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Math Anxiety, Math Self-Concept, and Math Self-Efficacy in Adult Learners Compared to Traditional Undergraduate Students

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Abstract

Adult learners comprise a significant portion of current undergraduate populations, and projections indicate steady or growing numbers of adult learners in the future. Previous research has suggested that adult learners possess lower self-confidence than and face barriers not experienced by traditional undergraduate students. These constructs have not been explored specifically within mathematics, however, which was the purpose of the current study. Using data collected from 226 undergraduate students (60 traditional students, 166 adult learners), the current research found that adult learners self-report lower levels of math self-efficacy and higher levels of math anxiety than their traditional peers. Implications for adult education are suggested.

Keywords

math anxiety, self-concept, self-efficacy

The common stereotype of a traditional college student is one between the ages of 18 and 22 years who attends classes full-time and lives on campus (Kasworm, 1990; Stokes, 2006), whereas any student older than 22 years is thought of as "nontraditional." Although age has historically been the characteristic predominantly used to identify students as traditional (Bean & Metzner, 1985; Horn, 1996), more modern interpretations of "adult learners" are being used to portray the reality of today's college

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students. The National Center for Education Statistics (NCES) provides a more modern interpretation by identifying a nontraditional college student as one who has one or more of the following characteristics: does not enter postsecondary enrollment in the same year that he or she completed high school, attends part-time for at least part of the academic year, works full-time, is considered financially independent from a legal guardian, has dependents other than a spouse, is a single parent, and/or does not have a high school diploma (Choy, 2002). Using this classification, NCES identifies approximately 73% of undergraduate college students as nontraditional (Choy, 2002). Horn (1996) further classified nontraditional students according to level of nontraditionality based on the number of characteristics present: Minimally nontraditional students have one characteristic, moderately nontraditional students have two or three characteristics, and highly nontraditional students have four or more characteristics. When looking specifically at age as a classifier of nontraditional status, however, a recent report by the NCES (2013) states that 50% of students at 4-year public institutions are older than 25 years. NCES projections suggest that the number of nontraditional college students will remain stable or increase in the coming years (Hussar & Bailey, 2009). According to Ross-Gordon (2011), the social and economic reasons for the increased participation of adults in postsecondary education include an aging population, the rapidity of technological advancements, and shifting demands of the workplace in our global economy.

Characteristics of Adult Learners

Adult learners differ from traditional-aged college students in several ways, both through strengths and barriers they face. According to Knowles's (1980) andragogy theory, adult learners prefer self-direction, bring to the educational environment a vast reservoir of experience, and exhibit a readiness to learn, a task- or problem-oriented approach to learning, and a high degree of intrinsic motivation. Others support Knowles's propositions regarding adult learners, specifically stating that past educational experiences and work and family responsibilities (Lieb, 1999) build expectations and experiences. Adult learners want to draw on these expectations and experiences in the classroom (Fidishun, 2000). In addition to the ideas of andragogy, others have proposed additional characteristics that differentiate adult learners from traditional-aged college students. Mezirow (2000) proposes that adult learners engage in transformative learning in which they transform their typical frames of reference to be more "inclusive, discriminating, open, emotionally capable of change, and reflective . . ." (p. 7). Adult learners are also viewed as more assertive and as developing a different relationship with faculty members than traditional college students (Lynch & Bishop-Clark, 1994). Much research has also indicated that adult learners are more strongly motivated by internal factors, such as self-concept, than are traditional college students (Delahaye & Ehrich, 2008; Sachs, 2001; Silverstein, Choi, & Bulot, 2001).

In addition to the strengths of adult learners, there are also areas that cause delay, struggle, or deficits. Ritt (2008) identifies barriers faced by adult learners in the form of personal, professional, and institutional barriers. Personal barriers include geographic location, personal and family commitments, work and family schedules, previous experiences in college, child care issues, financial limitations, and a general fear

of returning to school. Goto and Martin (2009) refer to these personal barriers as psychological barriers and purport that educators assume that these psychological issues are beyond their influence, instead concentrating on barriers that they most directly influence (King, 2002) such as institutional and instructional issues. Professional barriers are typically found in the workplace and relate to lack of tuition reimbursement, time management, and/or lack of release time from work. Institutional barriers include lack of access to higher education, the high cost of tuition, and diminished affordability. These barriers can hinder an adult's likelihood of returning to college or degree completion. Kerka (1995), while addressing the multifaceted nature of adult learners' attrition, relates several of these barriers to course withdrawal by adult learners. Adult learners have lower postsecondary persistence and completion rates than traditional students (Kazis et al., 2007) due in part to these barriers.

Adult learners can also experience negative self-perceptions and affect in the postsecondary environment that could affect their performance or degree completion. For many adult learners returning to school, a significant amount of time has passed since their past educational experience during which they acquired many life skills but not necessarily academic skills (Kenner & Weinerman, 2011; Zacharakis, Steichen, Diaz de Sabates, & Glass, 2011), and this can result in anxiety over school. Furthermore, because adult learners also face the barriers previously mentioned, they may be coping with life situations that can add additional stress and/or anxiety, and this life stress may compound the academic stress they are experiencing (Kasworm, 2008). According to Kasworm, adult students initially view themselves as novices in the educational environment, thus having lower self-confidence and efficacy regarding their academic abilities. Ross-Gordon (2003) supports this assertion, pointing to several research findings that suggest adult learners initially have low self-confidence and feel underprepared compared to their more traditional college peers. Furthermore, adult learners are affected by others' perceptions of them in the classroom. Stereotype threat, which occurs when a known stereotype about a group of which one is a member results in fear and anxiety, is routinely found to have a negative impact on test performance (Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995). Adult learners appear to be subject to age-related stereotype threat regarding their math performance (Hollis-Sawyer, 2011), suggesting that their perceptions of their own ability are negatively influenced by the stereotype that adults are not as cognitively competent as younger students.

Adult Learners and Math Attitudes

Literature on math attitudes in adult learners is quite sparse, though several projections can be made based on general math attitudes literature. Mathematical literacy is often touted to be one of the most important skills that a student can possess, frequently referred to as a critical filter through which literate individuals pass and go on to attain high-paying, prestigious, and technologically relevant careers whereas less literate individuals fail to attain such status (Sells, 1973, 1976; Shapka, Domene, & Keating, 2006; Sherman, 1982). Coffey (2011) points out, however, that mathematical literacy is important outside of our careers as well, no matter whether one is a citizen calculating the cost of something or a parent teaching his or her child how to compute averages. Yet

despite the importance of mathematical understanding, many adults dislike and avoid math, even those who are competent in math. The reason for this dislike and avoidance is likely a combination of math anxiety and low confidence.

Math anxiety, a feeling of "tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551), is related to decreased exposure to math, decreased enjoyment of math, and decreased self-confidence in math (Ashcraft, Kirk, & Hopko, 1998; Hembree, 1990). Although the majority of research has typically identified an inverse relationship between math anxiety and performance (Ashcraft & Kirk, 2001; Ashcraft & Krause, 2007; Jameson, 2013a; Ma, 1999), some research reveals no relationship between the two (Krinzinger, Kaufmann, & Willmes, 2009) or explains that the relationship is moderated by individuals' confidence in their ability to control their emotions (Galla & Wood, 2012). Research on math anxiety indicates that individuals in particular domains have higher levels of anxiety than others. Preservice education students and in-service elementary school teachers consistently report higher levels of math anxiety than individuals in other fields (Bursal & Paznokas, 2006; Hembree, 1990; Malinsky, Ross, Pannells, & McJunkin, 2006; Rech, Hartzel, & Stephens, 1993), and these higher levels of math anxiety can affect female students' math achievement (Beilock, Bunderson, Ramirez, & Levine, 2010). Although it is unclear how and why some individuals develop math anxiety, it is hypothesized that self-efficacy and self-concept play a role in its development, as individuals high in math anxiety tend to be low in these constructs as well. Self-efficacy, the belief that a person can successfully execute a desired behavior to result in a desired outcome (Bandura, 1977, 1989, 1993), has consistently been shown to be low in highly math-anxious individuals (Cooper & Robinson, 1991; Meece, Wigfield, & Eccles, 1990). This inverse relationship is quite sensical, as it is difficult to have confidence in one's abilities when anxiety results in self-doubt. Likewise, self-concept, a multifaceted and hierarchical construct that includes both general and specific perceptions an individual holds about him- or herself (Marsh & Shavelson, 1985), is negatively correlated with math anxiety (Lee, 2009). Whether self-efficacy or self-concept is more predictive of an individual's level of math anxiety and performance is cause for debate, though the two appear to work together, as many researchers have found that self-concept contains a self-efficacy component, particularly in mathematics (Jameson, 2013b; Pajares & Miller, 1994; Pietsch, Walker, & Chapman, 2003; Usher & Pajares, 2008).

Recent research with adult learners has examined these constructs outside mathematics and consistently finds that adult learners with higher levels of self-efficacy and self-concept are more satisfied with their postsecondary experience, more persistent when faced with educational roadblocks, and more likely to enroll in future courses (Kemp, 2002; Lim, 2001; Tyler-Smith, 2006). Clearly the constructs of efficacy and concept are important to the success of adult learners and specifically within the domain of mathematics and math anxiety are connected to adult learners' mathematical literacy and future success. As previously mentioned, adult learners often enter their postsecondary experience with lower confidence than their more traditional peers. Therefore, the question remains as to whether math anxiety, math self-efficacy, and math self-concept are lower among adult learners than among traditional college students. The purpose of the current research is to shed light on this question.

Method

Participants

Analyses for the current study used data from a total of 226 undergraduates from a medium-size state university in the United States. Using the NCES (2002) classification system, 60 were classified as traditional college students and 166 were classified as adult learners. Participants ranged in age from 18 to 59 years (M = 22.09; traditional student M = 19.70, SD = 1.47; adult learner M = 25.52, SD = 9.23). Using age as a classification for traditionality, however, shows that 160 participants were within the traditional age range for college students (i.e., <25), and the remaining 66 were older than 25 years. The majority of participants were Caucasian (76%), with 16% reporting their race as African American, 3% as biracial, 3% as Middle Eastern, 1% as Hispanic, and 0.5% as Asian. Although gender is typically gathered during data collection, the researchers purposefully excluded an item asking for gender as to reduce possible stereotype threat and increases in anxiety among female participants. However, extreme care was taken to collect data from approximately equal numbers of males and females (e.g., by collecting data at an additional open house, which traditionally consists of more male students) in order to allow for generalizability of results. Participants were recruited from several general education courses on campus (particularly general psychology, developmental math, and survey of mathematics) and through a collaboration with the university's adult learner program. The general psychology and survey of mathematics courses were selected for recruitment because they attract students from multiple disciplines and levels of preparation; the developmental math course was selected because of the high number of adult learners who take the course prior to their general education math course. All participants provided informed consent, and all responses were anonymous to align with institutional review board requirements.

Materials

To assess math anxiety, the Abbreviated Math Anxiety Scale (AMAS; Hopko, Mahadevan, Bare, & Hunt, 2003) was used. The AMAS is a nine-item Likert-type scale (1 = *low anxiety*, 5 = *high anxiety*) that prompts participants to rate each item in terms of how anxious they would be during mathematical events. Examples include "watching a teacher work an algebraic equation on the blackboard" and "thinking about an upcoming math test one day before." Scores are summed, with total scores ranging from 9 to 45; higher scores indicate higher mathematics anxiety. Hopko et al. (2003) report excellent internal consistency (Cronbach's α = .90) and test–retest reliability (r = .85 over a 2-week period) of the AMAS; they also provide strong evidence of validity through correlation with a well-established math anxiety measure (r = .85).

To assess math self-efficacy, the Mathematics Self-Efficacy Scale (MSES; Nielsen & Moore, 2003), a nine-item Likert-type scale (1 = *not at all confident*, 5 = *very confident*) that prompts participants to estimate their confidence in their ability to complete specific math tasks in the classroom, was used. For instance, participants are asked to rate their confidence in their ability to "work with decimals" or to "determine the degrees of a

missing angle." Responses are summed, with total scores ranging from 9 to 45; higher scores indicate higher levels of math self-efficacy. The MSES has been found to have both strong internal consistency reliability (Cronbach's $\alpha = .93$) and validity through relationships with students' past math grades, scores on an established math self-concept measure, and students' expected math grades (Nielsen & Moore, 2003). Although the MSES was originally created for use with high school students, internal consistency reliability remained very strong with the current sample (Cronbach's $\alpha = .87$).

To assess math self-concept, the math subscale of the Self-Description Questionnaire III (SDQIII; Marsh, 1990) was used. The SDQIII's math subscale is a 10-item Likert-type scale designed to assess domain-specific self-concept. The SDQIII uses an 8-point response scale to indicate how true each of the items is as a description of the participant (1 = *definitely false*, 8 = *definitely true*). Items are both positively and negatively worded and include items such as "I am quite good at mathematics" and "I have hesitated to take courses that involve mathematics." Total scores range from 10 to 80, with higher scores indicating a more positive math self-concept. The SDQIII has been found to be a valid measure of self-concept as its factor structure aligns with the theoretical orientation, and its scores are strongly correlated with academic grades (Marsh & O'Neill, 1984). Furthermore, Marsh (1992; as cited in Byrne, 1996) reports strong test–retest reliability ($r = .87$ after a 1-month interval, $r = .74$ after an 18-month interval).

Procedures

After receiving institutional review board approval, instructors of the recruitment courses were contacted, and the purpose and method were described. Instructors agreeing to allow data collection received a letter describing the study and data collection dates/times to announce. Participants wishing to receive extra credit for participating in the study (with an alternate assignment to avoid coercion) were to arrive at the designated laboratory space on campus to participate. The director of adult education at the University was also contacted and given the same description of the study, and she provided her approval for recruitment at adult education open houses. All data were collected within a 2-week period. Students recruited from the courses were tested in a laboratory setting in groups of approximately 10 students. Participants recruited from the open houses were introduced to the researcher and the purpose and method of the study at the beginning of the open house, and those wishing to participate were administered the materials in a quiet room adjacent to the main open house location. After providing informed consent, all participants completed the AMAS, MSES, and SDQIII in a counterbalanced order. Data collection took approximately 30 minutes per group and was anonymous.

Results

Before running analyses to explore adult learners' math attitudes, internal consistency reliability analyses were conducted on each measure used in this study. All tools had excellent internal consistency reliability (see Table 1), suggesting that results of subsequent analyses are robust.

Table 1. Internal Consistency of Study Measures.

Measure	Cronbach's α
Abbreviated Math Anxiety Scale	.844
Mathematics Self-Efficacy Scale	.872
Self-Description Questionnaire III–Math subscale	.917

Several analyses were used to answer the question regarding adult learners' levels of math anxiety compared to traditional college students. First, a Hotelling's T was conducted to explore differences in math anxiety, efficacy, and concept between traditional and adult learners. This analysis was conducted using the NCES classifications of adult learners, as they are more reflective of the student population at the data collection university (i.e., many "nontraditional" students are of traditional college age but are parents or work full-time). Results of this multivariate analysis indicate that adult learners do differ significantly from traditional students on the dependent variables, $F(3, 211) = 3.95$, $p = .009$, $\eta_p^2 = 0.05$. Examination of the between-subject effects indicates that only math self-efficacy was significantly different between the groups, $F(1, 213) = 8.34$, $p = .003$, $\eta_p^2 = 0.03$. Adult learners scored significantly lower on the math self-efficacy measure ($M = 29.38$, $SD = 0.61$, 95% CI [28.18, 30.59]) than those classified as traditional students ($M = 32.87$, $SD = 1.04$, 95% CI [30.82, 34.93]). An item analysis revealed that adult learners and their more traditional counterparts significantly differed on five of the nine self-efficacy items; these five items were pertaining to respondents' confidence in their ability to work a simultaneous equation, complete a problem in trigonometry, compute values of area and volume, sketch a curve, and determine the value of a missing side length. The four items that the groups did not differ on pertained to working with decimals, working with fractions, determining the degrees of a missing angle, and working an algebra problem. There were no significant differences between groups on anxiety or self-concept.

Because many students at the university are traditional age but have nontraditional characteristics, participants were further divided into three groups: traditional age (18-24) with traditional characteristics ($N = 55$), traditional age (18-24) with nontraditional characteristics ($N = 118$), and nontraditional age (≥25) with nontraditional characteristics ($N = 45$). A one-way analysis of variance (ANOVA) was conducted to further examine the previous finding, and the results of this analysis are similar to those of the previous analysis. Participants classified as nontraditional age with nontraditional characteristics had significantly lower math self-efficacy ($M = 27.16$, $SD = 9.6$) than both traditional age students with traditional characteristics ($M = 32.87$; $SD = 7.02$) and with nontraditional characteristics ($M = 30.12$, $SD = 7.06$), $F(2, 217) = 6.95$, $p = .001$, $\eta_p^2 = 0.061$. This medium effect size indicates a noticeable difference in the groups' scores. The difference between those of traditional age with both traditional characteristics and nontraditional characteristics was approaching significance ($p = .072$), suggesting that possessing characteristics of nontraditionality is influential in an

individual's efficacy. There were no differences between the groups on math anxiety or math self-concept.

To help explain the difference in self-efficacy levels between the groups, a correlation between the number of years since the participants' last math class and self-efficacy was undertaken. This analysis showed a moderate negative correlation between the two variables, $r(224) = -.20$, $p = .003$, indicating that the more time that passed since a participant's last math class, the lower their self-efficacy. Participants were then classified based on the length of time since their last math class (currently enrolled, within the past year, 2-5 years ago, 6-10 years ago, and >10 years ago), and a one-way ANOVA was conducted using this classification. The post hoc analysis of this significant ANOVA showed that participants whose last math class was more than 10 years ago have significantly lower self-efficacy than all other groups excluding those whose math class was 6 to 10 years ago. Therefore, the time that has passed since participants' most recent math class appears to play a role in their level of math self-efficacy.

Finally, a correlation between participants' age and their math anxiety, efficacy, and concept was conducted. The results of this correlation suggest a small and significant relationship between age and anxiety, $r = .13$, $p = .04$, and a moderate significant relationship between age and self-efficacy, $r = -.29$, $p = .00001$. As participants' age increased, so did their anxiety, but their self-efficacy decreased. A significant correlation between age and self-concept was not present.

Discussion

The current research examined differences in math anxiety, concept, and self-efficacy between adult learners and traditional college students. Because the literature is sparse in this domain, this research was exploratory and hoped to more clearly explain differences in math attitudes between these groups of students. Using the NCES classifications for adult learners, the current research found that adult learners had significantly lower levels of math self-efficacy, but not differing levels of anxiety or concept, than traditional students. An item analysis revealed that, more specifically, adult learners' math self-efficacy is lower than traditional college students in areas of math that are perceived as more academic such as geometry and trigonometry but not in areas that are perceived as more utilitarian such as fractions and decimals. This analysis could also explain why there were no differences in anxiety and concept; if participants were thinking of the more utilitarian math tasks, their anxiety would not have increased since they have higher efficacy in those areas. The lower efficacy for the "academic" tasks may also stem from a lack of experience with these tasks (e.g., they were never instructed on them in high school). Further examining participants' scores by grouping students according to their age and the absence or presence of nontraditional characteristics supported this finding by revealing that students who were nontraditional in both age and characteristics had the lowest math self-efficacy. These findings can be explained in part by Kasworm (2008) and Ross-Gordon (2003), who asserted that adult learners have lower self-confidence about their abilities because they perceive

themselves as less competent and more inexperienced in the academic environment. However, individuals with low levels of math self-efficacy would traditionally also have low levels of self-concept and high levels of anxiety (Ashcraft & Kirk, 2001; Ashcraft & Krause, 2007; Jameson, 2013; Ma, 1999), results not found in the current study when participants were classified according to the NCES classifications. It is possible that the forced classification of participants into groups based on the level of traditionality may partially explain these results.

To further elucidate this finding, analyses examining the relationship between age (instead of NCES classifications of adult learners) and math attitudes showed that as age increased, math anxiety increased and math self-efficacy decreased. Also, a correlation between time since the last math class and math self-efficacy suggested an inverse relationship between the two variables. Research conducted within the domain of self-efficacy can help more fully explain these relationships. Self-efficacy beliefs are sensitive to contextual factors, such as changing environments (Pajares, 1996). Furthermore, mastery experiences or having direct experiences with success or failure are especially important in self-efficacy levels (Bandura, 1994). The college classroom is a new environment for many adult learners, and within that new environment they may be surrounded by younger, more recently educated, and more technologically savvy classmates; these environmental factors may result in a decreased feeling of confidence in their ability to successfully navigate this new environment. Merriam, Caffarella, and Baumgartner (2007) suggest that adult learners tend to think that learning occurs in a formal classroom setting but fail to see the many informal learning opportunities they have experienced in their adult lives (e.g., learning to balance a checkbook or create a budget). Because adult learners do not perceive these experiences as learning, they are not likely to view them as mastery experiences and therefore experience decreased efficacy. The item analysis supports this finding; adult learners report lower confidence in their ability to complete "academic" math tasks but not in their ability to complete more routine math tasks. A plethora of studies have established the negative relationship between self-efficacy and anxiety (e.g., Cooper & Robinson, 1991; Hackett, 1985; Lent, Lopez, & Bieschke, 1991; Meece et al., 1990; Pajares & Miller, 1994), which explains the lower levels of self-efficacy and higher levels of anxiety experienced by the adult learners (when using age as the measure of adult learner) in this study.

Taken together, the results of this study suggest that adult learners are experiencing negative self-perceptions and affect that may hinder their learning. Previous research has indicated that these negative self-perceptions and affective reactions may be of particular import in adult learner retention and degree completion (Kazis et al., 2007; Lim, 2001). Therefore, all systems within colleges and universities should be knowledgeable about and aware of the diverse needs, skills, attitudes, and experiences of adult learners to aid in their degree completion. Adult learner programs, faculty, and staff should introduce adult learners to campus resources that can assist them through their college career, particularly in domains such as mathematics where adult learners may experience a lack of efficacy and high anxiety. Connecting adult learners with a peer mentor in mathematics may be especially valuable, as the positive impact of a

mentor on adult learners' overall educational experience has been stated with students at community colleges (Chavez, 2006; Mancuso, 2001; Rendón, 2002), 4-year colleges and universities (Mancuso, 2001; Pusser et al., 2007), and adult learners across all types of educational settings (Daloz, 2012). Furthermore, enrolling adult learners in developmental mathematics courses (Hussar & Bailey, 2009) can allow them to have mastery experiences with success in that content area, an extremely important factor in the development of high self-efficacy. As the purpose of developmental education is to equip underprepared students with the necessary skills and motivation to succeed in the remainder of their courses, a component of these courses should be interventions aimed specifically at adult learners' self-efficacy perceptions (Cervone, Artistico, & Berry, 2006). Mastery experiences in the classroom should be related to other fields of study, which will allow students to see the practical applications of mathematics. Additionally, teachers should stress learning goals rather than performance goals in these settings. Hall and Ponton (2005) have shown success in fostering self-efficacy in developmental courses that can be transferred to higher level mathematics courses. Furthermore, instructors working with adult learners should be aware of their practical experience and use them as teaching tools within the classroom. Kenner and Weinermann (2011) provide excellent strategies for application of adult learning theory to the classroom; of particular interest for the current research is that framing course information in a way that adult learners see it as meaningful and relevant is particularly useful. The idea that student learning does not exist in a vacuum is particularly important when working with adult learners (Kiely, Sandmann, & Truluck, 2004) and specifically with adult learners in mathematics education (Ginsburg, 2012). Recent studies of using math in the workplace indicate that adults use mathematics to solve problems in the workplace without the anxiety, frustration, and difficulty often exhibited in math classes (Coben, 2002; FitzSimons, Coben, & O'Donoghue, 2005). Therefore, contextualizing math may be beneficial to adult learners' experiences, thus increasing efficacy while reducing anxiety.

Limitations and Future Research

Although the current research adds much-needed insight to the literature regarding math anxiety, concept, and efficacy among adult learners, there are still limitations to the study that could be addressed by future researchers. The first limitation is the lack of performance measures in the current study. A robust finding in the field is that these math constructs, particularly anxiety and efficacy, are predictive of math performance (Ashcraft, 2002; Ashcraft et al., 1998; Hembree, 1990; Jameson, 2013a; Ma, 1999). Adult learners were recruited partially from a developmental math course; this may indicate that adult learners have low math performance compared to their traditional peers but that is unknown in the current study. However, because most research in affect and mathematics is completed with adolescents or traditional college students, it is unclear if adult learners experience this same relationship. Although it is likely that they do, future researchers should examine participants' math performance through either archival data (e.g., ACT/SAT math scores or college placement exam

scores) or current mathematics performance in relation to affective variables to provide empirical evidence of the relationship.

Additionally, gender and its effects on math anxiety, concept, and self-efficacy in adult learners should be explored. Most literature within math anxiety has found that women consistently report higher levels of math anxiety and lower levels of math self-efficacy and concept than men (Ashcraft, 2002; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Miller & Bischel, 2004). However, recent research has brought this gender difference into question. Research with adolescents has found that although girls do report higher levels of math anxiety, this is an ever-present trait anxiety, and they do not report higher levels of momentary state anxiety during math instruction or testing (Goetz, Bieg, Lüdtke, Pekrun, & Hall, 2013). Goetz et al. state that girls' perception of their math competence as inadequate, despite similar performance between boys and girls, may be partly responsible for their habitual math anxiety. Also, Haynes, Mullins, and Stein (2004) found that male students' math anxiety appears more strongly influenced by test anxiety and previous math performance, whereas female students' math anxiety appears influenced by these factors and self-perceptions of math ability. However, stereotype threat, which plays a role in women's but not men's math performance (Gunderson, Ramirez, Levine, & Beilock, 2012; Shapiro & Williams, 2012; Spencer et al., 1999), can influence these relationships. Because adult learners are influenced by age-related stereotype threat (Hollis-Sawyer, 2011), female adult learners may experience the compounded effects of both age- and gender-related stereotype threat. Obviously the relationship between gender and anxiety, efficacy, and concept is unclear, and future research will help elucidate this relationship.

Future research should also explore the role of college major in adult learners' math attitudes. Because the majority of the students who participated in this study were in their first year of college (76%), many of them had not selected a major. Therefore, no analysis exploring math attitude differences across majors were examined. It is likely, however, that individuals with different majors would have different levels of math attitudes. For instance, elementary education majors report the highest levels of math anxiety among all majors, whereas, not surprisingly, students majoring in physical sciences, engineering, and math report the lowest levels of anxiety (Hembree, 1990; Rech et al., 1993). It is possible that gender interacts with major, as the vast majority of elementary school teachers internationally are female, and although the number of women entering STEM fields is growing, men still outnumber women particularly at upper levels in these fields (Hill, Corbett, & St. Rose, 2010). However, this relationship is unclear, and how adult learners' math attitudes play a role in their major selection is currently unknown.

Perhaps most important, the field of adult education is lacking in the examination of the psychological barriers to adult learners' educational success. Both King (2002) and Goto and Martin (2009) report that educators often fail to focus on this component of adult education, but the role of psychological factors plays a central role in the choices, goals, attitudes, and behaviors of students (Bandura, 1977, 1989, 1993, 1994; Pajares, 1996; Usher & Pajares, 2008). Thus, these psychological factors should be the central focus of researchers and educators in the field of adult education to help ensure the development of appropriate interventions and curricular decisions.

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