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Mathematics Anxiety: One Size Does Not Fit All

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Author Biography

Kathleen Jablon Stoehr is an assistant professor of mathematics education in the Department of Education at Santa Clara University. Her research interests include issues that relate to preservice and early career teachers' processes and understandings of learning to teach. Through the use of narrative inquiry, she has explored equity and social justice issues of language, race, culture, and gender that occur in the classroom. Recent publications include *Journal of Urban Mathematics*, and *Journal of Mathematics Teacher Education*, and *ZDM Mathematics Education*.

Mathematics education researchers have demonstrated that students' experiences with mathematics anxiety can impede their participation and achievement in mathematics (Ball, 1988; Hembree, 1990). Accordingly, researchers interested in mathematics teacher education have investigated how prospective teachers' (PSTs) experiences with mathematics anxiety as K-12 students may affect their approaches to teaching mathematics as new professionals (Beilock, Gunderson, Ramirez, & Levine, 2010; Bursal & Paznokas, 2006; Mizala, Martinez, & Martinez, 2015). Particular attention has been given to women in elementary teacher-preparation programs, who have reported much higher levels of mathematics anxiety than have women secondary mathematics PSTs, men elementary PSTs, and men secondary mathematics PSTs (Brady & Bowd, 2005). In the U.S., 90% of elementary teachers are women (Beilock et al., 2010), so the prevalence of mathematics anxiety among this group is especially concerning.

Many previous studies of women elementary PSTs' experiences of mathematics anxiety have focused on women's real-time and recalled *sensations* of discomfort and distress while awaiting and undergoing assessment of their mathematical performances. Mathematics teacher educators have attempted to correlate women elementary PSTs' reported past and/or current levels of mathematics anxiety with their stated beliefs about mathematics and mathematics teaching (Brown, Westenskow, & Moyer-Packenham, 2012; Bursal & Paznokas, 2006; Harper & Daane, 1998). In other words, based on their data, *researchers* have tried to forge associations between women elementary teachers' experiences with learning mathematics as K-12 students and their experiences with learning to teach mathematics as participants in university-based teacher-preparation programs. However, more research is needed on how *women elementary PSTs*

themselves interpret their experiences with mathematics anxiety and make connections among their histories as students and teachers of mathematics. In this study, I explore mathematics-related life stories recounted by three women elementary PSTs across key phases in their teacher-preparation program. Through my analysis of their personal narratives, I offer PSTs' interpretations of their experiences of mathematics anxiety, by analyzing several kinds of personal narratives recounted by each woman during key phases of her teacher-preparation program.

Literature Review

Mathematics Anxiety as Mathematics Students

Prior studies in mathematics education have demonstrated that individuals' experiences with mathematics shape how they think about doing and teaching mathematics (Ball, 1988; Mizala et al., 2015; Swars, Daane, & Giesen, 2006). For example, previous studies of women elementary PSTs' experiences with mathematics anxiety revealed issues of inhibited learning experiences from early in their student learning days (Drake, 2006; Harper & Daane, 1998, Sloan, 2010; Stoehr and Carter, 2011, 2012). These studies suggests that K-12 schooling experiences play a significant role in creating mathematics anxiety in some women elementary PSTs. For example, Harper and Daane's study (1998) indicated that years later, elementary PSTs recalled incidents like feeling pressure to have the right answers, the inability to understand word problems, the fear of making mistakes, apprehension of timed tests, and/or being told by a teacher they "would just be one of those people who would never get math" (p.33). Sloan's (2010) investigation of PSTs' experiences in mathematics demonstrated that factors like how mathematics was taught, histories of low performance and weak

mathematics backgrounds, lack of positive experiences in the mathematics classroom and negative attitudes towards mathematics contributed to mathematics anxiety. Some participants shared that they felt “scared to death in many math classes” (p.253) or dreaded the thought of walking into a mathematics classroom. Other participants talked about never feeling successful in a mathematics classroom.

Stoehr and Carter’s (2011, 2012) work added to this discussion by unveiling how elementary PST teachers endured instances in the mathematics classroom where they felt embarrassed, humiliated, shamed, dumb, and/or stupid in front of their peers. In fact, as one PST reported, “I was too afraid to speak up and ask questions because I did not want to be the only student in the class who did not understand this concept” (p.767). Taken together, these studies have demonstrated that many elementary PSTs, especially women, have experienced intense feelings of discomfort and distress while learning mathematics as K-12 students. In addition, these studies also support Gavin and Reis’ (2003) findings regarding girls and their learning experiences in mathematics. Their research revealed that girls often believe they are not expected to excel in mathematics as they try to make sense of the stereotypical messages they receive from some teachers and peers. These messages can lead to a detrimental academic affect on girls in mathematics classes (Gavin & Reis, 2003).

Previous research has also demonstrated that some teachers perpetuate the stereotype that boys are stronger in mathematics than girls as they often overestimate boys’ potential in mathematics whereas they underestimate mathematical potential for girls (Goodell & Parker, 2001). One teacher in Garrahy’s study (2001) spoke of the innate differences in abilities between boys and girls in which she reported that “because

of the way in which different sexes' minds work, boys tend to lean toward more mathematical, concrete types of things whereas girls tend to lean more to the language arts types of tasks" (Garrahy, 2001, p.90). This type of teacher thinking can lead to a significant amount of gender imbalance and gender bias that is destructive to the education of girls and boys (Garrahy, 2001, Sadker, Sadker, & Zittleman, 2009). Moreover, mathematics classrooms that utilize ability grouping can intersect with and intensify the harmful effects of gender bias (Boaler, William & Brown, 2000). Steele, Spencer, and Aronson (2002) contend that not doing well in a content area like mathematics may be a result of "persistent patterns of social identity and stereotype threat" (p.424) that become tangled up in an individual's identity. This identity can then become a consistent part of the mathematics school experience. Taken together, these studies suggest the dangerous role that schools can play in creating mathematics anxiety in girls.

Research remains to be done on how women elementary PSTs interpret their historical positioning by teachers, curriculum, and educational policies as being mathematically (in)capable. This sense-making, often accomplished through self-narration, is a crucial influence on how mathematics anxiety is experienced. Additional knowledge on how women elementary PSTs experience mathematics anxiety would inform teacher-education efforts to prepare competent, confident mathematics teachers.

Mathematics Anxiety as Future Mathematics Teachers

Mathematics education researchers have examined the worries and distress that many women elementary PSTs experience while learning to teach mathematics (Brown et al., 2012; Bursal & Paznokas, 2006; McGlynn-Stewart, 2010). This is important to

study, reasoning that teachers who experienced mathematics anxiety as students may pass their anxiety onto the next generation of mathematics students (Beilock et al., 2010; Brady & Bowd, 2005; Sloan, 2010). Similarly, women elementary PSTs who had experienced mathematics anxiety have themselves voiced great concern about being able to teach mathematics effectively to their students (Brown et al., 2012), especially as they encountered new demands to understand and teach mathematical concepts and strategies (Bursal & Paznokas, 2006; McGlynn-Stewart, 2010). Prospective teachers particularly feel anxiety when planning mathematics lessons, situations that perhaps resemble exams (Brady & Bowd, 2005). Some would-be elementary PSTs are likely not admitted to university-based teacher-preparation programs because mathematics anxiety can impede them from taking the undergraduate mathematics coursework required for admission (Brady & Bowd, 2005). While the project of learning to teach, in general, may provoke anxiety in PSTs (Wood, Jilk, & Paine, 2012), stress, fear, and trauma related to mathematics learning and teaching represents a particularly serious challenge for women elementary PSTs. Accordingly, more research is needed on how these women make sense of their mathematical histories and use these understandings to devise and implement coping strategies.

Theoretical Framework

Mathematics Anxiety

Mathematics researchers have defined *mathematics anxiety* in multiple ways. Vinson (2001) defined mathematics anxiety as being more than just not liking mathematics whereas Trujillo and Hadfield (1999) described mathematics anxiety as “a state of discomfort that occurs in response to situations involving mathematical tasks that

are perceived as threatening to self-esteem” (p.173). Some researchers argue that mathematics anxiety can be viewed as a disease (Hembree, 1990; Luo, Wang, & Luo, 2009). Physiological reactions like sweaty palms, tight fists, being sick, vomiting, having dry lips, and a pale face can also occur potentially resulting in students losing not only their interest in mathematics but their confidence in their ability to learn mathematics (Luo et al., 2009). A lack of confidence can then lead to more feelings of mathematics anxiety. This in turn can then lead to dodging mathematics, which reinforces more mathematics anxiety (McGlynn-Stewart, 2010). However, few studies have investigated how women elementary PSTs make sense of the sensations that are attributed to mathematics anxiety, perhaps contextualizing them in terms of their other personal experiences. What is missing in the literature is how PSTs makes sense of mathematics anxiety as well as how teacher educators may address mathematics anxiety, which may be interpreted and coped with differently by PSTs. In this article, I analyze experiences of mathematics anxiety that emerged across time in three women elementary PSTs’ personal narratives by attending not only to “feeling words” (e.g., “nervous,” “scared,” “panicked”) but also to the larger interpretations the women gave those feelings.

Personal-Experiences Narratives

In the broader field of education, education researchers have approached narratives as rich evidence of personal experience (e.g., Connolly & Clandinin, 1990; Goodson & Sykes, 2001). Many of these studies have documented individual teachers’ narratives shared during interviews with researchers. However, Hollingsworth and Dybdahl (2007) have suggested that much can also be learned about teaching when teachers are given the opportunity to engage in extended, narrative-based conversations

with trusted colleagues. Accordingly, in my study, I gathered women elementary PSTs' personal-experience narratives through one-to-one and focus-group interviews, as narratives can create a pathway for individuals to form patterns and make connections across their experiences.

Within mathematics education, narrative researchers have elicited two broad kinds of personal-experience narrative: the “well-remembered event” (Carter, 1994) and the “life story” (e.g., Atkinson, 2007; Drake, 2006). Carter (1994) defined a well-remembered event as “an incident or episode that a student observes in a school situation and considers for his or her reasons as especially salient or memorable” (p.236). Research on well-remembered events showcases life experiences that are vividly recalled by participants, perhaps because such moments were intensely felt at the time of their occurrence or are of particular salience now.

Life-story narratives focus on a “collection of personal narratives that reveal how a specific human life is constructed and reconstructed in representing that life as a story” (Atkinson, 2007, p. 224). In contrast with “well-remembered event” narratives, which feature a single episode, “life story” narratives are life histories that note many events, including those that participants may consider less personally significant or powerfully emotional: for example, culturally valued milestones, like the first day of school. However, they can impose a frame for storytelling. It is not enough to examine isolated events of mathematics anxiety or to report a series of experiences of mathematics anxiety over time. This study goes beyond recounting single incidents of mathematics anxiety or experiences of mathematics anxiety that occur in chronological order. Therefore in this article, I examine the experiences of mathematics anxiety that three women elementary

PSTs chose to tell over time as well as how they made sense of these experiences in their mathematical histories to answer the following questions:

1. How were experiences of mathematics anxiety interpreted by three women elementary PSTs?
2. How did each woman relate her experiences with learning mathematics to her experiences of learning to teach mathematics?

Methodology

Site Selection

The study reported in this article was a part of a larger, multi-year and ongoing research project called Teachers Empowered to Advance Change in Mathematics (TEACH MATH)¹. The current study focused on three women who attended a large public university and whose fieldwork and student teaching experiences occurred in low socioeconomic schools in the southwestern part of the U.S. This site was especially advantageous for my study, as this particular teacher-preparation program was committed to creating strong mathematics methods courses and field placements in this content area.

Participant Selection

In this article, I focus on three women elementary PSTs, Estelle, Phoebe, and Roxanne (pseudonyms), who were in their early twenties during the research project. I selected them for my study because, as White women who reported having had intense experiences of mathematics anxiety as K-12 students, they each reflected the demographic composition of 90% of the current elementary teaching force in the U.S. (Beilock et al., 2010). While small in number, this group of participants shared many

¹ The larger TEACH MATH Project includes six university sites. Data for this study was drawn from one of those sites.

extended personal narratives of mathematics anxiety with me over 18 months, enabling me to develop rich portraits of mathematics anxiety through my long-term interactions with them during key phases of their teacher-preparation program. Other women PSTs from the elementary cohort who also reported having issues of mathematics anxiety chose not to participate in my study, citing the time commitment as a principal reason.

Data Sources and Collection Procedures

The three consecutive phases of data collection for my narrative-based study occurred over an 18-month period, beginning in January 2011 when the women were college juniors and ending in May 2012 when they graduated with their Bachelor's degree in Elementary Education. The following table outlines when each narrative data collection instrument was collected and how each one addresses my research questions.

[Insert Table 1]

I used specific types of interviews (i.e. individual and group) and semi-structured prompts to direct the PSTs to share narratives of their mathematical experiences as K-12 students and PSTs. Collecting data over eighteen months allowed me to theorize the mathematics experiences that they shared as they shifted from student to teacher.

Mathematics autobiography. The first kind of personal-experience narrative that I collected was a mathematics autobiography, or a first-person account of the women's experiences with learning and participating in mathematics across their lifespan. They wrote about 1) struggles in mathematics, 2) beliefs that they were viewed as incapable mathematics students, 3) negative mathematics experiences, and 4) unable to connect mathematics to their lives. This narrative source described clear and intense experiences with mathematics and mathematics anxiety.

Individual interviews. I conducted two individual interviews for each PST during their mathematics methods semester and accompanying internship (beginning/end), which focused on topics such as how they envisioned their future mathematics classroom, questions about learning to teach mathematics, and ideas regarding mathematics success and failure. I conducted three pre-observation and three post-observation interviews for each PST that pertained to specific mathematics lessons they taught during the beginning, middle, and end of their student teaching semester. These interviews focused on the content, goals, and concerns of each lesson. They provided me with an explicit data source of each woman's encounters of anxiety during their mathematics teaching.

I conducted a third type of interview during each PST's student teaching semester while each woman had full responsibility for teaching mathematics. Sample questions included rewarding and challenging student teaching experiences as well as questions and worries about teaching mathematics. This data source afforded the opportunity for the PSTs to share narratives about their K-16 histories of learning mathematics as well their experiences with learning to teach mathematics.

I conducted a final interview following each PST's student teaching semester. They were asked to describe their future mathematics class, identify important aspects in teaching mathematics, and describe rewarding and challenging parts of teaching mathematics. All interviews were between 30 and 50 minutes and were audiotaped.

Focus-group interviews. I utilized three focus-group interviews across two of the three semesters of data-collection, as previous research illustrates that conversations between teachers offers a platform for unanswered questions and concerns to be

addressed, even when the issues to be discussed address specific types of anxiety (Hollingsworth & Dybdahl, 2007). The focus group interviews were between one and two hours long and were audio and/or video recorded.

The goal of the first focus-group interview was to explore the narratives of Estelle, Phoebe, and Roxanne's experiences and understandings of their methods courses and fieldwork placements. Questions were asked about how they envisioned their student teaching experiences and future mathematics classes.

The second focus-group interview occurred during the PSTs' student teaching semester. The PSTs were asked to review their mathematics autobiographies and make notes of what they wanted to share with each other, how they felt about experiences recounted in their texts (i.e. meaningful, joyful, or sad passages), and questions they had about learning to teach mathematics (See Appendix A for participant directions and questions).

Conversations that Matter (Stoehr, 2012) was the final focus group data-collection activity utilized in this study. Conversations that Matter provided the women with a narrative tool to unpack their central hopes, fears, and questions about learning and teaching mathematics. Each PST was handed thirteen sentence strips with written prompts related to learning and teaching mathematics (See Appendix B for prompts).

After reading and discussing each prompt, the women individually selected the three sentence strips they believed most enhanced their sense of confidence in teaching mathematics and those three that most contributed to their feelings of mathematics anxiety as new teachers. As a group, they shared, explained, and compared their rankings.

Mathematics timeline. The mathematics timeline (Stoehr, 2012) was the final data-collection activity that was specifically designed and created for this study. In individual meetings, Estelle, Phoebe, and Roxanne were given a piece of chart paper with their photo on it. In the middle of the paper was a timeline. The paper was divided into three sections of boxes. There was one set of conversation bubble boxes above and below the timeline. The top set of boxes was used to record what each woman learned during the three semesters of the teacher-preparation program. The bottom box was for recording the questions and concerns she had encountered during these moments in time.

The women were asked to use the conversation bubble boxes to place themselves on the timeline and to record their storied memories of questions, concerns, and celebratory thoughts about mathematics. They made connections across the eighteen-month period by drawing lines across the different time periods. Upon completion, questions were asked to generate narrative conversations about their timeline (See Appendix C for participant directions and questions).

Data-Analysis Procedures

Phase 1: Did the PSTs experience mathematics anxiety? After collecting the narrative sources described above, I transcribed the audio and/or recordings of the interviews and timeline conversation. As a first analytic pass through the data, I then read the mathematics autobiographies, transcripts, and timelines for evidence of mathematics anxiety.

During multiple subsequent readings of the data, I began an iterative analysis (Bogdan & Biklen, 2006) of the data by demarcating the narratives that pertained specifically to mathematics anxiety in learning and teaching mathematics. I identified a

narrative to be an individual's lived experiences and/or their interpretation of their experiences (Connelly & Clandinin, 1990). For each PST, I identified narratives within transcript and text passages that included key words specific to mathematics anxiety and fears related to learning and learning to teach mathematics. Table 2 lists examples of key words for each participant.

[Insert Table 2]

If a transcript or text passage included one or more of the key words, I identified the passage as describing mathematics anxiety. Periodically, I repeated this demarcation procedure throughout the six months of data analysis to enhance reliability. I wrote analytic memos to gain a clearer understanding of my participants' narratives (Maxwell, 1996).

I divided the narratives that pertained to issues of mathematics anxiety into two categories, stories and reflections. I made this division as a means to capture mathematics anxiety that occurred across two different types of narrative sources. I defined a story as having a basic structure that included an event or a sequence of events with at least one character, a plot, a setting, a theme, and a pattern of action (Carter, 1993). I defined a reflection as pondering one's experiences to understand what had occurred (Schon, 1991). At times, these reflections spontaneously arose from the PSTs' revisiting of the stories of mathematics anxiety they told. Other times, the women were specifically asked to reflect upon mathematics anxiety (i.e. Reader's Theatre and Conversations That Matter). In addition, I noted whether reflections were participant-or researcher-prompted. All of the narrative sources included stories and/or reflections of mathematics anxiety.

Phase 2: In what situations did the PSTs experience mathematics anxiety?

After identifying mathematics-anxiety-related stories and reflections in Phase 1, I sorted these passages according to the period in each PST's educational history referenced by the account of mathematics anxiety (i.e., elementary, secondary, college mathematics, teaching methods courses, internships, student-teaching). I also distinguished between in- and out-of-school experiences of mathematics anxiety across the PSTs' lifespans. Some narratives were told multiple times across the phases but were counted only once and were assembled during the phase in which they occurred.

Phase 3: What did the PSTs fear when they experienced mathematics anxiety? For each story or reflection about mathematics anxiety, I then determined what the PST had feared, a crucial question unaddressed by previous research on elementary PSTs' experiences of mathematics anxiety. My analysis explored the women's specific fears while learning mathematics, learning to teach mathematics, and teaching mathematics. I also considered if their fears persisted or changed over time, and identified particular situations that seemed to trigger their fears.

Phase 4: How did the PSTs cope when they experienced mathematics anxiety? In addition, I investigated coping strategies that the PSTs reported having used in response to their experiences of mathematics anxiety, another important issue unexamined by previous studies. Once I identified a coping strategy, I explored its character according to each PST, when and how it was used, and to what effect(s). In other words, did the PSTs discuss feeling more, less, or the same mathematics anxiety after using the coping strategy? Did she describe the coping strategy as producing success and/or failure regarding learning mathematics, learning to teach mathematics, and teaching mathematics?

Construction of the Case Studies. Having rigorously analyzed each data source for the three women, I assembled case studies for Estelle, Phoebe, and Roxanne. This analytic approach enabled me to highlight the instances and the interpretations of mathematics anxiety that each woman encountered across the three key phases of learning mathematics and learning to teach mathematics. This methodological device allowed me to present each PST's narratives of mathematics anxiety as a substantive and distinct case of mathematics anxiety.

Across the five phases of my data analysis, I wrote analytic memos (Maxwell, 1996) to capture the themes of each PST's narratives. I then utilized the analytic memos to construct each woman's case while arranging their narratives in chronological order. I titled each set of narratives by themes using a composite of each woman's own words to encapsulate the essence of her narrative. Each case highlights how experiences of mathematics anxiety can be differentiated. In other words, mathematics anxiety may be experienced differently by women elementary PSTs, though the character of that fear may be consistent for individuals, as may also be their favored strategies for coping with mathematics anxiety.

Researcher Positionality

I had the unique opportunity and privilege to work with Estelle, Phoebe, and Roxanne for two years. As a woman and a former elementary teacher myself, my participants seemed to identify with me and value my teaching background. I was the instructor of their required classroom management course completed, before they entered the final eighteen months of their teacher-preparation program. Upon entering the first data-collection phase where they all were mathematics methods students, I had already

established a strong rapport and trust with them having provided the support they needed and sought in our previous instructor-student relationship. For example, I made myself available to all my students by arriving to class early and staying after class to entertain any questions or comments they had. I had an open door policy, which meant my students could seek my assistance beyond scheduled office hours.

Working with Estelle, Phoebe, and Roxanne over next eighteen months allowed for a deeper relationship to develop between us. Firstly, I was no longer responsible for assessing their work and attaching a grade to it. Secondly, they had already trusted me with narratives they had written the semester before about facets of teaching that excited and scared them. Moreover, a greater and continued sense of trust developed as the women progressed through the different phases of the teacher education program, as they experienced moments of success and uncertainty, while at the same time working to make sense of what it meant to teach mathematics. To create this trust, I listened to them without interruption, answered their emails in a timely fashion, and supported them as they developed their lessons in mathematics as well as other content areas. In other words, Estelle, Phoebe, and Roxanne knew they could count on me as they made their way through their last eighteen months of their teacher-preparation program. I emphasized to them that learning to teach takes time, especially for elementary teachers who are expected to teach multiple subjects, which may present different levels of competence and confidence. I did not evaluate what they said about their practices or judge them. I did not offer advice unless they asked me. My commitment to them was honoring who they were becoming – both as PSTs and people. The longitudinal quality of my study enabled me to develop rapport with the PSTs over time as I interviewed them

about their experiences with mathematics anxiety at different phases of their teacher-preparation program (James, 2012). Moreover, to address reservations that the PSTs may have felt about admitting their struggles and failures to me, a trusted mentor, I deliberately included in my study design a variety of narrative-eliciting activities for multiple audiences to encourage the teachers to recount many experiences and describe the complex situations in which they occurred.

Findings

Estelle's Experiences of Mathematics Anxiety as a Loss of Social Belonging

Elementary years: Separated from “the smarties.” Estelle described herself as being a fairly confident and capable elementary mathematics student. However, she remembered working “extremely hard” to understand the concepts that surrounded mathematics. By the time Estelle reached fourth grade she described feeling inadequate when the results of a mathematics test did not lead to her being identified as one of the “smart kids.” She recalled:

I really think experiences, you know, from my own personal experiences, being separated at a young age, even in fourth grade you know you're advanced in math yet I'm stuck in the regular class. It always made me feel like I'm just regular but you guys are awesome cause you get to go in a different classroom. Man, I really wished I could be in there! Oh math, I don't like you cause I'm not good at it. (Methods Post Interview, 05-11-11)

Estelle spoke of the sense of defeat she felt in mathematics as well as being partitioned from the students who were seen as the competent and smart kids. This separation or partition seemed to accentuate Estelle's belief that she was inferior in mathematics and

perhaps unable to be as successful as the “smart kids” in mathematics. Moreover, as part of the “regular class,” Estelle could not hide from the fact she had not been labeled as one of the “smart kids” nor she could hide the loss she felt being separated from this group. This loss of membership or opportunities to participate with the “smart kids” appeared to create great anxiety for her.

Secondary Years: Erecting the mathematics wall. As Estelle’s schooling experiences continued, she shared the following memory:

During middle and high school, I know my attitude towards math was 100% affected by my low-test scores. I began to build a wall towards math and it was, and it still is sometimes tough for me to open up and soak up information.

Sometimes teachers would want to talk to me in private about how I was doing in math and they usually were not positive talks. I began to get embarrassed and started to over think even the simplest math equations.

(Mathematics Autobiography, 01-18-11)

Estelle recounted having erected a psychological “wall” to protect herself from others’ negative evaluations of her mathematical performances in school. Initially, “low test scores” represented unfavorable feedback. Then, the “not positive talks” with mathematics teachers about her work became experiences to avoid. As the negative feedback accumulated, Estelle reinforced her wall, which increasingly interfered with her capacities to “open up and soak up information” and to think through the “simplest math equations. Driven by her fear of being seen as an unsuccessful mathematics student, her self-created wall was meant to protect her from the anxiety she encountered. However, the erection of her wall moved her further away from being viewed as one of the

mathematically successful students and limited her opportunities to participate in her mathematics classrooms.

Momentary protection. Estelle recalled by the time she reached high school she had serious doubts about being able to learn mathematics. In an effort to cope with the anxiety associated with her not comprehending mathematics she said the following:

Math is everywhere and it's like you can't get away from it. ... Maybe from like past experience. ... Sometimes I think maybe children can put up a wall against math, I don't know, that's what I did in high school when a teacher would start talking about math and I'd be like, I'm looking at the board, but I am not taking anything in. (Methods Pre-Interview, 02-02-11)

Estelle's narrative suggests she may have enlisted the wall to ward off the anxiety she experienced in the moments when the mathematics lessons were being taught. By her own account, the wall blocked her momentarily from the anxiety associated with not understanding the content but also appeared to distance her even more from opportunities to participate in learning the content. Moreover, the wall helped her to conceal the fact she was not "taking anything in" even as she appeared to be looking at the board and listening to her teacher talk about mathematics.

Undergraduate Teacher-Preparation: Can I be a teacher that knows how to teach mathematics? Despite her mathematics worries, Estelle entered the elementary teacher-preparation program. While taking the required mathematics methods course and internship semester, Estelle thought deeply about how she would teach mathematics to her future students. She shared that, with her student teaching semester looming ahead, she worried about teaching challenging mathematical topics, like decimals and fractions.

I am going to have to almost reteach myself those things again. I want to become a confident math teacher and confident in those lessons so my children, so yeah, this teacher knows what she's talking about.

(Methods Pre-Interview, 02-02-11)

However, as Estelle seriously thought about teaching mathematics she found herself pondering:

How am I going to be a good math teacher? What if I can't reach and teach all of my students?" I kept thinking, "I have to understand what I'm teaching for myself before I can teach it to anybody else." I kept thinking, "This is scary." Math is the one subject that gives me anxiety. (Timeline Activity, 05-02-12)

Estelle's fear of not being able to understand and teach mathematics in a confident manner created great worry for her. She worried that her lifelong struggles with mathematics would be visible to students and that she would, accordingly, be rejected or unable to participate in social interactions with students about/around mathematics.

Strain and stress in teaching fractions. During her student teaching semester, Estelle taught a mathematics lesson on fractions, a content area that created great anxiety for her. She expressed the importance of being able to properly and clearly explain to her students the definition of a numerator and denominator, a concern that tugged at her confidence. She admitted:

I don't know, for some reason when I try to explain the denominator and numerator to students I get a little fumbled. I guess I just don't really know how to, to say it or to explain it. So that would probably be, that would be the part

where I feel nervous about is explaining, you know, the differences between the numerator and denominator. (Pre-Observation Interview, 02-20-12)

When the lesson was over, she shared that when she taught the lesson her students explained to the class the definition of a numerator and denominator. She reported the great sense of relief she felt.

I anticipated, you know, some students getting confused on certain, certain parts that I think, I was mostly concerned with the numerator and denominators, but at, at the beginning of the class I had asked students if they knew which number was the numerator and which number was the denominator and I had students who raised their hand to tell me what a denominator was and what it stood for and what a numerator was and what it stood for. So that was just great that I didn't, I didn't have to explain it to them. They explained it to the entire class.

(Post Observation Interview, 02-21-12)

Estelle seemed to fear if she were unable to teach the fractions lesson well, her students would not regard her as a good teacher. However, she was able to teach from behind the wall as her students shielded her from her confusion of how to explain the two mathematical terms. Their explanations led to the class' understanding of the two words without a contribution from Estelle. Moreover, by teaching from behind the wall, Estelle may have been able to escape her feelings of failure while simultaneously preserving her own sense of worth. In other words, as her students defined the mathematics vocabulary, Estelle was able to associate herself as being a teacher who knew what she was doing.

Concealing the unknown while learning mathematics and learning to teach mathematics. After completing her teacher-preparation program, Estelle discovered that

teaching mathematics seemed to be as challenging as her student experiences of learning mathematics. Concealing or hiding what she did not know about the mathematics content to protect herself from being seen as less than competent was a strategy Estelle employed as a student learning mathematics and as a PST learning to teach mathematics. Thus, her invented wall appeared to enable her to cope with her fears of mathematics anxiety, while allowing her some participation in learning mathematics and learning to teach mathematics.

Phoebe's Experiences of Mathematics Anxiety As A Loss of Personal Identity

Elementary years: How could I be gifted when I have never really “got” mathematics? Phoebe reported that as a young child she was classified as a gifted and talented student despite not really “getting” mathematics. In fact, Phoebe recalled struggling to learn basic addition and subtraction facts. Phoebe remembered her teachers showing her just one way to “do” mathematics without an understanding of what she was doing. She described these early mathematics experiences in her life as being quite traumatic, causing her to “generally hate the subject.” Phoebe admits, “Even today I freeze up when asked a simple math problem.”

Despite her gifted and talented status, Phoebe said she wondered how that could have been true when mathematics was always so challenging for her but not for the other kids who were labeled as gifted and talented. She stated:

That's why it was so hard for me because all of my friends were of that same status I guess you could say. It was hard because I would think about them and they were better at math than I was. That was hard.

(Student Teaching Interview, 03-22-12)

It appeared that Phoebe could not quite understand why she was seen as being one of the more intelligent students when she believed her mathematics ability did not support this recognition. Phoebe's perceived loss of academic identity or recognition for being a gifted student in mathematics seemed to create great anxiety for her. Phoebe worried about how she could uphold her status of being a gifted student when she believed she did not measure up in mathematics.

Secondary years: Mathematics is just “not my thing.” Throughout her elementary and middle school years, Phoebe continued to compare her mathematics ability to the other students who were tracked as gifted. Although she was able to earn passing grades in her mathematics courses, she became more convinced mathematics was “not my thing” and she was not a “math person.” By the time Phoebe reached high school, she reported she struggled to “get” mathematics while her honor level classmates appeared to understand the content. She stated:

In high school when I would get like a D on the test or something and the kids would just, no problem, get As and Bs and it just made sense. I just remember thinking, I just remember not understanding how it made sense to them and not to me. (Student Teaching Interview, 03-22-12)

Phoebe seemed to persist in believing her classmates, who like herself were placed in honor-level classes, had the ability to understand mathematics more than she did. In fact, the tangible evidence of the grades her classmates received when she compared them to her own appeared to confirm to Phoebe she was not as good in mathematics as her advanced peers. These experiences may have served to heighten her anxiety and fear of not being recognized as a gifted student in mathematics, threatening her loss of personal

identity with her gifted label. She stated that as soon as she had met her high school mathematics requirement, she chose not to take any more mathematics classes.

Undergraduate teacher-preparation: I am more of a language arts/social studies teacher. During her teacher-preparation program, Phoebe took a required course in elementary mathematics teaching methods. A major component of Phoebe's mathematics methods course was a teaching internship in a local elementary school. Phoebe shared how challenged she felt when she was required to write a mathematics lesson plan. Moreover, she admitted the mathematics lesson plans were the hardest of the content lesson plans for her to write. She attributed her difficulty in preparing the mathematics lessons plans to the fact she considered herself to be more of a language person with a love of social studies who "shied" away from mathematics. Thus, Phoebe could protect her gifted status by not judging herself on her mathematics teaching, as after all, mathematics was "just not her thing."

Reaching for the teaching crutch. Phoebe talked about how using the curriculum could take control of what she needed to be teaching. She thought by adhering directly to the curriculum she might be able to overcome some of the anxiety she experienced when she thought about teaching mathematics in the future. She said:

It's easier to sit back because you really don't have anyone really like other than the test I guess breathing down your back. You could just be like okay, this is the curriculum, I'm just going to teach this because this is what it tells me to do. ... I really want to make math more relevant to the kids but being nervous you're just like okay. (Methods Post Interview, 05-11-11)

When Phoebe decided that teaching mathematics became too stressful for her, she devised a plan that would “tell her what to do.” She viewed letting the curriculum take over the teaching as a means to deal with her nervousness about teaching mathematics. Moreover, with Phoebe’s belief that she was not a “math person,” the utilization of the prescribed mathematics curriculum appeared to help alleviate her mathematics anxiety. Perhaps she could limit the anxiety she encountered when confronted with losing her personal identity of being gifted.

What do I do when I do not know what to do? During her student teaching semester, Phoebe reported she felt the most anxious about teaching mathematics when she was nervous about the content. She told the following story about her worries of teaching a geometry lesson, a content area that created great anxiety for her in high school. She recalled:

With this geometry lesson I just would go home at night thinking, “I don’t know what to do tomorrow!” I think I just feel so responsible for their learning that I think if I don’t know what to do, how are they gonna learn? And how are they gonna be successful? ... I want them to be learning, too, even though I am as well. Yeah, that’s been stressing me out a little bit lately.

(Student Teaching Interview, 03-22-12)

Phoebe expressed how unequipped she felt to be teaching a geometry lesson. She worried about how her own content weakness in geometry would affect her students. She displayed a deep concern for her students’ learning and seemed to wonder how she could learn and teach the geometry lesson at the same time. It appeared her anxiety was heightened, as she believed math was “not her thing.” Phoebe’s identity of being a gifted

person was at stake while she struggled to teach a geometry lesson - just like she had struggled to learn this content area in high school.

Will I ever get a break from teaching mathematics? As Phoebe finished student teaching and prepared to embark upon her new profession as an elementary teacher, she reflected upon her experiences as a student of mathematics and a PST. She said:

Math is not my favorite subject. I just don't particularly care for math. ... I prefer the language arts. Sometimes it's just like I'm tired of talking about math. I wanna move onto something else. I think it's because it's difficult sometimes. ... I think as much as I feel like math is going well in my class, sometimes I'm like can we just not do math for a week? It would be so nice. It's a stressful subject to teach and I just want to be effective and I want the students to learn what they need to learn. ... I want my students to not have the experiences that I had where I felt just completely unsuccessful. ... I just want them to feel successful and I think that's a struggle because I feel so much responsibility for their learning that it makes it really hard. (Conversations That Matter, 03-31-12)

Phoebe was open and honest about her negative feelings towards mathematics. She found mathematics to be a subject that was stressful for her as a student and as a practicing teacher as opposed to her fondness and excitement of language arts. Although she did not particularly like mathematics and did not envision herself as strong in mathematics, Phoebe felt great responsibility to provide her students with a positive and successful mathematics journey. The anxiety Phoebe encountered while teaching mathematics made her dream of having occasional breaks from teaching mathematics

altogether. Unlike Estelle, who created a wall to protect herself from the anxiety she encountered while learning mathematics and learning to teach mathematics, Phoebe coped with mathematics anxiety throughout her mathematics history by clearly stating her gifted status did not include mathematics. Thus, she hoped she could cling onto the status she was assigned as a young child.

Roxanne's Experiences of Mathematics Anxiety as a Loss of Practical Competency

Elementary years: The mathematics roller coaster ride. Roxanne described her experiences with mathematics as “a sore subject,” she never really understood. She stated that learning mathematics was not a fun nor relevant experience for her but a subject she needed to “get through.” During her elementary school days, she remembered her teachers modeling problem solving strategies she did not always understand but was required to use when completing her mathematics assignments. Roxanne recalled feeling nervous to ask her teachers for help when she did not understand a concept. In fact, Roxanne stated, “Really I can count on my hand good experiences in math for me that were memorable.” From early on, Roxanne’s narratives suggest she struggled knowing how to complete the mathematics tasks presented to her in school. Thus, Roxanne grappled with the loss of practical competency or the knowledge to complete required school mathematical tasks.

Roxanne stated as the years of learning mathematics pressed on, her confidence dropped, leaving her feeling “dumb” without much hope of ever really knowing what she was doing. However, when Roxanne was in sixth grade, her family moved to a different part of the U.S. She remembered being placed in a class where she felt inspired by her new teacher’s positive insight. Moreover, Roxanne discovered she had already been

introduced to the mathematics being taught in her new school. Therefore her confidence soared, especially as she was placed in the gifted and talented mathematics class.

Roxanne was able to revise mathematical concepts she had not mastered and/or had failed and that had previously been a source of mathematics anxiety. This led her to experiencing instances of successfully “getting through” mathematics.

Secondary years: From gifted to deficit. Unfortunately, by the time Roxanne entered high school, her attitude towards mathematics once again spiraled downwards. Having been tracked as a gifted and talented middle school mathematics student, she was placed in honors level mathematics classes. She found her classes to be taught primarily by teachers whom she reported utilized a lecture-based format, requiring her to memorize mathematical rules and formulas she did not completely understand. She remembered knowing how to take notes and follow the mathematics procedure modeled by her teachers that she hoped would result in her “getting through” this content area but “to use it and apply the material was just gone. I didn’t know how to do it.” Confronted once again with the loss of practical competency, Roxanne experienced failure as she sought to complete required mathematical tasks.

Sadly, Roxanne said her days of learning mathematics tended to be “one bad experience” with more instances of low grades than high marks. When Roxanne reflected upon her student days of learning mathematics she stated, “I didn’t have the confidence and I wasn’t doing well.” Roxanne’s continuous negative experiences of learning mathematics appeared to lead her to believe she lacked the comprehension to be successful in this content area.

Upon exiting from high school, Roxanne had self-doubts about her mathematical abilities, especially as she was labeled as having a mathematics deficit on her transcript. Moreover, as Roxanne entered the elementary teacher-preparation program, she shared how her limited mathematics background made her nervous. The creation of the mathematics deficit label assigned to Roxanne seemed to suggest to her she lacked competence in being successful in this content area. Thus, Roxanne experienced the loss of practical competency or the knowledge to complete required school mathematical tasks.

Undergraduate teacher-preparation: Can you show me how to teach mathematics? Like Estelle and Phoebe, Roxanne was enrolled in the required elementary mathematics teaching methods class where a major component of the course was a teaching internship in a local elementary school. Roxanne revealed that at the beginning of the semester she was anxious about learning to teach mathematics, stating one of her major concerns was how to “become the teacher who has everybody feel like they can do it.” As she pondered this concern, Roxanne said she was excited to learn procedures to help her meet this goal. Unfortunately, her experience in her mathematics methods internship did not help her to achieve this goal. As a matter of fact, Roxanne stated things “kind of went downhill.”

Roxanne stated she did not see a connection between what she was learning in mathematics methods and what Ms. A (her mentor teacher) was doing in her classroom.

She [Ms. A] didn't do the things the way we were doing in methods. She had like her own plan. ... Like I just didn't see a correlation to what we were doing [in methods] and what she was doing, so I was confused on what to do at that point.

That's why I was kind of like, "Am I dumb?" because I didn't know some of the things she was trying to teach and some of the stuff we were doing in class like concepts with problem solving and probability. I was just like, "Whoa, I don't know what's going on," and so I felt kind of dumb.

(Timeline Activity, 04- 25-12)

As Roxanne finished her mathematics methods course and the accompanying classroom internship she shared the nervousness she experienced as she thought about moving forward in her teacher-preparation program. She expressed the following concerns:

How do you teach something if you don't know it? There were projects and little problem solving things that we did in [methods] class ... and if I didn't know it I felt dumb, so I kept saying, "Well how can I be a teacher if I don't even know how to do this stuff myself," so I just kind of lost a little bit of confidence there.

(Timeline Activity, 04- 25-12)

As Roxanne was trying to make sense of what it meant to teach mathematics, she discovered she did not know some of the mathematics content she encountered in Ms. A's classroom and in her mathematics methods course. She questioned her mathematical confidence, just as she did during her K-12 years sharing she "felt kind of dumb." Roxanne worried about being able to teach the mathematics tasks expected of her, realizing she did not have the necessary knowledge she needed to complete the tasks. Her hope that she would "learn procedures" that would result in her future students' successful learning and that would help her "get through" teaching mathematics was

dashed, as she experienced the loss of practical competency expected of her in this content area.

Navigating her way through student teaching with the wonderful Ms. J.

Roxanne spent her final semester in her elementary education program student teaching in Ms. J.'s second grade classroom. She recalled how Ms. J consistently treated her in a kind, professional and supportive manner. In addition, Roxanne talked about the importance of being able to seek Ms. J's support when she experienced anxiety or nervousness while teaching mathematics. She also found she could accept Ms. J's feedback without feeling criticized or shamed. She talked about how Ms. J. "really built my confidence." She said:

I have a really good relationship with my mentor teacher, so I just go to her and am like what does this mean and how do I do this? I feel like as long as there's a safe person to go to, I don't want to feel dumb but I also want to make sure that I understand so that when I get up there I'm not confusing the kids. ... I felt like her criticism was structured enough. I accepted it because I knew she wasn't trying to belittle me, or make me feel dumb. (Timeline Activity, 04-25-12)

Roxanne's positive and trusting relationship with Ms. J suggested she could seek help when she needed support in teaching mathematics. Roxanne seemed to have built a level of trust level with Ms. J that allowed her to be vulnerable and admit when she needed help and Ms. J's input. Thus, Roxanne was able quell the anxiety she experienced when she lacked the knowledge to complete required mathematics teaching tasks. Therefore, the relationship Roxanne developed with Ms. J appeared to provide her with a way to "get through" teaching mathematics.

Just don't want to feel dumb. As Roxanne completed her elementary teacher education program she spoke of the importance of having “a safe person” to go to for help when she felt unsure about mathematics.

I just feel like as long as there's a safe person to go to, I don't want to feel dumb but I also want to make sure that I understand so that way when I get up there, I'm not confusing the kids. ... When I feel unsure about a math concept, I just feel unsure completely. ... Nobody wants to feel like they're dumb or can't do it.

(Conversations That Matter, 03-31-12)

Roxanne questioned if she was “dumb” in mathematics when she was a student learning mathematics, in her mathematics methods course and her accompanying internships and when she was a student teacher. Roxanne seemed to believe that this description was assigned to her from early on. She hoped she would always have a “safe person” by her side to guide her learning and teaching of mathematics to get her “through.” This was especially true, as she wrestled with the absence of knowledge she needed to complete the required task of teaching mathematics. Without such a person, Roxanne felt more susceptible to feeling anxious about her mathematical ability.

Unlike Estelle, who created a wall to protect herself from the anxiety she encountered throughout her mathematics history or Phoebe who coped with mathematics anxiety by clearly stating her gifted status did not include mathematics, Roxanne's experiences of mathematics anxiety were pinned to the hope that she could just “get through” this content area with a safe person to help guide her through the teaching of mathematics.

Discussion

All three women reported experiencing mathematics anxiety while learning mathematics as K-12 students, while learning to teach mathematics as college students enrolled in a teacher-preparation program, while imagining themselves as future mathematics teachers, and while engaging in their early attempts to teach mathematics during their student-teaching internships. Thus, my research suggests that experiences of mathematics anxiety may not be limited to formal testing situations as indicated by prior research (Bursal & Paznokas, 2006; Luo et al., 2009; Mc-Glynn-Stewart, 2010) but, instead, may arise in response to a range of experiences with mathematics, both enacted and imagined, across a lifetime. While I do not argue that all individuals who experience mathematics anxiety will find it pervades their mathematical histories, my participants' narratives suggest a generalized experience of mathematics anxiety can occur.

Additionally, I have shown that the three women experienced mathematics anxiety as specific and distinct fears. Estelle described the dreaded consequence of failing to exhibit mathematical competency as the loss of social belonging, or opportunities to participate; Phoebe, as the loss of personal identity, or recognition for being a gifted individual; and Roxanne, as the loss of practical competency or the knowledge to complete required school mathematics tasks. Moreover, as I have elaborated in my three case studies, each woman developed a related coping strategy, which she used repeatedly across her mathematical experiences, even when the strategy failed to protect her from stress, embarrassment, and demoralization. Estelle concealed from others behind "the wall" what she understood to be her lack of mathematical knowledge and skills; Phoebe insisted she was "not a math person," and Roxanne focused on concrete methods for

"getting through" mathematical experiences. Previous studies of mathematics anxiety have attended primarily to the physiological and psychological feelings of mathematics anxiety (Hembree, 1990; Trujillo & Hadfield, 1999; Vinson, 2001). For example, Luo et al., (2009) investigated affective responses to mathematics tests like panic, helplessness, confusion, depression, nervousness, fear, and dissociation. My study adds to this work by considering how individuals make sense of their feelings of mathematics anxiety and attempt to diminish its effects on their lives. Thus, my study challenges "one size fits all" orientations towards mathematics anxiety.

As an example of the range of activities that prompted mathematics anxiety for my participants, all three reported feeling their earliest experiences with mathematics anxiety in relation to what they perceived as "ability" grouping. When Estelle was separated from the advanced students in her childhood elementary mathematics class, she felt anxiety and in response created her own "wall" to conceal what she did not know about this content area. In response to being classified as a universally "gifted" student throughout her K-12 years, Phoebe invented another all-encompassing identity, "not a math person," to protect her from the anxiety she felt when she did not understand mathematics concepts. Phoebe hoped her non-math person status could co-exist with her gifted status. Roxanne was labeled as both a "gifted" and a "deficient" mathematics student, apparently without careful assessments of her mathematical abilities. Feeling confused and anxious about what group she belonged in, Roxanne came to regard mathematics education as something to endure, to bear for a limited time like an ill-fitting label. Thus my research indicates that the strategies for coping with mathematics anxiety that individuals seemingly create on their own may, in fact, be tightly related to their

experiences with ability grouping and may even have been suggested to them by those situations. Previous research confirms how harmful and misguided ability grouping in mathematics can be (Boaler, Williams, & Brown, 2000). My study adds to the conversation on ability grouping by showing that experiences of mathematics anxiety may arise from how individuals interpret their ability grouping status.

Although the women could not rely on their coping strategies to protect them from mathematics anxiety at all times (e.g. Estelle did not always have students who could provide mathematical explanations on her behalf, Phoebe's image of herself as a non-math person did not exempt her from teaching mathematics lessons, and Roxanne, after leaving Ms. J's classroom, could not always depend on mentor teachers to provide step-by-step explanations of mathematics teaching methods), their coping strategies nevertheless temporarily protected them from completely avoiding mathematics. Thus, my research provided evidence that strategies for coping with mathematics anxiety may be reused by individuals because at times, these strategies may work to temper the anxiety. Prior research has presented experiences of mathematics anxiety as momentary states rather than as recurring experiences (Brady & Bowd, 2005; Bursal & Paznokas, 2006; Harper & Daane, 1998; Hembree, 1990; Sloan, Daane, & Giesen, 2002). What has not been considered is the coping strategies that individuals develop in response to experiences of mathematics anxiety or examined how these strategies may be used repeatedly over time. Therefore my study adds to this literature by considering individuals' long histories not only with mathematics anxiety but also with particular strategies for coping with mathematics anxiety.

These three case studies also reveal that despite repeated experiences of mathematics anxiety as K-12 students and as PSTs, the women clung to the hope that when they stepped into their own classrooms, they would be able to teach elementary mathematics. Estelle hoped her desire to become a confident mathematics teacher would pull her through teaching this content area that created such angst for her. Phoebe's plan was to rely on the mathematics curriculum to guide her through teaching mathematics in her future classroom. Roxanne hoped she would find a "safe person" in whom to find support as she took on the responsibilities of a first-year teacher. Thus, my research indicates that although some PSTs experienced mathematics anxiety across the various junctures of learning mathematics and learning to teach mathematics, their strategies to cope with mathematics anxiety served as a means for them to continue to pursue their goal of becoming a competent and successful elementary teacher. Previous research has shown that PSTs who battle mathematics anxiety both while learning mathematics and while learning to teach mathematics often believe they will be able to teach mathematics (McGlynn-Stewart, 2010; Swars et al., 2006). My research suggests a possible, if partial, explanation for this surprising trend by demonstrating the power of PSTs' strategies for coping with mathematics anxiety in helping them to pursue careers as teachers, despite long-term experiences with mathematics anxiety.

Implications For Teacher Education Research and Practice

My findings suggest several possibilities for future teacher education research and practice. My study focused on three White women elementary PSTs who reported having experienced mathematics anxiety during their educational histories: in other words, PSTs whose demographic traits were consistent with the larger elementary teaching force in the

U.S. Nevertheless, opportunities remain to investigate how other social groups experience and respond to mathematics anxiety: for example, men, teachers of color, multilingual teachers, teachers with varying class backgrounds, secondary and college mathematics teachers, and teachers at different stages of their career. Such new research might help to establish the frequency and persistence of prospective and practicing teachers' experiences of mathematics anxiety in prospective and practicing teachers. Moreover, these inquiries might reveal important variations and patterns in the specific fears felt by sufferers of mathematics anxiety and in their coping strategies. Connections between mathematics anxiety and particular mathematical topics (to learn and to teach) might also be explored, as might anxiety related to other content areas.

This knowledge would inform the work of teacher educators, who might then exercise enhanced sensitivity while addressing certain topics and practices in their mathematics methods courses. Moreover, during such courses, teacher educators might themselves inquire into PSTs' experiences with mathematics anxiety, specific fears, and favored coping strategies. University-based teacher-preparation programs regularly invite PSTs to identify patterns in their thinking, speaking, and acting as a means of cultivating professional knowledge, skills, and dispositions. An additional focus on feeling would be consistent with this approach. However, time constraints might not allow teacher-preparation classes to generate and analyze the number of personal narratives and reflections collected in my study. As an adaptation, perhaps teacher educators might revisit one such narrative (e.g., mathematical autobiographies) at different critical moments in mathematics methods courses or across milestones in teacher-preparation programs. However, teacher educators might have to take special care in ensuring PSTs'

psychological safety as they create and share personal narratives of experiences with mathematics anxiety. Perhaps teacher educators might recount their own stories to their classes and thus model appropriate boundary-setting regarding personal disclosures. Knowing more about PSTs' experiences with mathematics anxiety, specific fears, and coping strategies might help teacher educators to highlight and challenge PSTs' less effective moves as new educators. Nevertheless, it may be that, for some PSTs, mathematics anxiety will not go away. The three cases in this study illustrate how pervasive and deep-seated mathematics anxiety can be. The persistence of Estelle's, Phoebe's, and Roxanne's experiences of mathematics anxiety across their educational histories and their reliance on coping strategies that brought little or no relief suggest a possible, if partial, explanation for elementary PSTs' well-documented resistance to new visions and methods of mathematics learning and teaching. They may simply be too afraid to experiment and too resigned to failure. However, collaborative research projects between mathematics education researchers and teacher educators would be necessary to fully investigate this possibility.

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References

- Atkinson, R. (2007). The life story interview as a bridge in narrative inquiry. In D. J. Clandinin (ed.), *Handbook of narrative inquiry* (1st ed., pp. 224–246). Thousand Oaks, CA: Sage.
- Boaler, J., William, D., & Brown, M. (2000). Students' experiences of ability grouping-disaffection, polarization, and the construction of failure. *British Educational Research Journal*, *26*(5), 631–648.
- Ball, D. (1988). Unlearning to teach mathematics. *For the Learning of Mathematics*, *8*(1), 40–48.
- Beilock, S., Gunderson, E., Ramirez, G., & Levine, S. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(5), 1860–1863.
- Bogdan, R.C, & Biklen, S. K. (2006). *Qualitative research for education: An introduction to theories and methods* (5th ed.). New York, NY: Pearson.
- Brady, P. & Bowd, A. (2005). Mathematics anxiety, prior experience and confidence to teach mathematics among pre-service education students. *Teachers and Teaching: Theory and Practice*, *11*(1), 37–46.
- Brown, A., Westenskow, A., & Moyer-Packenham, P. (2012). Teaching anxieties revealed: Preservice elementary teachers' reflections on their mathematics teaching experiences. *Teaching Education*, *23*(4), 365–385.
- Bursal, M., & Paznokas, L. (2006). Mathematics anxiety and preservice elementary teachers' confidence to teach mathematics and science. *School Science and Mathematics*, *106*(4), 173–180.

- Carter, K. (1993). The place of story in the study of teaching and teacher education. *Educational Researcher*, 22(1), 5–12.
- Carter, K. (1994). Preservice teachers' well-remembered events and the acquisition of event structured knowledge. *Journal of Curriculum Studies*, 26(3), 235–252.
- Clandinin, D. J. (1989). Developing rhythm in teaching: The narrative study of a beginning teacher's personal practical knowledge of classrooms. *Curriculum Inquiry*, 19(2), 121–141.
- Connelly, F. M. & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2–14.
- Drake, C. (2006). Turning points: Using teachers' mathematics life stories to understand the implementation of mathematics education reform. *Journal of Mathematics Teacher Education*, 9, 579–608.
- Garrahy, D. (2001). Three third-grade teachers' gender-related beliefs and behavior. *The Elementary School Journal*, 102(1), 81–94.
- Gavin, M. & Reis, S. (2003). Helping teachers to encourage talented girls in mathematics. *Gifted Child Today*, 26, 32–45.
- Goodell, J., & Parker, L. (2001). Creating a connected, equitable mathematics classroom: Facilitating gender equity. In B. Atweh & H. Forgas (Eds.), *Sociocultural research on mathematics education: an international perspective*. (pp. 411–432).
- Goodson, I., & Sikes, P. (2001). *Life history research in educational settings: Learning from lives*. Philadelphia, PA: Open University Press.
- Harper, N. W., & Daane, C. J. (1998). Causes and reductions of math anxiety in preservice elementary teachers. *Action in Teacher Education*, 19(4), 29–38.

- Hembree, (1990). Nature, effects and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, 21(1), 33–46.
- Hollingsworth, S., & Dybdahl, M. (2007). Talking to learn: The critical role of conversation in narrative inquiry. In D. J. Clandinin (ed.), *Handbook of narrative inquiry* (1st ed., pp. 146–176). Thousand Oaks, CA: Sage.
- James, J.H. (2012). Caring for others: Examining the interplay of mothering and deficit discourses in teaching. *Teaching and Teacher Education*, 28, 165–173.
- Luo, X., Wang, F., & Luo, Z. (2009). Investigation and analysis of mathematics anxiety in middle school students, *Journal of Mathematics Education*, 2(2), 12–19.
- Maxwell, J. A. (1996). *Qualitative research design: An interactive approach* (2nd ed.). Thousand Oaks, CA: Sage.
- McGlynn-Stewart, M. (2010). Listening to students, listening to myself: Addressing pre-service teachers' fears of mathematics and teaching mathematics. *Studying Teacher Education*, 6(2), 175–186.
- Mizala, A., Martinez, F., & Martinez, S. (2015). Pre-service elementary school teachers' expectations about student performance: How their beliefs are affected by their mathematics anxiety and student's gender. *Teaching and Teacher Education*, 50, 70–78.
- Sadker, D., Sadker, M., & Zittleman, K. (2009). *Still failing at fairness*. New York, NY: Scribner.
- Schon, D. (1991). *The reflective turn: Case studies in and on educational practice*. New York, NY: Teachers College Press.

- Sloan, T. (2010). A quantitative and qualitative study of math anxiety among preservice teachers. *The Educational Forum*, 74(3), 242–256.
- Sloan, T., Daane, C. J., & Giesen, J. (2002). Mathematics anxiety and learning styles: What is the relationship in elementary preservice teachers? *School Science and Mathematics*, 102(2), 84–87.
- Steele, C., Spencer, S., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. *Advances in Experimental Social Psychology*, 34, 379–440.
- Stoehr, K. & Carter, K. (2011). Girls vs. boys in mathematics: Test scores provide one interpretation girls narratives suggest a different story. *Proceedings of the Hawaii International Conference on Education*, p. 3276–3283. Honolulu, HI.
- Stoehr, K. & Carter, K. (2012). Positive turning points for girls in mathematics classrooms: Do they stand the test of time? In Van Zoest, L.R., Lo, J. J., & Kratky, J. L. (Eds.). *Proceedings of the 34th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, p.765–768. Kalamazoo, MI: Western Michigan University.
- Swars, S. L., Daane, C. J., & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary preservice teachers? *School Science and Mathematics*, 106(7), 306-315.
- Trujillo, K. & Hadfield, O. (1999). Tracing the roots of mathematics anxiety through in-depth interviews with preservice elementary teachers. *College Student Journal*, 33(2), 219–233.

Vinson, B. M. (2001). A comparison of preservice teachers' mathematics anxiety before and after a methods class emphasizing manipulatives. *Early Childhood Education Journal, 29*, 89–94.

Wood, M., Jilk, L., & Paine, L. (2012). Moving beyond sinking or swimming: Reconceptualizing the needs of beginning mathematics teachers. *Teachers College Record, 114*(8), 1–44.