RESEARCH EXPECTATIONS FOR MATHEMATICS EDUCATION FACULTY IN US INSTITUTIONS OF HIGHER EDUCATION

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This paper reports the results of a survey of 404 US mathematics education faculty regarding the research expectations for obtaining tenure. Survey questions asked about expected numbers of publications per year, how much different types of publications (e.g., journal articles, book chapters) and scholarly activities (e.g., giving presentations, obtaining funding) were valued. Statistical analyses were used to examine differences in these results across three demographic characteristics (institution type, research commitment, department). We found statistically significant differences related to each of these variables. Research expectations varied substantially across institution type. For example, the average expected number of yearly publications was 2.23, 1.63, and .99 papers at R1, R2, and Other institutions respectively. By contrast, research expectations seldom varied by department.

Keywords: research expectations; tenure; scholarly activity

In 1987 the Carnegie Foundation published a report of a multi-site study of the American academic profession (Clarke, 1987). It documented the three-fold division of academic work into research, teaching, and service that remains to this day as a framework for decisions about promotion, and compensation based on performance in these three areas (Barat & Harvey, 2015; Hardré et al., 2011; Needham, 1982; O'Meara, 2011; Schmidgall & Woods, 1994).

Of these three areas, research is often considered of most importance, being both highly valued and rewarded. Youn & Price (2009) pointed out that in the 1980s, research "became the dominant basis for academic rewards" (p. 205) and remains an important consideration in tenure and promotion decisions (Barat & Harvey, 2015; Kruger & Washburn, 1987; Fairweather, 1993; 2005; Hardré et al., 2011; Park & Gordon, 1996; Price & Cotton, 2006). Moreover, there is a documented positive effect of scholarship on salary (Barat & Harvey, 2015; Fairweather, 1993).

Despite the importance of scholarship in the lives and livelihoods of academics, it must compete with teaching and service obligations in the expectations for faculty positions. Those in academic positions need to know how to balance these obligations (Trower, 2010; Barat & Harvey, 2015). Unfortunately, studies have documented that many faculty feel expectations are not clearly communicated and that assessment is often subjective and/or politicized (Acker & Webber, 2016; Barat & Harvey, 2015; Hardré & Kollman, 2012: Lawrence et al., 2014; Park & Gordon, 1996; Price & Cotton, 2006; Schmidgall & Woods, 1994; Walker et al., 2010). Often, no official documents are available that specify expectations, or they may exist at administrative levels that can provide only very general guidance (Hardré & Cox, 2009).

These difficulties are complicated further because expectations for research vary substantially among disciplines and institutions (Acker & Webber, 2016; Brewer & Rickels, 2011; Clarke, 1987; Gardner & Veliz, 2014; Pellegrino et al., 2018; Price & Cotton, 2006; Schmidgall & Woods, 1994). Although some literature has explored expectations in specific disciplines (e.g., education, accounting, public administration, sociology), little is known about

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research expectations in comparatively small and relatively new fields like mathematics education. Information related to research expectations for mathematics education researchers from across the US would be of immense value to faculty in the ongoing processes of hiring, setting tenure expectations, mentoring new faculty, and refining department-level expectations documents, as well as its obvious value to faculty who are undergoing job searches, or tenure and promotion decisions. The purpose of this paper is to report the results of our investigation into the typical research expectations for mathematics education faculty in the United States.

Literature Review

Although research on expectations in mathematics education is sparse, a robust literature from other disciplines provides guidance on how research expectations vary across disciplines and what institution, or position-specific characteristics are likely to influence such expectations.

Demographic Characteristics Affecting Expectations for Scholarship

Perhaps the clearest results of research into expectations in higher education is that they vary across institutions. Indeed, the most used classification of institutions of higher education is the Carnegie classification, in which research productivity plays a prominent role. There is evidence to suggest that expectations can increase in institutions who are "striving" (Gardner & Velize , 2014) to emulate more prestigious institutions. Greene and colleagues (2008) found that some faculty reported spending 120% of their time on fulfilling their academic expectations. Significantly, these overloads occurred in R2 institutions, in which research might become more highly valued, but expectations for teaching and service may not be concomitantly adjusted.

A second major characteristic that may affect expectations is the type of department in which the faculty member is housed. In our field, faculty are typically housed either in a department within an education college, or in a department of mathematics, although of course other options are possible. A study by Shih et al. (2018) found that about half of the recent mathematics education PhDs in their sample were housed in mathematics departments, the other half being housed in schools or colleges of education with half of the education positions in R1 institutions, and three-quarters of the mathematics positions in neither R1 nor R2 institutions. Given results such as these and the hybrid nature of the discipline of mathematics education, we concluded it was important to explore potential differences in research expectations at the department level.

Finally, the fraction of time spent doing research is the third major characteristic we assumed would affect participant responses. Greene and colleagues (2008) noted that an R1 university's typical division is 40% research, 40% teaching, and 20% service. In an examination of expectation documents in academia, Hardré and Cox (2009) found significant variability in whether these percentages were specified, as well as variability in what the percentages were in cases where they were quantified. As another example, Davis et al. (2006) found that counseling program faculty reported spending 49% - 55% of their time teaching, 26% - 27% of their time on research and 18% - 21% of their time on service. Hardré et al. (2011) found that effort expended on research was positively correlated with productivity, whereas teaching load—likely time spent on teaching—had a significant negative correlation. We take from these results that, as with institution type and department type, the fraction of their time committed to research is an important consideration when seeking to understand research expectations.

Examples of Research Expectations from the Literature

A clear message from the literature is that scholarship is often measured by the quantity and sometimes quality of research publications. A number of studies have reported on expected numbers of published papers. Hardré and Cox (2009) reported that across disciplines,

departments that were categorized as having high research expectations generally expected "averages from one to two articles published every year" (p. 409) for tenure and promotion. Davis et al. (2006) reported that in counseling programs, "the perceived scholarly productivity for tenure and promotion is the equivalent of about one scholarly publication per year" (p. 152). Greene and colleagues (2008) found that the typical expectations for an education faculty member at an R1 university equates to "two publications per year" (p. 432). It is difficult to tell, however, whether the variation was a product of the discipline or the level of institution because of the lack of clarity on the level of institutions involved in the studies.

Studies have also explored the roles that different types of scholarly activities play in evaluating faculty work. In general, the extent to which scholarly activities are valued differs across disciplines and institutions (Hardré & Cox 2009; Price & Cotton, 2006). For example, Barat and Harvey (2015) report that in business schools, a wider variety of scholarly work (books, book chapters, book reviews) has recently come to be seen as valuable. Acker and Webber (2016) found that the perceived relative values of publications in research journals, books, and eternal funding differed by discipline. In nursing Kruger and Washburn (1987) found a hierarchy in the perceived values of activities, ranging from the most valued (publications in refereed journals, funded grants, and sole-authored publications) to the least valued (published teaching materials, publications in non-refereed venues). Goodnight and colleagues (2003) found that expectations for marketing faculty varied according to the highest degree offered in the program (Bachelor, MBA, or PhD).

Summary

We conclude that institution type, department type, and percent of time assigned to research are likely to affect faculty members' perceptions of research expectations. In order to measure research expectations, we chose to look at expected number of papers, types of publications, and other scholarly activities that may be counted as research in our field.

Defining and Measuring Expectations

We asked two research questions: (a) What are the typical research expectations for mathematics education faculty in the United States? (b) How do research expectations differ across institutions, types of departments, and proportion of time devoted to research? By the term *research expectations* we mean what is expected by those making tenure and promotion decisions. In some cases, these expectations may be codified in written documents. However, the literature suggests that such documents do not always exist, and when they do exist, they may not provide much detail to guide faculty members. In this paper, we report instead on the perceptions of mathematics education faculty members regarding expectations at their institutions. A second paper is under preparation that discusses what can be learned from an examination of official documents.

Because expectations are often not spelled out for faculty, building an argument for tenure or promotion is a matter of showing that the candidate has successfully engaged in 1) a sufficient number of activities that are 2) sufficiently valued by the institution. The relationship between the *number* of activities and the *value* of the activities is illustrated by a single research journal article possibly outweighing two or three practitioner journal articles. Thus measuring expectations must take into account both what is seen as necessary, and what is seen as valuable. We hope our data will provide guidance to faculty members about how to spend their time, and to departments as they seek to clearly communicate research expectations.

Measuring what our participants saw as *necessary* was straightforward. In cases where some activities (such as publishing research papers) were seen as necessary, we were also able to obtain clear-cut numerical measures (such as the number research papers that should be published in a given time period). Measuring the activities our participants saw as valuable typically took the form of asking them to judge whether an activity would count *a lot*, *some*, or *little or none*. These Likert-type scales allowed us to gather information on the relative value of various activities in the minds of our participants.

Methods

Participants

The target population for our study was US mathematics education faculty with research expectations. We chose to focus on US contexts because we were familiar with the US higher education system in general, and there is evidence that substantial variation exists between countries when it comes to academic positions and tenure at institutions of higher education (European University Institute, 2022; Pietilä, 2019). To create our sample, we first identified authors who had published in a collection of 55 mathematics education journals (see Williams & Leatham, 2017 for a list of these journals) from 2015 to 2017 and who were associated with a 4-year institution of higher education in the United States at the time of publication. To augment this list with researchers whose focus may have led them to publish in other venues during that same timeframe, we identified authors of chapters in the *Research in Mathematics Education* edited book series by Springer, the National Council of Teachers of Mathematics (NCTM) edited book series titled *Annual Perspectives in Mathematics Education*, and NCTM's practitioner journals *Teaching Children Mathematics*, *Mathematics Teaching in the Middle School*, and *Mathematics Teacher*. Once authors were identified, we verified email addresses and, in some cases, determined that individuals were no longer in a university position and removed them from our list. In total, we identified 1593[8] US university faculty members who had published in mathematics education from 2015 to 2017 and for whom we could find a current email address.

Although we knew that some of these individuals were likely not in our target population because they were coauthors but not mathematics education researchers, we decided to err on the side of inclusion and allow individuals to decide whether they were indeed in our target population. Of the 1593 to whom the survey was sent, 821 responded[9]. Of these 821, 411 identified themselves as not being part of the target population. When these were eliminated, along with six incomplete survey responses, there were 404 respondents from our target population. Based on the fact that half of those who responded were not in the target population, we infer that at least half of those to whom we sent the survey were not in the target population. Thus, it seems reasonable to assume a response rate of roughly 50% of the target population.

Survey

Based on our review of the literature on research expectations, we devised a set of questions in three categories: 1) demographics; 2) the number of publications expected each year; and 3) the types of scholarly publications and activities that would meet research expectations. Category 1 questions were designed to classify participants' institution and department as well as the relative time commitment for teaching, research, and service. For category 2 we asked both

[8] Due to clerical errors, 119 participants who should have been on the list of those who received surveys were not on the list. Unfortunately, the error was identified long after the survey had closed.

[9] Respondents are those who responded to the survey either directly or indirectly through email.

about the number of expected publications and whether that number was explicitly stated (e.g., in an official document) or implicitly understood. The types of publications we included for consideration in category 3 were research journal articles, books or book chapters, textbooks, conference proceedings papers, and practitioner journal articles. We also asked about pursuing and obtaining external funding, giving presentations, and providing professional development. To measure the extent to which these scholarly publications and activities were valued, we asked respondents to indicate whether they counted toward tenure and how much they counted. A draft survey was piloted with a group of 24 colleagues and as a result, items were extensively edited for clarity (e.g. clarifying that *citizenship* was the same as *service*).

Analysis

Our three key dependent variables are represented in our data by the demographic variables *institution type* (i.e. *R1*, *R2*, and *other*—meaning neither *R1* nor *R2*), *department* (i.e. *education* and *math*), and *research commitment* (i.e. percent time devoted to research). We began by counting frequencies of responses to the various survey questions, and then disaggregated the results across the demographic variables.

To assess the influence of the variables *institution type, department,* and *research commitment*, we conducted multinomial logistic regressions using these three variables as predictors. For example, we looked at the effects of these variables on how publications in practitioner journals were valued. The response variable was categorical with three levels—*a lot*, *some*, or *little or none*—so in the model we compared both *a lot* and *little or none* to *some* in the odds ratios. Because *institution type* had three levels, we compared both *R1* and *other* to *R2*. In the cases for which the response variables were numeric, such as the number of published papers expected per year or *research commitment*, the model was appropriately modified.

In our analysis significant effects were determined for each of our three dependent variables as the others were held constant. Since the literature review made it clear that our three demographic variables are likely related, it might be expected that respondents in R1 institutions would have higher research commitments. In looking for significant effects of *institution type*, therefore, we looked particularly at effects holding *research commitment* and *department* constant, thus minimizing the effects of possible correlations among our dependent variables.

In order to better understand the size and direction of the significant effects, we also conducted a series of *post-hoc* analyses further probing relationships shown to be significant by the regression analyses. Again, using the example of effects on reports on expectations regarding practitioner journal articles, we looked at pairwise comparisons among reported levels of importance (e.g., *a lot*, *some*, and *little or none*) and noted changes in the odds ratios.

Results

The primary purpose of this study was to learn what the typical research expectations are for mathematics education faculty in the United States. As conjectured, expectations often vary by institution type, department, and research commitment. We describe the data set as a whole and then synthesize the results according to these demographic variables, focusing initially on institution type as this variable most often resulted in statistically significant differences.

Respondents are located in a wide range of institutions, evenly split between departments of education and departments of mathematics. The proportion of time they are expected to devote to research is typically 20-40%, but the range varies from 0-70%. On average faculty are expected to publish about 1.64 papers per year where research journal articles are the most valued publication type and count a lot toward meeting expectations. Most view book and book

chapters, practitioner journal articles, and conference proceedings papers as counting some, and there is not clear consensus on the value of publishing textbooks. With respect to other scholarly activities beyond publication, typically there is an expectation to give presentations, although such presentations likely only count some (not a lot). For a majority, faculty are expected to pursue external funding, and this pursuit counts some or a lot even if the funding is not obtained. Over two-thirds of faculty report that obtaining external funding is not necessary but obtaining it counts a lot. Providing professional development is neither necessary nor much valued. With respect to authorship, first authorship is seen as a crucial element of the publication portfolio.

With respect to Carnegie classifications, mathematics education faculty at R1 institutions are more likely to be in departments of education than of mathematics. Typically, they are expected to devote 40% of their time to research endeavors. R1 faculty are expected, on average, to publish about 2.25 papers per year. That said, holding all else equal, R1 faculty are less likely than their R2 counterparts to have this expected number of papers articulated explicitly in a written expectations document. With respect to the types of publications that count, as with all respondents, research journal articles count a lot. For R1 faculty, however, all other types of publications that we asked about are less valued than at R2 and Other institutions. R1 faculty are more likely to be required to give presentations than R2 faculty. R1 faculty are more likely than their R2 and Other counterparts to be required to pursue and obtain external funding. Finally, R1 faculty were more likely than R2 faculty to report sole authorship as important.

Mathematics education faculty at R2 institutions are fairly evenly split between departments of education and of mathematics. About 65% of faculty at R2 institutions are expected to devote at least 40% of their time to research endeavors. R2 faculty are expected, on average, to publish about 1.5 papers per year. Furthermore, holding all else constant, R2 faculty are more likely than their R1 and Other counterparts to have this expected number of papers articulated explicitly in a written expectations document. Among types of publications, research journal articles count a lot, while all other types of publications that we asked about likely would count some. R2 faculty were less likely than R1 faculty but more likely than Other faculty to be required to pursue and obtain external funding. Finally, R2 faculty were less likely than R1 faculty but more likely than Other faculty to report sole authorship as important.

Mathematics education faculty at Other institutions are more likely to be in departments of mathematics than of education. Typically, they are expected to devote about 20% of their time to research; over 80% of respondents report 10-30% expected research time. Other faculty are expected, on average, to publish about 1 paper per year. That said, holding all else constant, Other faculty are less likely than their R2 counterparts to have this expected number of papers articulated explicitly in a written expectations document. Research journal articles count a lot. All other types of publications that we asked about likely would count some. Other faculty were more likely than R2 faculty to value giving presentations and providing professional development. Other faculty were more likely than their R1 and R2 counterparts to report that there was no expectation to pursue or obtain external funding. Finally, Other faculty were less likely than R2 faculty to report sole authorship as important.

With respect research commitment, for a 10% increase in the reported time spent on research there is a 0.184 increase in the reported number of expected papers. Moreover, respondents reporting higher research commitments (holding all else constant) were less likely to have this expected number of papers articulated explicitly in a written expectations document. Research journal articles count a lot independent of research commitment. Respondents with higher research commitments did report that books or book chapters and practitioner journal articles

were less valued than those with lower research commitments. Faculty with higher research commitments are more likely to report being required to pursue and obtain external funding and are less likely to report that providing professional development is valued. Finally, faculty with higher research commitments are more likely to report both sole authorship and lead authorship as being valued.

With respect to department type 50% of respondents belonged to education departments, 43% belonged to mathematics departments, and the remaining 7% were in departments with a mixture of disciplines like education, arts, and sciences. Over 50% of our respondents who were in education departments were in R1 institutions while half of our respondents in mathematics departments were from Other institutions. Regarding research commitment, 64% of respondents from education departments spend 40% of their time or more doing research while 55% of respondents from mathematics departments spend less than 40% of their time doing research. In general our results showed few differences in the expectations of mathematics and education departments. That said, holding all else constant, respondents in mathematics departments reported that 0.309 fewer papers were expected than was reported by those in education departments. The only difference in department expectations regarding types of publication is conference proceedings papers—respondents from mathematics departments were more likely than respondents in education departments to report that conference proceedings papers were valued. Regarding the other types of scholarly activities (giving presentations, providing professional development, pursuing or obtaining funding), mathematics departments valued pursuing funding and obtaining funding more than those in education departments. On the other hand, mathematics departments are less likely to require providing professional development and require giving presentations. Finally, respondents in mathematics departments were less likely than those in education departments to report that first authorship was important.

The results confirmed a number of suspicions we had going into this study about research expectations in mathematics education. There were, however, some results that were surprising. With respect to workload distribution, we suspected that the most common workload distribution would be a 40-40-20 split and that there would be variability in that distribution at R2 institutions. We were surprised by the variability at R1 and Other institutions. With respect to the expected number of yearly publications, we anticipated that the expectation would be highest for R1 faculty and lowest for faculty at Other institutions but we were surprised that 11% of R1 faculty reported the expectation of 3 or more papers per year.

With respect to publication types, we anticipated that research journal articles would be the most valued regardless of institution type, department or research commitment. Although we suspected that textbooks and practitioner journal articles would be less valued at R1 institutions than at R2 institutions, we were surprised that books or book chapters or conference proceedings papers are also less valued. We were surprised that mathematics department faculty were more likely than education department faculty to report that conference proceedings papers counted.

With respect to other scholarly activities, we suspected that pursuing funding would be most likely to be expected at R1 institutions and least likely to be expected at Other institutions. What surprised us is that over 75% of respondents indicated that presentations are necessary and that R1 faculty are more likely to be expected to give presentations than R2 or Other faculty.

Finally, with respect to whether the expected number of publications was in a written document, we did not expect to see any differences depending on demographic characteristics. We were thus surprised that the number was more likely to be in a written document at R2

institutions than at R1 or Other institutions. In addition, those with higher research commitments were less likely to have the expected number of publications in a written document.

Conclusion

The results of this study show some of the ways that research expectations for mathematics education faculty in the US vary based on institution type, department type, and research commitment. Knowing both that and how research expectations vary provides valuable information for individual faculty, mathematics education programs, and to the broader field of mathematics education. Individual faculty could profit from seeking clarification from their own department regarding the categories of expectations discussed herein, asking questions like:

- Does our department have an expected number of publications?
- To what extent are book chapters or conference proceedings papers valued?
- Is pursing funding, even if it is not funded, valued?
- To what extent is sole authorship expected?

Mathematics education programs could locate themselves within these results and consider questions like the following:

- To what extent do we align with what is typical of our particular combination of institution type, department type, and portion of time devoted to research?
- If we vary substantially from what is typical, do we want to make adjustments or provide further justification for the variation?
- To what extent are our expectations, whether they align or not with what is typical, made explicit in written documents?
- Might there be areas where we should articulate expectations that have thus far been left unaddressed? For example, do we make clear whether practitioner journal articles count and how much they count relative to other types of publications?

As a field of mathematics education, these results tell us something of the types of scholarly activities that are being expected of mathematics education faculty in the US. These results could prompt us to consider questions like the following:

- Are there other scholarly activities that, as a field, we feel should be valued more or less than they are? What might we do as a community to influence an increase or decrease in emphasis on such activities?
- Are there sufficient quality publication venues and outlets for other scholarly activities to support the needs of the field?
- Might mathematics education faculty benefit from supporting documentation from the field that articulates the value-added for certain scholarly activities (such as professional development activities) that would benefit the field but are not typically valued much?

We hope the results of this study will motivate all mathematics education faculty and the departments where they work to have an open, transparent dialogue about details related to research expectations and to create or refine their expectations documents. Given the variation that exists across institutions, departments, and research commitments, it would seem beneficial for expectations documents to make explicit mention of expected number of publications, how

much various types of publications count, how much other types of scholarly activities count and whether those activities are necessary. Such work would benefit individual faculty, mathematics education programs, and the entire field of mathematics education. We also hope that the results of this study begin a broader conversation in the field to consider not just what *is* expected, but what *could* or *should* be expected in order to continue to move the field of mathematics education forward.

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