The Associations of Social and Motivational Factors to Science and Mathematics Teacher Retention

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Abstract: Teacher turnover in science and mathematics is a significant and consistent challenge for K-12 education in the U.S. This paper provides: (a) an investigation of the relationship between teacher retention and several social and motivational factors; and (b) a comparison of Master Teaching Fellows (MTF) and non-MTF teachers in terms of their retention and social and motivational factors. Teachers are classified into three retention categories: (a) stayers, (b) shifters, and (c) leavers. Social and motivational factors included teaching self-efficacy, diversity dispositions, leadership skills, principal autonomy support, teacher-school fit (adapted from person-organization fit literature), and social networks related to teaching and education. Study 1 included about 250 science and math teachers from the gulf coast region of Texas. Study 2 included 167 science and math teachers across the country. Teachers completed a survey in the summer and fall of 2021. For study 1, multinomial logistics regression analyses indicate: (a) leavers have significantly higher levels of self-efficacy; and (b) shifters have significantly higher levels of leadership skills and lower levels of teacher-school fit. The second study findings indicate: (a) MTFs' teacher leadership network and teaching self-efficacy are significantly greater than that of non-MTFs'; and (b) MTFs significantly tend to shift to a leadership position than non-MTFs do.

Keywords: Teacher retention, Mathematics teacher, Science teacher, Teacher leadership.

Introduction

Mathematics and science teacher turnovers pose significant challenges for U.S. public schools for over decades, particularly in high-need schools (Cross, 2017). Most teachers leave the profession because of low job satisfaction, lack of autonomy, and not-enough support systems and collaboration opportunities (Carver-Thomas & Darling-Hammond, 2019). Thus, it is essential to understand how motivation, leadership, factors related to school-work environment, and social networks relate to teacher retention. For instance, teachers' self-efficacy beliefs are important in fostering constructivist learning, student motivation, and higher academic performance (Yost, 2006), which may conceivably affect job satisfaction and retention or attrition in the profession. Further, opportunities to develop leadership skills and engage in a collaborative school-work environment to improve school culture and instruction can support and sustain high-qualified teachers (Dauksas & White, 2010), and therefore, may improve teacher retention. Some features of teachers' social networks (e.g., density, size) positively correlate with their self-efficacy (Polizzi et al., 2021). Lastly, availing dispositions towards diversity and equity issues in public education

are associated with effective teaching in high-need schools (Williams et al., 2016), which may, in turn, result in persistence in these schools.

This paper provides initial results from an ongoing collaborative research study investigating the role of factors including self-efficacy, leadership, diversity dispositions, school-work environment, and social networks on teacher retention. Moreover, master teachers and non-master teachers are compared in terms of these aforementioned factors. There are mainly two sets of results to share. Study 1 was conducted with more than 250 K-12 science and mathematics teachers from Texas. Study 2 included Master Teaching Fellows (MTF; who participated in a federally funded multi-year leadership programs) and non-MTFs across the nation to compare the two groups on retention outcomes and other factors. In total, 167 teachers (84 MTFs and their 83 comparable counterparts—matched on demographics and professional background including teaching experience, school-level, subject area, degrees) participated in Study 2. The following research questions guided these studies:

1. To what extent do teachers' self-efficacy for teaching, leadership skills, diversity dispositions, school-work environment, and social networks relate to their retention?
2. How do Master Teaching Fellows compare to regular-track teachers in terms of their self-efficacy, leadership skills, diversity dispositions, school-work environment, social networks, and retention?

Literature

Most states and districts report severe teacher shortages, especially in areas of mathematics and science, and fill open positions with unqualified teachers (Cross, 2017). Unfavorable school conditions in many communities, particularly those of high-need communities, exacerbate the issue of teacher retention. Acknowledged and echoed by many, the issues of teacher mobility and attrition in the teaching profession have been found to account for about 90% of the annual demand for teachers. Approximately 8% of public school teachers leave the profession every year in the U.S. In addition, about another 8% of teachers move between schools annually, which is troubling to the schools they leave behind (Carver-Thomas & Darling-Hammond, 2019). Beyond financial and political issues that are not controllable by teacher educators or global issues like pandemic, there are some areas that teacher educators and administrators can have an impact to mitigate teacher mobility and turnover. Self-efficacy for teaching, leadership skills, school-work environment, diversity dispositions, and professional social networks are among the factors that have been found to either directly or indirectly relate to teacher retention. In this study, we provide a collective examination of these factors controlling for teachers' professional background. We briefly introduce these important factors below.

Teachers' self-efficacy for teaching

Teachers' self-efficacy for teaching can be defined as teachers' beliefs about their ability to successfully perform teaching tasks within particular contexts (Tschannen-Moran & Hoy, 2001). Teachers' self-efficacy for teaching has important implications for both teaching and student learning as myriad of studies indicate that higher levels of self-efficacy for teaching are associated with instructional approaches that foster constructivist learning, greater student motivation, and higher academic performance (e.g., Klassen & Tze, 2014; Stipek et al., 2001).

School-work environment: Teacher-school fit and autonomy

We adapt the concept of manager autonomy support for school-work environment where principals act as 'managers' of a school (Simon & Johnson, 2015) and define principal autonomy support as the degree to which principals provide teachers with choices and opportunities to make decisions, are receptive to teachers' perspectives, and demonstrate confidence in teachers' work. While prior studies demonstrate the importance of autonomy support in promoting intrinsic work motivation within business organizations, few studies have explored the effect of principal autonomy support on teachers' motivation for teaching, work satisfaction, and commitment to teaching (Skaalvik & Skaalvik, 2011). A concept similar to sense of relatedness in the workplace studied in organizational psychology is person-organization fit (Youngs et al., 2015). We adapt this concept to K-12 education as teacher-school fit and define it as the degree to which the school-work environment provides teachers with a sense of relatedness with other teachers within their schools. Teacher-school fit has been associated with teachers' sense of belonging and job satisfaction (Skaalvik & Skaalvik, 2011; Youngs et al., 2015), which can arguably relate to commitment to teaching.

Teacher leadership

Mounting evidence suggests that K-12 school-based leadership can be one of the most successful forms of support to develop and sustain highly-qualified teachers in the profession and to positively affect student achievement (e.g., Darling-Hammond, 1998; Elmore, 2002). Teacher leadership may be broadly defined as the

active involvement of teachers in the improvement of school culture and instruction and ultimately student learning through their participation in school-wide decision-making, and promotion of their teaching and learning expertise (York-Barr & Duke, 2004). A primary means in which teacher leaders can improve the quality of the school culture is through collaboration. Structures within schools that allow for collaboration, so that individuals who have developed increased content knowledge have the opportunity to increase the expertise of not only other teachers but also building administrators, are necessary to ensure that reform is not merely cosmetic. These structures should be based upon a thorough understanding of cognitive and affective skills needed for quality and committed teaching and must allow for sufficient time for collaboration (Elmore, 2002). Most of federally-funded leadership programs aim to change school culture to promote on-going improvement in mathematics and science teaching by providing leadership training emphasizing collaboration coupled with content knowledge instruction so that MTFs assume the role of "lead collaborator" in their school.

Teachers' understanding of diversity and inclusion

Culturally-relevant teaching that encompasses conception of self and others, social relations, and conception of knowledge is needed to educate and work with students from diverse backgrounds (Ladson-Billings, 1994). Teachers' retention and persistence in teaching in high-need schools with a diverse student body depend on being attentive to the needs of all students and creating equitable, inclusive, and supportive learning environments (Williams et al., 2016). Research indicates that teachers who possess positive cultural dispositions are more likely to persist in teaching in high-need schools (Williams, et al., 2016).

Teachers' professional social networks

Network theory provides a lens through which to view and describe teacher systems and educational organizations (Borgatti & Ofem, 2010) and can function as a methodological framework for studying teacher leadership and retention. The direct application of network theory to the retention of teachers represents a gap in the educational and organizational literature bases. However, social network analysis has been applied to the retention of freshman college students, who are characterized by periods of social adjustment, prone to identity clashes, and at risk for leaving schools (Gerdes & Mallinckrodt, 1994), which may parallel the identity transition from teacher to teacher leader and retention of teachers.

Methods

Participants and data collection

Study 1 and 2 were conducted using self-reported comprehensive surveys comprising three main sections: (a) background, (b) teaching and leadership, and (c) social networks. Background sections included questions about teachers' demographic and professional background. The second section included 4- or 5-point Likert-scale items about teaching self-efficacy (Klassen et al., 2009), leadership skills (Watt et al., 2010), teacher-school fit (Pogodzinski et al., 2013), teacher autonomy (Baard et al., 2004), and diversity dispositions (Schulte et al., 2009). The last section included two social network surveys: teaching network and teacher leadership network (e.g., interconnectedness, size; Polizzi et al., 2021).

In Study 1, about 250 teachers (27% male and 73% female; 30% elementary and 70% secondary teachers; (65% White and 35% from minoritized backgrounds) with, on average, 14 years of teaching experience ($SD = 8.70$) completed the survey. Among these teachers, 14 were identified as shifters (who shifted to a non-teaching position) and 18 as leavers (who left or retired from K-12 teaching/education).

In Study 2, 167 teachers completed the survey (30% male and 70% female; 19% elementary and 81% secondary teachers; 88% White and 12% from minoritized backgrounds). Of these teachers, 84 were MTF and 83 non-MTF with an average of 19 ($SD = 6.89$) and 18 ($SD = 8.67$) years of teaching experience respectively. Among the MTFs, nine were movers; 24 were shifters; and nine were leavers. Among non-MTFs, five were movers, 13 shifters, and three leavers. Although the quantitative data for Study 2 has been collected, its qualitative data collection is still in progress. Structured interviews will be conducted with teachers to further understand the differences between MTFs and non-MTFs regarding their teaching, leadership, and social networks. Only preliminary results from the quantitative analysis for Study 2 are presented in the paper. Further analyses (e.g., post-hoc) will be conducted based on the preliminary results and findings of the interview data.

Data analysis

To answer the first research question, we used Study 1 data to conduct multinomial logistics regression analyses with retention as a three-level nominal outcome (stayer—remained in teaching; shifter—shifted from teaching to a non-teaching/leadership position; and leaver—left or retired from K-12 education). To answer the second research question, using the data from Study 2, our preliminary analysis included independent samples *t*-test

to compare MTFs and non-MTFs in self-efficacy, leadership skills, diversity dispositions, school-work environment, social networks, and retention.

Results

In this paper, we investigated the extent of which teachers' self-efficacy for teaching, leadership skills, diversity dispositions, school-work environment, and social networks relate to their retention. We also compared MTFs with non-MTFs on these constructs. The findings of Study 1 indicated that secondary teachers were more likely to shift to a non-teaching position compared to stayers. The higher level of teacher leadership skills and lower degrees of teacher-school fit were associated with shifting to a leadership position. Lastly, a higher level of teaching self-efficacy was observed in leavers compared to stayers (see Table 1).

	Shifter[a]			*Leaver*[a]		
Variables	**B**	**S.E**	**Exp(B)**	**B**	**S.E**	**Exp(B)**
Intercept	-5.27	5.80		-5.90	5.44	
Male	-19.85	0.00	0.00	-0.12	0.68	0.89
URM	0.13	0.79	1.14	-1.03	0.90	0.36
Standard certification	0.95	1.29	2.58	-0.68	1.01	0.51
Degree in teaching subject	-0.88	0.76	0.41	-0.79	0.62	0.46
Secondary	**1.80**	**0.87**	**6.02***	0.96	0.74	2.62
Teaching self-efficacy	0.75	0.76	2.11	**2.52**	**0.78**	**12.37****
Teacher leadership skills	**2.30**	**0.77**	**10.02****	-0.44	0.59	0.65
Teacher-school fit	**-1.38**	**0.62**	**0.25***	-0.38	0.46	0.68
Principal autonomy support	0.06	0.38	1.06	-0.26	0.32	0.77
Diversity dispositions	-0.78	1.33	0.46	-0.75	1.21	0.47
Community connectedness	0.09	0.50	1.09	0.15	0.40	1.17
Teaching network size	0.01	0.09	1.01	0.02	0.09	1.02

[a] The reference category is: Stayer. *$p < .05$. **$p < .01$

Table 1. Summary of Regression Analyses Predicting Teachers' Retention

The findings of Study 2 illuminated that MTFs' teaching self-efficacy is significantly greater than non-MTFs. Although not statistically significant, MTFs' availing diversity dispositions are slightly higher than non-MTFs (practical significance $\alpha = .1$). MTFs' teacher leadership network size is significantly greater than non-MTFs. There was no statistical significance between MTFs and non-MTFs in their leadership skills, school-work environment, and teaching networks (see Table 2).

						95% Confidence Interval of the Difference	
Variables	*t* value	df	*p* value (2-tailed)	Mean (difference)	Standard error (difference)	Lower	Upper
Teaching network size	0.65	165	0.52	0.45	0.69	-0.92	1.81
Teacher leadership network size	**3.18**	**165**	**0.00**	**1.91**	**0.60**	**0.72**	**3.10**
Teaching self-efficacy	**2.23**	**165**	**0.03**	**0.187**	**0.08**	**0.02**	**0.35**
Teacher-school fit	-0.83	165	0.41	-0.10	0.12	-0.33	0.13
Principal autonomy support	0.19	165	0.85	0.03	0.16	-0.28	0.34
Diversity dispositions	*1.81*	*165*	*0.07*	*0.06*	*0.03*	*-0.01*	*0.12*
Community connectedness	0.69	165	0.49	0.08	0.12	-0.15	0.31
Teacher leadership skills	1.13	165	0.26	0.12	0.10	-0.08	0.32

Table 2. Summary of Independent Samples *t*-Test

Regarding moving to a different school, there seems to be no difference between MTFs and non-MTFs. However, MTFs significantly tend to shift to a leadership position than non-MTFs do ($p < .05$). Regarding leaving K-12 teaching/education, the results are inconclusive due to the low number of leavers in the sample ($n = 12$). Some of teachers' reasons for shifting to a non-teaching position included teaching burnout, better pay, and having greater impact. Reasons for leaving included the pandemic, retirement, family, stress, and burnout. Table 3 shows the retention- by MTF-status cross tabulation.

| | | **Retention** | | | | |
		Stayer	Mover	Shifter	Leaver	*Total*
Role	Non-MTF	62	5	13	3	*83*
	MTF	42	9	24	9	*84*
	Total	*104*	*14*	*37*	*12*	*167*

Table 3. Role and Retention Cross Tabulation

Discussion

Regarding Study 1, the fact that secondary teachers tend to shift more than the elementary teachers may signal a bigger issue of teacher turnover at the secondary level compared to elementary school level (Carver-Thomas & Darling-Hammond, 2019). However, when evaluating the act of shifting (i.e., changing to a non-teaching position), one needs to consider the possibility that shifting is not necessarily a negative move. Several teachers in our sample who shifted from teaching took leadership positions in which they feel they are having a greater impact. It always does contribute to the teacher turnover issue especially if it happens during the school year (finding a replacement teacher) but in the long-term, an effectively executed leadership position may actually produce a greater impact benefiting more students. The finding that leadership skills are positively associated with shifting supports this assertion that shifting is not all bad, especially when shifting to a leadership position where effective leaders can work with other teachers and indirectly affect more students (Darling-Hammond, 1998). Regarding the finding that shifters tend to have lower levels of teacher-school fit when compared to stayers. When we look into the data more closely, we see that when teachers shift to a non-teaching position, they also change their building (e.g., moving to another school or district office). Follow-up or further studies are needed to understand why this happens but perhaps, it is the lower levels of teacher-school fit that triggers the shifting. In other words, teachers may look for opportunities to change schools because they do not feel a good self-fit within the school culture. When this is coupled with their higher levels of leadership skills, they may find a non-teaching position at a different location as a better option for their career and workplace.

When compared to stayers, we see that leavers have higher levels of teaching self-efficacy in Study 1. This does not mean a causal impact of self-efficacy on leaving—i.e., higher levels of self-efficacy do not necessarily cause leaving teaching/education. Prior research indicates a positive relation between years of teaching experience and teaching self-efficacy (e.g., Corkin et al., 2015). Since leavers had more years of teaching experience than stayers (e.g., time to retire) and since several leavers choose to retire because they reached the retirement threshold, it is not surprising that they have higher levels of self-efficacy when they leave.

In Study 2, the significant differences between MTFs and non-MTFs in terms of teacher leadership network size and teaching self-efficacy favoring MTFs provides evidence for positive impact of NSF Noyce MTF programs. Similarly, the practical significant difference that MTFs have more availing diversity dispositions than non-MTFs do, indicates NSF Noyce MTF programs' positive impact on teachers' beliefs regarding diversity, equity, and inclusion issues. It is important to note that six different NSF Noyce MTF programs were included in the study and that they most likely differ in terms of program scope, foci, content, and other program characteristics. However, their common focus on teacher leadership (though through variety of approaches) and teachers in high-need school districts seems to be enough to make a difference in the aforementioned areas when compared to teachers who do not participate in these or similar programs.

Conclusions

The problem of teacher turnover has been a consistent concern in the U.S. educational system (Cross, 2017). Thus, there is a critical need to explore and understand factors influencing teachers' decisions to remain in the profession. To address this need, in this paper, we focused on examining the relations between teachers' motivational and social beliefs and their retention. In addition, preliminary results from comparing teachers who

participated in federally-funded multi-year leadership programs (MTFs) with those who did not (non-MTFs) indicates favorable results for MTFs. This supports the existence of Master Teaching Fellows programs. The results of this paper provide implications for practitioners, researchers, and administrators to sustain teachers' persistence and support shifting to a leadership position where they can have a greater impact for educational outcomes.

References

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic need satisfaction: A motivational basis of performance and well-being in two work settings. *Journal of Applied Social Psychology, 34*(10)*, 2045–2068.

Borgatti, S. P., & Ofem, B. (2010). Overview: Social network theory and analysis. In A. J. Daly (Ed.), *Social network theory and educational change*, (pp.17-29). Cambridge, MA: Harvard Education Press.

Carver-Thomas, D., & Darling-Hammond, L. (2019). The trouble with teacher turnover: How teacher attrition affects students and schools. *Education Policy Analysis Archives*, *27*(36), 1–27.

Corkin, D., Ekmekci, A**.**, & Papakonstantinou, A. (2015). Antecedents of teachers' educational beliefs about mathematics and mathematical knowledge for teaching among in-service teachers in high poverty urban schools. *Australian Journal of Teacher Education, 40(*9), 31-62. doi: 10.14221/ajte.2015v40n9.3

Cross, F. (2017, June). *Teacher shortage areas nationwide listing 1990–1991 through 2017–2018.* U.S. Department of Education Office of Postsecondary Education.

Darling-Hammond, L. (1998). Teacher learning that supports student learning. *Educational Leadership, 55,* 6-11.

Dauksas, L., & White, J. (2010). Should I stay or should I go? How teacher leadership can improve teacher retention. *AASA Journal of Scholarship and Practice, 7*(2), 27–32.

Elmore, R. F. (2002). Hard questions about practice. *Educational Leadership, 59*(8), 22-25.

Gerdes, H., & Mallinckrodt, B. (1994). Emotional, social, and academic adjustment of college students: A longitudinal study of retention. *Journal of Counseling & Development*, *72*(3), 281-288.

Klassen, R. M., Bong, M., Usher, E. L., Chong, W. H., Huan, V. S., Wong, I. Y., & Georgiou, T. (2009). Exploring the validity of a teachers' self-efficacy scale in five countries. *Contemporary Educational Psychology*, *34*(1), 67–76.

Klassen, R. M., & Tze, V. M. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review*, *12*, 59-76.

Ladson-Billings, G. (1994). What we can learn from multicultural education research. *Educational Leadership, 51*(8), 22-26.

Pogodzinski, B., Youngs, P., & Frank, K. A. (2013). Collegial climate and novice teachers' intent to remain teaching. *American Journal of Education, 120*, 27–54.

Polizzi, S. J., Zhu, Y., Reid, J. W., Ofem, B., Salisbury, S., Beeth, M., Gillia, R., Mohr-Schroeder, M. Sheppard, K. & Rushton, G. T. (2021). Science and mathematics teacher communities of practice: social influences on discipline-based identity and self-efficacy beliefs. *International Journal of STEM Education*, *8*(1), 1–18.

Schulte, L. E., Edwards, S., Edick, N. A. (2008). The development and validation of the diversity dispositions index. *Teacher Education Faculty Publications, 5*(3), 11–19.

Simon, N. S., & Johnson, S. M. (2015). Teacher turnover in high-poverty schools: What we know and can do. *Teachers College Record*, *117*(3), 1–36.

Skaalvik, E. M., & Skaalvik, S. (2011). Teacher job satisfaction and motivation to leave the teaching profession: Relations with school context, feeling of belonging, and emotional exhaustion. *Teaching and Teacher Education*, *27*(6), 1029–1038.

Stipek, D. J., Givvin, K. B., Salmon, J. M., & MacGyvers, V. L. (2001). Teachers' beliefs and practices related to mathematics instruction. *Teaching and Teacher Education*, *17*(2), 213–226.

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education*, *17*(7), 783–805

Watt, K. M., Huerta, J., & Mills, S. J. (2010). Advancement Via Individual Determination (AVID) professional development as a predictor of teacher leadership in the United States. *Professional Development in Education*, *36*(4), 547–562.

Williams, D. L., Edwards, B., Kuhel, K. A., & Lim, W. (2016). Culturally responsive dispositions in prospective mathematics teachers. *Discourse and Communication for Sustainable Education, 7*(2), 17–33.

York-Barr, J. & Duke, K. (2004). What do we know about teacher leadership? Findings from two decades of scholarship. *Review of Educational Research, 74,* 255–316.

Yost, D. S. (2006). Reflection and self-efficacy: Enhancing the retention of qualified teachers from a teacher education perspective. *Teacher Education Quarterly*, *33*, 59–76

Youngs, P., Pogodzinski, B., Grogan, E., & Perrone, F. (2015). Person-organization fit and research on instruction. *Educational Researcher*, *44*(1), 37–45. doi: [10.3102%2F0013189X15569531](10.3102%2F0013189X15569531)

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