working conditions in this study refers to all the experiences encountered by teachers while they are working in the classroom, including their salaries, induction experiences, and administrative support; this differs from some other researchers who use the same phrase to refer to only the conditions at the school, such as quality of the facilities, behavior of the student body, or collegiality among the staff. Here, the phrase working conditions accounts for those aspects of teachers' jobs as well as a teachers' salary, their

induction upon entering the profession, the behavior of the students in the school, the school culture and the support of the administration. Thus, reasons for early teacher attrition from studies within this constellation include: inadequate salaries, low job satisfaction, unwelcoming school cultures, poor administrative support, and problems with student behavior (e.g. Ingersoll, 2004; Luekens, Lyter, Fox & Changler, 2004). Furthermore, the lack of state and school district infrastructure to support teachers during their professional careers has also been noted as common factors associated with teachers' exiting the field (Johnson & Project of the Next Generation of Teachers, 2004; Darling-Hammond, Berry, Haselkorn & Fideler, 1999; NCTAF, 2003).

Recognition of the high rates of early teacher attrition has led to various intervention programs aimed at supporting beginning teachers (Ingersoll & Kralik, 2004). As Ingersoll and Kralik point out, some schools have attempted to offer support to new teachers through their "induction" phase, including the provision of mentoring, peer observations, and additional support in the classroom (e.g., teacher aides or instructional coaches). There is some evidence that it is the teachers entering the profession without an undergraduate degree in education who see the greatest increases in their retention rates when participating in induction programs (Duke, Karson & Wheeler, 2006). This suggests it is the characteristics, including the amount of preparation, that teachers have upon entering the profession or the conditions that they face once there that most influences their decisions to remain a classroom teacher.

The second constellation of research studies looks at aspects within the teachers' themselves to offer explanations of early teacher attrition. Here some studies take the perspective that teachers are ill prepared to manage the working conditions that they encounter (Haberman, 2005). This line of reasoning stands in contradiction to the previous argument about

working conditions being the primary factor leading to teacher attrition by positing that new teachers enter the profession with an awareness of impending difficulties and over half of them, despite experiencing these conditions first hand, still choose to stay in the profession (Haberman, 2005). Thus, the researchers in this second constellation argue that it is not the working conditions that push teachers to leave, but rather the new teachers' characteristics – that is, their skills, experiences and attributes – upon entering the classroom that leads to their early exits. Some examples of relevant teacher characteristics include: lack of commitment to teaching as a career (Fleener & Dahm, 2007; Shen, 1997); lack of preparation to work with diverse populations (Haberman, 2005); limited amount, and/or low-quality, of teacher preparation in pedagogy (Boe, Cook & Sunderland, 2006) or mentored classroom experience (Reynolds, Ross, & Rakow, 2002; Shen, 2003; Fleener & Dahm, 2007); and a lack of resiliency in the teachers themselves (Bernshausen & Cunningham 2001). The theories that guide research within this constellation are widely varied. For example, there are several studies that rely on economic theories, such as, labor economic theory and human capital theory. There are other studies within this constellation that utilize theories from psychology, such as Bandura's work in self-efficacy, or social cognitive theory. Furthermore, there are some studies that are inspired by theories within sociology, socio-cultural career theory and social organizational theory. While the elements within this constellation define a broader theoretical space, their proximity is defined by their shared perspective that early teacher attrition is a product of teacher characteristics, rather than defined by external influences.

Despite the high rates of teacher attrition and the variety of explanations offered, there is a dearth in literature exploring the link of teachers' characteristics and working conditions with their career trajectories (Johnson, Berg & Donaldson, 2005). In fact, in their thorough review of

the literature on teacher retention, Johnson, Berg and Donaldson (2005) emphasize the need for research that follows teachers over time through their transition from preservice to inservice teaching. These authors note that current research lacks adequate information regarding background, experience, and workplace conditions of teachers, which would allow for an examination of how these factors relate to each other and to retention over time.

Purpose of this Study

The purpose of this research, therefore, was to investigate the strength and merit of two constellations of research studies which offer overlapping yet contrasting perspectives on early teacher attrition -- teachers' characteristics and teachers' working conditions. By comparing and testing these perspectives, policy makers can have a better understanding of where to direct resources to promote teacher retention. Additionally, teacher educators can better understand the role of their work in supporting the retention of their teacher candidates into their careers. Specifically, this study addresses the following four research questions regarding prediction of teacher attrition. Results of this line of inquiry will offer insight into a comparison of the perspectives of teacher attrition noted above:

1. To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration?
2. To what extent do beginning teachers' characteristics predict their attrition the year following the SASS administration?
3. Which, if either, constellation of studies, working conditions or teacher characteristics, better predicts attrition the year following the SASS administration?

4. How do the unique elements within the teacher characteristics and working conditions models combine and interact to predict early teacher attrition the year following the SASS administration?

The study sought to answer these questions using a national sample collected via the National Center for Educational Statistics' School and Staffing Survey and Teacher Follow- up Survey. The research was executed by comparing the perspectives from the two constellations of research on teacher attrition in the first five years in the profession. The research studies forming the first constellation suggest that working conditions lead to low job satisfaction, which in turn, leads to the early attrition of teachers. The second constellation holds that early attrition is a function of teacher characteristics prior to entering the classroom, which accounts for the variation in teachers' ability to withstand the difficulty of the job. Specifically, this study investigates the extent to which working conditions and/or teacher characteristics are able to predict a beginning teacher's status (still teaching or left) for the year after they are initially surveyed.

Data

The School and Staffing Survey (SASS) and the Teacher Follow-Up Survey (TFS) are designed and administered by the U.S. Department of Education's National Center for Education Statistics (NCES). This survey system is the largest and most extensive survey of primary, middle and secondary schools in the United States and, with minor changes, has been conducted every five years since the 1987-1988 school year. The SASS comprises five separate surveys to each of the following groups: school-district personnel, school staff, teachers, administrators, and library and media center personnel. This study focused on the SASS Public School Teacher Questionnaires. This particular survey asks participants about their general teaching assignment,

their preservice experiences, perceptions of preservice preparation, their work conditions and attitudes about their working conditions. To measure the subsequent status of the teachers from the SASS, the Teacher Follow-Up Survey is administered to a subset of SASS participants one year following the SASS administration. Results from the Teacher Follow-Up surveys are used to determine the subsequent status of teachers who responded to the previous year's SASS administration. This study examined the 2003-2004 SASS Public School Questionnaires, which were linked to the 2004- 2005 Teacher Follow-Up Survey.

The SASS Public School Teacher Survey collects data from approximately 38,000 public school teachers; however, this available sample was reduced to the sample of interest. The sample of interest was defined as teachers who, upon taking the SASS survey, were in their first five years of teaching and either stayed in teaching the following year (their 2^{nd}, 3^{rd}, 4^{th}, 5^{th} or 6^{th} year) or left the profession the following year.

In this study, teachers who transfer schools, movers, were considered in the same category as teachers who stayed in their same school. The goal of this research was to investigate the difference between those who continue teaching and those who leave teaching; individuals who transfer schools, while a part of teacher turnover, continue to teach and are therefore part of the same group as those who stayed in the same classroom. While recognizing that these categories are a simplification of teachers' career trajectories, this approach is useful in determining what encourages teachers to leave classroom teaching and is not without precedent (e.g., Adams, 1996; Fleener & Dahm, 2007).

Using the SASS and TFS sample of teachers in their first five years of teaching, two logistic regression models were constructed. One of the regression models was informed by the first constellation of research studies and used measures of working conditions as predictor

variables, while the other model, informed by the second constellation of research studies, used variations in teacher characteristics to predict attrition in the first five years of teaching. This study then compared the two models in several ways to determine which, if either, offers a statistically and substantively better prediction of teacher attrition. Finally, a combined model of the most predictive elements within each model was constructed to examine how these elements combine and interact to predict early teacher attrition.

Scope of this Study

Despite the rigor of the research design and methodology, there are inherent limitations to the inferences that can be drawn from this work. For example, approaching the phenomenon of teacher attrition using multiple logistic regression models implicitly assumes (1) that the causal relationship is in one direction; (2) each factor contributes to the model independently (although interactions will be included in the model); and (3) the contribution of each factor is a fixed amount, meaning that the relationship between the factor and the outcome does not vary over time. This limits the ability to consider potential feedback influences, such as a snowball effect of attrition where, for example, teachers who leave are influenced by the propensity of teachers around them to leave. This research methodology also prevents understanding precisely the way these factors influence the teacher's decision to leave the classroom. That is, the models capture the direction and magnitude of the effect, but this model does not capture the mechanism of how these factors influence the observed effect.

There are also limitations due to the data collection procedure and the structure of the data set. For example, using responses from a single SASS and TFS administration cycle presents a possible history effect. The data are collected in a single year, so teachers who have already left the profession in years prior to the survey administration are not surveyed and may

have different reasons for leaving than their former colleagues did in this particular year. For example, it is possible that economic conditions or educational policies in the survey year may have had a special influence on the decisions of teachers to leave the profession that does not exist in other years. In the years that these data were collected (2003-04 and 2004-05) the nation was in a relatively stable economic environment. These limitations, along with others, are discussed in greater detail in Chapter 5.

Despite the limitations on the inferences that can be drawn from this research, it remains an important endeavor. Results of this work will allow researchers to understand how two different constellations of research about teacher attrition, teacher characteristics and working conditions, compare across a national data set in a recent SASS administration. This work will allow researchers to better understand the ways in which teachers' characteristics and working conditions can influence teachers' career decisions. With this knowledge, intervention designers and policy makers will have a better understanding of where to focus limited resources to have the greatest impact on the attrition of teachers, either in the preservice stage of teacher development or during the beginning years of their inservice careers. These interventions can lead to not only improved teacher induction practices and mentoring of new teachers, but also improved methods for preparing teachers to deal with the inservice stresses they are undoubtedly going to endure. Furthermore, this research serves to inform future research examining critical points to provide support and interventions for either preservice or inservice teachers. Ideally, this research along with the work of others will help to transform teaching from "a profession that eats its young" to one that prepares and supports its newcomers (Osborne, 1992).

Organization of this Dissertation

This dissertation comprises five chapters. Chapter 2 includes a review of the empirical and conceptual work that has framed the discussion of teacher attrition. Most specifically, the objective of the literature review is to provide an explanation of how other researchers have examined the influences on teachers' career decisions and to understand how the present work fits into this larger discussion. Articles included in the review were garnered though electronic database searches as well as an existing stand alone literature review (Johnson, Berg, & Donaldson 2005), a meta-analysis (Borman & Dowling, 2008) and a literature review from another dissertation (Scheopner, 2009). Databases searched include the ERIC database, which includes journals from *Resources in Education* and *Current Index to Journals in Education*, and EconLit, which houses the American Economic Association's *Journal of Economic Literature* and the *Index of Economic Articles*. The review focuses on scholarly work that seeks to differentiate the characteristics of teachers with different career trajectories within the United States at public and private K-12 schools. This chapter contains five sections, the first two sections describe the big picture of teacher attrition, the definition and the scope of the problem. The next two sections also describes the different perspectives of the two constellations of research studies as well as how the perspectives overlap.

Chapter 3 describes the proposed methods of analysis for this study. Specifically, this chapter describes the rationale supporting the uses of survey responses to answer these research questions and a clarification of the statistical modeling employed and why those models were chosen over other models. Finally, this chapter discusses the integrity of the research design and the limitations of the results based on the research design and data collected.

In Chapter 4, I present the results of the analyses described in Chapter 3. Beginning with a detailed description of the sample in the analysis, the chapter then describes the results of the inferential statistical models. This chapter shows that the statistical models, informed by the two constellations of research, provide statistically significant predictions of the subsequent teaching status of beginning teachers and that the working conditions model is a slightly better fit to the observed data than the teacher characteristics model. However, this chapter also shows that both models are able to statistically explain the residuals of the other model, implying that neither offers a sufficient picture of why teachers leave. This chapter then shows how the two models can be combined to provide a more complete model of teacher attrition.

In Chapter 5, I discuss the implications of the findings described in Chapter 4. It is in this chapter that the proper and improper inferences from these results are described and placed in context with previous research. This chapter offers suggestions for future work and calls for additional focus on the careers of beginning teachers.

Chapter 2: Review of the Literature

In 1983, the United States Department of Education released a report entitled *A Nation at Risk* (Gardner, 1983), in which the authors argued that the dismal quality of the knowledge amongst youth in the United States put the country at a disadvantage technologically and that this disadvantage would eventually result in a reduction of the nation's security. In the same decade, several reports suggested impending teacher shortages due to two converging changes in the demographics within schools: the workforce was 'graying,' meaning teachers were aging and would soon be retiring, and the number of students in the nations' schools was increasing (Darling-Hammond, 1984; Grissmer & Kirby, 1987; Murnane, Singer & Willet, 1989; National Academy of Sciences, 1987). These reports estimated that an additional 10 million new teachers would be needed over the coming decades.

These dire warnings seemed to warrant an increase in the recruitment of more and better teachers. The logic was that in order to fill the upcoming vacancies many new individuals needed to become teachers. This line of reasoning facilitated the development over the next decade of alternative paths into teaching. These programs include "troops-to-teachers" which began in 1994 and encourages retired military personnel to begin teaching (Keltner, 1994), and "Teach for America" (TFA) (Kopp, 1992) which started in 1990 and recruits college graduates from selective universities to commit to teaching for two years in traditionally hard to staff areas.

By the end of the 1990s, even after these newly developed programs provided an increase in the number of individuals able to enter teaching, school-staffing problems persisted. These alternative paths to teaching did not seem to be effective in providing the additional teachers needed in schools. Looking for other solutions, Richard Ingersoll (1999, 2001, 2003) used data

from the School and Staffing Survey and its companion, the Teacher Follow-Up Survey, to explore the role of alternative explanations for school staffing shortages. His exploration of the data demonstrated high rates of teacher attrition amongst beginning teachers in K-12 schools. He argued, then, that the solution to school staffing problems was not an increase in supply, but rather a decrease in demand through improving the retention of beginning teachers. His findings, along with the endorsement from the National Commission on Teaching & America's Future (NCTAF) (2003), that teacher retention had become a "national crisis" (p. 21), energized a previously small line of research over the subsequent decade.

Throughout the first decade of the new millennium, research pertaining to the school staffing problems and quality of the teacher workforce increased, especially studies of teacher retention. This burgeoning area of research included studies that examined the local context of teachers' experience in order to identify which factors influenced early exits from the profession (e.g. Milner, 2002; Milner & Hoy, 2003; Guin, 2004). It also spawned studies that aggregated data across districts (e.g. Aaronson, 1999; Stevenson, Dantley & Holcomb, 1999), states (e.g. Loeb, Darling-Hammond & Luczack, 2005; Harris 2007), and the nation (e.g. Harris & Adams, 2007; Smith, 2006; Connelly & Graham, 2009). However, the link between school staffing problems and teacher turnover was not universally accepted. For example, Boe, Cook and Sunderland (2008) looked at data from 1994-1995 and 2000-2001 Teacher Follow-up surveys and pointed out that although attrition and turnover were higher in 2000-2001 than in previous years, attrition still remained lower than in other professions and was unlikely to change without drastic changes to organization, management and funding of public schools. They concluded that addressing attrition was too slow and costly to have a real effect on schools. Therefore, they argued, increasing the supply of qualified teachers was the best path to reducing teacher

shortages. Despite dissent, the notion that teacher attrition was the root of the school staffing shortages so permeated the research landscape that many studies sought to explain issues around its correlates, like resiliency (e.g. Castro, Kelly & Shih, 2009), job satisfaction (e.g. McCann & Johannessen, 2004), and teacher salary (e.g. Hanushek, Kain & Rivkin, 2004). This chapter reviews work on teacher turnover and attrition in order to determine what has been learned from research about the influences on teachers' career decisions.

Although there are two overarching constellations of research studies, this review is organized into five sections. The first two investigate the scope of the teacher attrition problem including making sense of the terminology used in the field. The next two sections, sections 3 and 4, each review studies within one of the constellations of research studies. The final section reviews studies that look across the two genres of research offering some insight about how teacher characteristics and working conditions interact to influence teachers' career decisions.

Search Criteria

This review includes studies that examine various aspects of teacher attrition and have either teaching status (staying, leaving or moving) or a close proxy of teaching status (intent to stay or leave the subsequent year) as the outcome of the study. All studies have been published since 1998. This year was chosen because of the change that occurred in explanations for school staffing problems that began in that year and evolved over the subsequent decade. Additionally, because the way teachers are prepared prior to entering the profession is of interest to this study, consistency in national policy about teacher preparation is valuable. Cochran-Smith (2005) argues, due to the reauthorization of the Higher Education Act, that 1998 serves "as a rough marker for the emergence of the new teacher education" (page 4) and therefore an additional reason to define 1998 as the starting point for this literature review. Of course, the selection of

this year does exclude potentially important work from previous years, such as the work by Chapman (1984), which developed and then tested a model of the influences on teacher retention. These influences included personal characteristics, educational preparation, initial commitment to teaching, the quality of the first teaching employment experience, integration into teaching, and career satisfaction. However, studies within this review often adopt the theoretical framework espoused by Chapman or other studies prior to 1998 (Darling-Hammond, 1984; Grissmer & Kirby, 1987, 1992, 1997; Murnane, Singer and Willet, 1988, 1989; Osborne, 1992; Shen, 1997) , and therefore the contribution of their work is not entirely lost by this demarcation.

Because every country has a unique context regarding the policies and attrition rates of teachers, I have limited this review to studies within the context of the United States. Furthermore, as a baseline for rigor of research, I examined only empirical work from peer-reviewed journals, dissertations, and peer-reviewed research reports. This excludes, amongst other media, conference presentations, newspaper articles, blogs, and non-peer reviewed policy and research reports.

To locate peer-reviewed journals, I used the Education Resources Information Center (ERIC) using the keywords "teacher persistence," Sociological Abstracts with the keywords "teachers" and "attrition," and the American Economic Association's EconLit database using the keywords "teacher retention." Together these yielded 396 studies, the vast majority of which came from the ERIC database. In addition to these studies, work that fit the inclusion criteria from the 2005 literature review by Johnson, Berg and Donaldson (2005) along with the research included in the Borman and Dowling (2008) meta-analysis were examined. Finally, research reports that underwent an external peer review process were examined. However, because there

is no centralized way of determining which research organizations or reports undergo peer-review, studies that used publicly available data or made their data publicly available so that their results could be directly replicated were also included. To find these reports, I searched the websites of research organizations considered "influencers" by Cochran-Smith and Fries (2010) for work that examined teacher attrition. Then, the peer-review policies of these organizations were examined by either finding a statement within their reports about their review process or contacting the organization directly. Studies that underwent such a process (e.g. Ingersoll, 2003) or used data available to the public were included in this review. After studies from these various sources were pooled and filtered by the inclusion criteria, the total yield of studies included in the review is eighty-nine.

Organization of the Review

Over the last decade, several authors have organized this literature on teacher turnover and attrition in various ways. For example, Johnson, Berg, and Donaldson (2005) organized the research for an extensive literature review on teacher retention into six sub-categories based on their explanations of the phenomenon. These categories included: preparation, hiring, compensation, working conditions, school community, and career. Liu (2007), claimed: "Research on teacher attrition has centered around two separate thematic strands. One strand of research focuses on teacher demographics, individual characteristics, and salary. The other strand of research emphasizes school characteristics, governance and work conditions" (p. 2). These reviews highlight strands of research within the collection of teacher turnover studies by the influences on attrition the studies emphasize; they tend not to organize their reviews of the research based on the theoretical frameworks of the studies. Additionally, these reviews found that some studies gather data from prior to entering teaching and then follow those teachers into

their career. Therefore, little is known about the relative influence of teacher characteristics upon entry to the profession and the working conditions they soon face when teaching on their career decisions.

The rest of this chapter reviews the collected literature described above and offers insights into the lessons learned from over a decades' worth of work. Informed by previous literature reviews but using the aforementioned constellations as the central organizing principle, this review is divided into five sections. The first section discusses the various ways that research has defined, accounted for or measured an individual's teaching status. In this section I discuss how variation in the way researchers have operationalized teacher attrition has led to inconsistencies in research findings across studies. The second section reviews studies that examine the extent of teacher turnover nationally. These studies attempt to quantify the scope of teacher attrition and migration and the impacts that they can have at the school, district, state or national level.

The third section of the review examines studies within the teacher characteristics constellation. This includes studies that focus on the characteristics of teachers prior to entering the profession and how they influence the teachers' subsequent career decisions. This section includes research that examines teacher recruitment strategies or models of teacher preparation designed to entice non-traditional teacher candidates into the profession and how these relate to their persistence in the profession.

The fourth section reviews studies within the teachers' working conditions constellation. These studies view the working context of teachers as paramount in the explanation of teacher attrition.

The final section reviews the limited number of studies that look across both the teachers' characteristics and the working conditions constellations of research for explanations or correlates of teacher attrition. Studies in this final section examine how teachers' characteristics interact with working conditions to influence teachers' career decisions.

Section 1: Big Picture of Teacher Turnover

Since Richard Ingersoll's work in 2001, much of the literature has used similar language to describe an individual's teaching status. Ingersoll uses the blanket term "teacher turnover" to describe "the departure of teachers from their teaching jobs" (Ingersoll, 2001, p. 500). This is then delineated into two sub-categories: 1) those who leave the teaching profession altogether, a phenomenon often called attrition, and 2) the transfer of teachers to another school, often referred to as migration (Ingersoll, 2001; Johnson, Berg & Donaldson, 2005). For consistency with the literature and clarity in meaning, in this review the term teacher attrition is used to refer to the phenomenon of teachers leaving the profession altogether, while migration is used to refer to the phenomenon of teachers transferring schools. As others have, when these groups are combined, I call the phenomena "teacher turnover." When referring to teachers themselves, I refer to those who have remained in their teaching position as *stayers*, those who transfer to a new school or teaching position as *movers*, and those who exit the teaching profession entirely as *leavers*. These terms have been used rather consistently in the literature (see, for example, reviews by Luekens et al., 2004; Johnson, Berg, & Donaldson, 2005).

Although the terms are becoming consistent in the literature, the use of these categories for analysis has not been consistent. As Fleener and Dahm (2007) point out, "variance in teacher attrition rates, as found in the literature, offers what might first appear to be conflicting information, which may be attributed to two factors: the definition of attrition and the statistical

method used" (page 267). The variation is often directly related to individual research perspectives. Ingersoll (2001) came from a sociology of organizations and occupations perspective, seeing individual schools as organizations, which are concerned with whether or not teachers stay in their teaching position within the organization (school), not where the teachers go after leaving. From this perspective, teachers who transfer to another school, movers, represent the same drain on the school as those who leave the profession entirely, as either way the school is left with the task of filling that position. Other studies, using quantitative (e.g., Loeb et al., 2005; Strunk & Robinson, 2006; Connelly & Graham 2009), qualitative (e.g., Carter & Keiler, 2009; Olsen & Anderson 2007), and mixed method (e.g. Swars, Meyers, Mays & Lack, 2009) research designs, have followed this approach, combining those who transfer schools with those who leave teaching altogether and comparing them to those who stayed at their previous teaching position. However not all the studies that take this approach come from the same theoretical understanding of teacher attrition. For example, Strunk & Robinson (2006), who use economic labor theory, used responses to the 1999-2000 School and Staffing Survey (SASS) and its associated Teacher Follow-Up Survey (TFS) and "[grouped] together teachers who leave their school and/or district with teachers who actually quit the teaching profession" (page 76) and then compared them to teachers who stayed in their teaching position from the previous year. In this way, they compared *leavers* and *movers* against *stayers*.

Within this organizational perspective, some studies consider the district or state as the organization rather than the school. In these studies *stayers* are considered teachers who remain teaching in either the same district or state, regardless of moving between schools within the state. These studies consider teachers who leave the profession and teachers who move to other districts or states to teach in the same *leavers* category. Such distinctions are generally caused

by the data available to the researchers. For instance, Ingle (2009), who built a value-added model to examine how attrition and teacher quality related to one another, needed data both on teaching status but also on the test scores of the teachers' students. Therefore, he considered teachers that left classrooms where Florida Comprehensive Assessments Tests (FCAT) occurred in the Oakwood County public schools, *leavers*. Thus, teachers who continued to teach in the same school, but moved to a non-tested subject or grade level were considered *leavers*, but teachers who moved to another tested subject or grade level were considered movers. Finally, teachers who remained in the same classroom were understandably considered *stayers*. Such an approach is inconsistent with most other studies use of those same terms.

An alternative approach is to consider the teacher workforce as a labor force. With this view teachers' decisions to stay in or leave the teacher workforce is what is of interest, not whether they transfer schools. Again, there are quantitative studies (e.g., Liu, 2007; Krieg, 2006; Lathman & Vogt, 2007), qualitative studies (e.g. Gonzalez, Brown & Slate, 2008) and mixed method studies (e.g. Scheopner, 2010) that have examined teacher turnover using a labor force perspective. In these studies, teachers who transfer schools, movers, are combined with those who stayed in the profession, and the combined stayer and mover groups are compared to leavers. This treatment of combining movers and stayers is in direct contrast to Strunk and Robinson (2006).

There are a few studies that have treated stayers, movers and leavers as three separate categories, recognizing that the influences that might push a teacher to transfer schools may be different from the influences that push teachers to leave the profession. Within this perspective there is variation in how this is done. For example, Harris (2007) used a data set containing public school teachers in Florida and a multinomial logistic model of teaching status with stayers

coded as 0, movers as 1, and leavers as 2. This model used a host of variables that accounted for both the teachers' academic background and the demographic make up and achievement level of the schools and offers a single equation used to predict subsequent teacher status. Similarly, Swars et al. (2009) conducted a mixed methods study that examined the career paths of teachers within a single school and looked for antecedents of the three career decisions, the results were used to generate a two-dimensional model to explain both migration and attrition.

The notion that leavers and movers might represent separate categories was also examined by Imazeki (2005) who, using data on teachers in Wisconsin, constructed two separate survival analysis models, one examining the difference between stayers and leavers, the other examining the difference between stayers and movers. The results from this study indicate that the differences between stayers and leavers and the differences between stayers and movers are similar, but not the same, and therefore, none of these groups should be combined in analyses. Similarly, Smith (2006) and Kukla-Acevedo (2009) each used results from the 1999-2000 School and Staffing Survey (SASS) and the associated Teacher Follow-Up survey to create separate models to examine differences between stayers and leavers and stayers and movers. The results of each of these studies parallel those of Imazeki's (2005) and suggest that the predictors of leaving are not the same as the predictors of moving, implying that leavers and movers are not members of the same population, but rather represent distinct groups.

Complicating the stayer, mover and leaver distinctions further, Quartz, Thomas and Anderson (2008) identified another separate category, role changer. This category intends to capture teachers who have shifted into nonteaching professional roles but are still in the field of education. This category accounts for teachers who have left the classroom to pursue other

positions in education; this allows researchers to consider them as staying within the "education profession."

When examining these variations in the way studies have treated movers, stayers, and leavers, Fleener and Dahm's (2007) warning that results appear, at least at first, potentially inconsistent and occasionally conflicting seems warranted. But, upon more detailed examination, it becomes clear that part of the incongruence is a product of the perspective of the researcher -- an organizational perspective, a labor force perspective or some other perspective of the role teachers have in education. These perspectives offer different insights regarding teacher turnover. An organizational perspective is able to offer insights about local staffing concerns. A labor force perspective better serves policy makers seeking to adjust policy levers to improve the overall quality of the teacher workforce.

Section 2: Scope of Teacher Turnover

Teaching is a large occupation in the United States, representing over 3 million teachers, comprising approximately 4% of the civilian workforce (U.S. Bureau of the Census, 2002: as cited in Ingersoll, 2003). Although the actual values vary year to year, Ingersoll (2003) "shows that for the 1999-2000 school year, 534,861 teachers entered schools, while by the following school year an even larger number—539,778—had moved from or left their schools" (p. 11). He goes on to say, "in a 12-month period over one million teachers—almost a third of this relatively large workforce—were in job transition into, between, or out of schools" (p. 11). This interpretation of these values was also espoused by NCTAF (2003), saying that roughly 30% of the national teaching force was in transition during this period. As Boe, Cook, and Sunderland (2008) point out, this interpretation is misleading, as the teachers entering the profession are taking the places of those who are leaving each year, thus the teachers who are remaining in their

present position represent approximately 85% of the teaching workforce and therefore only 15% of the workforce is in transition. Given the same set of data, there are two different interpretations of their meaning. Ingersoll and NCTAF, who are among those that contend that teacher turnover is the root of school staffing issues, use the higher value, while Boe et al. use the lower value when describing the over emphasis of turnover on school staffing. The true number is probably something in between, as many of the teachers who are leaving their classrooms are entering the classroom of another teacher so Ingersoll and NCTAF's estimate counts some people twice. However, there are some individuals who leave teaching altogether and some who are just beginning, meaning that the estimate from Boe et al. is probably too low.

To inform this dialogue about the scope of teacher turnover in the United States, researchers have taken several approaches. The first approach, the one mentioned above, is to quantify the number of teachers leaving their teaching position each year. These measures include teachers across the spectrum of experience and calculations include teachers who leave voluntarily for retirement. Often, this has been done using the School and Staffing Survey and the Teacher Follow-Up Survey (e.g. Ingersoll, 2001, 2003; Boe, Cook, & Sunderland, 2008). Consistently, estimates of teacher turnover using the SASS and TFS are around 7.4% for attrition and 7.6% for migration.

Moreover, some researchers have used other data sources and found similar results. Using data from the 1992-2001 March Current Population Survey, a nationally representative survey of households collected monthly by the Census Bureau, Harris and Adams (2007), estimate the proportion of leavers to be 7.73%- though they do not specify a year. In the same study, they compare rates of attrition across similar professions, namely nurses, social workers, and accountants. They find that the rates of attrition across these professions are similar.

Others use smaller data sets, examining a local context and, therefore, obtain different results than those given by the national data. For example, Krieg (2006) used linked student and teacher files provided by the Washington State's Office of the Superintendent of Public Instruction to determine whether teachers who were more effective were more likely to leave the profession. In his sample of 2293 fourth grade teachers, he found that 4.97% (114 of the 2293) "left the profession after the 2001-2002 school year and did not return to a Washington public school in any capacity over either of the subsequent 2 years" (p. 17). He also found that the fourth grade teachers who had students with larger 4th grade gains in achievement were more likely to stay in the profession than their less well performing peers. He went on to claim that this provides some evidence that, at least in Washington State; it may be that the less effective teachers are the ones who are more likely to leave the profession.

Using value-added modeling to evaluate teachers' effectiveness in Florida, Ingle (2009) showed similar findings, that is, teachers' with higher value-added scores in reading were less likely to leave. Findings like these may have influenced the practice of one principal in Chicago who took over a school with very high attrition (Lewis, London, Fellow, Belfast & Brentwood, 2009). She capitalized on high rates of teacher attrition within her school to modify the teacher workforce there by supporting the teachers that she felt were high performing and allowing the weaker teachers to self-select out of the school. Unfortunately, such practice is not always possible and does not appear to be a long-term solution to school staffing problems as it relies too heavily on the opinion of a single individual in the school.

Studies of overall rates of turnover in the teaching profession often cite the work of Murnane, Singer and Willet (1988) as well as Grissmer and Kirby (1987, 1992, 1997) who found that teacher attrition generally follows a U-shaped curve, with heavy rates of attrition in the

beginning years, little attrition through the middle years, and then a rise in attrition in retirement years. This work often provides rationale for focusing on beginning teachers.

Other studies choose to examine only the first part of the U-shaped curve, the early attrition in teachers' careers. For instance, Henke, Zahn and Carroll in 2001, used data from the 1993 Baccalaureate and Beyond Longitudinal Study (B&B:93) for this purpose. They found that of those working one year after graduating with their bachelor's degree in any subject, in April 1994, 10% were full-time Kindergarten through 12th-grade teachers. Among those employed as full-time teachers in April of 1994 and who were working in April of 1997, 82% were still teaching. The authors do not report the proportion of teachers in April 1994 who were also teaching in April of 1997, nor do they give a year-to-year indication of attrition.

Quartz and her colleagues (Quartz, et al., 2008) examined turnover in the early years of teaching of graduates from a single program to determine their career trajectories. Their results indicate that among 838 study participants over a nine-year period there were 57 unique observed pathways of teachers' careers. Because of these results, the authors hesitate to use the unrefined classifications of movers, stayers and leavers utilized by many other researchers, and therefore it is difficult to make direct comparisons of their results with other research.

Ingersoll's report in 2003 included an estimate of the cumulative percentage of teachers who had left the teaching profession in each of the first five years. In a figure within this report, he estimates the cumulative attrition by year to be 14%, 24%, 33%, 40%, respectively for the first four years and 46% at the end of the fifth year. However, within the text of the article, he says the cumulative percentage of teachers who are no longer teaching after the fifth year is between 40% and 50%. It is this estimate that has been cited widely (see Boe, Cook & Sunderland, 2008). Yet, it is usually cited without the caveat that Ingersoll includes; that is, the

estimate does not indicate permanent loss from the profession since some of those who have left teaching in the first five years may subsequently choose to re-enter the profession (Boe, Cook & Sunderland, 2008).

Exact national rates of attrition of teachers in each of the first five years are difficult to estimate given the nature of the data; it is panel data rather than longitudinal data over several years. However, collectively these studies suggest a consistent national rate of teacher turnover of about 15% of the workforce per year, almost evenly split between leavers and movers. This rate is not consistent in all local contexts, with some locales experiencing higher or lower turnover rates. Additionally, there are especially high rates of teacher turnover both early in teachers' careers and later when they are approaching retirement age. Moreover, teacher turnover may become an increasing problem over the next decade as "Millennials," individuals born between 1980 and 2000, begin to enter the teaching profession. As Walker (2009) points out from the literature about this generation, these individuals will be different from their predecessors and can especially benefit from induction programs, staff development, incorporating technology into the classroom, and the opportunity to be supported as they develop through their careers. She argues that the profession must become more adept at inducting a new generation if it hopes to improve retention.

In the following section, I review studies that explore teacher characteristics as potential influences on the early turnover of teachers.

Section 3: Constellation 1: Teacher Characteristics

I use the phrase "teacher characteristics" as an umbrella term to describe the personal attributes, training, preparation and experience that new teachers bring into the classroom. Often in research, these pieces are parsed out, examining aspects of a teacher's characteristics that

might have some effect on their practice, effectiveness or persistence. Following that approach I discuss them separately in order to examine the research on their influence on attrition. The extent to which these studies capture teacher characteristics varies widely, from their entry pathway to teaching (e.g. Kane, Rockoff & Staiger, 2008), to far more explicit measures of their teacher preparation experiences (e.g. Yost, 2006). Additionally, these studies vary in how long they follow teachers into their career, the outcome measured, and the research methodology employed in the investigation. However, each of these studies speaks to the importance of the teacher's characteristics upon entering the profession.

Recruitment

Teacher recruitment plays a vital role in maintaining a quality applicant pool from which to select new teachers. In the 1990s, there was a great deal of research focused on developing new strategies to increase the teacher applicant pool. The logic underlying increasing the avenues to teaching is an economic perspective, that is, with a fixed demand for teachers to fill available positions and a greater supply of teachers to choose from, the hiring process can be more selective and therefore lead to a higher quality teacher workforce.

This is the logic that was called into question by Ingersoll (2001) and others (e.g. Merrow, 1999; NCTAF, 2003). These authors pointed out high attrition rates in schools amongst new teachers and suggested that retaining and developing the teachers already in the workforce is the path to an improved teacher workforce, not a larger applicant pool with potentially equal or greater turnover. Ingersoll (2001) uses the analogy of a revolving door to describe the attrition problem, and argued that increasing the applicant pool would not influence the attrition rates.

There are many studies that examine who enters teaching and how they are recruited to the profession. However, because the current literature review is focused on studies that

examine teacher attrition, studies in this section of the review link teacher recruitment strategies to teachers' career decisions. The underlying premise of the eight studies in this section is that teacher recruitment strategies will only be defined as successful if they produce at least average or increased retention rates for beginning teachers. In this way, these studies explore ways to bring new teachers into the profession, while also addressing the rate at which they leave the profession.

One of the prevailing perspectives of the studies in this section is that the relationship between recruitment and retention of teachers is a local issue. This is evidenced by the lack of any study that explores recruitment and retention of teachers across a national sample representative of all schools in the United States. Monk (2007) does use a national sample collected by NCES, the School and Staffing Survey, but limits his analysis to rural schools. He points out that often the term, "rural" is used as a catchword to represent anything that is not urban or metropolitan; however, in reality there are large variations in the local conditions surrounding rural schools.

Using descriptive statistics from the SASS and the Common Core of Data interwoven with research findings from others, Monk suggests that rural schools typically have more difficulty hiring and retaining teachers with strong academic backgrounds (defined both by selectivity of their undergraduate school and passing scores on teacher licensure exams, i.e. the state test of basic skills, the Praxis core professional practice exam, and the Praxis II content area exams). He points out the large difference between the average salaries of rural teachers ($38,000) and teachers in urban and suburban areas ($44,000). He also suggests that the population of students in rural schools presents more challenging working conditions, with rural schools typically having more students with Individual Education Plans (IEPs) and coming from

families of low socio-economic status. To improve both recruitment and retention within these schools, Monk suggests coupling increased pay with leveraging technology that will allow teachers from rural schools to collaborate with other rural-school teachers, thereby minimizing their feeling of isolation.

Despite the strong case that Monk builds for paying special attention to staffing issues in rural schools, his is the only study that explicitly examines recruitment of teachers to rural schools. There are two studies that explicitly study recruitment and retention in urban school contexts (Aaronson, 1999; Kearney, 2008). Both of these studies examine the context of a single school district, with Aaronson's study taking place in the District of Columbia Public Schools (1999) and Kearney's study at an urban Midwest school district (2008). In both of these studies, there were specific recruitment strategies under investigation, but this is where the similarities in their designs end. Aaronson (1999) took a retrospective look, much like a historian might, at new teacher support and development strategies implemented in the District of Columbia starting in the 1960s and then into the 1990s (the study was published in 1999). She found interventions to be largely a mirror of national reform efforts that "were not institutionalized within the school system and thus faded after only a few years" (p.335). This was particularly discouraging considering that specific interventions had been effective in recruiting, supporting and retaining teachers in the District of Columbia Public Schools. Specifically, programs that established a strong university connection, with either a school-system-sponsored master's degree program or an alternative certification program, and initiatives that "[enlisted] highly skilled veteran teachers to serve as mentors within a program of regular, in-classroom support" (p. 341) improved teachers' commitment to the profession and practice in the classroom.

The finding that specific programs can be successful in changing the local teacher workforce was echoed in the work of Kearney (2008). In her study of an urban Midwestern school district, using district-wide staffing information she found that with a specific goal of having at least 30% of new hires be teachers of color, the district was able to increase the overall proportion of teachers of color in the school system. But, equally as important was determining if these teachers of color remained teaching in the school district. By following the new hires in the 1989-1990 academic year for the subsequent three school years, she was able to determine that African American teachers had slightly higher retention rates than the European American teachers in the same school system. The work of Sohn (2009) may be able to explain some of this phenomenon. Sohn, informed by both diversity theory and social contact theory, used the SASS to examine the relationship between workgroup racial diversity and the attrition of white teachers. The study shows that young white teachers are more likely to stay in their same schools when the proportion of white teachers is high, confirming the old adage that "birds of a feather flock together." However, she found the opposite was true of older white teachers; they tended to stay in their same teaching position even if the proportion of white teachers in the school was low. Thus, it may be that successfully recruiting and retaining minority teachers is related to higher attrition of young white teachers.

In urban school districts, interventions aimed at attracting teachers to enter the district and supporting them once there, can make, at least temporary, changes to the teacher workforce within a school district. Kearney's (2008) results are encouraging, but, as Aaronson (1999) warns us, this change may only be temporary unless this program becomes integrated into the regular procedures of the school district.

Paralleling these findings are studies of the Massachusetts Signing Bonus Program (MSBP) (Fowler, 2003; Liu, Johnson & Peske, 2004). Instituted in 1998, the MSBP was a program that included a $20,000 signing bonus designed to "encourage high achieving candidates to enter the profession who would otherwise not consider a career in teaching" (Massachusetts Department of Education, 1998). Although these studies used different methods (Liu, et al. used a longitudinal qualitative design, and Fowler used statistics provided by the Massachusetts Department of Education), they both found less than positive results related to this initiative. Specifically, only a few teachers were recruited from outside of the state, relatively few were placed in urban districts where the need for high quality teachers was most pressing, and most discouraging was the small number of participants who taught beyond one or two years. Despite initially touting this program for national adoption, Massachusetts drastically modified the program in 2002 by expanding the teacher preparation from 7 weeks to a full year and abandoning the bonus and national recruitment efforts.

When considering the findings from these two studies in relation to the previous studies, it makes it clear that simply recruiting teachers is not effective in altering the teacher workforce. These newly recruited teachers must stay in the profession if there is to be a sustainable change to the teacher workforce.

The last two studies in this section make this point very clearly, even recognizing the importance of the connection between recruitment and retention in their titles: “Teacher Recruitment and Retention: An Essential Step in the Development of a System of Quality Teaching” (Gayton, 2008) and “Do School Accountability Systems Make It More Difficult for Low-Performing Schools to Attract and Retain High-Quality Teachers?” (Clotfelter, Ladd, Vigdor & Diaz, 2003). Gaytan’s (2008) research focused on Business Education Teachers in a

southeastern state and how their business department chairs viewed the teachers who entered and remained in teaching. Furthermore, Gayton examined the characteristics of schools that were successful in attracting and retaining business education teachers. Although it was unclear how success was defined, the survey responses indicated that rural and urban schools reported greater attrition of teachers than suburban schools.

Clotfelter and his colleagues also investigated a southeastern state, North Carolina, but rather than looking exclusively at business teachers, they looked at how school accountability programs and low performing schools related to the recruitment and retention of "quality" teachers. They use rather crude definitions of quality: whether teachers are beyond their first year of teaching and the selectivity of their undergraduate institution. To examine the effect of the accountability system on the retention of teachers, they followed two cohorts of teachers, one from before the implementation of the accountability system (1994-1995) and one from after (1996-1997). The proportion of teachers who returned in each of the following four years was lower for schools that had been labeled as "low performing" than it was for the comparison schools. They then constructed a discrete-time duration model, which is a particular type of event history model, to examine the length of time-spent teaching in North Carolina public schools. They found that for "experienced teachers in low-performing schools the main statistically significant effect relates to the labeling of the school rather than the accountability system itself. For new teachers, both the accountability system itself and the labeling component exert an impact" (p. 263). This means that experienced teachers were more likely to leave schools labeled as low-performing regardless of the accountability measures, while for less experienced teachers, the impact of being labeled a low performing school and the accountability that went with it were both incentives to leave the school.

Collectively these seven studies that examine the relationship between recruitment and retention of teachers demonstrate that policies, programs, and initiatives can influence who enters teaching, but when these strategies are not maintained or extended to support these new hires into the classroom, the initiative is not sufficient to change the teacher workforce (i.e. Aaronson, 1999; Fowler, 2003 and Liu, Johnson and Peske, 2004). Recruitment strategies must also consider the retention of teachers, as some teachers who are recruited into the profession quickly leave, creating a new vacancy in their wake. However, the studies in this section also demonstrate that focused recruitment strategies that support teachers once in the profession have some success (Monk, 2007; Kearney, 2008). Environments of high accountability tend to push new teachers out of the classroom faster than would otherwise be the case (Clotfelter, Ladd, Vigdor, & Diaz, 2003).

The studies in the next section extend the research about how teachers are recruited to enter teaching and how this can impact their persistence in the classroom by focusing less on recruitment and more on the ways that teachers are prepared for entering the classroom.

Certification Route

Eighteen studies within the teacher characteristics constellation examine the relationship between the certification routes or entry pathways to teaching and teacher attrition. Six of these studies examined teachers from professional development schools (PDS) (i.e. Reynolds et al., 2002; Reynolds & Wang, 2005; Fleener & Dahm, 2007; Latham & Vogt, 2007; Swars et al., 2009; Margolis, 2008) ten studies examined several entry pathways and structures (i.e. Weasmer, 2002; Edgar & Pair, 2005; Quartz, et al, 2008; Alger & Norman-Gloria, 2009; Freedman & Appleman, 2009; Moscovici, 2009) four of these ten examined the graduates of the New York City Teacher Fellowship (NYCTF) program (i.e. Easley, 2006; 2007; Malow-Iroff, O'Conner &

Bisland, 2007; Kane et al., 2008; Carter & Keiler, 2009), and the remaining two studies in this section examined persistence of teacher candidates within a single institution or program (Easterbrooks, Harper, Owens & Nickols, 2000; Helfeldt, Capraro, Margaret, Capraro & Carter, 2009).

Professional Development Schools

Five of the six studies that examined the teacher turnover of professional development school participants sought to determine how their retention rates compared to non-professional development school graduates (i.e. Reynolds et al., 2002; Reynolds & Wang, 2005, Fleener & Dahm, 2007; Latham & Vogt, 2007). Latham and Vogt used a regression analysis controlling for teacher demographics and years *not* in education as the outcome variable, while Fleener and Dahm employed a survival analysis with leaving teaching as the event of interest, and Reynolds, Ross and Rakow analyzed responses to open-ended questions administered through phone and written surveys. Latham et al. and Fleener et al. found that participants in the PDS programs persisted longer in teaching than did their non-PDS peers. Reynolds, Ross and Rakow, found no difference in their persistence, but did find that in general the graduates of the PDS program felt more prepared to teach.

Reynolds and Wang (2005) also investigated the role of PDS preparation in teachers' career decisions. Using the graduates from three school-university partnerships for a target sample, the researchers sent out surveys to graduates between 1988 and 2002. Respondents were classified as having been PDS or non-PDS participants and their retention rates were compared. Results from the surveys indicated that across the three sites, a higher proportion of non-PDS graduates (17%) had left teaching than PDS graduates (10%). They conducted a follow-up Internet search to identify the teaching status of non-responders and adjusted their findings,

which resulted in similar retention rates between PDS and non-PDS graduates. When they disaggregated the data by the three preparation sites, they found that in two of the sites, PDS graduates were more likely to stay in teaching than non-PDS graduates were, and in the third site, there was no difference in the retention rates. The authors speculate that the lack of a finding in the third site is due to a small sample of non-PDS graduates at that institution. An alternative explanation, one that might include the results of the other three studies on PDS retention rates, is that the retention rates of graduates from PDSs vary across sites. Some PDSs may be more effective in impacting retention than others. However, these studies are not very informative as to what leads to this variation in effectiveness.

To determine critical aspects of PDS programs that might influence retention, the study by Swars et al. (2009) may be useful. This study sought to determine the causes of teacher turnover within one professional development school. Using a modified version of NCES's Teacher Follow-Up Survey (Luekens et al., 2004) along with open-ended questionnaires and interviews, the authors found themes relating to turnover decisions. The researchers then developed these themes into a two-dimensional model of teacher retention and mobility that includes a dimension of a teacher's relational needs and a dimension of congruency between a teacher's beliefs and practices with their principal's beliefs and practices. In this study the PDS nature of the school was merely a backdrop, not truly a part of the research, and therefore does not adequately describe the structures within the PDS that allowed it to influence retention, instead discussing teacher retention more generally.

Margolis (2008) took a different perspective than the other researchers and rather than examining the eventual attrition of the teacher candidates in a PDS, he investigated the retention and continued commitment to teaching of the teacher mentors in the PDS with 4-7 years of

teaching experience. By interviewing seven such teachers in one PDS in the Northwest United States, he discovered that teachers at this point in their career are looking for roles/activities that further engage them in teaching, either by renewing an interest or widening their role in the school.

These studies provide evidence that retention rates may be improved when teachers enter the profession through professional development schools; the schools themselves may help to keep more veteran teachers teaching. However, what are still left unanswered are the specific aspects of the PDS, which might be enhanced or replicated at other sites to continue to increase retention.

Teacher Entry Pathways and Structures

Four studies that examine variations in retention across teacher entry pathway use teachers within New York City (NYC) for their study sample (i.e. Easley, 2006; 2007; Malow-Iroff et al., 2007; Kane et al., 2008; Carter & Keiler, 2009). Carter & Keiler used a semi-structured interview format to investigate the experience of nine beginning teachers in NYC small schools who had each completed their teacher certification through an "alternative" route, the New York City Teacher Fellowship (NYCTF) program. Through their research and experience they conclude that "alternatively certified new teachers...may be unprepared for their work in small schools for several reasons" (p. 455). These reasons include the short period of training in pedagogy and student development, lack of congruency between the theory and practice of teaching in NYC small schools, and "new teachers have a narrow and inaccurate perception of their work and this perception is connected to both their limited pre-service preparation and their experiences working in their small schools" (p. 455).

Easley (2006; 2007) conducted a focus group with eleven graduates of the NYCTF program to examine the relationship between their career decisions and the moral leadership of their principals. Data gathered during the focus group discussion was triangulated with open-ended responses to a survey (Easley, 2006; 2007) and produced three themes which comprise the NYCTF graduates' definition of moral leadership from their principals: "recognizing teachers as professionals, providing support through dialogue with teachers and focusing on the right things" (p. 35). The link of this moral leadership with teacher retention is merely speculative in this research as Easley (2006; 2007) used a single survey item to measure their "retention potential," not on the teachers' actual career decisions. From this he suggests that moral leadership "raises the likelihood for [alternative route certification] teacher retention" (p. 35).

Malow-Iroff and her colleagues (2007) also studied NYCTFs by looking at graduates from the program within their first two years of teaching and their intent to return to their current teaching position. They found that 29% of their sample of sixty-eight teachers planned to leave their current contract at the end of the school year. Their results indicate that these decisions were correlated with measures of working conditions such as, the teacher's perception of the socioeconomic status of their students, administrative support and the teacher's self-reported general teaching efficacy. They do not differentiate teachers leaving the profession from teachers moving to another school.

Kane et al. (2008) took a different perspective than the other three NYC studies. Rather than examining factors associated with teacher retention, they recognize it as a part of the teacher landscape that varies with certification route. With this perspective, along with the finding that student test scores are associated with teacher experience, they then examine the relationship between certification route and student test scores taking into account the fact that some

certification routes, on average, have higher teacher attrition rates than others. They pose the problem as such:

> Suppose that there were two groups of teachers with identical impacts on student achievement after controlling for experience, but with different retention rates. A school district would be better off hiring the group of teachers with higher retention rates, since they would be less likely to forfeit the benefits of on-the-job learning when a teacher leaves. However, the magnitude of the preference depends upon two things: the payoff to teaching experience and the proportion of teachers at each experience level in steady state. (p. 625)

While the focus on student test scores is of interest to researchers examining teacher effectiveness, this review is focused on retention, and therefore their findings on the retention rates associated with different certification routes are of interest. Primarily, the authors find that the attrition rates for regularly certified teachers and teaching fellow graduates are approximately the same. First-year attrition rates are slightly higher for teachers who are not certified in the content area they are teaching, but are on par with certified and teaching fellow rates in subsequent years. However, the attrition rates for Teach for America graduates are much higher in the first two years, only slightly higher in the third year and finally below average in the fourth and fifth year, when presumably most have already left the profession.

In a study of the morale of beginning science teachers, Alger and Norman-Gloria (2009) compare graduates of three types of teacher preparation programs: 1) traditional undergraduate, 2) post-baccalaureate certification, or 3) alternative route to certification. The particular alternative route to teacher certification studied was created in 1988 and conducted by the Connecticut Department of Higher Education, which seeks to attract mid-career professionals into teaching. They found that the teachers from the alternative route were more likely to teach in more affluent school districts and to be less satisfied with their salary. While this does not

speak directly to retention, but more to levels of job satisfaction, the results are concerning when considering that Weasmer's (2002) work suggests that mid-career or late entry teachers may be the very kind of teacher to keep in the profession. Weasmer (2002), in a research article, describes Marge, a late-entry teacher. Weasmer found that Marge's life experiences, suffering through the death of two of her children and studying education in college, led to "the kind of teacher who rises to the challenges that scare out half of those who enter the profession and leave by the fifth year" (p.221). He suggests programs designed to recruit people like Marge into the profession may be useful in minimizing early teacher attrition.

Moscovici (2009) also studied teachers from an "alternative" certification route, but focused on science teachers in California's urban schools. The subjects of this 6-year study taught science with emergency permits or internship credentials during the day and took courses in pursuit of their teaching licenses in the late afternoons. Combining data from written assignments, verbal communications and field notes during classroom observations, Moscovici concluded that "secondary science interns tend to thrive in schools where there is a perceived cohesive vision regarding science education" and where stakeholders share a common goal. "Thriving" here intends to capture both their desire to stay in their current teaching position, but also, the high quality of their practice in these settings. In situations with less vision or focus on a shared goal, teachers either exhibited poor practice or sought employment elsewhere.

Other studies in California include Freedman and Appleman's work in 2009, in which they followed graduates from the Multicultural Urban Secondary English (MUSE) Credential and MA program at the University of California, Berkeley. The goal of the MUSE program was to "prepare teachers in ways that would give them necessary skills, help them develop robust identities as urban teachers, and support them to stay" (p. 110). By reviewing informal contacts,

emails, conversations and meetings, of 22 graduates through their first five years of teaching and using a questionnaire along with several interviews with about 15 of the 22 graduates the authors conducted one of the very few studies to follow teachers from their preservice experience through the first five years of their teaching. They found that 73% of their graduates were still teaching or doing curriculum development after five years. Their findings are quite similar to those of the Center X at UCLA, another teacher education program focused on preparing teachers for urban schools, which found 71% of their graduates still teaching and 88% still working in education five years after entering teaching (Quartz et al., 2008). Freedman and Appleman recognize that these retention rates are much higher than the national average after five years but they do represent some attrition, and therefore they seek to explain the causes of the attrition. Their results indicate six areas that seemed to contribute to teachers remaining in high-poverty, urban schools "(a) a sense of mission, which was reinforced and developed by the teacher education program; (b) a disposition for hard work and persistence, which was reinforced and developed by the teacher education program; (c) substantive preparation that included both the practical, the academic, and the harmony between the two; (d) training in assuming the reflective stance of a teacher researcher; (e) the opportunity, given the high demand for teachers in high-poverty schools, to be able to change schools or districts yet still remain in their chosen profession; and (f) ongoing support from members of the cohort as well as other supportive professional networks across the years" (p. 323).

Special education teacher turnover has been noted by several authors as being especially high, partly because it includes teachers who leave special education positions for regular education positions. Edgar and Pair (2005) investigated the graduates from the University of Washington's special education program between the years of 1995 and 2001. They found their

graduates did not leave teaching in especially high numbers, but their persistence in any particular position is rather short, in other words, the teachers tended to be mobile. This highlights the different standpoints of teacher turnover; as Edgar and Pair point out, the career trajectories of these teachers depends upon your perspective, either within the school or across the teacher workforce.

There are several studies that take place within the context of one certification program and examine the retention of its teacher candidates rather than graduates (Easterbrooks et al., 2000; Helfeldt et al., 2009). Easterbrooks et al. (2000) describes and studies the Process for Remediating Identified Marginal Education (PRIME) Candidates at a regional university in a southern state. Here the university has devised a strategy to identify teacher candidates who are at risk of leaving the teacher candidate pool, either during the preservice experience or in the initial years of teaching. This process was designed to either provide them with additional support, or to encourage them to consider another career option prior to entering the teaching workforce. During the two years over which the study took place, there were 39 candidates who entered the intervention program for reasons such as: poor writing skills/incomplete work, sleeping in class/unprepared to teach, and shouting at/rude behavior toward university supervisor. Eighteen of the 39 students left education, 12 went on to apply for and earn teacher certification, and for nine there was insufficient data to determine their subsequent path. Because there is no comparison group there is no way to determine if the PRIME program was effective in altering the career trajectories of the teachers that went through it.

Helfledt and colleagues (2009) looked at a partnership between urban schools and a university that sought to prepare and retain quality teachers in high needs schools. They followed teacher interns, teacher candidates given teaching positions in the schools with heavy

oversight, through their first year of teaching and used questionnaires of the teachers during the year along with principal ratings of their teaching ability to investigate the internship program. Their results were encouraging as all teacher interns remained in their position for the entire year of internship, felt they had improved their teaching and were rated as proficient by their principals. What is left unclear is how long the teachers remained in the profession in subsequent years when the additional support from the university was not available.

Collectively the studies that examine the link between entry pathway into teaching, including PDS, and retention demonstrate that the experiences that teacher candidates have prior to entering the classroom can lead to persistence in the classroom or attrition either during the preservice experience or soon after entry to the profession. What is left unclear from these studies is exactly what aspects of the certification process influence these career decisions, that is, is it the length of teaching experience, particular coursework they take, or the feedback they receive from a teaching mentor. Over the next several pages, I will review studies that parse out aspects of teacher preparation programs and their influence on retention, which may be able to explain some of the observed variation in attrition rates noted in these studies.

Student Teaching

There were four studies that explicitly examined the role that student teaching played in teachers' subsequent career decisions (Boe et al., 2006; Connelly & Graham, 2009; Oh, Ankers, Llamas & Tomyoy, 2005; Wilkerson, 2008). Oh and her coauthors surveyed 204 K-12 teachers to determine, amongst other things, if "student teaching and the amount of direct supervision during student teaching [had] any long-term impact on [a] new teachers' goal to remain in the classroom teaching or stay in the teaching profession" (p. 83). The authors found that there was no significant difference in teachers' plans to remain in the profession by whether they had

student teaching or not prior to teaching. Furthermore, "the level of supervision they received during student teaching did not show a relationship to their decision to remain in teaching" (p. 87). Results of this study are somewhat surprising. The sample for this survey was rather small (204) and was highly locally dependent, located across four schools in the same school district. In addition, the authors did not study retention directly, instead using a proxy, intent to continue teaching, which may lead to different results.

These critiques are important to consider as the findings from Oh and colleagues are in contrast to those of Connelly and Graham (2009) who use data from the 1999-2000 administration of the SASS and its associated TFS from 2000-2001 to examine the role of pre-service teaching and attrition amongst special education teachers nationwide. Using a logistic regression, they find that "substantial pre-service student teaching experience has a strong effect on the probability that a beginning special educator will remain in the field 1 year later (estimated odds ratio 2.18)" (p. 257). Furthermore, they found that after controlling for the number of weeks of student teaching, "none of the effects of aspects of teacher pre-service preparation or teacher or school demographics analyzed had an impact on attrition" (p. 257). This provides rather strong national evidence of the critical importance student teaching plays in the retention of new teachers.

Boe et al. (2006) also used the 1999-2000 SASS with its 2000-2001 TFS to examine the role of preparation on teacher attrition. The researchers use the number of weeks of student teaching experience combined with common components of teacher preparation, namely "(a) coursework in selecting and adapting instructional materials, (b) coursework in educational psychology, (c) observation of other classroom teaching, and (d) received feedback on their teaching" (p. 5) to define three levels of teacher preparation. These levels, denoted as; extensive

teacher preparation, some teacher preparation, and little or no teacher preparation, were then used in a multiple regression which demonstrated teachers with extensive were more likely to remain in the profession than those with little or no teacher preparation.

The study by Wilkerson (2008), from Kennesaw State University, comprised questionnaires to 14 graduates from the foreign language education program. The questionnaires prompted responses about their teaching preparation, their current working conditions and their job satisfaction. By following up with these 14 students with phone interviews and emails and identifying "categories of attrition" (p. 32), she found that "dissatisfied teachers who left the profession did not have the same insight into schools as workplaces as teachers who chose to remain" (p. 33). Wilkerson interpreted this to mean that more time in the schools prior to entering the profession would allow teachers to have a better understanding of workplace realities and therefore allow them a more comfortable transition into the profession.

These four studies offer contrasting interpretations of the importance of student teaching in teacher's career decisions. They use different samples, one local and from all grade levels and subject areas, another national but limited to beginning special education teachers and the last a small group of foreign language teachers. They also have different outcome measures: intent to remain in teaching versus direct measures of retention status, which combined attrition and migration into a single category used to contrast retention. Finally, they use different statistical procedures, chi-square for one, logistic regression for another, and the last did not discuss their methodology. Any one of these differences could be an explanation for the differing results.

Disposition

The research in this section examines the beliefs or perspectives that teachers hold and how those relate to their career decisions. One of the most common dispositions investigated in

teacher attrition research is that of resiliency. Many of the studies of teacher disposition are conducted within a teacher education program and the researchers use their graduates as the research sample. Studies here have rich data on their participants, generally drawing from interviews, focus groups, or written responses to probing questions.

Gu and Day (2007) define resiliency as being two-pronged, the first, describes resiliency as a psychological construct incorporating personal factors, which combine to form a protective barrier in the face of adversity. The second extends beyond the personal factors to include the support systems around an individual to help them cope with adverse conditions. This distinction is critical in understanding the role of resiliency in teacher attrition. If resiliency is entirely a personal characteristic, then the extent to which it exists in the teacher workforce is a product of the teachers recruited into the profession. If, on the other hand, resiliency is, at least in part, a function of a supporting context, then a school climate can have a direct influence on the resiliency of a teacher, or throughout an entire school faculty.

Expanding on Gu and Day (2007), Castro, Kelly and Shih (2009) borrow from the work of Patterson, Collins and Abbott (2004) to define resiliency as a process which occurs throughout a life time and gives individuals the opportunity to learn from various strategies employed and thereby better equip themselves against future adverse experiences. With this definition they sought to investigate resiliency strategies employed by first year teachers and what resources these teachers rely on to "overcome challenges and obstacles to teaching" (p.623). They interviewed fifteen first year teachers in high need areas for 60-90 minutes, transcribed the interviews and then coded them using a constant comparative approach. Castro et al. found four strategies often employed by teachers in their sample: help-seeking, problem-solving, managing difficult relationships, and seeking rejuvenation/renewal. What is most interesting about this

study is the perspective that these resiliency strategies can be learned and developed, either during preservice or from the school context.

Two studies by Milner (2002; Milner & Hoy, 2003) look at resiliency within an individual without directly naming it resiliency. Both studies are case studies of beginning teachers and include interviews and observations as their data collection procedures. These studies take a perspective that persistence in teaching and overcoming difficult experiences is a personal trait rather than a constructed behavior. One study examines how an experienced English teacher has persisted through "crisis" situations (2002) while the other examines the experience of an African American Teacher's persistence through threats to her self-efficacy. Both of these studies use Bandura's (1977, 1986) description of self efficacy and the role it plays in teacher's persistence, which is quite similar to the way resiliency accounts for teachers abilities to respond to adverse experiences.

In a study of a first year teacher, Ms. Young, the combination of the two perspectives coalesce (Murphy, 2005). Ms. Young begins the school year with a great deal of enthusiasm despite lacking the support she desires from her colleagues and administration. Through her individual efforts to seek help, work with her students, and sustained efforts, she helps to create an environment in the school that allows for greater support. By the end of the first year, this first year teacher no longer views the administration as an adversary, but rather as a resource to utilize in her teaching.

Although these studies describe teachers' abilities to persevere through difficult encounters in their teaching, they do not all name this trait as resilience. Rather, Milner views it through a frame of self efficacy while Murphy uses language describing a first year teacher's energy and exuberance. However, using the definition of resiliency espoused by Gu and Day,

each of these studies describes the role that resiliency plays in a teachers' persistence through difficulty. What remains unclear is the direction of the causation arrow. Each of these studies describes difficult situations that teachers survived and attributes their successful navigation to their personal or contextual qualities (i.e. resilience), but in Castro et al.'s definition of resiliency it is the difficult experience that brings about the actions of resiliency, which would not have been present without encountering the difficult situations. Thus, it seems that there is something missing from these studies to explain the mechanisms of how resiliency is developed and fostered in teachers.

The views teachers hold about poverty or reflection (Robinson, 2007) and their self-efficacy (Yost, 2006) have also been linked to teacher retention. More specifically, Robinson (2007) found that teachers in San Diego who believed that "poverty was rooted in social structure were more apt to be present in and to persist at poor schools" (p. 541) than teachers who though poverty stemmed from individual pathology. The authors compare the work of teaching in urban school settings to that of being a union organizer, someone who sees the structural issues in poverty and seeks to change that through their work. They further argue that it is this perspective, which draws some teachers to and keeps teachers in urban education.

Yost (2006) looked at what characteristics or dispositions kept novice teachers in teaching. Using graduates from one teacher education program who were in their second year of teaching, Yost used qualitative research methods to learn what obstacles these successful novice teachers had faced during their first year, and what factors shaped their views and successes. She also investigated the extent to which "these teachers [were] able to use critical reflection as a problem-solving tool" (p. 63). Her findings suggest that teacher persistence is aided by strong student teaching experiences where teacher candidates are able to develop confidence in their

practice. She also found that the teacher education program's ability to instill critical reflection as a method to solve problems leads to teachers that are more resilient. Yost claimed that these "results therefore shift attention away from a primary focus on school culture and induction to the crucial role teacher education programs play in the retention of qualified teachers" (p. 72). Such statements suggest reasons for contrasting views in the research about the root causes of teacher attrition.

This contrast is also evidenced in the way articles respond to each other in the literature. For example, Duck's article in 2007 is a response to an article written by McCann and Johannessen (2004) that asks "Why Do New Teachers Cry?" Both McCann & Johannessen and Duck describe difficult experiences of beginning teachers. However, McCann and Johannessen examine the experiences of teachers when in the workforce, such as relationships with students, parents, colleagues, and supervisors; workload; content knowledge; grading; and autonomy or control of the classroom. They find overwhelming workloads and poor relationships with students are related to teachers' decisions to leave the profession. Duck (2007) responds to this analysis by describing the graduates from a foundation course that includes teacher candidates "studying themselves and their preferences for teaching styles, learning styles, and classroom management by living through case studies of sample lessons and classroom simulations" (p. 29). Unlike McCann and Johannessen (2004), Duck does not extend this research to when the teachers enter the classroom; instead, the research is limited to a proxy of teacher retention, self-efficacy and commitment to the profession. The discussion section of Duck's article interprets these findings to imply that with the proper foundation, teachers can develop a disposition of critical reflection to combat the difficulties teachers encounter in the first year teaching.

Still another way to examine the relationship between teacher disposition and teacher retention is to study veteran teachers and figure out what they have in common that may have led to their longevity. One such study (Williams, 2003) interviewed 12 teachers in North Carolina and had difficulty finding demographic similarities among these individuals. Instead, the researcher discovered that their personalities or more specifically their disposition toward consistent intellectual stimulation is what tied them all together. Williams concludes that it is this attitude that allows teachers to persist and strive in the profession.

These studies collectively offer some evidence that teacher attrition rates vary with the disposition of teachers. However, unless desirable dispositions are recruited into the profession, it is not clear how policy can be adjusted to capitalize on this relationship.

Teachers' Education

Several studies have an underlying assumption that the educational background of teachers, including whether they have a master's degree or a bachelor's degree in the subject they teach, is indicative of teacher quality and then use this assumption to determine if higher quality teachers are more or less likely to remain in the profession.

One such study, conducted by Clayton and Schoonmaker (2007), followed graduates from a single teacher education program, into their teaching careers. They sought to determine what kept these "academically able" teachers in the classroom. The assumption in this study is that teachers who are "academically able" are the teachers who are preferred in the profession and efforts should be made to encourage their retention. The authors examined the experience of three teachers via interviews. Analyzing the responses from these interviews, the researchers grounded their work in the teachers' statements and used a constant to comparative method with their understanding of the literature. They found that the teachers who stayed in the profession

had received critical support in their "development as teacher leaders and in school environments that nurtured teacher development (p.263).

Another such study examined the relationship between educational background and turnover amongst music teachers (Hancock, 2008). Using SASS and TFS data, Hancock utilized a logistic regression with several predictor variables and a constructed risk leaving dichotomous variable: low risk (indicated by the desire to teach as long as they were able or to retirement age) and high risk (indicated by teachers with plans to leave, uncertain plans, or "waiting for something better to come along" (p.134)). Two of the predictor variables sought to capture the music teachers' educational backgrounds: whether they had a master's degree of any kind and whether they had a bachelor's degree in music. Neither of these variables were found to be significant predictors, even in models that included school level covariates. In this study, Hancock used teachers at all levels of experience, not limiting his study to beginning teachers, which is the focus of most of the other studies in this review.

When examining variations in commitment to teaching amongst math and science teachers, LaTurner (2002), identified four pathways to teaching; having taken 18 semester hours or more in math and science and having a credential in math or science (minimally qualified), having taken 18 semester hours or more in math and science and not having a credential in math or science (subject only), having taken less than 18 semester hours in math and science and having a credential in math or science (credential only), and having taken less than 18 semester hours in math and science and not having a credential in math or science (non-qualified). He found that teachers, who were non-qualified or subject only, the two categories that do not hold teaching credentials, expressed the highest commitment to still be teaching in 2 years.

Conclusion

There are several insights from the constellation of research studies on the relationship between teacher's characteristics and subsequent teacher attrition. First, focused measures of recruiting teachers into the profession have demonstrated varying levels of success. However, from the available research it is unclear what methods of recruitment can be adopted on the necessary scale to promote teacher retention. Second, while exceptions exist, teachers from professional development schools, on average, have greater persistence rates through the first several years of teaching than both national averages and their peers at the same institution in the non-PDS programs. However, the design of research is unable to disentangle if this result is because it is the type of individual attracted to PDS schools or something about their experience with in the PDS. Third, at least within New York City, persistence in the first several years of teaching does vary by entry pathway. Programs such as the NYCTF demonstrate retention rates on par with more traditional certification routes; however, teachers from Teach-for-America have much lower retention rates. Again, because of research designs it is difficult to determine if it is a product of selection or preparation experiences. Fourth, the education of teacher candidates, including specific course work or program focuses, can instill in teachers a greater ability to withstand the difficulties encountered in the first years of teaching. Fifth, greater amounts of student teaching seem to promote retention rates in the beginning years of teaching, though not always. Finally, a teacher's disposition prior to entering the profession can impact her persistence in the classroom. Of course, due to the research designs of those reviewed the causes of teacher turnover are not possible to isolate. The next section of this review examines the other constellation of research, working conditions.

Section 4: Constellation 2: Working Conditions

As much of the aforementioned research has alluded, the first several years of teaching can be challenging. This section reviews studies comprising the second constellation of research studies that examine the role of workplace conditions and their impact on teacher attrition. In much of the research the phrase "workplace conditions" is used to describe the conditions at the school, such as the safety of the school, the quality of the school building, and the relationships amongst the faculty, staff and administration. In this review, I use this phrase as an umbrella term to capture these aspects as well as others that occur while working as a teacher, including salary, job satisfaction, stress of the position and other experiences of teachers while in the profession.

Salary

Most of the studies that examine the role that salary plays in teacher attrition decisions hold a similar theoretical perspective. The general perspective of these articles is nicely summarized in Strunk and Robinson's work from 2006. In this article they suggest "The theoretical underpinning of [their] study is based in standard labor economics and social theory and relies on the understanding that teachers are, like other professionals, rational actors who make choices about their careers and lives in accordance with their own preferences for wages, working conditions, and other unobservable factors" (p. 67). Most of these studies use multiple regression analysis, often logistic, and independent variables to predict teacher attrition. These variables generally include salary, determined or estimated in various ways; working conditions, operationalized in a myriad of ways; and other factors the researchers had available to include in their model.

Probably the most widely cited study examining the influence of salary on teacher's career decisions was conducted by Hanushek et al. (2004). In this study, the authors, economists by training, examined teachers and their career decisions in Texas. Their modeling of a teacher's mobility, either to another school or out of teaching, includes characteristics of the job, including salary; the feasible set of districts in which the teacher could obtain a job; and the cost of moving. To account for teacher salary, they constructed an annual salary schedule for each year of experience within each district for elementary teachers that did not have graduate degrees. Recognizing that there are other attributes of working conditions that teachers might value, such as smaller classes, suburban neighborhoods, proximity to their home or school achievement levels, and that a failure to include these alternatives in the model may bias the estimates of the relationship between salary and mobility, the researchers attempted to include proxies for these conditions in their model. However, of the proxies they used (percent of low-income, Black, and Hispanic students in the school, the average student achievement score) only matched one of the several influences on teacher attrition that they identified, school achievement score.

Despite this limitation, their model "confirm[ed] the difficulty that schools serving academically disadvantaged students have in retaining teachers, particularly those early in their careers" (p. 347). Additionally, they found that a higher proportion of Black or Hispanic students in a school increase the probability that White teachers exit the school, but the opposite was true for Black or Hispanic teachers. Using their results, the authors calculate the increases in salary necessary to keep teachers in schools with high turnover. For example, a nonminority female in a school with "10 percent more black students would require about 10 percent higher salaries in order to neutralize the increased probability of leaving" (p. 350). Their results indicate that men are far more responsive to salary differentials than women. This means that

the size difference in salary that encourages men to transition schools tends to be much smaller than it is for women. Overall, the effect of salary is small relative to other factors, such as school demographics. He suggested that it would be cheaper to change other working conditions within a school than to raise teacher salaries to have the same impact on teacher retention.

Strunk and Robinson (2006), using the 1999-2000 SASS and 2000-2001 TFS, employed a Hierarchical Generalized Linear Model (HGLM) and had results that paralleled those of Hanushek, et al. (2004); specifically, their results found that White teachers were more likely to leave schools that had a greater proportion of Black and American Indian students in the school. Furthermore, Strunk and Robinson found that the subject matter taught, especially foreign language, was associated with increases in the probability of leaving teaching. Their results also indicated that probationary teachers and less experienced teachers were more likely to leave their teaching positions, which is consistent with findings discussed earlier in this review. Finally, the authors found that salary, at the district level, had a small effect on teacher turnover. Specifically, higher salaries were related to higher rates of retention, but only marginally when compared to school demographics across all teachers. A similar relationship was found among English Language Arts teachers, where salary along with being male, working in a private school and teaching in classrooms with over 20% of the students receiving free or reduced price lunch were all associated with leaving teaching early (Hahs-Vaughn & Scherff, 2008; Scherff & Hahs-Vaughn, 2008).

Using the same data set, Kelly (2004), constructed a person-year data file and conducted an event history analysis, specifically a Cox Proportional hazard model. Kelly argued that this analysis procedure is most appropriate for teacher turnover studies because "the question is not *if* a teacher will attrite but *when* a teacher will decide to leave a school or teaching profession

altogether"(p. 201, emphasis in the original). In this way, the analysis procedure could examine interactions between duration of teaching and specific variables of interest. With that in mind, he split the duration into three time points, the early years (1-5), the middle years (6-31) and the retirement years (32+). Of most interest for this review are the factors influencing the first five years. He found that salary was a significant factor, with higher salaries for teachers generally leading to lower rates of attrition. The effect of salary was largest when the teacher is new to teaching. This model also demonstrated that teachers with "regular certification [were] much less likely to leave a school than teachers with emergency or provisional certification, independent of experience level" (p. 211). However, this finding calls into question the specification of the model. An individual can only teach with a provisional license for a few years before either needing to leave the profession or obtain a full credential. Because the SASS and TFS data are not collected longitudinally for more than one year, there is no way to determine if the provisionally licensed teachers subsequently obtain full certifications. So almost by definition, provisional license status should have a relationship with the number of years of teaching experience. Therefore, when the researcher uses 10, 20 and 30 years of experience as covariates to illustrate the individual effects of certification status on the retention rates of teachers, it is misleading because teachers cannot teach for 30 years without certification.

Although there are many studies that include salary in the analysis, there are only a few that use a data source other than the SASS and TFS and include salary as the primary variable of interest. One such study was conducted by Imazeki (2005) where she considered attrition and migration as separate outcomes in an event history analysis for new teachers in Wisconsin. Like others (Figlio, 2002; Lankford, Loeb and Wycoff, 2002), Imazeki found that migration is influenced by relative changes in district salaries compared to nearby districts. The overall

effects of salary are rather modest, meaning that "fairly large salary increases are needed to reduce attrition out of Milwaukee down to the levels experienced by the average Wisconsin district" (p. 431).

Another study that used a data set other than SASS and TFS looked at "business education graduates identified by the National Association for Business Teacher Education (NABTE) member institutes" (p. 216, Ruhland, 2001). Graduates were sent a survey; the return rate was 34%. The respondents were then designated into one of two categories, those who left or never entered teaching (14%) and those who remained in the teaching profession (86%). Those who were not teaching were asked to respond with the reasons that influenced their decision; 57% of these non-teachers reported salary as an important factor in their decision (next highest was the lack of job advancement (30%)). This represents a different relative importance of salary for these beginning teachers than was found in the previous studies; however, there are substantial differences in this study's sample and methods. It is possible that the subjects are fundamentally different than subjects from other studies, for example, business teachers may be more motivated by salary than non-business teachers. Furthermore, the analysis procedures are also different from other studies, grouping individuals who never enter teaching with people who left teaching, not analyzing the data in a multivariate way, and finally, using salary as a nominal variable rather than using actual salaries as a scale variable and estimating how differences in the amount of salary influences teacher attrition. Any one or combination of these could be possible explanations for this finding.

One of the most extensive studies to examine the effects of salary on teacher retention using a non-SASS/TFS data set was that of Stinebrickner (2001a; 2001b). He used data from the National Longitudinal Study of the High School Class of 1972 and examined teachers who were

certified between 1975 and 1985. He constructed a dynamic, discrete choice framework, to model three career choices—stay in teaching, work in another career, or stay home. He found that higher salaries were associated with a longer stay in teaching through the first nine years. Specifically, if there were a 20% increase of teacher salaries, then the average number of years teaching as a percentage of the total possible number of working years would increase from 50% to 80%.

Taking these results together, there is consistent evidence that there is a relationship between teacher salary and teacher retention. This relationship is often confounded with other school factors and appears to be rather minor compared to some other teacher characteristics, such as certification status and some school characteristics, such as school demographics. There is some evidence that focused salary increases, in schools with less desirable working conditions, may be more efficient than across the board changes to teacher salaries, as much of the influence of salary differential is on migration across districts rather than out of the profession altogether.

Student Composition

As was alluded to in the previous section, there is a relationship between the student demographic composition in a classroom and teachers' longevity in that classroom. However, much of the research on this topic is plagued by the overlap between student composition differences that align with salary differences.

Often these studies fail to account for the better working conditions that exist at schools that can offer the higher salaries and are therefore unable to disentangle the relative importance salary and other desirable working conditions play in teacher's career decisions. One study conducted by Loeb et al. (2005) examined this entanglement of salary and school composition specifically using survey data linked to district salary schedules for teachers in California. They

found that there is strong overlap in the predictive power of student demographics and teacher working conditions, including their salaries, class sizes, facilities problems, multi-track schools, and lack of textbooks on teacher turnover. Meaning that these factors are entangled and therefore concluding that the reason for migration is due to any one of these in isolation is misguided.

Investigating the same issue, Scafidi, Sjoquist and Stinebrickner (2007), constructed "linear probability and a competing risks model of transitions out of first teaching jobs" which allowed them to disentangle the effects of low school-wide achievement, low salaries, and high proportions of minority students. These researchers had a rather unique data set in Georgia, which allowed them to determine if ex-teachers were working in some other capacity within Georgia and were able to determine what the salary of the new position was. The results of their statistical model indicated that, holding everything else constant; teachers were more likely to leave schools with high proportions of black students. This factor seemed to outweigh the effects of low salaries and low school-wide achievement.

Hanushek et al. (2004) had similar findings with teachers in Texas. Their, not so humbly titled study, "Why Public Schools Lose Teachers," found that teacher turnover was "much more strongly related to characteristics of the students, particularly race and achievement, than to salary, although salary exerts a modest impact once compensating differentials are taken into account" (p. 326). For reference, their results suggest that for a nonminority female "a school with 10 percent more Black students would require about 10 percent higher salaries in order to neutralize the increased probability of leaving" (p. 350). Based on their findings the authors suggest that urban schools may have an easier time retaining teachers by modifying working conditions, such as student behavior, poor leadership, rigid bureaucracies, and general safety

rather than focusing on salary increases, since the size of those increases would need to be quite substantial. Moreover, modifying these school characteristics may have a more efficient effect on retaining teachers and have the added benefit of improving student performance. However, Hanushek et al. (2004) did not directly investigate whether these are the working conditions of importance, rather they merely speculate that these would influence teachers' career decisions.

For information about working conditions within schools, a research approach taken by Brunetti (2006) is more useful. In this study, Brunetti used a survey and extended interviews of nine high school teachers in an inner city school in California. He focused on the teachers who, despite facing enormous challenges, persisted for many years (12+) in the classroom and "experience success and satisfaction in their work" (p. 812). He analyzed the interview responses using a constant comparative method (Glaser & Straus, 1967). He concludes that there are three major factors that influence these teachers to continue working in this school and with these student populations: (1) the devotion to their students, (2) their pursuit of professional and personal fulfillment, and (3) the support received from administrators, colleagues and the organization of the school. This third piece, the support from administration from colleagues and the organization of the school comprises the school culture. Other studies which examine the role school culture has on teacher attrition are reviewed in the next section.

School Culture

When I discussed studies that focused on the role of salary in attrition, I commented on the difficulty disentangling salary differences from the composition of the student body. In many of the studies within this section suffer from the same confounding issue, that is, schools with low salaries, tend to also have a more challenging student body and less desirable school cultures. Thus, these studies struggle to isolate the importance of school culture on teacher

retention compared to salaries or student composition. The next several studies attempt to tease out the direct impact of school culture on teachers' career decisions.

A study by Guin (2004) gets at some of these questions by examining the characteristics of elementary schools that experience "chronic teacher turnover" (p. 1). Guin compares responses to a staff climate survey from schools within a single district over a three year period with their annual turnover rates. She also uses case studies at five schools to look deeper into what is occurring within these schools. Five of the six scales on the staff climate survey (School Climate, Teacher Climate, Principal Leadership, Teacher Influence, and Feeling Respected) were found to be statistically significantly correlated with the turnover rates at the schools in the district. In order to interpret what these correlations mean, Guin discusses her five case studies. Across these case studies, she identifies five factors that differentiate the schools with high turnover from the schools with low turnover. Specifically, the instructional program at low turnover schools is consistent across and within grade levels, but not for high turnover schools. Teacher professional development at high turnover schools tends to be a repeat from previous years due to the constant influx of new teachers and is unable to build upon previous years. In low turnover schools there is a great deal of teacher collaboration, but not at high turnover schools where individuals often have to work with new people each year. This also manifests itself in the amount of trust that teachers have for one another, with low turnover schools having high levels of trust amongst the staff, especially so when compared with the staff at high turnover schools. And finally, there is a huge difference in the number of applicants for an opening with low turnover schools often receiving more than 150 applications and high turnover schools receiving merely 5 or fewer.

There are two studies that used the SASS to examine the influence of school culture on observed teacher attrition (Liu, 2007; Weiss, 1999). Liu's study was primarily interested in how teachers' influence at school impacted first year teacher attrition. Liu found that first-year teachers who stayed at the same teaching position their second-year tended to have higher mean scores on perceived general teacher influence over school policy within their school than either movers or leavers. Furthermore, Liu found that movers, on average, had higher mean scores on perceived teacher influence over school policy than leavers. The model demonstrated that "predicted probability of first-year teacher attrition can decrease from 19% to 4% as teacher influence at school changes from no influence to a great deal of influence" (p. 13). However, a major limitation of this study was its lack of covariates known to also influence teacher's career decisions, such as student composition and salary. Lacking these covariates makes any causal relationships merely speculative at best.

Weiss (1999) used the data from two SASS administrations (1987-88 and 1993-94) to examine the relationship between working conditions and planned teacher retention, that is, a teacher's intent to continue teaching. She found that school cultures "that support collaboration and teacher participation in decision-making was most strongly related to…intentions to stay in the profession" (p. 861). In this study, Weiss included the following covariates in her model: "teacher demographics (gender, family income, race, age, marital status); teacher academic background, degrees, specialty field, level); teacher financial variables (salary, incentive pay, views of salary); class size; and teacher views of the work- place (school leadership, student behavior, autonomy and discretion, class size, and SES of students)" (p. 864). Therefore, interpretations from her results are more warranted than those of Liu's. The results are based on data from two survey administrations thereby lending additional credence to these findings.

However, a major limitation of this study is that it does not use actual teacher retention statistics, instead using the number of years the individual plans to continue teaching.

Another way to think about school culture is to consider the changes to school policy and how they influence the conditions within schools. With the introduction of NCLB, new legal requirements were introduced for special education teachers. These new requirements increased the amount of assessment of students and drastically increased the amount of paperwork necessary to complete a teacher's work. Nance and Calabrese (2009), using multiple case studies, focus groups with experienced special education teachers, "the Left Hand and Right-Hand Column Case Method" (p. 45) and other relevant documents, reported that current and former special education teachers claimed to be overwhelmed by the new legally required changes and felt that the time used to complete the paperwork would be better spent with their students. Bueker (2007) took a similar perspective when she investigated the effects of a change in the literacy curriculum in a school and how it affected teacher turnover. By conducting 30-40 minute phone interviews with 16 teachers she found that schools with supportive principals and staff could mediate the difficulties encountered with a changing curriculum.

Collectively these studies demonstrate that the way teachers perceive their school culture can have an influence on the length of their teaching career. More specifically, schools where teachers feel they have a collaborative environment and share in the decision-making at the school tend to retain more teachers than schools where teachers work in isolation or have little to no influence on decision-making. A new teacher's feeling about the school environment can be shaped by her induction into teaching. Therefore, many schools offer induction programs intended to serve as a catalyst for a smooth transition from pre-service student teaching to a fulltime teaching load.

Induction

Many states require induction programs for beginning teachers. Smith (2006) used the 1999-2000 SASS survey linked to state-level data to examine how variations in state policy influence the amount of induction occurring in schools and their effects on teacher retention. Not surprisingly, he found that there is an association between states mandating induction of new teachers and the amount of mentorship occurring in schools. However, whether states had the mandate or not did not significantly impact the amount of money spent on teacher induction across states; that is, states that mandated teacher induction programs did not spend more money on teacher induction than states that did not mandate teacher induction. Furthermore, he found that states that required that mentors of teachers match their mentees in grade level and subject(s) taught did not uniformly see this matching come to fruition, meaning that many states that required mentors to teach the same grade level and subject as there mentees did not actually have this happen. However, states that required matching between mentor and mentee did see a decrease in their attrition rates compared to states that did not have this mandate despite the matching not always being in place. Therefore, the decrease in attrition rates observed appeared to be a result of the mandate more than a result of the quality of implementation of the mandate.

In 2004, Ingersoll and Kralik conducted a literature review of the impact of mentoring on teacher retention. Only ten studies met their inclusion criteria, which required that studies be quantitative, include verifiable outcomes, and include a comparison group. After reviewing these studies, the authors came to the conclusion that "collectively the studies do provide empirical support for the claim that assistance for new teachers and, in particular, mentoring programs have a positive impact on teachers and their retention" (page 1). Similar findings have been shown from studies of special education teachers (Whitaker, 2000).

Later, Smith and Ingersoll (2004) conducted an analysis of 1999-2000 SASS and 2000-2001 TFS data examining the impact of induction programs on the retention of first year teachers. In their study, they used one logistic regression model to predict leaving teaching and another to predict moving to a new school, and in both cases, the target group was compared to teachers who stayed in their original position. In their study, they found that having a mentor in the same field as the mentee led to a reduction of the risk of leaving teaching by 30%, but with a p-value of 0.084, which they deemed statistically significant using the liberal cut off value of 0.10. However, mentoring is just one type of induction program that is available to beginning teachers throughout the country. When they examined other aspects of induction they found that having common planning time with other teachers in their subject area or participating in regularly scheduled collaboration with other teachers on issues of instruction reduced the risk of leaving compared to staying by 43% ($p<0.001$). But none of the other types of programs to help transition new teachers into the profession (i.e., having a teacher's aide, a reduced teaching load, few independent classroom preparations, participating in a network of teachers, and communication with the principal) had a significant effect on the probability of a teacher staying in the profession. However, Smith and Ingersoll recognized that many of these teachers experienced multiple forms of induction; that is, they did not often receive just one of the above mentioned induction components, but rather, participated in several. Looking at how these combined, and comparing their relative impact on career decisions to tease out aspects that might be more beneficial than others, the authors concluded that, "the largest reductions in turnover were associated with activities that tied new teachers into a collaborative network of their more experienced peers" (p. 704). This finding is similar to the findings of the qualitative study conducted by Johnson and Birkeland (2003) in which they discovered that teachers were more

likely to stay in schools that had a strong integrated culture amongst the new and veteran teachers.

Examining a partnership between the University of Colorado and six school districts, Kelley (2004) also found that a comprehensive induction program could be quite successful in promoting the retention of beginning teachers. More specifically, the induction program described in the study included intensive mentoring, cohort group mentoring, and ongoing inquiry into practice. Kelley found that after 4 years 94% of the participants that completed the program were still teaching. This number is a little misleading as they exclude teachers who left teaching during the first two years from their calculation; their rationale is that these teachers did not experience the entire two-year induction program. Including these teachers would decrease the percentage of teachers who are still teaching and it seems that the induction program should be aimed at retaining teachers while they are in the program, not only after the program is over. Even still, this "comprehensive" approach led to a much higher retention rate than is observed around the country.

Several models of teacher induction programs were highlighted in another study released in 2004 (Alliance for Excellent Education, 2004) that described four case studies of "effective induction programs" across the country. They define effective programs as programs that; keep quality teachers in the profession, weed out poor teachers, teach new teachers clinical and practical skills, build a community of teachers who are learners, orient teachers into their local schools and orient teachers into the efficacy and worth of their profession. Two of these programs were partnerships between universities and local schools or districts, while state and teacher unions organized the other two. What all four had in common was their use of a comprehensive approach to teacher induction, including mentoring, time for collaboration, and

attention to local context. The report argues that it is essential for induction programs to offer a suite of services in order be successful and not rely solely on the use of mentoring or professional development to induct teachers. But the work by Patterson, Roehrig and Luft (2003) shows that not all induction programs are successful. Their study of 33 high school science teachers in southern Arizona used interviews at the beginning and end of the school year along with the Teachers' Philosophical and Pedagogical Inventory and found that 20% of participants in their induction program left teaching during their first three years, which is on par with national averages after three years.

Mathematica recently released a report describing a randomized control trial of the impact of a "comprehensive" induction program (Glazerman et al., 2010). They cite Smith and Ingersoll (2004), Kelley (2004) and the Alliance for Excellent Education (2004) as being influences on the development of their induction program used for their study. Mathematica subcontracted the development of the induction programs and selected one designed by the Educational Testing Service (ETS) and another designed by the New Teacher Center (NTC). Both induction program were heavily reliant on mentoring and offered "opportunities" for collaboration amongst new teachers and professional development. Thus, despite Glazerman's claim that their induction programs were comprehensive, the induction programs implemented did not fit the description of comprehensive espoused by Smith and Ingersoll (2004), Kelly (2004) and the Alliance for Excellent Education (2004). Instead, the induction program seems to follow the advice from Ingersoll and Kralik (2004) who found that there is some evidence that mentoring programs, when well designed, can have an impact on the retention of beginning teachers. Their findings should be interpreted accordingly.

Despite this limitation in the design of the induction program itself, the design of the study was quite thorough. Glazerman and his colleagues only invited school districts that were spending less than $1,000 per teacher on induction, had a sufficient number of elementary teachers (570) and schools (10), and where at least 50% of the student body was eligible for free or reduced price lunch. Additionally districts that had recently tried a similar induction program were ineligible to participate in the study. The number of districts willing to participate further reduced the sample. At the end of the vetting process, they had 17 school districts in 13 states that were not necessarily representative of the nation's school districts. Using random assignment to treatment status at the school level, they allowed districts to select if they wanted the ETS or NTC induction program; thus, all treatment schools within a district received the same treatment. Then they issued a survey to the mentors and several surveys to the beginning teachers. Furthermore, they conducted classroom observations in a subsample of classrooms and collected student test scores from the student's of the teachers in the program as well as comparison schools. After implementing the induction programs, they used multiple regression analyses and found: no difference in the practices that teachers exhibited in the classroom, a slight improvement in student achievement for the schools that had two years of induction program implementation, and no difference in terms of teacher retention between the treatment groups and the business-as-usual groups. Meaning that despite previous findings regarding the ability of mentoring to positively impact retention rates, these programs alone were not able to produce statistically significant increases in the probability of retaining a teacher in these school districts. This study is the only randomized control trial to study the impact of induction on retention and its findings are inconsistent with previous research. A possible explanation is the design of the induction program itself, much of the literature argues that induction programs

must be comprehensive in structure to work, not just in name as it appears the ETS and NTC programs were. Furthermore, Ingersoll and Strong (in press) point out that the induction program considered as the "treatment" in this study was not much different from the business-as-usual induction programs already in place at the school districts, which served as the comparison group for the study. Therefore, Ingersoll and Strong (in press) argue, that the lack of finding a treatment effect may be the result of a "treatment" that is only slightly different from the "non-treatment."

Although not spelled out in the report, it is possible that this treatment was chosen because it was rather simple to implement uniformly across schools and school districts, while the other aspects would require site specific specialization, something that is difficult to implement externally across the country. The studies reviewed here offer some examples as to how local, smaller implementation is able to produce this type of a comprehensive induction program. Specifically, the study by Kelley (2004) offers insight into an induction program that is a partnership between UC Boulder and six school districts, and the Alliance for Excellent Education provides cases studies of four promising induction programs from around the country.

Administrative Support

Other important aspects related to local context include the support that a new teacher feels and the resources that are available to them at the start of their professional career. Several researchers have investigated, in vastly different ways, the relationship between how supported a teacher feels and their subsequent teaching status, while others have examined the relationship between the availability of resources and teachers' career decisions.

Coming from a local context perspective, Certo and Fox (2002) studied teachers in seven school divisions within Virginia. They employed focus groups with the teachers who stayed in

their school divisions and used telephone interviews to gather data about the experience of teachers who moved to another school division or left teaching entirely. Two researchers used a microanalysis approach, going through the transcripts line-by-line and coding themes using the language of the participants rather than those of the literature. The two researchers had 94% agreement on the codes. From these data emerged several themes that seemed to influence teachers' decisions to move to another school division or leave teaching. Salary and benefits emerged as a major factor on teachers' decisions to move to another school division, especially for math and science teachers. The next most common theme was administrative support. However, among teachers who left their school division, the lack of administrative support was the most often cited explanation for why they chose to leave the profession or for another school, above and beyond salary. Thus, the teachers who left cited the lack of administrative support as a dominant reason for leaving, but the teachers who remained perceived that the reason those teachers left was due to a desire for increased salary. These findings were similar to those of Gonzales et al., (2008) who also interviewed teachers who had left the teaching profession. These teachers expressed that their reasons for leaving were the lack of administrative support, difficulties with student discipline and low salary levels. In fact, seven of the eight teachers interviewed "cited disrespect from administration as one of the biggest problems" (page 6).

The importance of administrative support in retaining beginning teachers also exists for special education teachers. In a study conducted by Gehrke and McCoy (2007), five first year special education teachers described the persons and activities that provided them the support they needed and valued. More specifically, the teachers described the importance of the support from their principals and the other teachers they could communicate with in their induction meetings. This led to the authors' conclusion that retaining teachers "takes a village," implying

that teachers need multiple supports to meet their needs throughout their initial transition into the profession. A part of that village might be the resources that teachers need to conduct their work, in particular special education teachers. Kaufhold, Alvarez and Arnold (2006) surveyed 750 special education teachers in Texas. Of the 228 teachers who responded to the survey, 50% strongly agreed and 40% agreed that they lacked sufficient supplies, materials and resources.

Using an entirely different research methodology, but asking a similar question about the support structures available to new teachers and how they related to retention, Kukla-Acevedo (2009) constructed binomial and multinomial logistic regression models to estimate the effects of administrative support, classroom control and behavioral climate on teacher turnover. Using the SASS data from 1999-2000 linked to the TFS data from 2000-2001, the author constructed three scales. The first, classroom autonomy, was designed to measure the amount of control a teacher had over his or her own classroom. The second, administrative support, captured the "perceived amount of support to the teachers from the school's principal and administration" (page 445). Finally, the behavioral climate scale measured the teacher's perception of the challenging student behaviors at the school. When comparing teachers who left their teaching post, either movers or leavers, to stayers across all years of experience "the multivariate analyses revealed that after other teacher, student and school characteristics, administrative support was the only workplace condition that exhibited a statistically significant relation with teacher turnover" (p. 448). However, when a multinomial model was constructed with leavers, movers, and stayers as separate outcomes from each other and the sample was limited to first year teachers, administrative support was found to be statistically significant but in the direction opposite to what one would expect. This implies that first year teachers who felt support from their principals were more likely to leave the profession than to stay in it. The author does not

investigate this finding further, but speculates administrative support may be correlated with some unaccounted for negative influence on teacher retention. However, the model demonstrated that the behavioral climate at the school was far more influential on first year teachers leaving the profession than administrative support.

Another way to investigate how teacher turnover relates to administrative support is to ask the administrators directly. In a study by Stevenson et al. (1999), 22 directors of the Urban Systemic Initiative (USI) school districts were contacted and encouraged to fill out a survey form. On this form, they were asked to indicate the reasons they thought teachers were leaving the profession. Only four response options were available: insufficient salary, lack of administrative support, the need to improve teacher proficiency in a content area, or another explanation. Insufficient salary was the most frequently selected option, followed by lack of administrative support and the need to improve teacher content proficiency. While this is a novel research approach, it is unfortunate that the options available for administrators were so limited and no data was reported about the number or type of "other" responses. Thus, while this study offers some initial insight that district administrators believe that teachers leave because they are underpaid, this finding is similar to the focus groups of teachers who stayed in the same classroom in the study by Certo and Fox (2002) in that they are relying on the opinion of the people who stayed in the school about why their colleagues left teaching and are citing salary as a critical piece. However, the former teachers suggest that response far less often than their former colleagues think.

In sum, lack of administrative support seems to emerge as a reason for leaving teaching, especially when the teachers themselves are asked and, to a lesser extent, when their colleagues are asked. What is left unanswered from these studies is exactly what this support should look

like for beginning teachers to encourage them to stay in the profession. This is especially true considering the findings of Kukla-Acevedo (2009) that demonstrated that increases in the perception of administrative support were associated with greater risks of leaving teaching. One promising line of research was initiated by Gersten, Keating, Yovanoff and Harniss (2001). These researchers designed a path analysis to determine how support structures, such as the principal or other teachers, relate and interact with other aspects of working conditions to potentially minimize the difficulties teachers encounter during their career. Their results indicated that indeed, at least for special education teachers, support from principals and fellow teachers "can help make a seemingly unmanageable job manageable" (p. 560). While this analysis is unable to illuminate how this works, it does highlight the importance of administrative support for the retention of teachers.

Job Satisfaction

It almost goes without saying that a teacher's satisfaction with her job is related to her desire to stay in that job. When teachers who were once enthusiastic about their work become exhausted with it, the phenomenon is called burnout, much like a match that burns bright for a time, but is not able to sustain the fire for very long. Several researchers have attempted to measure teachers' job satisfactions and determine how they relate to retention. One particularly well-conceived study was conducted by Mau, Ellsworth and Hawley (2008). The authors, guided by social cognitive theory, focused on four hundred and fifty-one tenth grade students who had self-identified a desire to become a teacher within the larger National Educational Longitudinal Survey of 1988 (NELS: 88). They followed these students for ten years, including the span into their burgeoning careers. Scales measuring intrinsic, extrinsic and overall job satisfactions were constructed from the survey items. Of the original 451 tenth grade students

who desired to become teachers, ninety-eight (22%) were teachers ten years later. Their findings indicate that these 98 individuals, holding all else equal, were more satisfied with their jobs than the individuals who had dropped out of the teacher pipeline.

Another study examining the relationship between job satisfaction and persistence was conducted in Missouri public elementary schools (Perrachione, Rosser & Petersen, 2008). In this study, the authors use a measure of job satisfaction in a linear regression model to predict teacher intent to remain in the profession. One interesting caveat to this study is that they only looked at teachers who had been teaching more than five years, thereby examining the relationship between satisfaction and retention among more veteran teachers. The definition of retention in this study was comprised of responses to three Likert-scale items (1) I plan to remain in this position; (2) I plan to remain in this school; and (3) I plan to remain in this profession. Exactly how these responses were combined is not clear; they may have generated composite scores, added or taken the average of the response to the three items. However, they did report that these items had a high internal consistency (Alpha=0.90) and therefore held together as a homogenous construct of intent to remain. This is the only study in this review that conceived teacher retention or even the intent to continue teaching in such a manner. Using this as the outcome measure, a regression model was constructed that included measures of teachers' job satisfaction. The final model found that teachers who were satisfied with the profession of teaching and those who were satisfied with being a teacher at this school were more likely to score highly on the outcome measure. This implies that teacher satisfaction with the profession and with being a teacher at that, school had higher scores on the scale measuring "intent to remain."

Billingsley (2007) described the ex-special education teachers in Crockett City, a pseudonym for a large urban school district that served as a case study for her research. In the study, she lists the primary reasons ex-special education teachers give as reasons leading to their desire to leave the profession. These data were collected via a survey that asked questions about their previous employment, current employment and reasons for leaving. These reasons, when taken together, indicate that these teachers were dissatisfied with many aspects of the profession: over 50% of the teachers who left reported that they were dissatisfied with their teaching assignment. When these leavers were asked to rate their satisfaction with various aspects of the work, items that scored the lowest were the non-teaching demands (e.g. meetings and paperwork), support from parents, availability of resources, class size, and the quality of the facilities and classrooms. Self (2001) found similar complaints amongst trade and industrial education teachers she interviewed. Many of the study participants related their disappointment in the way that schools worked in contrast to the less bureaucratic private sector they had been a part of in previous positions.

Conclusion

Taking the studies that examine the effects of working conditions on teacher attrition together, there are several aspects of the teaching profession that may lead new teachers out of the classroom. Specifically, there is some evidence that teachers leave their teaching positions to seek higher salaries, and while that is sometimes associated with migration to new school districts, it also is associated with leaving the profession. Despite the high prevalence of research on the relationship between salary and attrition, the findings do not support the widespread, common understanding that salary is the primary influencer on teachers' decisions to leave teaching. If in fact it is of primary concern, one of the reasons that research may be

unable to substantiate this belief is the high correlation between low salaries and what are generally considered less popular schools to teach in, that is, low-achieving schools composed of low income students with a high proportion of minority students that are often located in urban centers in the United States. The research does demonstrate that providing sufficient administrative support and instilling a collaborative school culture can support teacher resilience to seemingly unmanageable working conditions. Thus, there is some empirical evidence that teachers' working conditions may have an influence on their decisions to stay or to leave the profession in spite of how well or poorly they were prepared upon entry to the profession.

Section 5: Interaction of Teachers' Characteristics with Working Conditions

The previous two sections have reviewed studies that, explicitly or implicitly, perceived either teachers' characteristics or working conditions as the primary source of explaining teacher attrition. The three studies in this section take a more holistic perspective about the antecedents of early teacher attrition. Schoepner (2009) described this as "an approach that examines teachers' entire experiences throughout their short time in the profession" (abstract). In the vast array of literature reviewed in this chapter, only these three studies use theoretical frameworks and research design models that explicitly combine teacher characteristics with their working conditions to build a theory of early teacher attrition.

Schoepner (2009) used interviews with 25 former teachers along with responses to the 2003-2004 SASS and 2004-2005 TFS to investigate why public and Catholic schoolteachers leave the profession early in their careers. Using both sociocultural and commitment theories, she examined the relationship between entering commitment, teaching experience and decision to leave teaching. Her findings suggest that the decision to leave teaching is more complicated than the common assumptions that teachers leave due to lack of initial commitment or

dissatisfaction with their salaries. What is most intriguing about this work is the recognition in the theoretical framework and research design that both what teachers bring into the profession and what teachers experience once in the profession have an influence on the career decisions of teachers. What is left unanswered from this study is how these teachers differ from those who stayed in the profession. The study may have been able to better define differences between those who stayed in teaching from those who left teaching had this study also interviewed teachers who stayed in the classroom.

Olsen and Anderson (2007) did just that. The 15 teachers who participated in their study were urban teachers who had attended the same teacher education program at UCLA called Center X. Six of these teachers were staying in their teaching position the following year and planned to continue classroom teaching throughout their career. Another six were continuing to teach the following year, but were uncertain about their future in teaching; they were considering moving to administration, leaving to start a family or to pursue another career entirely. Finally, three of the teachers were leaving classroom teaching the following year and were shifting into other roles within education. Two entered a doctoral program and the third was becoming an administrator. This research study examined these teachers' reasons for entering teaching, their preparation, working experiences and finally their future career plans. With this research approach, the authors were able to account for entry characteristics to both the preparation program and into the profession as well as the working conditions and experiences of the study participants. Then comparing these characteristics to the teachers' future career decisions Olsen and Anderson were able to study the relationships among these factors with the participant's future careers. In so doing, they found that teacher retention, specifically in urban settings, can be improved by allowing these new teachers to develop into new roles, both inside and outside

the classroom, and to experience professional development and support throughout their career, not just in the first couple of years as induction programs currently do. This study did not weigh the relative importance of teachers' characteristics against working conditions, only that after several years into teaching (2-6) these teachers reported that professional development opportunities and continued support would increase their desire to continue teaching.

One of the most thorough and well-known studies was conducted by Johnson and Birkeland and included 50 interviews of new teachers in Massachusetts (2003). The study found that teachers' career decisions were influenced by their "prior career orientations, financial situations, and preparation" (p. 581) but that it was their experience in the schools that had the greatest impact on their career decisions. Johnson and Birkeland found that teachers who stated that their schools supported their teaching were the teachers that were most likely to remain teaching. On the other hand, teachers who found their schools to be less organized and without the supporting mechanisms for their teaching were more likely to leave teaching. Of particular importance was the professional culture in the school. Some teachers reported working in a "veteran-oriented professional culture," where teachers valued their independence, privacy and professional autonomy. Others worked in "novice-oriented professional cultures" where youth, idealism and inexperience reign. Finally, there were teachers that worked in "integrated professional cultures" where teachers of all experience levels engaged in "collegial and collaborative efforts" (p. 605). The researchers found that teachers in integrated professional cultures more often stayed in their position from one year to the next. The other two professional cultures, veteran-oriented and novice-oriented, tended to have teachers that were more likely to leave their teaching position or the profession altogether. What is unclear from this study is how to create these school environments. It is possible that veteran-oriented schools develop that

culture as a result of seeing many new teachers come in only to leave soon after. Also, it might be that novice-oriented schools, which Johnson and Birkeland point out are often charter schools, are too new to have veteran teachers in the school and therefore lack the teaching experience to have another cultural model. In other words, it may be that the composition of the teaching force at the school determines the climate, or it may be that the climate dictates who remains in the school.

Only three studies took this broad view of teacher attrition and asked teachers to report their experiences that may have lead to their leaving the profession. While learning from teachers' statements about why they left teaching is critical to understanding teacher perspectives, the teachers themselves may not be the best at isolating or differentiating personal experience from larger trends. Also, they may not be able to adequately compare the role that preparation prior to entering the profession that took place several years earlier to the more recent experience in the schools to know which of the of the two were more critical in determining their career path. While the work of Schoepner (2009) included large-scale analysis using the SASS and TFS data sets, they were used to inform the interview data rather than place the teacher interviews in a larger context. Thus, despite these studies' research approach, they are not able to determine if teacher attrition is a result of teachers' characteristics or working conditions, or even if it is some combination of the two.

Conclusion

Recognizing that what teachers bring into the profession and what they experience once there both play a role in the career decision making of teachers is a critical piece of understanding what leads to early teacher attrition. That only three studies within this review take this perspective both in their framing of the question but also in their research design is

indicative of the lack of cohesive research that sufficiently has addressed the issue of what leads to teacher attrition. Primarily examining the impact of teachers' characteristics or working conditions on teacher attrition leads to an incomplete understanding of the phenomenon and is not able to answer the important policy question of when induction strategies should be implemented to reduce teacher attrition. The next chapter will discuss how this study will compare the relative importance of teachers' characteristics with working conditions in determining which is the greater influence on early teacher attrition.

Chapter 3: Research Design

This dissertation sought to examine the extent to which working conditions or teachers' characteristics are able to predict a beginning teacher's status (teacher retained=0, teacher attrited=1), the year after they are initially surveyed, using a national sample of teachers in their first five years of teaching. As was discussed in the literature review, although there is some research that considers both of these perspectives, there is no research that directly compares these perspectives; rather the research tends to either adopt one or the other, or combine them into one mixed theory that is unable to distinguish their relative importance in explaining the phenomenon of early teacher attrition.

This empirical research utilizes quantitative methods to compare these perspectives of early teacher attrition that derive from the two constellations of research studies discussed in Chapter 2. In Chapter 3, I first discuss the data and the quantitative methodological approach to answer the research questions: To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration?; To what extent do beginning

teachers' characteristics predict their attrition the year following the SASS administration?; Which, if either, constellation of studies, working conditions or teacher characteristics, better predicts attrition the year following the SASS administration?; And, how do the significant elements from both models combine and interact to explain teacher attrition in the year following the SASS administration? Then, I discuss the appropriateness for the research design and methods to answer these research questions. This chapter concludes by outlining the analysis procedures.

The research design of this study calls for the construction of two statistical models of teacher attrition, one based on teacher characteristics, the other based on measures of teachers' working conditions. These models were then compared to one another to compare their model fit statistics. Finally these two models were combined to find the most predictive elements of teacher attrition from the two models.

Data

As was evidenced in the literature review, there are several possible ways to gather data for studies of teacher attrition. However, studies that desire to examine this phenomenon at the national level typically use the School and Staffing Survey (SASS) and many of those link these data to either the Teacher Follow-Up Survey (TFS) or the Teacher Status File. These surveys are designed and administered by the U.S. Department of Education's National Center for Education Statistics (NCES). This survey system is the largest and most extensive survey of primary, middle and secondary schools in the United States.

Since the present study was interested in examining teacher attrition in public schools throughout the United States, it focuses on the SASS Public School Teacher Questionnaires. This particular survey asks public school teachers about their general teaching assignment; their

preservice experiences, including student teaching; their working conditions and attitudes about their working conditions, each of which was identified in the literature review as being relevant to the issue of teacher attrition.

There are two options for determining the subsequent teaching status of the SASS participants. The first option is to make use of the Teacher Follow-Up Survey (TFS) that is issued to a subsample of the SASS participants on which teachers report their current teaching status and provide reasons for that decision. This is the survey that most researchers use and is suggested for analysis by NCES. Another option is to make use of the teacher status files (TSF) that are completed by an individual at each school, often the principal. For the TSF the principal, or other school staff member, fills out the teaching status for each teacher in the school that was surveyed in the SASS.

Thus, deciding between these two forms of data involves weighing the sample sizes versus the "accuracy" of the data. The teacher status file provides a much larger sample of participants but relies on a third party to indicate a teacher's teaching status. It is reasonable to expect that the teachers themselves would give more accurate responses of their teaching status than a third party, be it the principal or other school staff member. However, there is no external check of either of these survey reports to determine their accuracy, and there is some evidence that even teachers do not always reliably report their own teaching status (Ludlow, Pedulla, Cannady, Chappe, Mitesceu & Enterline, in press). Furthermore, the NCES "perturbs" these data, which means they intentionally change values within the data to protect the anonymity of the survey respondents and do not disclose the degree or method of this process. Thus neither of these data sets represents the "truth."

The teacher status survey used to construct the teacher status files offers seven response

options for the teachers' teaching status. These response options are: (1) teacher in the same school; (2) returning to same school this year (but currently not teaching in the school) (3) Mover, still k-12 teacher; (4) Leaver, still working in same school [presumably no longer teaching]; (5) Leaver, still in education but not teaching; (6) left education or not returning this year; (7) Non-stayer, no other information available. By first excluding the teachers for whom the principal knows has left the school but is unsure of their current teaching status (weighted estimate: 173,297 teachers) and collapsing the available categories to either retained (stayers and movers) or attrited (leavers) an overall measure of stayers/movers and leavers can be determined. The same can be done for the teacher follow-up survey. Given the inherent measurement error in both the TFS and the TSF one way to determine the reliability of the data is to compare the teacher status designations reported on the separate surveys. The IES subcontractor, American Institutes for Research, completed this task for the 2004-2005 TFS and 2004 TSF. Their results make use of the available sample weights in both the SASS and TFS data to generalize to the total population. The proportion of agreement between the two files is displayed in Table 3.1. For example, of the teachers who self-reported as teaching the following year, the Teacher Status file had 96.1% of them marked as still teaching and 3.9% as having left teaching. The vast majority of teachers (~85%) are represented by the cell where both the principal and teacher report that they are retained and the agreement in this cell is very high, thus the overall agreement between these two files, which is not displayed in this table, is 95.5% of all teachers represented by the SASS sample.

Table 3.1: Agreement Between the Teacher Status File and the Teacher Follow-Up Survey

	Teacher Follow-Up Survey (Teacher Report)	
Teacher Status File (Principal Report)	Retained	Attrited
Retained	96.1%	3.9%

Attrited	19.5%	80.5%

Because the teacher status file has the capacity to identify the teaching status of all teachers in the SASS, it provides a much larger sample to support the construction of a model. However, when looking more closely at the data available for the separate categories in the analysis a different story emerges. Table 3.2 shows how the number of survey respondents, that are public school teachers in their first five years of teaching, who are in the stayers/movers category and how many are in the leavers category. Despite there being many more overall teachers in the Teacher Status File, there are far fewer leavers than there are in the Teacher Follow-Up Survey. This could be the result of the principals not being sure if the individuals who have left their school are teaching or not the following year.

Table 3.2: Sample Comparison between the Teacher Status File and the Teacher Follow-Up Survey

	Teacher Follow-Up Survey	Teacher Status File
Leavers	307	146
Stayers/Movers	1159	8076
Total	1466	8222

The sample size for the two groups in this analysis is especially important not only for power considerations, but also for the statistical techniques proposed in this research. Specifically, logistic regression residuals follow a binomial distribution which, when very large, can approximate a normal distribution at its tails. Since the J-test proposed assumes a purely random, normally distributed error term the larger sample size in the leavers category available in the Teacher Follow-Up Survey offers statistical benefits. Furthermore, the Teacher Follow-up Survey is suggested by NCES to be the more accurate representation of the true teaching status of its respondents and is widely used in other research. Therefore, this study examines the 2003-2004 SASS Public School Teacher file linked to the 2004-2005 Teacher Follow-Up Survey.

The SASS Public School Teacher Survey collects data from approximately 38,000 public school teachers; however, this available sample needs to be reduced to the sample of interest. As discussed in Chapter 1, the sample of interest is defined as teachers who, upon taking the SASS survey, were in their first five years of teaching and either stayed in teaching the following year (their 2nd, 3rd, 4th, 5th, or 6th year) or who left the profession the following year.

Teachers who transfer schools, movers, are considered to remain in the profession and were not excluded from the analysis as other researchers have chosen to do (e.g., Borman & Dowling, 2008), nor were they considered as leavers as other researchers have done (e.g., Ingersoll, 2003), nor were movers treated as a separate outcome as still other researchers have done (e.g., Imizeki, 2005). The decision to consider movers in the same category as teachers who stayed in their same school was made because the purpose of this research was to investigate how those who continue teaching and those who leave teaching differ on the variables in the model and individuals who transfer schools, while a part of teacher turnover, still continue to teach. Therefore, movers are a part of the same group as those who stayed in the same classroom. While recognizing that these categories are a simplification of teachers' career trajectories, this approach was useful in determining what encourages teachers to leave classroom teaching and is not without precedent (e.g., Adams, 1996; Fleener & Dahm, 2007).

The SASS teacher questionnaires provide nationally representative estimates of the number of public school teachers (including public charter school teachers). Specifically, teacher questionnaire data were obtained from a large national probability sample of public teachers (N=53,188) in the 2003-04 school year with a weighted questionnaire response rate of 84.8%. This yielded a sample of 45,103 K-12 public school teachers who completed the

questionnaires. More detailed information about the 2003-04 SASS is provided by Tourkin et al. (2007).

Methodological Approaches

Sampling Weights

The SASS sample was selected to be nationally representative of the teacher workforce, however this is only through the use of sampling weights. In order to be nationally representative the responses to the survey must be weighted according to the probability of selection for the sample and for systematic non-response to the surveys. These sample weights are intended to account for the discrepancy between the composition of the sample and the composition of the population by weighting responses based on the number of people that each individual respondent should represent. There is some disagreement in the literature about the appropriateness of using sample weights in regression analysis. Recent standard practice dictates not using sample weights when they are based solely on demographic variables that will be incorporated into the model, including nonlinear and interaction terms (e.g. gender, race, gender x race). In this case, the use of sample weights actually serves to increase standard errors, thereby reducing the power of statistical tests. On the other hand, when weights are not only based on recorded variables but also are meant to compensate for sample features, such as selection bias, clustered sampling with probability proportional to size, then sampling weights should be included because there are no recorded variables that can replace the weights (Winship & Radbill, 1994).

The TFS weights are meant to account for the sampling frame and non-response characteristics of the TFS sample, thus using demographic variables will not be able to account

for the sampling weights separately. Therefore, for the regression analysis, the statistical software package STATA was used and included the "svyreg" designation to incorporate the sampling weights to calculate the appropriate standard errors. This allowed the model to be an unbiased representation of the national population of teachers.

Analytical Methods

Several researchers, as discussed in the preceding chapter, have modeled the SASS data using a multilevel approach, often referred to as hierarchical linear modeling (HLM). Such modeling offers several advantages over single level models. Specifically, HLM takes into account data that are grouped or nested, within classrooms, schools, districts or States. In doing so, it appropriates the degrees of freedom according to the level of the analysis, meaning that when determining the statistical significance of a variable at the school level, the degrees of freedom used in the calculation are based on the number of schools in the analysis rather than the number of teachers, as there may be multiple teachers within one school. Without this adjustment, the model would have an inflated type I error rate, meaning that it would be more likely to find a statistically significant difference when in fact, one does not exist in the population. But when there are relatively few individuals clustered within a level, HLM becomes unnecessary, as there is virtually no difference in the degrees of freedom by level; the number of teachers is similar to the number of classrooms. In their book suggesting improvements for the SASS, Mullens and Kasprzyk (1996) discussed how the sampling strategy behind the SASS precluded true multilevel analyses because of how few teachers are sampled within schools. In the 2003-2004 SASS, there were on average, 5.7 teachers per school. This number is further reduced when limiting the sample to teachers in their first five years of

teaching. Such small nesting does not warrant the use of HLM because there is not enough of a nesting effect.

Despite not needing to use HLM, the outcome variable, teaching status, is a dichotomous variable and is limited to two states (retained vs. attrited). Ordinary least squares regression (OLS), the workhorse of social science research, assumes a continuous unbounded outcome variable. If employed with teacher attrition as the outcome variable, an OLS model will produce predicted values extending beyond the range of the bounded outcome variable and is therefore inappropriate to use in this instance. However, there are many options for examining dichotomous data, especially event data. Specifically, the outcome variable can be conceived of as an unobserved trait within individuals that manifests as the observed outcome. That is, the outcome variable can be viewed as a latent trait that causes someone to remain in teaching or to leave teaching. In this way the outcome has been transformed into a continuous variable that can be modeled, despite not being able to observe the trait directly. There are several options on how to conduct this transformation.

One such option is to think of the underlying trait as having an influence on the duration of a teachers' career. Rather than thinking of the decision of leaving teaching existing as a yearly concept, instead the underlying trait is that of the longevity, or duration, of the career. In this instance, the outcome variable is modeled as duration until an event occurs. These models take various forms but are collectively known as Event History, or Survival Analysis, models. The advantage of such models is that they take into account that individuals, who did not experience the event, attrition, will eventually experience it, as all teachers must at some point stop teaching. The individuals who did not leave teaching during the observed time period are considered censored by the data collection period, instead of existing as an entirely separate

population from those who have experienced the event during the period of observation. Several researchers have taken this approach at modeling teachers' career decisions.

For example, Kelly (2004) constructed a "person year" data set from the SASS data and conducted an event history analysis. However such a model required the assumption that the variables included are time invariant because they are only collected once from each teacher. In other words, because teachers are only responding to the survey once, their responses are assumed constant over their entire teaching career. So, for teachers who have been teaching for 30 years and respond that they are satisfied with their salary, or that their preparation prior to teaching was insufficient, the model assumes that these responses would be the same in their first year of teaching. Because the variables must be modeled in this way, the model cannot account for how factors change within a person over time, only the average influence of variables for individuals at the time they are surveyed, because the data for each year the teacher taught are not available. When this time period is small relative to the number of data collection points, the resulting function ends up similar to logistic regression. Even in Kelly's (2004) work, which spanned the entire length of teaching careers, he only examined three separate time periods, 1-5 years, 6-31 years, and 32+ years. Thus, Kelly's model was only able to distinguish differences among the three periods, not within the periods. The model proposed here examines only the first period and is interested in determining if individuals leave teaching at any point during this interval. Survival analysis would predict the length of time before leaving teaching instead of whether or not someone remains in teaching for this period and therefore is misaligned with the research question. Therefore, this research does not use survival analysis.

Another approach to modeling dichotomous outcome variables is logistic regression. A logistic regression model transforms the outcome into a continuous variable by conceptualizing a

latent trait that can be thought of as the "probability of teacher attrition". The model does this by calculating the log of the odds ratio, which is the odds of attrition divided by the odds of retention, and uses this as the outcome variable for the model. This transformation circumvents the limitations of OLS and allows for modeling teacher attrition using a logistic regression. Also, this model predicts the probability of teaching the subsequent year rather than the duration of teaching, as the event history model does. Logistic regression accounts directly for the fact that data are collected only once, rather than through time as would be preferred in event history models. Logistic regression assumes two separate populations, stayers/movers versus leavers, and uses independent variables to differentiate these two groups. One limitation of using logistic regression for this study is the assumption that the leaver category is a homogeneous population, that is, leavers after one year of teaching are a part of the same population as leavers after two, three or four years of teaching. Although these individuals are grouped into a single category by this research design, variations in their attrition rates and reasons for leaving may be different.

Research Design

Two logistic regression models, one for variables of working conditions and one for variables capturing teachers' characteristics, were constructed and examined to compare their relative efficacy in explaining the phenomenon of teacher attrition. Each model includes demographic variables and variables identified by previous research, reviewed in the last chapter, as being related to teacher attrition, but these variables are not exclusive to either category of explanation. These variables include indicators of the teacher's gender and race, their years of teaching experience, and the urbanicity of the school in which they teach. This serves to remove variation in the probability of attrition associated with these variables prior to the inclusion of measures capturing either working conditions or teachers' characteristics. In this way, the model

minimized construct irrelevant variances in attrition to better compare the two logistic regression models.

After constructing both of these regression models, their relative ability to model teacher attrition were compared in three ways. These methods included a comparison of their model fit characteristics (e.g. pseudo-R^2, Akaike Information Criteria, Bayesian Information Criteria); a comparison of their classification effectiveness using receiver operating curves (ROC); and the J test. Finally, the most predictive elements from the two models were combined into a single logistic regression model to investigate how these elements combine and interact to explain teacher attrition.

Working Conditions Regression Model

The first research question asks if a teacher's working conditions predict the subsequent teaching status of beginning teachers. To answer this question a logistic regression model attempted to predict the subsequent teaching status of teachers responding to the SASS using two blocks of variables. The first block included variables capturing variations in demographic characteristics. The second block of variables included responses to items pertaining to the teachers' working conditions, including items relating to salary, administrative support, school climate, student composition, and job satisfaction each of which was discussed in Chapter 2. The following section describes how these constructs were measured in the survey and how they were included in the logistic regression model.

Salary

As discussed in Chapter 2, variations in teachers' salaries have typically demonstrated a greater effect on teachers' decisions to move to new schools rather than to leave the profession

entirely. In order to examine the effect of a teacher's salary on her career decisions, the model included responses to items determining her academic base salary and her satisfaction with her teaching salary (i.e. I am satisfied with my teaching salary). Furthermore, the model included a variable accounting for all money earned beyond the teacher's academic base salary, but from within the school (e.g. from teaching summer school, coaching, yearbook, or merit pay) and a variable accounting for money earned while working outside of the school (i.e. "During the current school year, do you, or will you, earn additional compensation from working any job outside this school system?" and "Which of these best describes this job outside of this school system". This allows for a picture of the role income, rather than just salary, can have on a teacher's career decisions. This approach captured both the monetary income for the teacher, from inside and outside the school, but also her satisfaction with this income as each of these may relate to her desire to stay in the profession.

School Culture

Supportive and cooperative school cultures have been found to have a positive influence on teachers' desire to stay in classroom teaching. To model the influence of school culture on teachers' career decisions, there are several items within the SASS that were used. These items follow the stem: "To what extent do you agree or disagree with each of the following statements?" Respondents were offered four response options ranging from Strongly Agree to Strongly Disagree to seven items: "There is a great deal of cooperative effort among the staff members", "I receive a great deal of support from parents for the work that I do", "I like the way things are run at this school", "In this school, staff members are recognized for a job well done", "I make a conscious effort to coordinate the content of my courses with that of other teachers", "The teachers at this school like being here; I would describe us as a satisfied group", and "I am

generally satisfied with being a teacher at this school." These items together had a reasonable reliability ($\alpha = 0.761$). The mean of the responses across these items, coded as Strongly Agree=4; Agree=3; Disagree=2; and Strongly Disagree=1, was included in the model.

Induction and Professional Development

All teachers whose first year of teaching was after the 1999-2000 school year, that is teachers teaching less than five years, are asked about their induction experience, if they participated in one and what components it included. Smith and Ingersoll (2004) used the 1999-2000 SASS and TFS and demonstrated that when induction comprises a suite of components, they collectively influenced attrition rates of first year teachers, however, were not necessarily influential by themselves. The same might be true for teachers in the 2003-2004 data set. Thus, a similar modeling strategy to account for induction of beginning teachers that Smith and Ingersoll used was also used in this model for the induction practices for beginning teachers. Their strategy included modeling various levels of induction, no induction, basic induction (a mentor and supportive communication with their principal), basic induction + collaboration (mentor in the same subject area, regular supportive communication with their principal, common planning time or regularly scheduled collaboration with other teachers in their same subject area, and they participated in a seminar for beginning teachers) and, for the very few teachers with even more induction support, basic induction + collaboration + teacher network + extra resources (participating in a network of teachers, having a reduced number of preparations and being assigned a teacher's aide). Given that less than one percent of the new teachers participated in the full induction program modeled by Smith and Ingersoll, I used only three categories, no induction, basic induction and more than basic induction. This was accomplished using two dummy variables with no induction as the reference group. The only difference between the

coding scheme used in this study and the scheme used by Ingersoll and Smith is the current study combined the top two levels of induction, more than basic and full induction, into a single category.

Student Composition

Prior research demonstrated that the composition of students could be associated with high attrition rates of teachers from that school. Specifically, schools with a large portion of minority or low-income students, often have high rates of attrition of their teachers. However, as was discussed in Chapter 2, much of this research suffers from confounding variables, such as teacher salary, and therefore it is difficult to disentangle the findings between the influences of salary on teacher attrition from the influence of student composition on teacher attrition. The current study included measures of salary and measures of student composition and was not concerned with disentangling their unique contributions to teacher attrition. Instead, their joint contributions were of interest in this study. Respondents to the SASS provided information about the student composition of the school's students, including the proportion of minority students or students eligible for free or reduced price lunch. This information is not available at the classroom level, therefore the proportion of minority students and students receiving free or reduced priced lunch in the school will be modeled as representative of the teacher's working conditions. Additionally, several schools did not report the proportion of students receiving free or reduced price lunch and these values remain missing in the data set. Therefore, inclusion of this variable reduces the sample size in the model and is therefor only used descriptively rather than in the multivariate models.

There are data available regarding school level student behavior reported by the teacher. Using responses from items capturing student behavior problems a scale was developed. Items

on this scale offer five response options (happens daily, happens at least once per week, happens at least once a month, happens on occasion, never happens). These options are available for items following the stem: "To the best of your knowledge how often do the following types of problems occur with student at this school?" The items are: physical conflicts among students; robbery of theft; vandalism; use of alcohol; use of illegal drugs; possession of weapons; physical abuse of teachers; student racial tensions; student bullying; student verbal abuse of teachers; widespread disorder in classrooms; student acts of disrespect for teachers; and gang activities. To get a weighted composite of the most important factors related to this construct, I used principal component factoring to determine a single component accounting for the maximum amount of variation among these items. Although, there were two eigenvalues greater than 1 (the average amount of variation accounted for per item) the first factor accounted for 48% of the total variance in all the items. No item had a component loading less than .5 on the first component, and only two items loaded more strongly on the second component than the first. Those two items referred to student's use of alcohol or illegal drugs and both loaded above .6 on the first component. Thus, I concluded that a singe component was sufficient to account for the variation among these items. I saved the regression component scores and used them in future models to account for student behavior at the school level. This scale is referred to as the "student behavior scale" and higher scores indicate better student behavior.

Administrative support

In Chapter 2, several studies were reviewed that demonstrated that there is some positive relationship between administrative support and teachers' retention rates. Therefore, items from the SASS, which pertain to administrative support were included in the model. Such items follow the stem: "To what extent do you agree or disagree with each of the following

statements?" Respondents are offered four response options ranging from Strongly Agree to Strongly Disagree to several items; these include: "The school administration's behavior toward the staff is supportive and encouraging; The principal lets staff members know what is expected of them; My principal enforces school rules for student conduct and backs me up when I need it; and The principal knows what kind of school he/she wants and has communicated it to the staff." A scale score was derived from the mean of the scores to these responses with Strongly Agree being the high value. These four items demonstrated a high degree of reliability ($\alpha = 0.851$), forming a consistent scale.

Teacher Characteristics Regression Model

To answer the second research question, do a teacher's characteristics predict the subsequent teaching status of beginning teachers; a logistic regression model attempts to predict the subsequent teaching status of teachers responding to the SASS using two blocks of variables. The first block includes variables capturing variations in demographic characteristics. The second block of variables includes responses to items pertaining to the teachers' characteristics. This includes items relating to recruitment, certification route, student teaching experience, entry pathway, and their education each of which was discussed in Chapter 2. The following sections describe how the survey measures these constructs and how they were coded and included in the logistic regression model.

Recruitment

In Chapter 2 several studies were reviewed that examined the relationship between how teachers are recruited to the profession and their persistence once there. The variations in recruitment strategies included focused attention to minority applicants and offering signing

bonuses to attract teachers from non-traditional routes. One of the findings from this section of the review was that recruitment strategies are highly localized and often are not linked with teacher persistence. Furthermore, the data available in the SASS at the teacher level lacks the appropriate information to model the recruitment of any particular teacher. However, there is information about a district's teacher recruitment strategies including whether districts have signing bonuses, student loan forgiveness, relocation assistance and a finder's fee for new teacher referrals. Each of these are yes or no responses at the district level and can provide some insight as to the recruitment strategies available to the school districts where the teachers work, however, it is not possible to determine if a teacher actually benefited from any of these strategies. Because this is the case, this variable is included in the model as a dichotomous variable with any yes response to questions about teacher recruitment coded as one and districts with no such strategy coded as zero.

Certification

In Chapter 2 there were several studies that looked at the link between certification route and teacher attrition. These studies collectively demonstrate that the experiences that teacher candidates have prior to entering the classroom can lead to either persistence in the classroom or attrition either during the preservice experience or soon after entry to the profession. The SASS captures several aspects of the certification route for teachers, including asking each teacher "which of the following describes the teaching certificate you currently hold in this state." The response options to these questions are: "Regular standard state certificate or advanced professional certificate;" "Probationary certificate" (issued after satisfying all requirements except the completion of a probationary period); "Provisional or other type of certification" given to persons who are still participating in what the state calls an 'alternative certification

program; “Temporary certification” (requires some additional college coursework student teaching, and/or passage of a test before regular certification can be obtained); “Waiver or emergency certification” (issued to persons with insufficient teacher preparation who must complete a regular certification program in order to continue teaching); and “I do not have any of the above certifications in THIS state.” Teachers are then asked if their credential is grade specific, elementary (including early childhood, preschool and kindergarten), secondary (including middle school), or ungraded and what the particular content area is that the certificate allows the teacher to teach. These categories include general certifications such as Early childhood/Pre-K, Elementary grades, middle grades, secondary grades and specific areas of special education. They also include subject matter specific credential categories, such as, music English, German, Physics, Economics, Keyboarding and Driver education. Because it is possible that teachers hold multiple credentials teachers are asked to describe any additional certificates they hold with the same series of questions.

To account for the variations in teacher certification in the model, dummy codes for each of the certification statuses (probationary, provisional, temporary, emergency, not certified in this state) were used to compare their attrition probabilities to regular or standard certified teachers. Additionally, the grade level certification that teachers hold may influence their attrition rates, secondary/middle school teachers were compared to teachers holding elementary, early childhood or ungraded certifications. Finally, amongst secondary teachers, several studies suggested that there may exist variations in teacher attrition rates based on the subject matter for which the teacher is certified to teach. Thus, subject matter certification was included in the model by including 4 categories identified in previous research as having higher than average attrition rates (English, Foreign Language, Science, Mathematics). The reference category for

these variables are all other full-time teachers, including elementary, early childhood, and secondary teachers of social science, physical education, etc.

Student Teaching Experience

Several studies were reviewed in Chapter 2 that established a link between the amount of mentored student teaching teacher candidates experienced prior to entering the classroom and their persistence in teaching. To account for the influence of student or practice teaching in the model, responses to the item "How long did your practice teaching last?" were used to account for the extent of student teaching experienced. The response options presented to the SASS teacher sample are; "I had no practice teaching"; "4 weeks or less"; "5-7 weeks"; "8-11 weeks"; "12 weeks or more." Despite the granularity of these response options, they represent an underlying continuous factor: weeks of student teaching. Thus, rather than modeling these options as categorical, they were recoded to the minimum number of weeks specified within each category, except for the category "4 weeks or less" which was coded as two weeks. The reason this coding scheme is employed is to account for the value at the high end, 12 weeks or more, for which there is no mid-point or upper limit. This resulted in a single variable accounting for the length of student teaching in the model. Because the structure of student teaching is also important, yes or no responses to the item "did your preparation for teaching include…formal feedback on your teaching?" was included as a main effect in the model as well as tested for an interaction with the length of student teaching.

Entry Pathway

The pathway that teachers take into the profession has also been studied as having influence on the teachers' probability of attrition. There are two ways to model the pathway that teachers took to the profession. The first is a crude distinction among various structures and

programs that are available to teacher candidates. To account for the variation in attrition rates based on these measures, the model included responses to the item: "Which of the following describes how you obtained the teaching methods or teaching strategies coursework?" The response options for this item are: "Through an 'alternative' program designed to expedite the transition of non-teachers to a teaching career (e.g., a state, district or university alternative program)"; "Through a bachelor's degree granting program (B.A. or B.S.)"; "Through a fifth year program (not leading to a master's degree)"; "Through a master's degree granting program (M.A., M.S., M.Ed., M.A.T.)"; "Through individual courses (not part of a program leading to a degree)". These responses were dummy coded with the reference group being those who respond that they received their teaching instruction "Through a bachelor's degree granting program (B.A. or B.S.)."

The second piece of accounting for the pathway that teachers take into the profession is the extent and type of preparation that they receive in that pathway. To account for this variation, responses to several SASS items were used. The first set of questions follows the stem: "Did your preparation for teaching include." The prompts that follow are "Coursework in how to select and adapt instruction"; "Coursework in learning theory or psychology appropriate to the age of students you teach"; and "Your observation of other classroom teaching". Each of these prompts includes yes or no as response options. Each question was included in the model as a dummy code, with the yes response as the target (yes=1, no=0).

The survey also offers the opportunity to include a measure of the number of courses a teacher took that focused on teaching methods or strategies before they started teaching. Teachers indicated if they have taken any graduate or undergraduate courses that focus on teaching methods or strategies, and if yes, then they indicate how many courses they took (1 or

2; 3 or 4; 5 to 9; or 10 or more). Subsequently, the teachers are asked how many (all, some, or none) of these courses they took before they started teaching. Because this model is capturing teachers' entry characteristics only the courses for individuals who respond "all" were included. Responses of "none," were coded as having taken no teaching methods or strategy courses prior to teaching and responses of "some" were coded as one half of the total number of courses taken.

Finally, teachers in their first five years of teaching are asked how prepared they were in their first year of teaching in each of six areas. The six areas include: (1) handle a range of classroom management or discipline situations; (2) use a variety of instructional methods; (3) teach your subject matter; (4) use computers in classroom instruction; (5) Assess students; (6) select and adapt curriculum and instructional methods. The teachers are able to respond with four options; Not prepared at all (0); Somewhat Prepared (1); Well Prepared (2); and Very Well Prepared (3). The sum of these responses is used as scale of preparation.

Teachers' Education

In Chapter 2, there were several studies that examined the relationship between the educational background and teacher attrition. This relationship was modeled by including a dummy code with bachelor's degree as a reference group and advanced degree (masters or doctorate degree) as the target group. Furthermore, to account for the academic competency of the individual teacher, the selectivity of the teacher's undergraduate institution was included in the model. This information is not a part of the SASS, however, respondents state the name of the institution where they received their undergraduate degree. This can be linked to the selectivity rankings provided publicly by the Integrated Postsecondary Education System by the university ID provided in the SASS data set. This selectivity includes three levels, "inclusive", "selective" and "more selective." These categories are discussed in greater detail in Chapter 4.

Regression Model Construction

For both of the regression models, working conditions and teachers' characteristics, standard diagnostic practices were employed to minimize the potential of model misspecification. Model misspecification refers to any errors in specifying the model to be tested, such as: including unnecessary predictor variables, excluding necessary predictor variables, or violating an assumption that underlies the model. During this process, the influence of interactions among these predictor variables and the potential for non-linear relationships between the predictors and the outcome were investigated.

There are several measures of model fit in regression analyses. If evaluating models generated via OLS, their F statistic or R^2 values could be used. The F-statistic is used to determine the probability of observing the observed relationship, if there is no relationship between the outcome and predicting variables. On the other hand, the R^2 value is a substantive measure of the proportion of variation in the outcome variable that is accounted for by the predicting variables, often referred to as the amount of "explained variance."

Logistic regression uses a different estimation procedure than OLS and therefore these statistics cannot be calculated directly. However, for logistic regression there exist analogous measures. Where OLS makes use of the sum of squared errors as a measure to determine the quality of a model, the Maximum Likelihood Estimation (MLE) procedure used in logistic regression employs the log likelihood to determine the quality of the model. The method of MLE selects values for the model parameters that are most likely to have resulted in the observed data. Larger values of the log likelihood are indicative of better fitting models. It is possible to construct a test of the probability of observing a likelihood value and therefore create a statistical test of the model. For example, the log likelihood for the intercept-only model, that is, the model

informed only by the proportion of leavers in the sample, can be compared to the log likelihood for the specified model. The difference between these two values (if they are each multiplied by -2) can be interpreted as a Chi-Square statistic. This value is denoted as G_m. If G_m is statistically significant ($p<0.05$), then the difference between the specified model and the intercept-only model is greater than would be expected by chance (Mernard, 2001). Therefore, the model specified is preferred to the intercept only model. Once this is established, the next step is to determine if the specified model is similar to a theorized full model. This was done by constructing a loss function to estimate the amount of information "lost" from a theorized full model to the specified model. Small differences are preferred. There are several techniques available to estimate a loss function (the amount of information lost from a theorized full model) and the specification with the least amount of loss is generally chosen. The loss function can be estimated either through a Bayesian approach by updating some a priori knowledge about the model with information from the observations or via accounting for the tradeoff between the goodness-of-fit and the complexity of the model by using an adjusted R^2 or the Akaike information criterion (AIC) (Akaike, 1973).

The AIC is an estimation of the information lost when the specific model is used to explain the phenomenon. Therefore, small values of the AIC are preferred to large values. However, the AIC is not a statistical test; there is no critical value of AIC which determines the probability of observing such a value by chance. The AIC does not take into consideration the degrees of freedom in a model and therefore tends to prefer less parsimonious models.

In an attempt to account for model parsimony, the Bayesian Information Criterion (BIC) has also been introduced (Schwarz, 1978). The BIC is similar to the AIC, but accounts for the degrees of freedom used in the model and, therefore, often advantages the more parsimonious

models. As above, the BIC is not a part of a statistical test, and there is no critical value of BIC to compare the observed value against to determine the probability of observing that value by chance. Both the AIC and the BIC are most useful when comparing models nested within other models to determine the contribution of variables above and beyond what is already in the model.

These techniques of evaluating the model fit employ a loss function approach. That is, these approaches determine how much information is lost from the theorized full model, to the final model constructed. Lost information is the difference in the amount of information about the outcome contained in the model between a theorized full model and the specified model. It can be thought of as the amount of entropy, or random data loss, from the true relationship to the one that is modeled. When utilizing this approach in statistical analyses, the goal is to construct logistic regression models that improve their model fit by minimizing the amount of entropy, that is, specifying a model as close to the theorized full model as possible.

However, these techniques all assume that one of the models being compared to the other is a subset of that model or that they are both subsets of a greater supermodel. That is, one of the models is merely a subset, or simplification of the model it is being compared to. Measures such as these are not appropriate for models that are not nested within each other. Therefore, both the AIC and BIC were useful in generating each of the logistic regression models, but are not very useful for comparing their relative model fit. For example the BIC tends to prefer the parsimonious model; however, the concern with parsimony is most critical when comparing the marginal effects of variables in nested models and is of less concern when comparing non-nested models.

To address the third and fourth research questions, that is, are teachers' characteristics or working conditions a better predictor of teachers' subsequent teaching status, the quality of these two models must be compared. Again, if these were nested models, the pseudo R-squared change, or the t-statistic testing if the coefficients of predicting variables are significantly different from zero would be sufficient statistics to examine. However, when comparing non-nested models this is not possible, as one model cannot be viewed as a subset of the other. Instead there are competing hypotheses, where neither model can be expressed as a subset of the other, and no "supermodel" which encompasses both theories exists. In such a case the comparison is between two models with unique elements.

In this case, it is not possible to simply inquire about the marginal contribution of a particular variable in the model; instead what is desired is a general overarching conclusion as to which set of variables better model the observed phenomenon. Approaches aiming to determine the superiority of non-nested models can most often be traced to the work of two authors, Cox (1961, 1962) and Atkinson (1970). Cox's work developed a generalization of the likelihood ratio procedure used when comparing nested models to non-nested models. This procedure developed into what is now called the Cox Test. Atkinson (1970) took a conceptually different approach by introducing a third model that fully encompassed the two models to be compared. In this way he was able to artificially nest the two models in a larger more complex model and then use the procedures described in the previous section to compare the fit of the models (AIC, BIC, etc.). Both of these techniques were evaluated and revised for particular applications throughout the 1970s (for a description of this development see Gourieroux and Monfort, 1986).

By the mid 1980s, these approaches began to collectively use what is now called the Encompassing Principle (Gourieroux & Monfort, 1986). The Encompassing Principle states that

a model that can explain more variation in the outcome than another model subsumes that model. For instance, if one model was able to account for the same variation and the residual variation of another model, beyond what would be expected by chance, then that model is said to *encompass* the other model. Using this principle several techniques have been developed and used to compare non-nested models.

One of the most oft-cited and widely used tests in this category is the J-test introduced by Davidson and MacKinnon in 1981. The J-test takes a rather simple approach: if model A has explanatory power over and above that of model B, then model A is superior, or vice versa. This test is carried out by first stating two possible hypotheses:

$$H_A : y_i = e^{f(X_i,\beta)+\varepsilon_{Ai}} \qquad 3.1$$

$$H_B : y_i = e^{g(Z_i,\gamma)+\varepsilon_{Bi}} \qquad 3.2$$

In this case, the first hypothesis, H_A, is a logistic regression model of the outcome, y_i, and composed of predicting variables, X_i, in the form of working conditions and coefficients, β which together define a predicting function $f_i(X_i,\beta)$ with an error term, ε_{Ai}. The second hypothesis, H_B is a logistic regression model of the outcome, y_i, composed of predicting variables, Z_i in the form of teachers' characteristics and coefficients, γ which together define a predicting function $g_i(Z_i,\gamma)$ with an error term, ε_{Bi}. To test the superiority of the second hypothesis, model B, to the first hypothesis, model A, the following logistic regression is modeled, where $\hat{g}_i = g_i(Z_i,\gamma)$.

$$y_i = e^{(1-\alpha_b)f_i(X_i,\beta)+\alpha_b[g_i(Z_i,\gamma)]+\varepsilon_i} \qquad 3.3$$

But in such a regression the value of α_b is not directly identifiable because it will not be independent of the regression coefficients in $f_i(X_i,\beta)$. In order to get around this problem, $g_i(Z_i,\gamma)$ is replaced with the fitted values, $\hat{g}_i$, from equation 3.2. By also combining like terms to simplify the equation, the resulting logistic regression then takes the form.

$$y_i = e^{f_i(X_i,\beta)+\alpha_b(\hat{g}_i-\hat{f}_i)+\varepsilon_i} \qquad 3.4$$

Estimating equation 3.4 allows testing of the non-nested model by testing statistical significance of one parameter, α_b. The parameter α_b is the regression coefficient for the fitted values from model B. When $\alpha_b = 0$, equation 3.4 simplifies to equation 3.1, leaving model A. When $\alpha_b = 1$, equation 3.4 reduces to equation 3.2, leaving model B. Thus, if model B can explain residual variation of model A then the coefficient α_b will be different from zero and model B will be said to encompass model A. If in truth model A is not encompassed by model B, then the expectation of α_b is zero, and it reduces to model A. If α_b is zero, then the investigation is reversed to test if model A encompasses model B by reversing equation 3.4 and estimating the following logistic regression, where $\hat{f}_i = f_i(X_i,\beta)$:

$$y_i = e^{g_i(Z_i,\gamma)+\alpha_a(\hat{f}_i-\hat{g}_i)+\varepsilon_i} \qquad 3.5$$

If model B is the true model and not encompassed by model A, then the expectation of α_a is zero. If α_a is indistinguishable from zero, then model A does not have predictive value in explaining the residual variation of model B. Evaluating each model this way determines if

either model – working conditions or teachers' characteristics – is able to *encompass* the other model. If one model does encompass the other, then that model is able to explain the residual variation of the other model and therefore is the superior model.

The necessary steps to conduct the J-test are detailed in Table 3.3. First the two models are specified as logistic regressions and the predicted values, as logits, are saved. The logits are preferred because they have better statistical properties and will be in the same units of the specified models. The next step is subtracting the predicted logits of one model from the other model's predicted logits to calculate the difference between them. Finally, each model is re-specified with the difference between the two predicted values added as the last term. If this term has a coefficient statistically significantly different from zero, this implies that the other model was able to predict some of the residual variation from the specified model.

Table 3.3: Steps to Perform the J-Test

	Working Conditions	Teacher Characteristics
Specify the Model	$H_A : y_i = e^{f(X_i,\beta)+\varepsilon_{Ai}}$	$H_B : y_i = e^{g(Z_i,\gamma)+\varepsilon_{Bi}}$
Save the Predicted Logits	$\hat{f}_i = f_i(X_i,\beta)$	$\hat{g}_i = g_i(Z_i,\gamma)$
Determine if the predicted logits can explain the residual variation from the other model	$y_i = e^{g_i(Z_i,\gamma)+\alpha_a(\hat{f}_i-\hat{g}_i)+\varepsilon_i}$	$y_i = e^{f_i(X_i,\beta)+\alpha_b(\hat{g}_i-\hat{f}_i)+\varepsilon_i}$

The two alpha parameters, α_a and α_b, cannot be directly compared. Thus, if both are found to be indistinguishable from zero, then this modeling technique is unable to distinguish between the predictive powers of the two models. Similarly, if both α's are found to differ from zero, then the test implies that neither model is independently sufficient to explain early teacher attrition.

Another method to determine model quality often used in logistic regressions is classification tables. Classification tables indicate the classification status of each unit in the analyses compared to their observed classification. In this way, it is possible to determine how many units were correctly classified as being a stayer/mover or a leaver. A limitation of classification tables is their high dependence on where a cutoff point is to determine what probability of leaving is considered as indicating a leaver. To avoid this dependence on a relatively subjective cutpoint, I constructed receiver operating curves (ROC). ROCs plot the sensitivity - correctly identified leavers, the true positive rate - of the model on the y-axis and one minus the specificity - incorrectly identified leavers (stayers classified as leavers), the false positive rate - on the x-axis. An ideal model would have high sensitivity (true positives) across much of the range in specificity. This would result in a curve that rose rapidly from left to right, quickly approaching one and having a great deal of area underneath the curve. Thus, the model with the greatest area under the curve gives the best predictions. Using the area under the curve, a direct comparison of ability of these two models to correctly classify teachers can be examined.

There are a handful of studies that look across the two constellations of research to examine the combined contribution of teacher characteristics with working conditions. To model the way the elements within these two constellations combine and interact to explain teacher attrition a final logistic regression model was constructed. This model comprises the significant elements from the two previous models and the interactions among them. It was constructed using all the unique elements from the separate working conditions and teacher characteristics models in a backward entry stepwise logistic regression. Variables with coefficients with significance less than 0.1 were kept in the model. The remaining variables were then tested for significant interactions. This model addresses the fifth research question:

How do the unique elements within the teachers' characteristics and working conditions models combine and interact to predict early teacher attrition the year following the SASS administration? The results of these models are discussed in the next chapter, Chapter 4.

Chapter 4: Results

The previous chapter described the analysis plan for the current study. The results from those analyses are presented in this chapter. This chapter begins with a description of the sample used in the study along with descriptive statistics, properly weighted, for the dependent and independent variables. The chapter then describes the results of the statistical models built to answer each research question. The statistical model associated with each research question is displayed in Table 4.1.

Table 4.1 Research Questions

	Research Question	Statistical Model
1	To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration?	$\boldsymbol{y_i = e^{f_i(X,\beta)+\varepsilon_{Ai}}}$
2	To what extent do beginning teachers' characteristics predict their attrition the year following the SASS administration?	$\boldsymbol{y_i = e^{g_i(Z,\gamma)+\varepsilon_{Bi}}}$
3	Which, if either, constellation of studies, working conditions or teacher characteristics, better predicts attrition the year following the SASS administration?	$\boldsymbol{y_i = e^{g_i(Z,\gamma)+\alpha(\hat{g}_i-\hat{f}_i)+\varepsilon_i}}$ $\boldsymbol{y_i = e^{f_i(X,\beta)+\alpha(\hat{f}_i-\hat{g}_i)+\varepsilon_i}}$
4	How do the significant elements from both models combine and interact to explain teacher attrition the year following the SASS administration?	

Sample

The Schools and Staffing Survey system is the largest and most extensive survey system of primary, middle and secondary schools in the United States. With minor changes this survey system has been conducted every five years since the 1987-1988 school year. The SASS comprises five separate surveys to each of the following groups: school-district personnel, school staff, teachers, administrators, and library and media center personnel. This study focused on the

SASS Public School Teacher Questionnaires. Schools are sampled from the Common Core of Data (a dataset that includes the population of schools in the United States). Schools are stratified and sampled to provide adequate representation at the state level. Because schools are the primary selection unit, some teachers within the schools are randomly selected to respond to the surveys used in this study. This particular survey asks participants about their general teaching assignment, their preservice experiences, perceptions of preservice preparation, their work conditions and attitudes about their working conditions. To measure the subsequent status of the teachers from the SASS, the Teacher Follow-Up Survey is administered to a subset of SASS participants one year following the SASS administration. Thus, results from the Teacher Follow-Up surveys are used to determine the subsequent status of teachers who responded to the previous year's SASS administration. Minority teachers and Leavers, who are smaller portions of the larger population, are oversampled to give adequate representation of these subpopulations. This study examined the 2003-2004 SASS Public School Questionnaires, which were linked to the 2004- 2005 Teacher Follow-Up Survey.

The SASS Public School Teacher Survey collects data from approximately 38,000 public school teachers; however, this available sample was reduced to the sample of interest. The sample of interest was defined as teachers who, upon taking the SASS survey, were in their first five years of teaching and either stayed in teaching the following year (their 2^{nd}, 3^{rd}, 4^{th}, 5^{th} or 6^{th} year) or who left the profession the following year. The sample of interest includes 1,451 individual respondents, however, due to the sampling frame, these teachers represent a much larger population of teachers. That is, the 1,451 observations are not a simple random sample of full-time teachers in their first five years of teaching in U.S. public schools; rather, the sample is stratified to insure appropriate sample sizes for sub groups of interest, for example, minority

teachers, teachers in rural schools, and teachers who were likely to leave their current teaching positions. Therefore, each observation does not represent the same number of teachers in the larger population. The variation in how many teachers each observation represents is accounted for using the sampling weights provided by NCES.

Although there is some discussion on the appropriateness of using weights in regression analyses, NCES strongly encourages their use, even when analyzing a subset of the population (Tourkin, et al, 2007). The sampling weights provided by NCES are balanced-repeated replicate weights (BRR), and the weights used in this study are associated with the TFS file because that is the subsample of the SASS this study is using. BRRs are generated by selecting balanced half samples from the full sample for each of the stratum, then calculating a statistic for each half-sample. Finally the variance is estimated on the statistic based on the difference between the full-sample and half-sample values. The influence sampling weights have on results is illustrated in Table 4.2. When the raw data are used without using the sampling weights, the responses indicate that 20.95% of the sample left teaching the year after the initial SASS survey. However, because there is an over sampling of teachers likely to leave teaching, when the responses are weighted, they indicate that 15.39% of the sample left teaching the following year. This corresponds to a difference of 5.56 percentage points in the estimate of attrition. Considering that the 1,466 observations represent 213,286 teachers, 5.56% represents 11,859 teachers nationally. Thus, failing to utilize the sampling weights severely influences the estimates obtained.

Table 4.2: Comparison of Weighted and Unweighted Estimates of Attrition

	Raw (Un-Weighted)	NCES BRR Weights	Difference
Stayer/Mover	79.05%	84.61%	-5.56%
Leaver	20.95%	15.39%	5.56%

Descriptive Statistics

Using the sample weights is necessary to accurately describe the sample of interest. Specifically, we are interested in the population that this sample represents, rather than the composition of the sample itself. Therefore, when describing the sample, the weights are used giving a description not of the sample, but of the population of teachers this sample represents. For example, in Table 4.3 there are several descriptive statistics, including the gender and average age of full time teachers in their first five years of teaching for both stayer/movers and leavers. The table also indicates the proportion of teachers in three levels of urbanicity (rural, suburban and urban). The table indicates that among beginning teachers more teachers teach in suburban settings than in either urban or rural settings and that the ratio of leavers to stayer/movers is greatest in rural schools. This description is not directly indicative of the raw data; instead it describes the best estimates of the population of teachers working as full-time teachers in their first five years of teaching throughout the nation.

Table 4.3 Demographic Descriptive Statistics

	Proportion	BRR Std. Err.	95% Conf. Interval	
Gender (Female=1, Male=0)				
Stayer/Mover	0.81	0.02	0.78	0.85
Leaver	0.75	0.05	0.66	0.85
Urbanicity				
Urban				
Stayer/Mover	0.38	0.03	0.32	0.43
Leaver	0.38	0.05	0.27	0.49
Suburban				
Stayer/Mover	0.52	0.02	0.47	0.57
Leaver	0.49	0.05	0.39	0.59
Rural				
Stayer/Mover	0.10	0.01	0.09	0.12
Leaver	0.13	0.02	0.08	0.17
Race (white, non-hispanic=1)				
Stayer/Mover	0.85	0.01	0.82	0.88
Leaver	0.90	0.02	0.86	0.95
First Year Teaching				
Stayer/Mover	0.26	0.02	0.23	0.30
Leaver	0.28	0.04	0.19	0.37
Second Year Teaching				
Stayer/Mover	0.26**	0.02	0.22	0.30
Leaver	0.18**	0.02	0.13	0.23
Third Year Teaching				
Stayer/Mover	0.26	0.02	0.22	0.30
Leaver	0.22	0.04	0.14	0.29
Fourth Year Teaching				
Stayer/Mover	0.12	0.01	0.09	0.15
Leaver	0.18	0.05	0.09	0.28
Fifth Year Teaching				
Stayer/Mover	0.09	0.01	0.07	0.12
Leaver	0.14	0.04	0.07	0.22
	Mean	BRR Std. Err.	95% Conf. Interval	
Age (years)				
Stayer/Mover	30.64*	0.31	30.02	31.26
Leaver	32.44*	0.90	30.65	34.23

(*** p<0.01, ** p<0.05, * p<0.1)

Working Conditions Variable Descriptions

Salary. The literature identified salary as an important contributor to teachers' career decisions. The average base salary, any additional money issued to the teacher by the school, and out of school earnings are displayed in Table 4.4 in units of thousands of dollars. Additionally, the teachers' rating of their satisfaction with their salary is displayed in Table 4.4 for both Leavers and Stayer/Movers. Agreement with the statement that they are satisfied with their salary is on a 4 point scale from strongly disagree (1) to strongly agree (4). The base salary for stayers/movers and leavers are fairly similar $34,535 versus $34,816. Those who remained in teaching (stayer/movers) earned, on average, more from the school in addition to their base salary ($p<0.01$) and were, on average, more satisfied with their salary ($p<0.05$). Those who left teaching, on average, earned more outside of school than those who remained in teaching the following year ($p<0.05$).

School Environment. In addition to salary, one of the critical pieces in describing a teachers' working conditions is the school environment, specifically the composition of the student body and the school culture along with the administrative support. Table 4.4 gives the scale scores for the School Culture and Administrative Support scales. For each of these scores, higher numbers indicated more desirable working conditions, either more inclusive school cultures or more supportive administrations. For both scales the mean score across the items is reported, with a scale range of 1 to 4. There is a significant difference in mean scores on the school culture scale between stayer/movers and leavers, with stayer/movers rating their school culture more favorably than leavers. Table 4.4 indicates that the schools of teachers who left had, on average a proportion of minority students of 0.60, while schools of teachers who stayed or moved had a proportion of minority students of 0.55; this difference is not statistically

significant. Also in Table 4.4 is the student behavior scale. Higher scores on this scale are indicative of schools with less abundant (both in frequency and scope) student behavior problems. The student behavior scale is a factor score estimated using OLS regression techniques. This means that the average score across all teacher reports is zero; positive values are schools with better than average student behavior and negative scores are schools where student behavior is worse than average. The mean score on the student behavior scale for stayer/movers was 0.12; the mean score on the same scale for leavers was -0.01. This difference was not statistically significant.

Table 4.4 also displays the proportion of minority students and students eligible for free or reduced price lunch in the school for both teachers who stayed or moved and teachers who left teaching. The item measuring students eligible for free or reduced price lunch had missing data for 44 respondents. There was no statistically significant difference between the stayer/movers that responded to this item and the leavers that responded to this item; therefore to avoid a reduction in sample size, this variable was excluded from all regression analyses in order to use a consistent sample across all models; this allows comparison of the models without confounding the comparisons with differences in samples.

Induction. One of the main strategies schools employ to both improve the quality of instruction from beginning teachers and improve their retention is the use of induction programs. Table 4.4 indicates the proportion of full-time public school teachers in their first five years of teaching that experience no induction, basic induction, or full induction. The proportion of stayer/movers that had no induction (0.38) is smaller than the proportion of leavers that had no induction (0.56) at the 0.01 significance level. Conversely, the proportion of stayer/movers that had basic induction (0.33) is *greater* than the proportion of leavers that had no induction (0.21) at

the 0.05 significance level. There was no difference between the proportion of stayer/movers with full induction and the proportion of leavers with full induction.

Table 4.4 Descriptive Statistics: Working Conditions

	Mean	BRR Std. Err.	95% Conf. Interval	
Base Salary (in thousands)				
Stayer/Mover	$34.54	0.29	33.96	35.11
Leaver	$34.82	0.79	33.24	36.39
Additional School Earnings (in thousands)				
Stayer/Mover	$0.96***	0.09	0.78	1.14
Leaver	$0.42***	0.07	0.29	0.56
Out of School Earnings (in thousands)				
Stayer/Mover	$0.53**	0.16	0.20	0.85
Leaver	$1.00**	0.28	0.43	1.57
Satisfaction with Salary				
Stayer/Mover	2.32**	0.04	2.24	2.40
Leaver	2.08**	0.09	1.90	2.26
School Culture Scale				
Stayer/Mover	2.03***	0.04	2.24	2.40
Leaver	1.88***	0.09	1.90	2.26
Administrative Support Scale				
Stayer/Mover	1.62	0.02	1.58	1.66
Leaver	1.57	0.04	1.48	1.66
Student Behavior Scale				
Stayer/Mover	0.12	0.05	0.03	0.21
Leaver	-0.01	0.10	-0.21	0.20
Proportion of Minority Students				
Stayer/Mover	0.55	1.86	51.46	58.86
Leaver	0.60	3.52	53.20	67.18
Proportion of Students Eligible for Free or Reduced Price Lunch (N=1406)				
Stayer/Mover	0.53	1.60	49.69	56.06
Leaver	0.54	3.49	47.53	61.39
Proportion with No Induction				
Stayer/Mover	0.38***	0.02	0.34	0.43
Leaver	0.56***	0.05	0.45	0.66
Proportion with Basic Induction				
Stayer/Mover	0.33**	0.02	0.29	0.38
Leaver	0.21**	0.04	0.13	0.30
Proportion with Full Induction				
Stayer/Mover	0.29	0.02	0.25	0.32
Leaver	0.23	0.04	0.15	0.31

(*** p<0.01, ** p<0.05, * p<0.1) – Indicates a significant difference between stayer/mover and leaver for a given measure.

Teacher Characteristics Variable Descriptions

Certification. There are various ways that teachers can earn certification to teach. For both stayer/movers and leavers the largest proportion of teaching credentials (0.62 and 0.55, respectively) are standard credentials, meaning that the teacher has satisfied all state requirements to earn their certification. Probationary (0.13 Stayer/Mover and 0.15 Leaver) and Provisional certifications (0.13 Stayer/Mover and 0.13 Leaver) make up the second and third largest proportions of certification types (see Table 4.5); these certifications are common among beginning teachers who may need additional classroom experience before earning standard credential status. The smallest proportion (0.03) of the responding stayer/movers and (0.07) leavers indicated that they did not have a teaching credential in the state where they are currently teaching. It is not known if these teachers lack a teaching credential altogether or if they are certified in another state, because the survey does not separate these two response options. For each of these credential statuses, the proportion of stayer/movers and the proportion of leavers are not statistically significantly different from one another. This is not true, however, for Temporary and Waiver or Emergency credentials. These credentials are often issued to teachers who are nearly finished with their required coursework, or have certification in another state and have not yet completed the necessary steps to earn a standard certification in their current state. There is a statistically significant difference ($p<0.1$) between the proportion of stayer/movers with waiver credentials (0.02) and the proportion of leavers with waiver credentials (0.05).

In Table 4.5, the breakdown of stayer/movers and leavers by grade level and teachers' subject certifications are presented. Because many states do not have separate middle school credentials from high school teaching credentials, the middle school and high school categories are collapsed into a single designation. The two corresponding rows indicate that a proportion of

0.46 of stayers/movers were credentialed to teach secondary or middle school while 0.48 of leavers held secondary or middle school credentials; these proportions are not statistically significantly different from one another. A small proportion (0.04) of all teachers held credentials that were not grade specific (ungraded). Table 4.5 also shows the proportion of credentials in particular subject areas that were identified in large scale studies as having higher than average attrition rates: English, Math, Science, Foreign Language and Special Education. Of particular note is the relatively high proportion of leavers that held Math or Computer Science credentials (0.10) compared to the proportion of stayer/movers that held Math or Computer Science credentials (0.03); this difference was statistically significant ($p<0.01$).

Table 4.5 Descriptive Statistics: Teacher Characteristics - Certification

(Yes = 1, No = 0)	Proportion	BRR Std. Err.	95% Conf. Interval	
Certification Type				
Regular				
Stayer/Mover	0.62	0.02	0.58	0.65
Leaver	0.55	0.05	0.46	0.64
Probationary				
Stayer/Mover	0.13	0.01	0.11	0.16
Leaver	0.15	0.04	0.06	0.23
Provisional				
Stayer/Mover	0.13	0.02	0.09	0.16
Leaver	0.13	0.03	0.07	0.19
Temporary				
Stayer/Mover	0.07	0.01	0.04	0.10
Leaver	0.05	0.02	0.02	0.09
Waiver				
Stayer/Mover	0.02*	0.00	0.01	0.03
Leaver	0.05*	0.01	0.02	0.07
Not in the State				
Stayer/Mover	0.03	0.01	0.02	0.05
Leaver	0.07	0.03	0.01	0.13
Certification Grade Level or Subject				
Secondary or Middle School				
Stayer/Mover	0.46	0.03	0.41	0.51
Leaver	0.48	0.05	0.37	0.58
Special Education				
Stayer/Mover	0.11	0.01	0.08	0.13
Leaver	0.15	0.04	0.07	0.22
English				
Stayer/Mover	0.07	0.02	0.04	0.10
Leaver	0.05	0.01	0.02	0.08
Foreign Language				
Stayer/Mover	0.01	0.00	0.00	0.02
Leaver	0.01	0.01	0.00	0.02
Science				
Stayer/Mover	0.05	0.01	0.02	0.07
Leaver	0.03	0.01	0.01	0.05
Math or Computer Science				
Stayer/Mover	0.03***	0.01	0.02	0.04
Leaver	0.10***	0.03	0.05	0.16

(*** p<0.01, ** p<0.05, * p<0.1) – Indicates a significant difference between stayer/mover and leaver for a given measure.

Entry Pathway. As described in the literature review, there are many routes teachers can take to certification. Table 4.6 illustrates the pathway designations used by the SASS survey,

indicating the proportion of teachers from each of these pathways and the breakdown of percentage of teachers who continued teaching versus those who left teaching by pathway. The highest proportion of teachers, stayers/movers or leavers, entered teaching through what SASS calls the Traditional BS or BA degree route (0.44 and 0.39, respectively; $p>0.1$) meaning that these teachers earned bachelor's degrees in education while pursuing a teaching credential. The proportion of stayer/movers and leavers are not statistically different from one another for any of the entry routes to teaching (pathways to becoming a teacher and earning certification).

Table 4.6 Descriptive Statistics: Teacher Characteristics - Certification

(Yes = 1, No = 0)	Proportion	BRR Std. Err.	95% Conf. Interval	
Entry Pathway				
Traditional				
Stayer/Mover	0.44	0.02	0.40	0.48
Leaver	0.39	0.05	0.28	0.50
Alternative				
Stayer/Mover	0.15	0.02	0.12	0.19
Leaver	0.16	0.04	0.09	0.23
5th Year				
Stayer/Mover	0.05	0.01	0.03	0.07
Leaver	0.05	0.02	0.01	0.09
Master's Degree				
Stayer/Mover	0.14	0.02	0.11	0.18
Leaver	0.16	0.04	0.08	0.24
Courses				
Stayer/Mover	0.04	0.01	0.02	0.05
Leaver	0.03	0.01	0.01	0.06
Other				
Stayer/Mover	0.04	0.01	0.02	0.05
Leaver	0.04	0.02	0.00	0.08

(*** $p<0.01$, ** $p<0.05$, * $p<0.1$)

Student Teaching. Table 4.7 describes the student teaching experiences of the beginning teachers in this sample. Stayer/movers had, on average, an additional week of student teaching compared to those who left teaching (8.77 compared to 7.78; $p<0.1$). Along with weeks of student teaching, it is important to examine if teacher candidates were given feedback on their

student teaching. Illustrated in Table 4.8 a high proportion (0.91) of beginning stayer/movers received feedback during their student teaching experience; this is statistically significantly higher than the proportion of leavers that received feedback on their student teaching (0.84; $p<0.05$).

Preparation. In order to capture teachers' self-assessments of their preparation to teach, I generated a teaching preparation scale using items from the SASS described in Chapter 3. Teachers were asked how prepared they were in their first year of teaching in each of six areas. The six areas included: (1) handle a range of classroom management or discipline situations; (2) use a variety of instructional methods; (3) teach your subject matter; (4) use computers in classroom instruction; (5) assess students; and (6) select and adapt curriculum and instructional methods. The teachers responded with one of four options; Not prepared at all (0); Somewhat Prepared (1); Well Prepared (2); and Very Well Prepared (3). The mean of these responses is used as the scale of preparation. Table 4.7 displays the results of this analysis. Teachers who were still teaching at the time of the TFS (stayer/movers) had a mean preparation scale score of 1.80, which is just below the an average response of "Well Prepared." Those who left teaching had a mean score of 1.57, which is half-way between an average response of "Somewhat Prepared" and "Well Prepared." This difference was statistically significant at the 0.01 level.

Table 4.7 Descriptive Statistics: Teacher Characteristics - Preparation

	Mean	BRR Std. Err.	95% Conf. Interval	
Weeks of Student Teaching				
Stayer/Mover	8.77*	0.22	8.33	9.21
Leaver	7.78*	0.49	6.81	8.76
Preparation Scale				
Stayer/Mover	1.81***	0.03	1.75	1.86
Leaver	1.57***	0.07	1.43	1.71

(*** p<0.01, ** p<0.05, * p<0.1)

Preparation Experience. Table 4.8 describes the various experiences, including coursework and observations, that beginning teachers had while learning to be a teacher. For

example, the two rows under the label "Selecting and Adapting Instructional Material" indicate the proportion of stayer/movers who had coursework in selecting and adapting instructional material for their students (0.90) and of leavers who had the same coursework (0.85). Along with the type of coursework, the amount of coursework in teaching methods taken prior to teaching may be related to attrition rates. The row labeled "Number of Courses Prior to Teaching" displays the number of methods courses taken prior to becoming a full-time teacher. Because the SASS respondents do not answer this question directly, these are estimates based on the teachers' response to three items. First they are asked if they have taken any coursework in methods or teaching strategies. If they respond yes, the next item asks them how many courses they have taken to which they can respond with 1 or 2; 3 or 4; 5 to 9; or 10 or more. Subsequently, the teachers are asked how many (all, some, or none) of these courses they took before they started teaching. Because this model is capturing teachers' characteristics when entering the profession, all the courses for individuals who respond "all" to this last question are included; responses of "none," are coded as having taken no teaching methods or strategy courses prior to teaching and responses of "some" are coded as one half of the total number of courses taken. Each range is set to the midpoint of the range (e.g. 5 to 9 is set to 7) and the highest option, 10 or more, is set to ten as it has no upper limit. As can be seen in Table 4.8 stayers/movers took, on average, 0.2 more courses in teaching methods or strategies prior to full-time teaching than leavers, but this difference was not statistically significant.

Education. Teachers' academic background has also been linked to teacher attrition. The bottom of Table 4.8 details how teachers rated their own preparedness to teach, the proportion of teachers with advanced degrees and the proportion of teachers that went to selective, or more selective institutions for their undergraduate degree. Table 4.8 shows that the proportion of

beginning teachers that earned either a master's or doctoral degree (in any subject) is 0.20; this is true for both stayer/movers and leavers.

The Carnegie selectivity classifications from IPEDS, which are based on the test scores of entering freshman, were used to define the selectivity ratings of the teachers' undergraduate institutions. The reference category includes institutions that reported test scores indicating the institution offered admission to students with relatively lower entrance exam scores or, in rare circumstances, where insufficient data was available. Insufficient data occurred when either the institutions did not provide test scores for entering students, or the information for that teacher's undergraduate school was not available in the IPEDS data set. Despite the fact that many of these institutions have less selective admissions standards, referring to the institutions of this category as "unselective" would be misleading as there are institutions in this group that simply lack the data to infer their selectivity. I use the term "inclusive" for this category to remain consistent with the Carnegie classification terminology, to reflect that many of these institutions have a more inclusive rather than selective admissions policy and to portray the inclusion of institutions without data. Institutions are considered "selective" if their incoming student test scores are in the middle 2/5ths of the overall distribution. "More selective" institutions tend to admit only students in the top fifth of test scores.

Table 4.8 indicates that nearly half of beginning teachers attended selective institutions and just over a quarter attended more selective institutions. The use of these classifications in the model is not intended to imply that these are good, or even adequate measures of teacher quality or even of a teachers' academic preparation. The use of test scores (i.e. SAT and ACT) to determine the quality of an undergraduate institution, or even its selectivity, captures only a portion of the admissions standards of a university. To then extend the selectivity indicator to

the individual student level (in this case the graduate who is now teaching) introduces another level of error in inferring the individual's academic background, in that it is not his or her SAT or ACT scores used in the model. Despite these caveats, the Carnegie classifications remain the best available measures to fit to these data available to the researcher that capture some aspect of the quality of their undergraduate experience.

There is information about a district's teacher recruitment strategies including whether districts have signing bonuses, student loan forgiveness, relocation assistance and a finder's fee for new teacher referrals. Each of these are yes or no responses at the district level and can provide some insight as to the recruitment strategies available to the school districts where the teachers work, however, it is not possible to determine if a teacher actually benefited from any of these strategies. Because this is the case, this variable is included in the model as a dichotomous variable with any yes response to questions about teacher recruitment coded as one and districts with no such strategy coded as zero. As seen in Table 4.8 there is a statistically significant difference ($p<0.05$) in between the proportion of stayer/movers (0.30) that worked in district with recruitment strategies and the proportion of leavers (0.45) that worked in districts with recruitment strategies.

Table 4.8 Descriptive Statistics: Teacher Characteristics - Education

(Yes = 1, No = 0)	Proportion	BRR Std. Err.	95% Conf. Interval	
Feedback on Student Teaching				
Stayer/Mover	0.91**	0.01	0.89	0.94
Leaver	0.84**	0.04	0.75	0.92
Coursework				
Selecting and Adapting Instructional Material				
Stayer/Mover	0.90	0.01	0.88	0.93
Leaver	0.85	0.04	0.78	0.93
Learning Theory or Psychology of Students				
Stayer/Mover	0.93	0.01	0.91	0.95
Leaver	0.90	0.03	0.85	0.96
Number of Courses Prior to Teaching				
Stayer/Mover	3.51	0.14	3.23	3.78
Leaver	3.33	0.40	2.53	4.13
Observed Classroom Teaching				
Stayer/Mover	0.93	0.02	0.90	0.96
Leaver	0.89	0.03	0.83	0.96
District has Recruitment Strategies				
Stayer/Mover	0.30**	0.02	0.26	0.35
Leaver	0.45**	0.06	0.34	0.56
Selectivity of Undergraduate Institution				
Selective				
Stayer/Mover	0.44	0.02	0.40	0.48
Leaver	0.41	0.05	0.30	0.51
More Selective				
Stayer/Mover	0.26	0.01	0.23	0.29
Leaver	0.33	0.06	0.22	0.44
Advanced Degree				
Stayer/Mover	0.20	0.02	0.16	0.24
Leaver	0.20	0.04	0.11	0.29

(*** p<0.01, ** p<0.05, * p<0.1)

Working Conditions Model

The first research question asks: "To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration?" To answer this question, a logistic regression equation was constructed using variables derived from the School and Staffing Survey to predict the subsequent teaching status of survey respondents. The model's function takes the following form: where $\boldsymbol{y_i}$ is the observed outcome, $\boldsymbol{f}_i(\boldsymbol{X}, \boldsymbol{\beta})$ is the

function comprised of working conditions and coefficients and ε_{Ai} is the error term accounting for the difference between the predicted value and the observed value.

$$\boldsymbol{y_i = e^{f_i(X,\beta)+\varepsilon_{Ai}}}$$

Standard diagnostic procedures for a weighted logistic regression analysis were conducted. The model was tested for linearity in the logit, meaning that I tested the assumption that the relationship between the independent variables and the log of the odds ratio of attrition for each teacher is a straight line. First, I calculated the square and cube of the predicted values in logits. These were then included in a regression along with the linear predicted values (logits) of the observed outcome to see if any of these functional forms would improve upon the linear prediction of the log odds ratio of attrition. None offered a significant improvement to the linear model. But that only tested two additional powers of the models and did not test each predictor independently. To address this situation a Stata user wrote a program that is available to all Stata users. This program, like many others, is made available to other Stata users by posting the program in specific Internet locations. Through Stata other users can search these locations and find "ado" files, download them and install them for use in their own research. Issues of quality are maintained through a very active Stata user peer evaluation system that functions much like Wikipedia; users evaluate the programs by using them and determining if they produce the desired results. Good programs then become suggested to other users on the Stata list-serve; bad programs are edited by the original author, or modified and updated by other authors. The program I used for testing the linearity of the relationship between the predictors and the logits, the Box-Tidwell model test (stata command: boxtid), transforms the independent variables using power transformations to determine the best power for each independent variable to maximize model fit. The test resulted in finding only one transformation that offered a statistically significant ($p<0.05$) improvement to the model. This was raising the age variable to the power of

72.6. As there is no substantive explanation to this extreme value, I did not consider this transformation a useful addition to the model and continued to use only the linear form of age in the model.

The model was also tested for multicollinearity using another user written program, collin. This user written program is only available for non-survey data, therefore the analysis was conducted without incorporating the survey weights. This analysis found no variance inflation factor (VIF) values greater than 2 and the lowest tolerance was 0.48 (see Appendix A); traditionally tolerance values less than 0.10 warrant further investigation (Pedhazur, 1997). To independently test the accuracy of the program collin, I checked to see if I could reproduce the same values for the R-squared regression for a variable (Base Salary) using the other variables in the model. The results confirmed the value calculated by the program collin. To confirm that similar results would be obtained if the weights were included, I independently calculated the tolerance using the weights for the variables with the smallest tolerance values in the unweighted analysis (school culture=0.456 and administrative support=0.539). To do this, I ran two separate regressions using each of these variables as the outcome. Then I calculated the tolerance ($1-R^2$) for each regression analysis. The tolerances calculated for the school culture variable (tol=0.42) and the administrative support variable (tol=0.52) were both found to be within the acceptable range and do not warrant concern of a multicollinearity.

Stata does not provide a way to calculate residuals when using replicate weights. These are not provided because the Stata developers do not feel that there is sufficient evidence to describe the distribution of these residuals. Therefore, I constructed the same model as above without making use of the sampling weights in order to obtain residual values and look for outlying cases. Some problems with making the assumption that residuals estimated from

unweighted regression analyses are adequate substitutes for residuals from weighted regression analyses have been called into question (Hinkins, Mulrow & Scheuren, 2009). However, the same researchers recognize that there remains controversy regarding the use of sample weights in regression analyses and that researchers often make the assumption that the unweighted residuals are similar enough for diagnostic use. Hinkins and her colleagues suggest taking simple random samples of observations from within each strata and examining the residuals for each strata. This approach offers a possible solution, however NCES does not provide the strata used in the survey design, just the balance repeated replicate (BRR) weights, therefore it is impossible to take samples within each strata. Thus, despite the possible inadequacy to identify model misspecification with the residuals, I fit the data using an unweighted logistic regression to look for outlying cases.

One such case presented itself as being quite poorly fit by the model. This teacher reported earning $70,000 outside of school during the 2003-2004 school year. This extreme value heavily influenced the out of school earnings variable, because the teacher actually continued to teach the next year, although in a different school. In the unweighted logistic regression the out of school earnings variable had a p value of 0.186 with this individual in the analysis and went down to 0.015 with this individual removed. In the logistic regression including the weights the p value of out of school earnings was 0.770 with the individual in the model and it went down to 0.073 with this individual removed. Furthermore, this individual's DFBETA (calculated using OLS regression instead of logistic regression so the value could be determined) for out of school earnings was -1.72 with the next highest DFBETA -0.19. Using a rule of thumb cutoff for DFBETAs of 2/sqrt(n) with n=1451 gives a cut off value of ± 0.052. Thus, both values are cause for concern, but considering the sampling weight, this single

observation has an even larger influence on the model because this person represented 326.69 individuals in the population[1], The average number or individual represented by each survey respondent was 146.87. Because this teacher largely influenced the model she was removed from the analysis.

Table 4.9 shows the results of two models. The first model, column 1, includes variables accounting for the teacher's gender (female=1, male=0), age, race (white, non-hispanic=1; non-white or Hispanic =0), dummy codes for the years of teaching experience (first year teachers are the reference group and each year of teaching is a separate variable compared to the first year of teaching) and the urbanicity of the school (suburban is the reference group for the urban and rural dummy variables). The second model includes the variables of the first model plus variables that account for the working conditions the teacher experiences in the school that are discussed in the literature review in the previous chapter. These variables include: base salary, additional school earnings and out-of-school earnings in units of $1,000; satisfaction with salary; proportion of minority students in the school; proportion of students in the school eligible for free or reduced price lunch; the level of induction offered to the teacher, either basic (basic=1, otherwise=0) or full (full=1, otherwise=0); the school culture scale, and the administrative support scale.

Testing the model for overall fit using the logistic regression log likelihood indicates that model 2 is significant at the 0.01 level. This implies that the model is a statistically significant improvement over a null model. The Hosmer and Lemeshow test, modified to be appropriate for weighted data using Stata 11.1's estat gof function, gives a non-significant F-statistic (0.22,

[1] This was calculated by running two regressions including the survey weights and examining the difference in the population size with this person included and with this person excluded. The average representatives represented by the survey respondents was determined by dividing the number of people in the population (212,959.37) by the number of observations (1451).

p=0.99). The non-significant finding indicates that the model prediction is not significantly different from the observed values. This does not imply that the model necessarily explains a great deal of the variance in the outcome. In fact, despite the literature supporting the importance of each of these variables on teacher attrition, only seven variables in the model are found to be statistically significant using the liberal significance level of 0.1 and only two variables are significant at the 0.05 level according to the Wald test. In Table 4.9 the coefficients of the model are presented; positive values mean increases in the variable lead to increases in the predicted probability of attrition and negative values mean increases in the variable lead to decreases in the predicted probability of attrition. Male and female teachers were equally likely to leave teaching (-0.518, $p>0.1$) and white teachers were more likely to leave teaching (0.698, $p<0.1$). The larger a teachers' additional earnings from their school (-0.388, $p<0.001$) and the more satisfied they were with their teaching salary (-0.263, $p<0.05$) the less likely they were to leave teaching. Additionally, the more money a teacher earned outside of school, the more likely they were to leave teaching the following year (0.084, $p<0.1$). If a teacher did participate in basic induction (-0.813, $p<0.01$) or full induction (-0.543, $p<0.05$) they were less likely to leave teaching the following year. Finally, teachers who had more favorable perceptions of their school culture (-0.048, $p>0.1$), administrative support (0.054, $p>0.1$) or of their students' behavior (0.0303, $p>0.1$) were no more likely to leave teaching the next year than their peers with less favorable views.

One interesting phenomenon in the model is the change in sign for the variable Urban. In Model one, teachers working at an urban school are more likely to leave teaching than their peers teaching in a suburban school. However, after controlling for the working conditions across schools, the sign of the variable flips from positive to negative. This means, holding all else

constant, teachers in suburban schools are actually more likely to leave teaching than urban school teachers. Interpretation of this result is tenuous as neither coefficient is statistically significant.

Table 4.9 Working Conditions Logistic Regression

VARIABLES	(1)	(2)
Female	-0.339	-0.518
Race (white, non-hispanic=1)	0.551	0.698*
Age	0.021	0.013
Second Year Teacher	-0.395	-0.328
Third Year Teacher	-0.316	-0.292
Fourth Year Teacher	0.313	0.375
Fifth Year Teacher	0.314	0.337
Urban (urban=1, suburban=0)	0.136	-0.244
Rural (rural=1, suburban=0)	0.303	0.490*
Base Salary		0.001
Additional School Earnings		-0.388***
Out of School Earnings		0.084*
Satisfaction with Salary		-0.263**
Proportion of Minority Students		0.005
Student Behavior Scale		-0.028
Basic Induction		-0.813***
Full Induction		-0.543**
School Culture		-0.336
Administrative Support		0.327
Constant	-2.591***	-1.328
Observations	1,450	1,450
Variables in the Model	9	19
N (Population)	212959	212959
F	1.493	2.354***

(*** p<0.01, ** p<0.05, * p<0.1)

Teacher Characteristics Model

The next research question asks: "To what extent do beginning teachers' characteristics predict their attrition the year following the SASS administration?" Again, to answer this question a logistic regression was constructed using variables derived from the School and Staffing Survey to predict the subsequent teaching status of survey respondents. Standard diagnostic procedures for a weighted logistic regression analysis were conducted for this model also. The model was tested for linearity in the logit, meaning that the relationship between the independent variables and the log of the probability of attrition for each teacher was tested for linearity. The Box-Tidwell model test did not find powers for the independent variables that would improve the model. The model was also tested for multicollinearity using the user written program, collin. This analysis, as above, found no variance inflation factors (VIF) values greater than 1.8 and no tolerance values less than 0.58. (see Appendix B) Typically VIF values greater than 10 or tolerance values smaller than 0.1 are a cause for concern; therefore, collinearity does not appear to be a major concern in this analysis.

Because Stata does not provide a way to calculate residuals when using replicate weights, I constructed the same model as above without making use of the sampling weights in order to obtain residual values and look for outlying cases, both in the residual value and the leverage statistic. No such case was found.

Table 4.10 shows the results of two models. As above, the first model, presented in column 1, includes variables accounting for the teachers' gender, race, age, years of teaching experience and the urbanicity of the school. The second model, column 2, includes the variables of the first model plus variables that account for variations in teachers' characteristics upon entering teaching.

The demographic variables are the same as the previous model. The first new variable in the second model accounts for the teachers' certification as a dummy code comparing regular full certification to the others (Regular vs. Probationary, Provisional, Temporary, Waiver, Emergency or Not for that state). Initially a model was constructed with each certification type used as a dummy code compared to regular certification. However, the dummy variables were not statistically significant, and therefore their ability to explain the variance in teacher attrition was not greater than the loss in degrees of freedom in the model. Therefore, I recoded them to the current state as seen in Table 4.10. The coefficient for this variable is also not statistically significant (-0.304, $p>0.1$). The grade level that a teacher is certified to teach is also not a significant predictor of teaching status (-0.176, $p>0.1$). Of the various types of subject certifications that secondary and middle school teachers can hold, only being certified in math was a significant predictor of attrition (1.409, $p<0.01$). This means that secondary math teachers were more likely to leave teaching than other teachers (excluding English, science, foreign language and special education teachers as they are separate dummy codes in the model).

The number of weeks of student teaching was not a significant predictor, nor was whether or not teachers received feedback on their student teaching. Among the various entry pathways through which teachers can enter the profession, none had a statistically significantly different retention rate from the reference group, teachers who enter teaching through four-year undergraduate program.

Not truly an entry pathway, but teachers who worked in school districts that had teacher recruitment strategies tended to be more likely to leave (0.700, $p<0.05$). It is not clear if the teachers themselves benefited from these recruitment strategies. It may be that the recruitment strategies made the positions appear attractive by portraying the schools unrealistically to

candidates, and then when teachers entered the difficulties within those schools they were more likely to leave teaching. Considering the district recruitment strategies were in the form of reduced workload or increased assistance during the first year(s) of teaching, another explanation for the link between higher attrition and schools with recruitment strategies could be district policies responding to the high rates of attrition within their schools and offering recruitment strategies in response.

Specific courses or experiences during preparation were not associated with variations in attrition rates; neither was the number of courses taken prior to entering teaching. However, the scale accounting for the self-reported sense of preparation had a statistically significant coefficient (-0.632, $p<0.01$); thus, teachers who felt less well prepared were more likely to leave teaching than teachers who felt better prepared. This important finding is discussed in greater detail in Chapter 5.

No significant effect of university selectivity was found, although both dummy codes (selective and more selective) had positive coefficients, implying that there may be a trend that graduates of selective and more selective institutions may be more likely to leave teaching than their peers who attended more "inclusive" institutions[2]. Perhaps a sharper measure of selectivity than the Carnegie classification is necessary for statistical significance.

Despite the relatively few significant variables in the model, the Hosmer and Lemeshow goodness of fit test indicates that the second model does not differ significantly from the observed outcome. [$F(9, 79)=0.66$] This implies that the model fits the observed data well.

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[2] Although I use the term "inclusive" many of the institutions in this category could be considered less selective than the "selective" and "more selective" categories. The term "inclusive" is to account for the schools for which there were missing data and therefore coded into this group.

Table 4.10 Teacher Characteristics Logistic Regression

Variables		(1)	(2)
Female		-0.339	-0.252
Race (white, non-hispanic=1)		0.551	0.649*
Age		0.021	0.022
Years Teaching			
	Second	-0.395	-0.237
	Third	-0.316	-0.260
	Fourth	0.313	0.625*
	Fifth	0.314	0.507
Urban (urban=1, suburban=0)		0.0136	-0.171
Rural (rural=1, suburban=0)		0.303	0.329
Certification			
	Regular		-0.304
	Sec/Mid		-0.176
	English		-0.212
	Frgn. Lang.		0.106
	Science		-0.542
	Math		1.409***
	Special Ed.		0.420
Weeks of student teaching			-0.012
Feedback on student teaching			-0.425
Entry Pathway			
	Alternative		-0.539
	5th Year		-0.062
	Masters		-0.073
	Courses		-0.766
	Other		-0.162
District Recruitment			0.700**
Coursework			
	Select/Adapt Instr. Mat.		0.209
	Learn. Theory		-0.460
Classroom Observations			-0.040
Number of Courses			0.009
Preparation Scale			-0.632***
Advanced Degree			-0.071
Selectivity of Undergraduate Institution			
	Selective		0.055
	More Selective		0.294
Constant		-2.591***	-1.054
	Observations	1,450	1,450
	N (Population)	212,959	212,959
	F	1.493	2.079***

(*** p<0.01, ** p<0.05, * p<0.1)

Model Comparison

The next research question: "Are beginning teachers' working conditions or teacher characteristics better predictors of attrition?" seeks to determine if one of these models is a better fit than the other model. This is calculated in several ways.

Psuedo-R-Square. An initial method is to compare the amount of variation in the outcome that each model can explain. Because these are logistic regression models, the concept of variation in the outcome, as was discussed in the previous chapter, is not exactly the same as it is in ordinary least squares regression. Instead, for logistic regression pseudo-R-squareds are calculated which give an approximation of the model's ability to describe the observed phenomenon. Furthermore, the use of weights in the analysis complicates the estimates of the pseudo-R-squared values, the relative size of these values are compared ignoring the regression weights for both models. These values are presented below (Table 4.11).

The McFadden R^2 compares the likelihood for the intercept only model to the likelihood for the specified model. The adjusted McFadden R^2 (McFadden's Adj R^2) subtracts the number of parameters in the model to avoid favoring the model with additional factors. Both suggest that the working conditions model is preferred. The maximum likelihood R^2 expresses the model fit as a transformation of likelihood ratio chi-square in an analogous way to that of R^2 in OLS regression which can be thought of as a transformation of the F-statistic. The Craig and Uhler's R^2 is an adjustment of the maximum likelihood R^2 that allows the value to range from zero to one. The McKelvey and Zavoina's R^2 and Efron's R^2 are statistics attempting to measure the model fit as the proportion of variance in the latent variable accounted for by the model. Each of these statistics indicates that the Working Conditions Model is a better fit to the

observed data than the Teacher Characteristics Model, however there is no test of statistical significance.

To compare non-nested models, the information criteria measures are preferred. In terms of the information criteria, a lower value is indicative of a better fitting model, meaning that there is less information (entropy) remaining in the model. The AIC, does not account for the number of variables in the model and therefore tends to prefer overspecified models. The BIC accounts for the number of parameters in the model and therefore tends to favor parsimonious models. There are two BIC measures presented below. The BIC is based on the deviance from the observed data; the BIC` uses the likelihood ratio chi-square. Although the difference in AIC is small, even small differences indicate that the working conditions model is a better fit to the data, despite having fewer predictors. The BIC and the BIC' are lower for the working conditions model with a difference of 110.245 between two models. Differences in BIC and BIC` values greater than 10 are considered strong evidence of a difference between the models' ability to reproduce the observed data. From this comparison, the Working Conditions model appears to better fit the observed data than the Teachers' Characteristics model.

Table 4.11 Psuedo-R^2 and Information Criteria Comparison

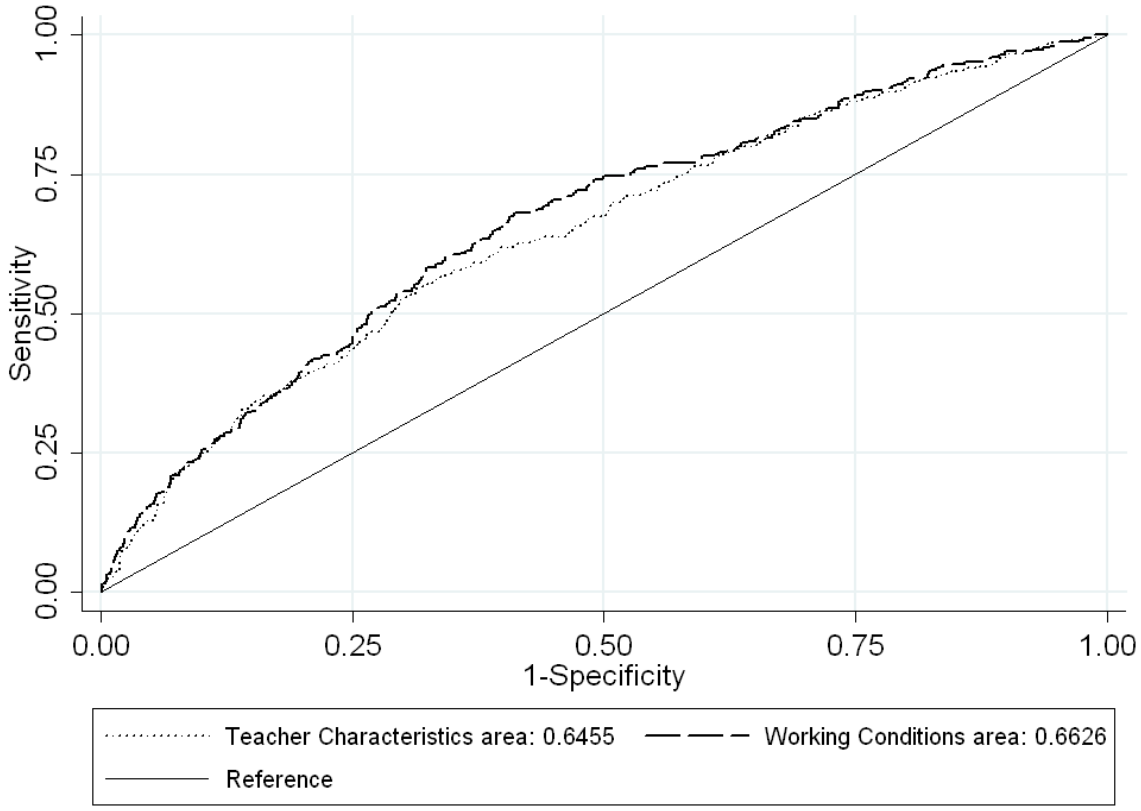
	TC	WC	Difference
Model:	Logistic	Logistic	
N:	1450	1450	0
McFadden's R2:	0.045	0.055	-0.010
McFadden's Adj R2:	0.001	0.029	-0.028
Maximum Likelihood R2:	0.045	0.055	-0.010
Cragg & Uhler's R2:	0.070	0.086	-0.016
McKelvey and Zavoina's R2:	0.079	0.110	-0.031
Efron's R2:	0.048	0.060	-0.011
AIC:	1.026	0.998	0.029
AIC*n:	1488.259	1446.646	41.613
BIC:	-8892.536	-9002.780	110.245
BIC':	166.049	55.804	110.245

ROC Curve. Another way to compare logistic models is in their ability to correctly classify the respondents to their observed categories, in this case stayer/mover or leaver. However, this process is heavily dependent on where the cutoff in the probability is placed for one to be in the target group. Since there are so few leavers compared to stayers and movers, a rather high rate of successful predictions could be made by simply placing all observations in the stayer/mover category (i.e. making the cutoff prob. = .99).

Additionally, there could be locations along the continuum that would favor one model over the other; thus ideally the models would be compared at all values of the cutoff to see which one has greater overall predictive ability to classify observations to their observed status across the range of cutoffs. Another way to think about the location of the cutoff is how its location affects both the sensitivity, the models ability to identify the leavers, and the specificity, the model's ability to identify stayers and movers. In order to investigate this relationship, I plotted the sensitivity - correctly identified leavers, the true positive rate - of the model on the y-axis and one minus the specificity - incorrectly identified leavers (stayers classified as leavers), the false positive rate - on the x-axis. For a reference I included the prediction from a null model, the solid straight line. An ideal model would have high sensitivity (true positives) across much of the range in specificity. This would result in a curve that rose rapidly from left to right, quickly approaching one and having a great deal of area underneath the curve. Thus, the model with the greatest area under the curve gives the best predictions. These curves are called receiver operating characteristic (ROC) curves and were originally developed during World War II by radar receiver operators who were trying to detect signal (e.g., enemy aircraft) from noise (e.g., clouds) (Swets, 1988).

As seen in Figure 4.1 the line represented by dashes and three dots, corresponding to working conditions model, is slightly higher along the range of 1-specificity than the dotted line corresponding to the teacher characteristics model. Therefore, there is slightly more area under the working conditions curve (0.6626) compared to that of the teacher characteristics curve (0.6455). This area can be interpreted as the probability that a randomly selected leaver has a higher predicted probability of leaving than a randomly selected stayer/mover. Said another way, if one takes a random leaver with a predicted probability of leaving X, and a random stayer with predicted probability Y, the area under the curve is the estimate of the probability that X is greater than Y. Hence, larger values are better and in this instance, the working conditions model has the larger value. Therefore, the working conditions model is more likely to correctly classify survey respondents.

Figure 4.1 Comparison of Logistic Regressions: Receiver Operation Characteristic Curve



J-test. However, the above comparison was conducted without using the sampling weights, as the statistics presented are not available when using BRR weights. A third technique, using the predicted values from each model as the final element in the other model, offers another way to compare the models. This method was developed by Davidson and MacKinnon (1981). To accomplish this, I saved the predicted values, in logits, from each model. Then I found the difference between these predicted values and called them α_1 and α_2, based on the direction of the difference, such that α_1 is equal to the negative of α_2, or vice versa. Then I specified two new models, one with the saved logits from the teacher characteristics model and α_1, the other model contained the saved logits from the working conditions model and α_2. The equations are presented in Table 4.12 to remind the reader. For both models teacher attrition is the outcome variable.

Table 4.12 Steps to perform the J-Test

	Working Conditions	Teacher Attributes
Specify the Model	$\boldsymbol{y_i = e^{f_i(X,\beta)+\varepsilon_{Ai}}}$	$\boldsymbol{y_i = e^{g_i(Z,\gamma)+\varepsilon_{Bi}}}$
Save the Predicted logits	$\hat{f}_i = f_i(X_i,\beta)$	$\hat{g}_i = g_i(Z_i,\gamma)$
Determine if the predicted values can explain the residual variation from the other model	$\boldsymbol{y_i = e^{g_i(Z,\gamma)+\alpha(\hat{g}_i-\hat{f}_i)+\varepsilon_i}}$	$\boldsymbol{y_i = e^{f_i(X,\beta)+\alpha(\hat{f}_i-\hat{g}_i)+\varepsilon_i}}$

This technique also allows for the weights to be included in the analysis unlike the pseudo-R^2s and the ROC curves discussed above. As can be seen in Table. 4.13, the resultant α is statistically significant in both cases. This implies that both models fully encompass the other model. The result then indicates that neither model can fully explain the phenomenon of early teacher attrition and instead, there must be a combination across teacher characteristics and working conditions that leads to teacher attrition.

Table 4.13 Comparison of Logistic Regression: J-test

Variable	(1)	(2)
Teacher Characteristics α_1	-0.927****	
Working Conditions α_2		-0.930****
Observations	1,450	1,450

(**** p<0.001)

Combined Model

The analyses to this point indicate that neither model offers a complete picture of the reasons teachers leave teaching. Rather, there are elements within both models, and potentially outside of either model, that are related to teachers' career decisions. The next section seeks to examine how the elements interact with one another to explain teacher attrition and in the process address the fourth research question: How do the significant elements from both models combine and interact to explain teacher attrition? To begin the investigation to answer this question, I first specified a model including the predicted logits from both the teacher characteristics and working conditions logistic regression models along with their interaction, that is, the product of the two predicted logits. This model investigates if the teachers that are less likely to leave teaching are differentially influenced by their working conditions. Results from this model are presented in Table 4.14. In this model, the logits from both the working conditions and teacher characteristics models are statistically significantly related to teacher attrition. However, the interaction is not statistically significant. This may be a result of collinearity between the variables in the model.

Table 4.14 Predicting Attrition with Logits from both models and their Interaction

Variables	(1)
Logit: Teacher Characteristics	0.730**
Logit: Working Conditions	0.771**
Logit: Interaction	0.016
Constant	0.811
Observations	1,450
N_pop	212959
F	27.36***

(*** p<0.01, ** p<0.05, * p<0.1)

To unpack the ways the unique elements of the two models are significantly related to teacher attrition within this data set, I specified a new logistic regression model using all the unique elements of the two models using backward stepwise entry. In this way, variables that are not statistically significantly related (using the threshold of 0.1) to teacher attrition are removed from the model leaving only variables that are statistically significantly related to the outcome. I conducted this analysis one step at a time, rather than using the software program to make decisions about the inclusion or exclusion of variables in the model. There were two advantages to this approach. The first was user control over the exclusion process and which variables were to be tested in a set. The second was that this approach allowed for the use of the weighted data as the software algorithms for backwards stepwise entry do not accommodate weighted survey data. The process was conducted by first specifying a full model including all separate elements from both the working conditions and teacher characteristics models. Then, I tested to see if the omission of the variables accounting for a teacher's education (advanced degree, selective university, and more selective university) would statistically significantly reduce the quality of the model. It did not. This process was then repeated for measures of teacher preparation content (i.e. course in preparation for instructional material, course in learning theory, observed classroom teaching, and the number of courses taken during preparation), measures of entry route to teaching (i.e. alternative, 5th year, masters degree, series

of courses, or other), measures of pupil demographics (i.e. proportion of minority students and the student behavior scale), measures of professional school environment (school culture, administrative support), student teaching (weeks of student teaching, feedback on student teaching), induction and recruitment (basic induction, full induction, district recruitment), years of teaching experience (2 years, 3 years, 4 years, 5 years), urbanicity (urban rural), teacher earnings (base salary, school bonus, out of school earnings, satisfaction with salary), certification type (secondary/middle school, regular), subject area, and finally interactions between school bonus and both induction and certification in math as well as interactions between satisfaction with salary and both induction and certification in math.

The result of this analysis is presented in Table 4.15. The remaining variables represent substantive sets of variables; for example, all the variables that accounted for a teacher's income except for the teacher's base salary (out of school earnings, additional school earnings and their satisfaction with their salary) remained in the model. This allows for a substantive interpretation of these variables, such as, smaller additional school earnings or less satisfaction with salary are associated with leaving teaching. However, less income was not always associated with attrition. When teachers earned more from outside of school, they were more likely to leave teaching the following year as the positive coefficient indicates (0.081, $p<0.1$). Furthermore, measures of induction and recruitment remained in the model and indicate that participating in basic induction (-0.784, $p<0.05$) or full induction (-0.462, $p<0.1$) are associated with a greater likelihood of staying in teaching, but district recruitment did not have an influence on teachers' career decisions. Furthermore, despite research looking at attrition rates among particular types of teachers, only Math teachers were more likely to leave teaching than their peers (1.385, $p<0.01$). Finally, the higher a teacher rated their sense of preparation upon entering teaching, the

more likely they were to continue teaching in the 2004-2005 school year (-0.530, p<0.01). There were no significant interactions among the final variables in the model.

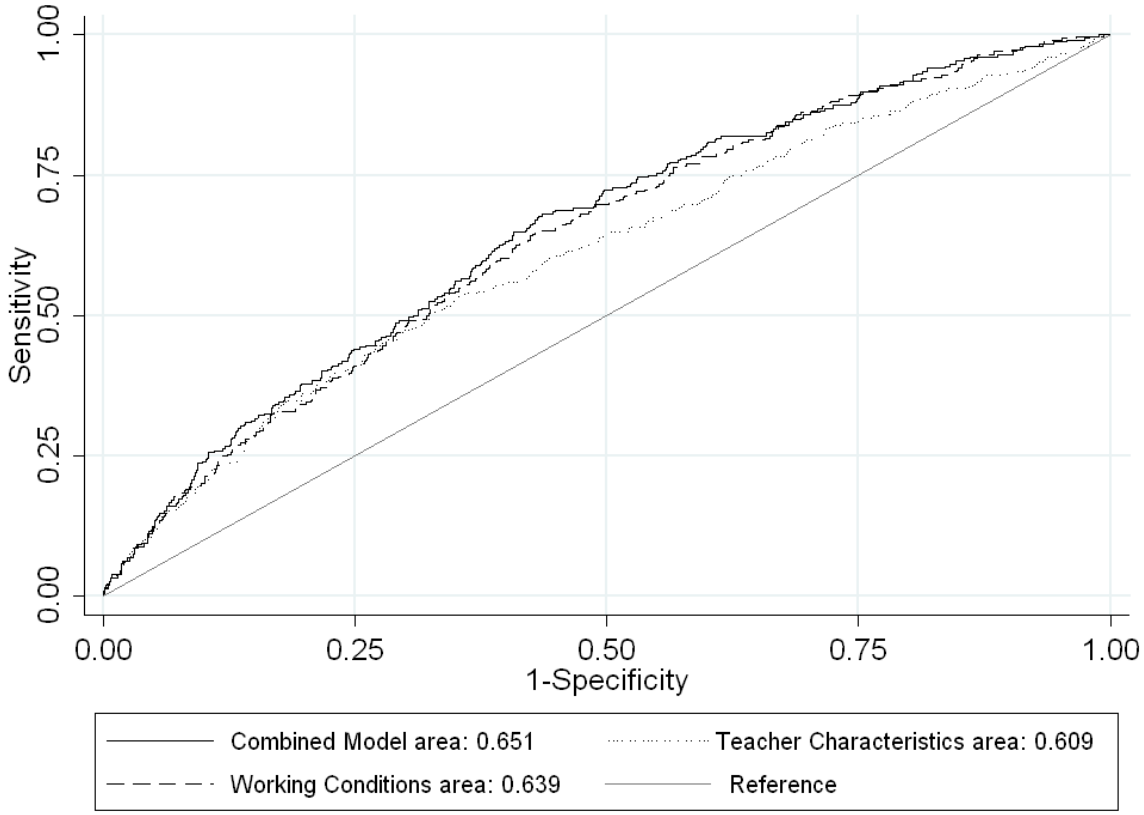
Table 4.15 Combined Model: Stepwise Backward Entry

Variables	Coefficients
Base Salary	-0.003
Out of School Earnings	0.081*
Additional School Earnings	0.327***
Satisfaction with Salary	-0.237**
Basic Induction	-0.784**
Full Induction	-0.462*
District Recruits	-0.441
Certification in Math	1.385***
Certification in English	-0.408
Certification in Foreign Language	0.392
Certification in special education	0.279
Preparation Scale	-0.530***
Constant	0.0464
Observations	1,450
F	4.599***

(*** p<0.01, ** p<0.05, * p<0.1)

The model described above is a combination of the statistically significant elements from the teacher characteristics and working conditions models. Therefore, it should better fit the data than either of the two previous models. To investigate this, I plotted another receiver operation characteristic (ROC) curve including all three models: teacher characteristics, working conditions, and the combined model excluding the demographic variable common to all three models. This plot is presented in Figure 4.2. As would be expected, the combined model has greater area under the curve (0.651) than either the working conditions model (0.639) or the teacher characteristics model (0.609). Therefore, the combined model is better in predicting the teaching status the subsequent year for the SASS respondents than either of the other two.

Figure 4.2 ROC Curve: Combined Model, Teacher Characteristics Model, Working Conditions Model



Conclusion

This chapter described first the construction and then the comparison of two logistic regression models developed from two separate constellations of research on teacher attrition, teacher characteristics and working conditions. The results indicate that a teacher's working conditions are more predictive of teacher attrition than the teachers' characteristics. However, neither model sufficiently fit the observed data to the point where it was not improved upon by including elements of the other model. Therefore, I then discussed the results obtained when I combined the unique elements from the two logistic regression models into a single overarching model. Thus, a combined model was developed to better fit the data. The combined model offered an improvement in the probability of correctly classifying observations to their observed

status (stayer/mover or leaver) over either of the teacher characteristics or working conditions models.

The next chapter interprets these findings by linking them directly to the research questions and to the larger literature discussed in Chapter 2. More specifically, the next chapter will discuss the implications of these findings and offer policy suggestions toward improving teacher retention through the beginning years of teaching.

Chapter 5: Discussion

This dissertation sought to answer four research questions, each of which focused on the reasons teachers leave teaching.

1. To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration?
2. To what extent do beginning teachers' characteristics predict their attrition the year following the SASS administration?
3. Which, if either, constellation of studies, working conditions or teacher characteristics, better predicts attrition the year following the SASS administration?
4. How do the significant elements from both models combine and interact to explain teacher attrition the year following the SASS administration?

Through the use of multiple logistic regressions, statistical models were built to address these questions. This chapter discusses these results and how they relate to each research question and to the greater body of research discussed in Chapter 2. Then I describe the limitations of this study, including the use of archived data, the way variables were used as proxies for constructs, and the statistical methods used. The finish the chapter and dissertation with a discussion of implications of this research and for future research.

Teacher Attrition and Working Conditions

The first research question asked how working conditions could influence a teacher's career decisions:

To what extent do beginning teachers' working conditions predict their attrition the year following the SASS administration ?

As discussed in the previous chapter, the logistic regression model of teacher attrition using variables accounting for a teacher's working conditions (i.e. salary, additional school earnings, outside of school earnings, satisfaction with their salary, their perceived school culture and administrative support, the proportion of minority students in the school, the behavior of students in the school, and their induction experience) was statistically significantly different from the null model ($p<0.01$), and the Hosmer and Lemeshow test was not statistically significant ($p=0.99$) implying that the model does not deviate significantly from the observed data. These model-fit statistics provide evidence that teachers' self-reported working conditions were related to their decision to stay in or leave teaching the following year. Thus, to answer the research question, measures of beginning teachers' working conditions are able to statistically significantly predict teacher attrition the following year. Looking in greater detail at the unique elements within the models, I relate the findings to the previous research.

Consistent with previous literature (e.g. Smith & Ingersoll, 2004; Kelley, 2004), this dissertation found that teachers who participated in basic induction programs (a mentor and supportive communication with their principal) were more likely to remain in teaching than teachers who did not participate in an induction program (-0.812, $p<0.05$). Moreover, teachers who had full induction experiences (basic induction plus any of the following: a mentor in the same subject area, common planning time or regularly scheduled collaboration with other teachers in their same subject area, participation in a seminar for beginning teachers, having a reduced number of preparations or being assigned a teacher's aide) also demonstrated lower attrition rates than teachers who experienced no induction (-0.550, $p<0.05$).

There has been a great deal of research examining the role of salary on teacher turnover. The results are mixed, but tended to indicate that differences between salaries influence migration more than attrition from teaching altogether. Findings from the current study were consistent with previous research in that they did not show strong evidence of a relationship between teacher salary and attrition from teaching, but did demonstrate that a teacher's satisfaction with her salary was related to her decision to leave, with more satisfied teachers being more likely to remain in teaching. The current study complicated previous findings by examining additional school earnings separately from teacher salaries. Earnings from their school beyond the base salary reported by teachers was negatively related to teacher attrition, meaning that teachers with larger earnings from their school above and beyond their base salary were more likely to stay in teaching the following year than teachers who had earned less or nothing beyond the base salary from their school. This finding could be interpreted as either a financial decision by teachers to remain in their teaching position based on the additional earnings, or there may be some other effect correlated with teachers who earn money from the school beyond their base salary. For instance, teachers who also coach at the school, serve as a moderator for a club or perform some other function valued by the school are often given a stipend for this work. Therefore, the relationship between additional earnings and remaining in teaching might be present because additional earnings are serving as a proxy for additional commitment to the school. The relationship might also exist simply due to teachers' desire for additional pay or a combination of both.

This relationship between additional pay and attrition begins to make more sense when considering what allows a teacher to earn additional money from her school. As mentioned, additional earnings are often the result of the teacher participating in some additional role in the

school, for instance acting as a coach or the moderator of a club. In fact, when I regressed whether or not a teacher received additional pay on whether or not a teacher coached a sport, moderated a club, served as a department chair, earned a stipend or recognition for participating in a professional development program, each of these variables was statistically significantly related to additional pay from the school (see Appendix C). This implies that additional pay is a reward for the teacher making an additional investment to the school or in their professional practice; additional teacher pay is not randomly distributed. Thus, awarding additional earnings to promote retention of specific teachers, be they math or science teachers; or more academically able teachers, (Stinebrickner, 2001) may not be a useful intervention. Rather, providing opportunities at the school for teachers to become involved above and beyond their teaching *and* compensating these teachers for that additional commitment could provide a better intervention for teacher attrition.

Teacher Attrition and Teacher Characteristics

The second research question asked how teacher characteristics could influence a teacher's career decisions:

> *To what extent do beginning teacher characteristics predict their attrition the year following the SASS administration r?*

As discussed in the previous chapter, the logistic regression model of teacher attrition using variables accounting for a teacher's characteristics (i.e. certification type and subject, weeks of student teaching, whether or not they received feedback on their student teaching, their pathway into teaching, if their school district has recruitment strategies in place, specific coursework, if they observed classrooms prior to teaching, the number of methods courses taken prior to teaching, their self-reported sense of preparation, if they had an advanced degree and the

selectivity of their undergraduate institution) was statistically significantly different from the null model ($p<0.01$), and the Hosmer and Lemeshow test was not statistically significant ($p=0.66$) implying that the model does not deviate significantly from the observed data. These model-fit statistics provide evidence that the variables used to account for the influence of teacher characteristics on teacher attrition fit the data well.

Despite the evidence in the literature of many teacher characteristics that influence teacher attrition, this dissertation found only three variables in the multivariate model that were statistically significantly related to teacher attrition: certification in math or computer science, if the district had recruitment strategies, and scores on the preparation scale. Teachers who held certification in math or computer science were more likely to leave teaching than other teachers (1.413, $p<0.01$). These findings are consistent with previous research; teachers who are certified in math (or computer science) tend to be more likely to leave the teaching profession (e.g. Certo and Fox, 2002) and the reason most often given is that these teachers have the greatest opportunity for employment outside of teaching, and there is some evidence that this is indeed true (U.S. Department of Education, 2000).

Beginning teachers in districts that had strategies in place to recruit teachers to their schools were more likely to leave teaching than teachers who taught in districts without these strategies (0.712, $p<0.01$). One possible reason for this finding is that districts that have recruitment strategies in place may experience greater school staffing problems and therefore have higher than average attrition rates. So rather than the recruitment strategies influencing attrition rates, it could be the reverse, that greater attrition in these districts necessitates teacher recruitment programs. Another explanation is that the recruitment strategies draw in teachers that are ill-fit to work in that school environment and therefore have an increased likelihood of

leaving. Additionally, the variable for district recruitment was not measured at the teacher level, meaning that it is unclear if the teachers themselves actually benefited from the recruitment strategies. Therefore, interpretations of this variable, especially considering that its direction changed in some of the multivariate specifications, seem tenuous.

Finally, according to several studies, teachers who are more prepared, as self-reported in the current study, are more likely to stay in the teaching profession (e.g. Boe et al. 2006). This study supports the argument made by many teacher educators, and others, that a teacher's sense of preparation can play a prominent role in teachers' ability to persist in teaching. Most likely the preparation scale is measuring, in part, a teachers' sense of agency, their ability to be successful in their work. Thus teachers who felt more prepared and better able to engage in the work of teaching were the teachers who stayed in the profession. Teacher educators have studied the importance of agency in aiding teachers to exhibit practices learned during preservice preparation and have thereby developed ways to encourage greater agency within their teacher candidates. The findings here support the continued effort on improving teacher agency, not only to improve teacher retention, but more importantly to improve the retention of the teachers best prepared to teach.

Findings from this work also indicated that teachers who attended undergraduate institutions considered by the Carnegie classification as "selective" or "more selective" were no more likely to leave teaching than teachers who attended undergraduate universities considered "inclusive." The inclusive category largely consists of institutions with less selective admission criteria. Considering on-going discourse about recruiting and then attempting to retain teachers from top undergraduate institutions (Auguste, Kihn & Miller, 2010), this finding lends some hope that the recruitment of these teachers many not be in vain considering they are just as likely

to remain in the profession, at least through the first five years. However, both coefficients (although not statistically significant) were in the direction of more attrition for teachers from both selective and more selective institutions. Thus, more research is necessary to understand exactly how beginning teacher attrition relates to academic backgrounds, especially considering how unrefined the Carnegie classifications are in capturing an individual's academic capabilities.

Comparing Working Conditions and Teacher Characteristics Logistic Regression Models

The third research question asked if the relative ability of teacher characteristics and working conditions were able to predict a teacher's career decisions:

> *Which, if either, constellation of studies, working conditions or teacher characteristics, better predicts attrition the* year following the SASS administration*?*

Considering both logistic regression models adequately fit the data, this research question sought to compare their relative efficacy in explaining teacher attrition. Comparisons between the two models were carried out in three ways.

The first was to compare their model fit characteristics, specifically the indictors of information criteria. Both the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) indicated that the model of working conditions was a better fit to the data than the model of teacher characteristics, implying that the working conditions logistic regression model was superior to the teacher characteristics logistic regression model in fitting the data. Therefore, it may be that a teacher's decision to leave the teaching profession is more influenced by her experiences in the workplace than the attributes she brings to the workplace. Despite the

importance of teacher preparation, it seems that for many teachers the amount of preparation they had was insufficient to encourage teachers to remain in the profession.

The second comparison of the two models used of the J-test (Davidson and MacKinnon, 1981). The J-test is a test of each model's ability to predict the residuals of the other model. In practice, both models were able to statistically significantly predict the residual values of the other model, implying that neither model sufficiently explained the phenomenon of early teacher attrition. This result may be a function of the J-test itself. Ghali and Krieg (2009) point out that despite the theoretical underpinning of the J-test, "when each of the competing hypotheses is successful in explaining the variations in the data, the J-test may not be able to discriminate between alternative specifications" (page 3). Similarly, McAleer (1995) examined the empirical studies that used the J-test and other non-nested model techniques. In the twelve studies they highlight, each comparing econometric models developed from either new classical or Keynesian economic perspectives, seven used the paired J-test. Only three of these seven were able to determine a preferred model. Thus, the inability of the J-test to distinguish a clearly superior model is disappointing but may not be surprising considering the wide-spread inability of the J-test to do so in other settings. The fact that both models are able to predict the residuals of the other model means that neither working conditions nor teacher characteristics offer a complete picture of why teachers leave teaching and elements from both groups of research are needed to explain why teachers leave teaching.

The third technique utilized to compare the two logistic regression models, either using variables measuring teacher characteristics or working conditions, was their ability to correctly classify participants as stayers/movers or leavers. Given that the accuracy of prediction is highly dependent on what value is used as the cut point for discriminating one from the other, I chose to

examine the overall predictive efficiency rather than a particular point. For this comparison, I constructed ROC curves for both models and found that the working conditions model (0.663) had slightly more area under the curve than the teacher characteristics model (0.629). This indicates that the working conditions model would correctly predict the stayer/mover versus leaver status of a randomly selected survey respondent 3.4% (the difference between the two areas) more often than the teacher characteristics model. However, both values are in an area that is considered as "fair" predictors of the observed data.

These three comparisons offer some evidence that the working conditions model provides a stronger statistical fit to the observed data. However, the model did not explain a great deal of the overall variation (pseudo R^2 <5%) and therefore left a great deal of residual variation that was statistically significantly related to the predicted values from the teacher characteristics model. Despite some evidence from this dissertation supporting the continued emphasis on providing interventions in school settings, often in the form of induction programs, as a way to increase retention of beginning teachers, it is also clear that the characteristics teachers bring into the profession are an important component of their decisions to continue teaching. For example, their sense of preparation prior to entering the profession was positively related to teachers' decisions to continue teaching. Thus, future work on teacher attrition must pay attention to not only conditions at the school, but the characteristics including the preparation of the teachers at the school when examining teacher attrition.

Combining Working Conditions and Teacher Characteristics Logistic Regression Models

The fourth research question focused on the relative ability of teacher characteristics and working conditions to predict a teacher's career decisions:

> *How do the unique elements within the teacher characteristics and working conditions models combine and interact to predict early teacher attrition the year following the SASS administration?*

Given that neither logistic regression model independently offered a satisfactory fit to the observed data, the final research question was how these two models can be combined to explain teacher attrition. The process to combine these models resulted in seven statistically significant variables; additional school earnings, out of school earnings, satisfaction with salary, induction – both basic and full, certification in math or computer science, and a teacher's sense of preparedness.

Teachers who reported being more satisfied with their salary were more likely to continue teaching the following year. Most of the studies reviewed in Chapter 2 that focused on the role that salary played in a teacher's decision about staying or leaving teaching focused on the value of the salary rather than the teacher's satisfaction with the salary. These studies found that teachers' actual salaries had a small influence on their career decisions. In this analysis, I found no evidence that the base salary was predictive of teachers' career decisions. Weiss (1999) conducted the only study that did include an analysis of teachers' satisfaction with salary. She did not find a relationship between an individual's satisfaction with salary and teacher morale or plans to stay in teaching in either the 1987-88 or 1993-94 SASS data sets. The only consistent finding regarding salary across these studies is that it plays a relatively minor role

compared to other school factors in teachers' career decisions. The findings presented in this dissertation are consistent with the previous work. Teachers' actual salaries did not have an influence on their career decisions, but their satisfaction with their salary did. Thus, it is not the actual value of the salary that may cause teachers to leave the profession, but that they feel they are being adequately compensated for their work. The same may be true of additional compensation earned for additional work for the school.

This finding could have a direct impact on current policy discussions regarding teacher compensation occurring throughout the country. For example, the movement in Wisconsin's state senate to remove teachers' collective bargaining rights was met with days of adamant protest (Davey & Greenhouse, 2011). The teachers' salaries are not being directly threatened, but the proposal to eliminate their ability to advocate for themselves may be causing the teachers to feel undervalued and that the integrity of their profession is under attack. In fact, with the recent movement nationally to increase/expand teacher layoffs, reduce benefits to teachers and further cuts in spending to education there has been a 29% decline in the number of teaching credentials earned in the state of California (Gordon, 2011). As politicians respond to strict budget limitations by devaluing education and teachers, potential teachers are already less likely to pursue teaching as a career and more teachers may decide to leave the profession. Instead of undermining the teaching profession, policy makers, who must determine ways to balance budgets but desire high quality instruction in schools, might better use their resources to celebrate the teaching profession and make cuts from accountability measures. Such moves would demonstrate support for the teachers currently in the profession and offer an attractive career option for incoming teachers.

One way beginning teachers are supported through their transition into teaching is with induction programs. Induction programs have been studied primarily to determine what aspects of induction are the critical pieces to promoting teacher retention. For example, Smith and Ingersoll (2004) found that "activities that tied new teachers into a collaborative network of their more experienced peers" (p. 704) had the largest impact on reducing teacher turnover rates. Rather than modeling the types of induction experienced, this dissertation sought to determine if overall induction practices were able to promote teacher retention. I examined induction using categories similar to those of Smith and Ingersoll (2004); teachers who had no induction experiences were compared to teachers who had basic induction (a mentor and supportive communication with their principal) or full induction (basic induction plus any of the following: mentor in the same subject area, common planning time or regularly scheduled collaboration with other teachers in their same subject area, participation in a seminar for beginning teachers, participation in a network of teachers, reduced number of preparations and assigned a teacher's aide). Teachers who went through no specific induction were more likely to leave teaching than teachers who experienced an induction program. This finding is encouraging considering how widespread induction programs are, evidenced by one study's difficulty in finding comparison sites for a random control trial of induction (Glazerman et al., 2010). For example, in 2008 almost 80 percent of beginning teachers participated in some form of induction program (Ingersoll & Strong, 2011), and there were 22 states funding induction programs for beginning teachers (Education Week, 2008). Most research supports the effectiveness of induction programs to improve teacher retention (Ingersoll & Strong, 2011) however, Mathematica's study, the largest randomly controlled trial conducted to date examining how induction relates to teacher attrition, found no relationship (Glazerman et al., 2010). In a critical review of the

Mathematica study, Ingersoll and Strong (in press) point out that there was little difference between the induction experience of those in the treatment group and those in the control group. This means that, overall, both the treatment group and the control group had fairly comprehensive induction experiences, which explains the lack of a difference in the observed outcome, teacher retention. This point is important to mention, because policy makers may misinterpret the findings from the Mathematica study and conclude that teacher induction programs are not worth the cost. However, the current study and many others find quite the opposite, that induction practices, especially mentored teaching, have a positive impact on teacher retention.

Teachers who hold certification in mathematics or computer science were more likely to leave teaching in the first five years than other teachers. This finding, although commonly believed, was not clearly evident in the research reviewed. In fact, Kukla-Acevedo (2009) only found evidence of math certification being associated with greater attrition of first year teachers. When he looked at teacher attrition across several years he did not find teachers with math or computer science credentials to be any more likely to leave than other teachers. Kelly's (2004) event history analysis of teachers having from one to thirty years of teaching experience did not identify math teachers as being more likely to leave teaching than other teachers. Thus the finding here is surprisingly unique, that math teachers in their first five years of teaching are more likely to leave teaching than other teachers. Many researchers hypothesize that math and computer science teachers leave at a greater rate due to greater employability of math and computer science teachers outside of education. There is some evidence that this is true (U.S. Department of Education, 2000). Considering the outside job market during the time that these data were collected (2003-2005) there were many high paying positions available for people with

high tech skills in computer science. Though no direct evidence of where these teachers went was available for this study, future work could examine patterns of math teacher attrition over time using several SASS/TFS survey administrations to determine if there is a similar effect during other time periods. Future work is also necessary to determine what jobs math teachers turn to after teaching to better understand their career opportunities outside teaching.

An important finding from this work is the role that a teacher's sense of preparation plays in encouraging teachers to stay in the profession. Teachers that reported a greater sense of preparation upon entering the profession were more likely to continue teaching into the year after the survey. This finding is important for the debates regarding the barriers to entering teaching. Some argue that teacher education and the process of obtaining certification represent barriers to entering the teaching profession (Goldhaber and Brewer, 2000). However, it is likely that teachers develop their sense of preparation during teacher education and via the steps necessary to acquire certification. While barriers may restrict the number of teacher applicants, it may be these same barriers that serve as processes of development for individuals to pass through in order to hone the skills to persist in the profession. This distinction harkens back to the debate about solving school staffing problems, whether it is better to increase the supply of teachers or to decrease demand by improving teacher retention. The findings here indicate that teachers that develop a sense of preparation prior to entering teaching are the teachers that are more likely to stay in teaching, implying better prepared teachers could be a way to both reduce school staffing problems and improve the quality of teachers.

Limitations

Despite the rigor of the research design and methodology, there are inherent limitations to the inferences that can be drawn from this work. For example, approaching the phenomenon of

teacher attrition using a logistic regression model implicitly assumes: (1) the causal relationship is in one direction; (2) each factor contributes to the model independently (although interactions may be included in the model); and (3) the contribution of each factor is a fixed amount. Assuming a unidirectional causal relationship limits the opportunity to consider potential feedback influences, such as a snowball effect of attrition where, for example, teachers who leave are influenced by the number of teachers around them who are leaving. It could also be that teachers influence the school culture as much as the school culture influences their decisions to leave teaching, which complicates the directional arrow of such a relationship. By assuming that each factor contributes to the model independently the model cannot examine how the independent variables may influence one another. Assuming that the contribution of each factor is a fixed amount means that it is the average effect of that factor for all participants and is not allowed to vary across people. So a basic induction experience is assumed to have the same benefits for all beginning teachers despite their personal experience in the program or the wide variation in the programs across teachers, schools, districts and states.

This research methodology also prevents understanding precisely the way these factors influence the teacher's decision to leave the classroom. That is, the regression analysis can model the direction and magnitude of the effect, but this model does not capture how the effect works within an individual teacher's decision-making process.

There are also limitations due to the data collection procedure and the structure of the data set. For example, using responses from a single SASS and TFS administration cycle presents a possible history effect. The data are only collected in a single year, so teachers who have already left the profession before the survey administration are not surveyed and may have different reasons for leaving than their colleagues did in this particular year. It is possible that

economic conditions or educational policies in the survey year may have had a special influence on the decisions of teachers to leave the profession that does not exist in other years. For example, the economic conditions in 2003-2004 were quite different than they are in 2010-2011. Opportunities for employment outside of teaching were much greater in 2003-2004 and staffing decisions at schools were more likely to be based on limited funds in 2010-2011 than they were in 2003-2004.

Other limitations to this study are true of many secondary research analyses. The questionnaire items offer limited depth and detail of the constructs they measure. For example, the entry pathway variable offered only five response options; this lack of specificity eliminates the possibility for a more nuanced analysis of attrition rates by various entry programs and reduces the analysis to pathway structures.

The SASS data set is a cross-sectional survey system, when this is merged with the TFS data set the two form a single-year longitudinal survey. Thus, when examining differences between stayers/movers and leavers, only the cohort of teachers in the first year of teaching during the SASS administration are a full, intact cohort. For example, teachers in their second year of teaching at the SASS administration are the teachers who continued to teach after their first year and do not include any teachers who had left teaching after their first year. Thus, this analysis is not a five-year longitudinal study of the same cohort of teachers through time, rather this is a one-year longitudinal study of first, second, third, fourth and fifth year teachers into the next year. This design assumes that the reasons teachers leave in the first year of teaching are the same as they are in the second, third, fourth and fifth or that knowing the average reason for leaving during these years is of interest. Despite the use of dummy coding for years, only the difference in the average attrition rate between the first year and each subsequent year was

examined. This study cannot say, for example, if induction was more or less important in teacher's career decisions in their fifth year of teaching compared to their first year of teaching. This is a major limitation of this work and the findings should be interpreted accordingly.

Implications

Even with the limitations on the inferences that can be drawn from this research, it remains an important endeavor. The purpose of this research was to investigate the strength and merit of two overlapping yet contrasting constellations of research on teacher attrition: teachers' characteristics and teachers' working conditions. The study sought to address the research questions using a national sample collected via the National Center for Educational Statistics' School and Staffing Survey and Teacher Follow- up Survey and focused on teacher attrition in the first five years in the profession. The first body of research holds that early attrition is a function of teacher characteristics, which accounts for the variation in teachers' ability to withstand the difficulty of the job. The second body of research is that poor working conditions lead to the early attrition of teachers. The elements from both models are statistically significantly related to teacher attrition. The two statistical models are compared using model fit characteristics, the J-test and receiver operating characteristic curves. Results indicate that beginning teachers' decisions to leave the teaching profession are slightly more influenced by their working conditions than their own characteristics; however, there are important teacher characteristics that play a role in these decisions. Therefore, future research that attempts to statistically model teacher attrition using only measures of teachers' working conditions or teacher characteristics would not appropriately account for the variation in teachers' decisions to leave teaching. Finally, the unique elements of both models are combined to generate a final

model and to examine the interaction between elements of working conditions and elements of teacher's characteristics.

Research

This work allows researchers to understand how two contrasting constellations of research on teacher attrition, teacher characteristics and working conditions, compare across a national data set in a recent SASS administration. The work allows researchers to better understand the ways in which teacher characteristics and working conditions can influence teachers' career decisions.

Further study is needed to explore the finding that teachers in school districts with recruiting strategies are more likely to leave teaching than other teachers. Studies that are able to understand what is occurring at these school districts, if they are able to recruit the type of teachers that they desire to fill those positions, if they are misrepresenting their school, but most importantly, to know if the teachers that actually receive the benefits of such recruitment are the ones who are leaving early. Additionally, studies that follow a nationally representative cohort of teachers through their first five years of teaching would be able to better model how the reasons teachers leave change over time, a major limitation of the current study. The Beginning Teacher Longitudinal Study (BTLS), which began in the 2007-2008 school year during the most recent administration of the School and Staffing Survey, will fill the need for these data. This longitudinal study will follow the same cohort of teachers through the first ten years of their teaching career; the data will allow researchers to learn how influences on teachers' career decisions change through time.

While the longitudinal study will be extremely useful in allowing researchers to understand the beginning careers of teachers, it only follows a single cohort of teachers and

therefore is subject to history effects. Therefore, studies that look at cohorts from multiple years will also be useful, particularly studies that use data from previous SASS administrations to look for similar relationships between working conditions and teacher characteristics on teachers' career decisions. For example, studies could use the longitudinal study and find that after three years the impact of induction on teacher retention is no longer evident, however, salary becomes a greater influence on teacher retention. Researchers could then use previous SASS administrations to determine if similar findings were true of teachers in their third year of teaching in 2007-2008, 2003-2004 or even earlier SASS administrations. Such findings would be useful to understand what influences on teacher retention persist over time and would therefore be most useful in policy decisions.

Policy

The findings of this dissertation support preservice time in classrooms, being sufficiently compensated (defined by individual perception), being rewarded financially beyond the base salary for additional valued work, and induction practices that include mentored teaching and meaningful conversations with administration can jointly serve to improve teacher retention. Finally, math and computer science teachers are the most likely teachers to leave early in their career. Thus, focused efforts to support these teachers through the beginning years could serve to crimp the attrition of the most likely group of teachers to do so.

Practice

Using the results of this work, teacher educators can better understand the role of their work in supporting the retention of their teacher candidates in the profession. Specifically, that extended classroom experience prior to teaching is critical in aiding teachers to persist in teaching during their first five years of teaching. Furthermore, beginning teachers who feel more

prepared to teach upon entering the profession are more likely to remain teaching. Thus, the agency teacher educators instill in teachers manifests itself in their decisions to remain in the profession. These findings demonstrate that extended preparation experience is key to aiding teachers to persist in the profession, providing evidence in support of programs and structures of teacher education that require extended preparation. These results are in direct contradiction to arguments in support of streamlined teacher education programs that offer lower barriers to entering the profession (e.g. McKinsey, 2010).

It is unwise, however, to entirely place the burden of increasing teacher retention on teacher educators and their programs, especially considering that teachers' working conditions, that is, the context in which teachers engage in their work, has a greater influence on teachers' career decisions than the characteristics teachers brought into teaching. Teachers that participated in structured mentoring programs, programs with a mentor and an opportunity for feedback from their administration, tended to persist in teaching. Furthermore, teachers that were financially rewarded, above and beyond their base salary, for their work in the school were more likely to remain in teaching. Thus, teachers who are have a greater commitment to the school, either as a mentee or through additional school service, are also the teachers that stay in the profession. Thus, schools that provide opportunities for teachers to engage and be connected to the school beyond their classroom are likely to have teachers that stay teaching and likely teaching at their school. It is critical to understand that teacher attrition is a problem caused both by undesirable working conditions and ill-equipped teachers. Thus, to improve teacher retention, schools should select applicants with extended classroom experience and a confidence in their preparation, but should also mentor these teachers in their first years teaching and provide them with opportunities to engage more fully in the school. Ideally, these efforts will help to transform

teaching from “a profession that eats its young” to one that prepares and supports its newcomers (Osborne, 1992).

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Appendix A

Working Conditions

Variable	VIF	SQRT VIF	Tolerance	Eigenval	Cond Index	R-Squared
female	1.09	1.04	0.9209	2.3243	1	0.0791
age	1.06	1.03	0.9464	1.773	1.145	0.0536
year2	1.48	1.22	0.6765	1.4328	1.2737	0.3235
year3	1.53	1.24	0.6517	1.2978	1.3383	0.3483
year4	1.38	1.17	0.7248	1.2138	1.3838	0.2752
year5	1.37	1.17	0.7298	1.1651	1.4124	0.2702
urbanicity	1.27	1.13	0.7865	1.1204	1.4403	0.2135
BaseSalary	1.28	1.13	0.7803	1.0555	1.4839	0.2197
SchoolBonus	1.06	1.03	0.9448	1.0404	1.4946	0.0552
OutSchoolEarn	1.02	1.01	0.9773	0.9247	1.5855	0.0227
SatWSalary	1.17	1.08	0.8520	0.8662	1.638	0.148
prpminstud	1.87	1.37	0.5339	0.7292	1.7853	0.4661
prpFRlunch	1.58	1.26	0.6344	0.5844	1.9943	0.3656
bscINDCT	1.34	1.16	0.7448	0.5232	2.1077	0.2552
fullINDCT	1.3	1.14	0.7669	0.354	2.5625	0.2331
SchoolCulture	2.06	1.44	0.4853	0.3107	2.7352	0.5147
AdminSprt	1.86	1.37	0.5367	0.2846	2.8577	0.4633

Mean VIF 1.40 Condition Number 2.8577

Determinant of correlation matrix 0.0745

Appendix B

Teacher Characteristics

Variable	VIF	SQRT VIF	Tolerance	Eigenval	Cond Index	R-Squared
female	1.17	1.08	0.8527	3.2575	1	0.1473
age	1.16	1.08	0.8621	1.834	1.3327	0.1379
year2	1.51	1.23	0.6617	1.6714	1.3961	0.3383
year3	1.52	1.23	0.6575	1.557	1.4464	0.3425
year4	1.43	1.20	0.6993	1.3767	1.5382	0.3007
year5	1.4	1.18	0.7132	1.3044	1.5803	0.2868
urbanicity	1.05	1.03	0.9502	1.2885	1.59	0.0498
certREG	1.23	1.11	0.8105	1.2418	1.6196	0.1895
certSecMid	1.78	1.33	0.5629	1.1666	1.671	0.4371
certUngraded	1.06	1.03	0.9450	1.1394	1.6908	0.055
certEnglish	1.28	1.13	0.7809	1.1021	1.7192	0.2191
certFrgnLang	1.09	1.04	0.9199	1.0883	1.7301	0.0801
certScnc	1.24	1.11	0.8091	1.0715	1.7436	0.1909
certMath	1.3	1.14	0.7722	1.0236	1.7839	0.2278
certSocSc	1.27	1.13	0.7892	1.0088	1.797	0.2108
certOthr	1.46	1.21	0.6837	0.9616	1.8405	0.3163
wksStdTeach	1.71	1.31	0.5853	0.9043	1.8979	0.4147
fdbkStdTeach	1.72	1.31	0.5829	0.8647	1.941	0.4171
epALT	1.34	1.16	0.7459	0.8437	1.9649	0.2541
ep5thyr	1.07	1.04	0.9307	0.8062	2.0102	0.0693
epMAMSMED	1.39	1.18	0.7207	0.7681	2.0594	0.2793
epCourses	1.11	1.05	0.9038	0.7264	2.1176	0.0962
epOthr	1.07	1.03	0.9357	0.6798	2.1891	0.0643
prepInstrcMat	1.66	1.29	0.6026	0.6095	2.3118	0.3974
prepLrnThry	1.65	1.28	0.6077	0.5377	2.4615	0.3923
prepObsrv	1.7	1.31	0.5866	0.4331	2.7424	0.4134
numCours	1.21	1.10	0.8290	0.4086	2.8234	0.171
prpSCALE	1.15	1.07	0.8679	0.3974	2.8632	0.1321
univSelectiv	1.59	1.26	0.6299	0.3813	2.923	0.3701
univMrSelect	1.61	1.27	0.6221	0.2848	3.3817	0.3779
AdvncDgr	1.33	1.15	0.7517	0.2612	3.5313	0.2483

Appendix C

```
Logistic regression                                     Number of obs   =       1451
                                                        LR chi2(5)      =     332.96
                                                        Prob > chi2     =     0.0000
Log likelihood = -834.55386                             Pseudo R2       =     0.1663

------------------------------------------------------------------------------
      addpay | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       t0264 |   .7344323   .1240234    -1.83   0.068     .5274844    1.022572
       t0258 |   .7171586   .0877184    -2.72   0.007     .5642889    .9114419
       t0300 |   .1076164   .0194989   -12.30   0.000     .0754484    .1534995
       t0301 |   .3491737   .0430838    -8.53   0.000      .274166    .4447025
       t0302 |   .4558312   .0816056    -4.39   0.000     .3209349    .6474277
------------------------------------------------------------------------------

addpay= 1 if teacher received additional pay from the school
addpay= 0 if teacher did not receive additional pay from the school
T0264= rewards recognition
T0258= stipend
T0300= coach a sport
T0301= club sponsor
T0302= department chair
```