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Time, Time, Time: Perceptions of the Causes of Mathematics Anxiety in Highly Maths Anxious Female Adult Learners

Molly M. Jameson[1]

Abstract

Adult learners and female students report higher levels of mathematics anxiety than their peers, suggesting that female adult learners may be particularly vulnerable. This study used Bandura's triarchic reciprocal causality model as a foundation and interviewed five highly mathematics anxious female adult learners to understand their perceptions of the causes of their mathematics anxiety. Thematic interpretation revealed five themes from the interviews; *time since last educational experience* emerged as the strongest theme, with other personal and environmental factors also emerging. The findings support a social cognitive perspective of mathematics anxiety. Suggestions for pedagogical techniques with adult learners are included.

Keywords

mathematics anxiety, female adult learners, triarchic reciprocal causality, social cognitive perspective

The undergraduate population has recently diversified, particularly in adult learners (approximately 38% of the postsecondary population in the United States; National Center for Education Statistics, 2009). Adult learners are postsecondary students aged 25 years and older or those younger than 25 years who have characteristics indicative of adult responsibilities (e.g., full-time employment, having dependents, financial

[1]University of Northern Colorado, Greeley, CO, USA

Corresponding Author:
Molly M. Jameson, Educational Psychology, School of Psychological Sciences, College of Education and Behavioral Science, University of Northern Colorado, 501 20th Street, Campus Box 94, Greeley, CO 80639, USA.
Email: molly.jameson@unco.edu

independence, single parenthood, and a nontraditional educational trajectory [e.g., delayed entry into university]; Choy, 2002). Adult learners face different barriers to their education than other students which can result in delay in returning to college, repetition of courses, and increased attrition (Bailey & Alfonso, 2005; Osam et al., 2017). The least understood barrier faced by adult learners are psychological barriers (Goto & Martin, 2009; Osam et al., 2017)-the barriers that include personal factors such as confidence, self-esteem, and emotions. These barriers, the causes, and impact on adult learners' performance, beliefs, and outcomes, are not well-studied. Literature in psychological science points to the likely impact these barriers have on learning. Looking closer at one psychological barrier that may be especially influential, mathematics anxiety, can help explain the difficulties adult learners face in mathematics courses (FitzSimons & Godden, 2000). Using Bandura's (1978, 1989) triarchic reciprocal causality model, this research seeks to understand the psychological barrier of mathematics anxiety in female adult learners through their own voices. Using interviews, five female adult learners who self-reported high mathematics anxiety discussed their perceptions of the causes of that personal barrier and what universities can do to assist them.

Literature Review and Theoretical Perspective

Mathematics anxiety, feelings of tension when completing numeric problems (Ashcraft, 2002), is not specific to adult learners. Mathematics anxiety occurs in primary and elementary students (Cargnelutti et al., 2017; Jameson, 2013, 2014), secondary students (Passolunghi et al., 2016), and traditional college students (Hendy et al., 2014). Similar correlates are found across these groups including low mathematics confidence, decreased enrollment in elective mathematics courses or mathematical majors in college, and decreased mathematics performance (Dowker et al., 2016). Maths anxiety is likely the result of both cognitive (e.g., Ashcraft & Krause, 2007; Suarez-Pellicioni et al., 2016) and social cognitive factors (e.g., Chang & Beilock, 2016; Ramirez et al., 2018). This area has been understudied in adult learners, however. Evans (2000) conducted qualitative work with adult students in mathematics and found that 75% of men participants and 100% of women participants were coded as expressing anxiety in relation to math. Jameson and Fusco (2014) found lower levels of mathematics self-efficacy among adult learners and a positive correlation between age and math anxiety. These studies provide valuable evidence of psychological barriers in adult learners but fail to explain *why* adult learners have maths anxiety. Exploring this from Bandura's model of triarchic reciprocal causality can provide some answers.

Triarchic Reciprocal Causality

Bandura's (1978, 1989) model of triarchic reciprocal causality purports that individuals learn through a combination of personal, environmental, and behavioral factors that reciprocally influence one another. As one factor is modified, it influences other

factors, which in turn influence other factors. Through this dynamic interaction of factors, individuals learn both how to perform behaviors and self-relevant information.

Personal Factors Influencing Learning. Perhaps the most influential personal factor is self-efficacy, an individual's confidence in their ability to successfully complete a task (Schunk & DiBenedetto, 2016). While a person's actual ability level matters in their success, their belief about the likelihood of success is quite influential to whether they succeed and their behaviors and thoughts surrounding the task. Highly self-efficacious individuals are likely to begin tasks quickly, persist through difficulties, ask for help when needed, and have mastery-oriented goals, all success-related behaviors (Schwarzer, 2014). In mathematics, highly self-efficacious individuals have higher scores on mathematics tests and in mathematics courses (Chang & Beilock, 2016; Jameson & Fusco, 2014).

The source of self-efficacy is particularly relevant; in adults, self-efficacy is most strongly developed through mastery experiences, our direct experiences with success or failure (Usher & Pajares, 2008). A student who earns a good grade on an exam will likely see this as a positive direct experience and have an increase in self-efficacy; conversely, a student who earns a low grade on an exam will likely see this as a negative direct experience and have a decrease in self-efficacy. While self-efficacy develops through other means (Usher & Pajares, 2008), our mastery experiences are particularly important in adulthood. Because adult learners typically return to university after non-academic experiences, they bring real-world mastery experiences to draw on in the classroom; using these personal experiences can be an effective technique to teaching and increasing adult learners' efficacy (Chen, 2017). Helping adult learners transfer experiences to the classroom can be difficult due to disconnect between student perceptions about learning inside and outside of the classroom (Leberman & McDonald, 2006). Jameson and Fusco (2014) suggest that adult learners' low self-efficacy may be due to the lack of recent formal educational experiences, and thus a lack of academic mastery experiences to build their self-efficacy in academic tasks.

Environmental Factors Influencing Learning. Family can serve as either a barrier or a support to success in higher education. While some students report family support for returning to school (Kasworm, 2008), others experience discouraging remarks, such as being called "worth nothing" (Zacharakis et al., 2011). In focus groups with adult learners, students reported that education was not valued by their family, friends, or community, leaving little to no support for academic efforts (Zacharakis et al., 2011). However, family can also serve as encouragement for educational attainments. Elman and O'Rand (2007) report that family commitments may temporarily impede educational progress, but may actually serve as a platform to increase likelihood of college entry. This is supported by Deutsch and Schmertz (2011) who report that nearly half of their participants state that obtaining a college degree supersedes the challenge of raising a family while attending college.

Most research with adult learners indicates that they prefer instructors who they view as high in warmth and high in academic expectations, that is who are motivating, approachable, available, and supportive (Donaldson et al., 1993; Miglietti & Strange, 1998; Phillips et al., 2017; Ross-Gordon, 1991) but also clear, organized, and knowledgeable (Ross-Gordon, 1991; Sogunro, 2015). Hands-on activities and more student-centered techniques are frequently cited by adult learners as desirable in-class teaching methods (Ross-Gordon, 2003; Zacharakis et al., 2011).

The classroom environment, including attitudes, can affect student learning. Adult learners may be aware of the differences between them and traditional students, which may activate the stereotype that they are not "college material." When a stereotype is activated it can result in stereotype threat, fear of confirming the stereotype leads to decreased performance (Steele & Aronson, 1994). Relevant to this study is stereotype threat in women and mathematics (Spencer et al., 1999) and older students. Hollis-Sawyer (2011) found an age-related decrement stereotype belief (i.e., that older students are not as intellectually competent as their younger counterparts) may result in adult learners' lower performance. This may be particularly true for women in mathematics, as a stereotype continues to exist that mathematics is a masculine domain (Siivonen, 2013), so female adult learners may be subject to a double stereotype effect in mathematics (Lamont et al., 2015). This suggests that female adult learners are a particularly important student group to understand.

Behavioral Factors Influencing Learning. Rate of degree completion is a strong behavioral factor in adult learners. Older students are less likely than younger students to complete their degrees (Adelman, 2005; McGivney, 2004) particularly in online or distance courses (Park & Choi, 2009). Older students are also more likely to experience barriers to their education, and several (e.g., family support, financial issues, and institutional factors) are particularly important to degree completion. Mathematics may serve as a specific barrier to degree completion. Calcagno et al. (2007) found that adult learners entered college with almost 87 points standardized mathematics deficit compared with traditional counterparts and are more likely to take remediation in mathematics. Students who take remedial courses are less likely to complete their degrees (Adelman, 1999; Bailey & Alfonso, 2005). However, adult learners in Calcagno et al.'s (2007) study were not negatively affected by remediation as were traditional students, suggesting that remediation may be beneficial to adult learners. However, this study only included adult learners who completed the developmental mathematics course, and these courses tend to have the highest rates of failure and noncompletion of any developmental subject area (Bonham & Boylan, 2011).

Current Study

Despite the connections made between Bandura's (1978, 1989) triarchic reciprocal causality model and adult learners in mathematics classes, there is a dearth of scholarship with adult learners' maths anxiety. Therefore, this exploratory study sought to use information from adult learning and triarchic reciprocal causality to understand the

experiences of highly mathematics anxious female adult learners. We sought to answer the following research questions through interviews:

Research Question 1: To what do highly mathematics anxious female adult learners attribute their high levels of anxiety?
Research Question 2: How do highly mathematics anxious female adult learners perceive various environmental and personal factors in the development of their mathematics anxiety?
Research Question 3: What do highly mathematics anxious female adult learners believe that higher education institutions can do to assist them in mathematics?

Method and Data Analysis

Participants

Through collaboration with the University's adult learner services program, five female adult learners who self-identified as highly mathematics anxious were recruited. All participants were completing baccalaureate degrees at a public university in the Midwestern United States. Participants selected a pseudonym, provided below, which is used throughout the research.

Jess is a 30-year-old White female in her sophomore year. She is a social work major with a self-reported cumulative grade point average (GPA) of 3.0. Her most recent mathematics course in college was the semester prior to her interview and she had completed four mathematics courses during college (three developmental courses). She identified history as her favorite core subject and her highest performing course during her K-12 experience. Jess reported an overall mathematics anxiety score of 30/45.

Josie is a 33-year-old White female in her sophomore year. She is a psychology major with a self-reported cumulative GPA of 2.0. Her most recent college mathematics course was concurrent with data collection and she had previously taken a developmental mathematics course. She identified English as her favorite and highest scored course during K-12 school. Josie reported an overall mathematics anxiety score of 34/45.

Mel is a 30-year-old Multiracial female in her sophomore year. She is a sociology major with a self-reported cumulative GPA of 3.79. Her most recent college mathematics course was concurrent with data collection and she had previously taken a developmental mathematics course. She identified English as her favorite and highest performing subject in K-12 education. Mel reported an overall mathematics anxiety score of 32/45.

Mimi is a 61-year-old Black woman in her junior year of college. She is a psychology major with a self-reported cumulative GPA of 3.2. Her most recent college mathematics course was concurrent with data collection and was a developmental mathematics course. She identified history as her favorite and best course subject during K-12. Mimi reported an overall mathematics anxiety score of 36/45.

Niki is a 31-year-old White woman in her senior year. She is a psychology major with a self-reported cumulative GPA of 3.8. Her most recent college mathematics course was over 10 years prior to data collection, though she was enrolled in advanced statistics concurrent with data collection. Her favorite subject was reported as English, and she reported earning her best grades in history. She reported an overall mathematics anxiety score of 29/45.

Materials

The Abbreviated Math Anxiety Scale (AMAS; Hopko et al., 2003), a nine-item Likert-type scale (1 = *low anxiety*; 5 = *high anxiety*; score range 9–45) measuring participants' level of anxiety while completing specific academic mathematics tasks (e.g., use a table in the back of a maths book), was administered to all participants. The AMAS served two purposes: (a) screen participants for high mathematics anxiety before the interview and (b) provide descriptive information about participant's self-reported level of mathematics anxiety. All participants scored within the moderate to high levels of maths anxiety.

A semistructured interview protocol was developed in collaboration with a developmental psychologist. A semistructured format provides comparability across interviews but allows for important themes that arise to be elaborated on (Huberman & Miles, 1994). This protocol had several standard interview questions stemming from the first question, "You self-identified as having high mathematics anxiety. Where do you think those feelings about mathematics come from?" Based on their response, subsequent questions to elicit further explanation were asked (e.g., if the participant responded that their maths anxiety is because they are not good at maths, the interviewer would ask why they think they are not good at maths and where those messages came from.). The interviewer also had several general questions to ask pertaining to family, friends, teachers, mathematics in school and everyday life, and their emotions about math. Last, participants were asked what they believed universities could do to help adult learners with mathematics.

Procedure

Following recruitment through the University's adult learner services, participants were instructed to contact the researcher to schedule an interview. The researcher spoke with each individual to explain the study's purposes, answer questions, and arrange an interview time. Interviews were conducted by the author or a trained undergraduate research assistant in the researcher's centrally located office. After providing informed consent and completing standard demographic information and the AMAS, the interview was conducted. Interviews ranged in time from 45 to 90 minutes, and were all audio recorded with handwritten notes. Behavioral observations (i.e., mood, emotional state, verbalizations, and related behaviors) of the participant were noted by the interviewer. Audio recorded interviews were transcribed by the interviewer within 48 hours. Participants were contacted via e-mail after data analysis as a source of validity evidence; they read each identified theme (described below) and their related

quotes and asked to provide feedback/clarification about the use of each quote to exemplify the theme. No participants made any modifications, and all agreed that the themes and associated quotes were accurate representations of their experiences.

Epistemological Perspective

The author's epistemological perspective could best be described as pragmatist, which focuses on the characteristic approaches to inquiry of constructivist and objectivist paradigms, recognizing the utility of each to provide various types of experiential knowledge (Morgan, 2014). The author received training in both quantitative and qualitative methodologies, but primarily is more objectivist. However, mathematics anxiety and the experiences of adult learners are complex issues; this complexity encouraged the author to view this study through the lens of pragmatism to best understand the lived experiences of mathematics anxious female adult learners.

Data Analysis Procedure

Data were analyzed using the Strategic Analysis of Representations Approach (Steichen, 1996), an iterative thematic analysis that uncovers themes in multiple steps of revisiting transcripts. At all steps, researchers independently approach the transcript to uncover themes based on general and then specific interpretations; the researchers mutually discuss and compare interpretations, come to agreement, and progress to the next step. Using this approach, the lead researcher, the research assistant who conducted interviews, and an additional undergraduate research assistant not involved in this study independently reviewed each transcription. Across three meetings, the researchers (a) discussed the overall messages from reading all transcripts, (b) discussed the themes that emerged from the messages, and (c) discussed the specific quotes that exemplified each theme. Cohen's Kappa coefficient showed a very good inter-rater agreement of .95 across all meetings (Landis & Koch, 1977). After analyzing the data, member checks were conducted and interpretations were considered robust. Data analysis occurred over a 3-week period approximately 2 weeks after the final interview was transcribed.

Results

The analysis revealed five major themes across the interviews. These themes are listed below in order of salience (as determined by the number of instances the theme was mentioned during interviews and the behavioral indicators of importance gathered by the interviewer).

Theme 1: Time Since Last Educational Experience

The amount of time that had passed between the participants' last and current educational experiences emerged as the strongest theme. Every participant stated this theme served as a source of their current anxiety.

Jess: When I first came back . . . I had to do the beginning math. And the simple stuff, I was like "Oh my goodness! I just forgot everything" . . . there are kids in third grade who know how to do this.

Josie: There are some things in how to do math that have changed since I last learned it that make it difficult now, make me feel like I don't know what I'm doing.

Mimi: It's been 40 years since I've been out of school, so it's been a long time. So the things they be [sic] doing now, I have no idea. . . . They've [traditional students] been in school but we've been out of school for a long time.

Mel: It's really hard to come back after so many years . . . not only are you older than most of the people you are around in college . . . you also are well into your life . . . when I left school is all I knew from math and coming to college you have to have certain levels of math so I'm having to go back and search through my mind and relearn everything basically . . . that's where this anxiety comes from, because of the period between high school and . . . now, coming back to college.

Niki: Even though I'm in Advanced Stats now, it isn't because I like math or am comfortable with it; it is because I want to go to graduate school. In fact, I had to be convinced . . . to take it because math is so stressful. And I think it is because it has been such a long time since I have taken any math . . . it has been like 10 years!

Theme 2: Classroom Teaching Style

Classroom teaching style emerged as the second theme with participants addressing teaching styles throughout their K-12 and higher education experiences. Overall, participants reported their elementary mathematics experiences as more positive and becoming more negative in later contexts. All interviewees stated that instructor teaching style, both good and bad, was impactful to their mathematics attitudes.

Positive Teaching Attributes. The teaching characteristics identified as having a positive impact on attitudes toward mathematics included a combination of teacher warmth and high academic expectations (e.g., Jess stated, "And if you had a question or something, even if it was over something he just talked about, he would make it fun and interesting. He would say that he knew I could understand it and we would work on it together. He would then look and talk to the whole class and answer the question and tell us we could do it but we had to work . . . but he was really talking to *me*" and "They were real personable, and they wanted to form a relationship with the students . . . they would look at your face and see if you looked confused, and then they would make sure to give an example to help you understand it." Mimi stated, "He build your confidence up, and keeps you going, keeps your memory going. He has a positive attitude and makes you want to get his help. He takes his time, he is patient and slow. He would work you through the problem and help you") and seeing the students as individuals (e.g., Josey stated, "My college math professor would let us work together sometimes

and by ourselves sometimes, it was whatever we felt helped us most. I liked working in groups because we could help each other out." Niki stated, "I have had a few math teachers who saw I was nervous and would give me the push to get a tutor or stay after class for help. They would break things down in a way that made sense to me and giving me lots of positive feedback . . ." Mel stated, "If I called the teacher over, she'll teach me in a way that helps me. It's like she knows what level I'm at. She knows how to help me find my bearings and show me what I can do to figure things out").

Negative Teaching Attributes. The teaching characteristics identified as having a negative impact on attitudes toward mathematics include a lack of personal connection or warmth (e.g., Jess stated, "I had some teachers and professors where they just go through it, they don't even look at the class. Their back is turned the whole time . . . " and "This one class, whew! The teacher really did not have any interaction with the class, I didn't do good there." Mimi also addressed this: "She would just put it [the problem] on the board, not much explaining, and just sit while you worked it out. That was it. And I didn't feel like I could raise my hand or go up to her, she was not approachable. And I felt like she didn't care. When class was over, she was done") and teaching methods including (a) timed assessments (e.g., Josie reported, "You shouldn't have math timed. You have to take a minute to figure out what the problem is asking and how to solve it, and then you're worried about running out of time too"); (b) lack of examples (e.g., Josie stated, "In college I feel like they don't give as many examples. . . . So you end up forgetting as the semester goes on because there wasn't much practice, so you confuse one step for another." And Mimi stated, " . . . wasn't a lot of practice, we could just go to the Math Lab for extra practice but I have four babies I'm responsible for at home, I needed that practice in class"); and (c) pacing of the instruction (e.g., Mimi reported, " . . . an instructor . . . would just ZOOOOOOM!!! And you either got it or you didn't . . ." Mel also reported this concern: " . . . and she would just (zoom sound) and that was it. If you were lost, oh well, on to the next thing").

Theme 3: Holding Negative Self-Beliefs

Four participants discussed holding negative self-beliefs including lack of self-efficacy, learned helplessness, and a self-perception as "stupid."

> Jess: I don't have much confidence in it [her ability to do mathematics]. And I don't put in as much effort . . . and it causes me to fall further and further behind . . . if I don't get it then it's just a bomb, I fail, there's no hope for me . . . a lot of people seemed to understand it and I didn't, so that would make me not want to ask questions.
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> Josie: I don't think I'm stupid, but I feel like I am because I'm not getting it. It seems like it doesn't matter how much I try, I just won't get it. I look at the paper, and I can feel the fear of not being able to do it creep over me. Then, that's all there is, just that fear and doubt.

Mimi: I was never really good at math in the first place, never . . . I've always been scared of numbers. I felt like I could never catch up, since I wasn't any good at it, it didn't seem worth it to try very hard. And then I would just fall farther and farther behind. Then it was totally hopeless.

Niki: I am someone who doesn't like to do bad [sic] at things. . . . I always felt that math was something I just wasn't very good at and so I would be afraid of failing and it would make me extra nervous. I put off taking Stats in college for so long because I thought I was going to fail the class . . . I wasn't even thinking about grad school because I just assumed I was too stupid in math.

Theme 4: Perceiving Differences Between Academic and Every Day Maths

Four participants addressed this theme. They reported feeling a lack of anxiety in nonacademic settings as well as more utility in the mathematics they do on a daily basis than the mathematics they learn in the classroom.

Jess: When I do math outside school . . . a restaurant or home, it's pretty easy for me to do. But I am doing the math for something useful then, like adding a tip or working on my budget.

Josie: Basic math, like addition or multiplication, I use that all the time. But algebra? I don't understand, and I don't ever use that outside of school.

Mel: I mean, when I am balancing my checkbook or cooking, I guess I am using math but it's different. I feel like I can do it then.

Niki: When I am in a nonacademic world, I feel less like people are critiquing me, I worry because that essentially equates to how good you are. Math is more intimidating any time you're in an academic setting because, I know I will be graded . . . I will be judged. No one is judging if I mess up figuring a tip at dinner.

Theme 5: Family as a Source of Motivation

All five participants identified family as a source of positive motivation. Jess mentioned her mother and sister as being supportive of her education and continuing to help her with mathematics homework in college. Josie identified her mother as a role model, someone who was really good at mathematics and who Josie looked up to. Mel also identified her parents and sibling as influential, saying, "I call my parents up . . . they'll talk me through the rough times. Their positive attitude keeps me going. And my brother is going back to college now, and that pushes me to keep going." Mimi's matriarchal family role influences her motivation:

I will be the first person in my family to graduate college. I want to do that for my grandkids, to show them that they can do it too, no matter how old, no matter how bad you might be or think you be at some things-like me with math-that you can do it. My

> parents didn't have no education, and it was important to them. Education was big . . . And I want my grandkids to think that too.

Niki also addressed the support of her family and stated,

> Both parents always told me to be whatever I want to be. . . . They always told me to have my own opinion, don't let anyone tell you that boys are better, that I can literally do anything. And that support and their belief makes [sic] me want to succeed and show them they were right.

Opinions About How Universities Can Assist Adult Learners With Mathematics. When asked this question, all participants alluded to the need for universities to have mathematics courses specific to adult learners. These classes should break instruction down into smaller steps at a slower pace and provide student-centered pedagogy. Jess responded,

> . . . There should be a beginning math class, like a refresher for adults. Go over all the basic stuff, reintroduce us. That would be a nice way to not make us feel at a disadvantage when we take the higher level math classes.

Josie stated, "Teachers who know how to break it down, take it slower, not rush through or time us would help . . . training college professors and math teachers how people learn could probably help too." Mel also noted the importance of teacher training and stated, " . . . More teachers who know how to teach adults, who have experience teaching adults, who know how to teach math lower to people like me." Mimi confirmed the importance of a special course for adult learners:

> They [the University] should have a special lab or class . . . just for us grown folk . . . it'll refresh us and give us a better chance of success in later classes. Adults out of school for decades can't just go in and take algebra.

Finally, Niki addressed the need for resource availability specific to adult learners and stated,

> . . . Schools should make sure that there are services for adults, specific to adults returning to college after a break . . . things like free tutors trained in working with adults and technology workshops. And they should make sure they are free and they announce that because we have other responsibilities and can't pay . . .

Discussion

This research sought to understand the causes of mathematics anxiety in female adult learners through their voices. Because adult learners report high mathematics anxiety and low mathematics efficacy (Evans, 2000; Jameson & Fusco, 2014), it is important to understand why this sample of student demographic believes they have mathematics anxiety. Through thematic interpretation of interview transcripts, results support a

triarchic reciprocal causality perspective for the development of mathematics anxiety, suggesting personal factors (e.g., self-efficacy and perception of ability) and environmental factors (e.g., family support and teaching style) contribute to highly mathematics anxious female adult learners' self-reported mathematics anxiety. The *time since last educational experience* emerged as the strongest theme, and along with *holding negative self-perceptions* and *perceiving differences between academic and every day maths* provide an excellent example of Bandura's (1978, 1989) model; the combination of these three themes suggests that adult learners lack mastery experiences and/or are failing to transfer their utilitarian mastery experiences to academic self-efficacy resulting in their experiencing maths anxiety. Because adults' strongest source of self-efficacy is mastery experiences (Usher & Pajares, 2008), this research indicates the need for adult learners to transfer their real-world mathematics experience to the classroom. Fidishun (2000) and Miller-Reilly (2007) suggest that classes of adult learners should incorporate personal experiences; asking students for their experiences with real-world mathematics or using examples relevant to adult learners to teach the concepts is an environmental factor that would benefit adult learners. Using pedagogy that elicits personal experience/prior knowledge results in meaningful learning (Hay et al., 2008) and is perceived by students as more student-centered, a teaching method to which adult learners are particularly receptive (Ross-Gordon, 2003). Student-centered methods that align with constructivism (i.e., allowing students to use prior knowledge to build new knowledge) result in decreased anxiety and increased efficacy (Perry et al., 2016).

Students in the current study addressed the need for slower-paced and example-based pedagogies. These suggestions again align with cognitive science, as information is more successfully retained when it is elaborated and rehearsed (Butler et al., 2014), and time between last and current educational experience has likely caused decay in the memory of mathematics computation strategies, which results in the need for extra elaboration and repetition. Calcagno et al. (2007) stated adult learners have "rusty" skills, not deficient skills; this indicates they would benefit from appropriate practice. This emphasis on pedagogical style echoes Evans (2000) findings with adult learners who stated " . . . [The instructor] never explained how to work through it step by step so it certainly makes me feel very anxious . . . " and " . . . it was too fast for me . . ." (p. 192).

Previous research has included family obligations as both a barrier (Osam et al., 2017) and an impetus (Elman & O'Rand, 2007) for adult learners. Family served as an important source of support in the current study. While this environmental factor does contribute to other barriers (e.g., time, financial, and emotional stress) family support also provides another source of self-efficacy social persuasion. Important persons in our environment can influence our confidence in our abilities; these highly mathematics anxious female adult learners pointed to their families as sources of increased efficacy. In fact, Mimi explained her desire to be a source of efficacy for her grandchildren as motivation for attaining her degree despite difficulties in mathematics. Clark (2012) found that community college students identified a sense of belonging with their fellow adult learners through the shared struggle of filling multiple roles (e.g., "parent" and "student"). This suggests that family can serve a multifunctional support role for adult learners.

The participants' attention to the need for courses specifically for adult learners is important, given that many adult learners are routed into developmental mathematics courses, which often have low retention rates and decreased degree completion (Bailey & Alfonso, 2005). Instead of developmental mathematics courses, universities should offer "adult learner only" mathematics courses led by instructors trained in learning theory and adult pedagogy. The courses would allow the "rusty" mathematics skills (Calcagno et al., 2007) to be taught in a more task-specific to whole-method technique. This aligns with female adult learners' need for mathematics material to be taught at a slower pace, and research indicates that this approach reduces cognitive load, making it more likely that new information is accurately encoded and retained (van Merrienboer et al., 2003). Work by Miller-Reilly (2007), Johnson and O'Keeffe (2016), and Kallison (2017) find that mathematics bridging programs to provide fundamentals to adult learners significantly increased their mathematics performance (Kallison, 2017), self-efficacy and retention rate (Johnson & O'Keeffe, 2016), and transferability of mathematics to real-world situations particularly for older and/or female students (Miller-Reilly, 2007). These courses created for adult learners could also incorporate the adults' mastery experiences as a way to increase their self-efficacy, and could be taught using more student-centered approaches. Phillips et al. (2017) found that adult students prefer instructors with understanding of and respect for adult learners, a sentiment also expressed by Josie. Finally, Niki pointed to the need for universities to ensure adult learners have access to services that fit their needs; as Hardin (2008) explained colleges need to mitigate the effects of the unique barriers adult learners face through resources distinct to them (e.g., flexible scheduling). Chen (2017) noted the "youth-centric" nature of higher education, which often privileges younger students, adds an easily remedied institutional barrier for adult learners.

It is important to note that many of these findings can likely be applied outside mathematics classrooms. Successful and effective college teaching to both adult and traditional students includes many of the ideas found in this research. Ambrose et al. (2010) provide research-based principles for teaching in higher education across all disciplines and with all students; their summary aligns well with the findings of the current research, namely the importance of self-efficacy and meaningful and relevant information. Similarly, Wlodkowski and Ginsberg (2017) identify emotions and expectations as important in adult learners' motivation to learn, emphasizing that this is not domain-specific but general to learning.

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ORCID iD

Molly M. Jameson https://orcid.org/0000-0002-3610-3066

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Author Biography

Molly M. Jameson is an associate professor of educational psychology whose pedagogical topics include learning, instruction, and assessment. Her research focuses on factors that contribute to student learning and attitudes about learning. Dr. Jameson has primarily explored this through the lens of mathematics across students from primary grades to adult learners with specific emphasis on anxiety and efficacy.