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A MATH-RELATED DECREMENT STEREOTYPE THREAT REACTION AMONG OLDER NONTRADITIONAL COLLEGE LEARNERS

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It is important to address quality of life issues, such as education participation, with a growing aging population. The focus for the present research was on possible reactions among a broad age range of nontraditional learners. The present study found significant aging-related issues in perceived willingness to be involved in math-related learning and associated assessment contexts. Although nontraditional male and female learners differed in their characterization of personal past social role models' messages toward gender-related math ability, there was no significant differences in math test performance. This finding supports a possible decrement *stereotype threat belief among relatively older learners.*

For educators and researchers to be effective, there needs to be a more in-depth examination of the characteristics and needs of students in math education at all levels of education (Fuchs et al., 2005; Fuchs et al., 2008; Hart, Petrill, Thompson, & Plomin, 2009a, 2009b; Swanson, Jerman, & Zheng, 2008). There is an increasing presence of nontraditional students on college campuses (Ross, 2008). Thus, there is an imperative to address the learning needs of a growing nontraditional college student population (e.g., Principi & Lamura, 2009; Strage, 2008).

The present study examined the evaluative anxiety concept of *stereotype threat* (e.g., Steele & Aronson, 1995, 2004), as it relates

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to nontraditional college students' anxieties, behavior, and testing performance with a math-learning task (e.g., Brodish & Devine, 2009; Waller, 2006). Understanding these self-perception issues may assist in reducing anxiety reactions in response to learning tasks (e.g., Grimm, Markman, Maddox, & Baldwin, 2009; Rydell, McConnell, & Beilock, 2009). According to Steele and Aronson (1995, 2004), stereotype threat is a reaction derived from a personal belief that taking a test, or being evaluated in some way, puts one at risk of confirming a negative stereotype about one's group (e.g., women perform less well in math when compared to men) (e.g., Steele, 1997). Group membership identification appears to create comparisons with other groups, and this comparison process may elicit a stereotype threat reaction (e.g., sex, race/ethnicity; Aronson, Quinn, & Spencer, 1998; Croizet & Claire, 1998; Steele & Aronson, 1998). The aging-related anxiety is termed *decrement stereotype threat* in the present study.

Research in college settings indicates different learning motivations between younger and older adult learners, with older learners being more motivated by internal factors (e.g., self-concept) (Cross & Florio, 1978; Delahaye & Ehrich, 2008; Sachs, 2001; Silverstein, Choi, & Bulot, 2001). Gaining this understanding can assist in creating more older-learner-friendly educational contexts. The present study was solely focused on nontraditional college students' experience for this purpose. As preliminary background for the proposed study, the present researcher and colleagues assessed a diverse sample of both young and older college students regarding their reactions toward, and performance on, cognitive ability tests and testing condition factors (Hollis-Sawyer & Sawyer, 2008; Sawyer & Hollis-Sawyer, 2005).

According to the design of the present study, dependent variables consisted of three foci: (a) an analysis of studying behavior (estimated time, actual time, posttest description of process/strategies); (b) an analysis of math test performance; and (c) an analysis of various evaluative and math anxiety reactions. Test performance was operationalized in two ways, actual math test performance and subgroup differences (e.g., by sex) in math test performance.

The general purpose of this research was to gather information, which can be used as the basis for *andragogical* interventions with older students (Forrest & Peterson, 2006), with a specific examination of potential double jeopardy issues of gender and/or race/ethnicity. Why is this important? From a proactive perspective, we, as educators, need to better understand and address the needs of a growing, diverse aging student population. Their educational experiences transfer to their participation in the workplace, their feelings of personal self-efficacy, and their willingness to engage in life-long learning.

METHOD

Study Participants

The total sample was $n = 120$ undergraduate college students across educational levels (i.e., freshman, sophomore, junior, and senior levels). Nontraditional college women ($n = 28$, ages 40–72; 49.9 (3.7)) and men ($n = 25$, ages 40–58; 43.6 (2.8)) were recruited from a large diverse midwestern university. The designation of "age 40 and older" reflects the operational definition of a relatively older nontraditional learner on a typical college campus. A control group of younger (i.e., ages 18–29; 23.4 (1.2)) women ($n = 39$) and men ($n = 28$; 21.2 (1.0)) were also tested for study comparison purposes. Participants were diverse in race/ethnicity (e.g., 38% Hispanic or Latino) and balanced across age level and gender groups. Please refer to Table 1 for the distribution of participants' race/ethnicity by the associated age and gender groups. Participants were reimbursed $30 for about one hour and 30 minutes of their time, funded through a 2008–2009 NIH Pilot Study grant.

Materials

A record sheet was used for each learner to record his/her time estimate for studying the math skills manual. On this same sheet, the

Table 1. Total number of each racial/ethnic category by age-level and gender

	Women		Men		
Race/ethnicity	Younger	Older	Younger	Older	Total
Caucasian/White (Non-Hispanic)	22	11	7	5	45
African-American	5	4	5	5	19
Hispanic/Latino	9	12	14	12	47
Asian-American	3	1	2	2	8
Native American/Alaskan	0	0	0	1	1
Total	39	28	28	25	120

Note. No participants chose "Other" for the race/ethnicity category.

researcher recorded the actual time each learner used in studying the math manual prior to taking the test.

A tape recorder was used to record participants' oral answers when asked to describe the process(es) or strategy(ies) used to study for the test. Also recorded were participants' recollections of past or current math-related role model(s) that affected his/her perceptions of personal math ability.

A developed 30-item math test was used to assess participants' math performance. This test covered a domain of math knowledge from high school level introductory algebra to elementary geometry, utilizing both numerical and word problem formats. The test was developed and pilot tested during Spring 2005 ($n = 30$). Pilot testing assisted in reducing an original pool of 55 to 30 items; initial analyses indicate good interitem reliability (.77) within and across (.81) math content categories. The more difficult items, identified through pilot testing, were presented first to heighten participants' math test anxiety/self-efficacy reaction. In addition, a three-page math review handout (i.e., common types of problems explained with practice problems) was developed and administered to participants in order to assess effort expended, etc. during studying time before testing.

To assess personality, study participants were administered Costa and McCrae's (2007) NEO FFI – Form S Scale. Costa and McCrae (2007) reported coefficient alphas of .86, .77, .73, .68, and .81 for the personality dimensions of neuroticism, extroversion, openness, agreeableness, and conscientiousness; respectively.

Questionnaire #1 assessed the following three test reaction dimensions: (a) evaluation apprehension (items 1–5) (based on Spencer, Steele, & Quinn, 1999); (b) math self-efficacy (items 6–9) (based on Spencer et al., 1999), and (c) math anxiety (items 10–14) (based on Spencer et al., 1999). Respondents were asked to judge the degree to which statements reflect their self image (i.e., ranging from *extremely not like me* to *extremely like me* on a six-point scale).

Questionnaire #2 assessed participants' belief in stereotype threat and test bias (items 1–4), based on Steele and Aronson (1995); personal beliefs about one's own cognitive aging and later-life learning ability and perceptions of society's associated attitudes (items 5–14); and belief in the malleability of intelligence, based on Dweck, Chiu, and Hong (1995) (items 15–20; degree of decrement or rigidity in intelligence over time assessed). Respondents were instructed to respond to each item, ranging from *Strongly Agree* to *Strongly Disagree* on a five-point scale.

Questionnaire #3 assessed participants' levels of tests anxiety, using items from the Friedben scale of test anxiety (Friedman &

Bendas-Jacob, 1997). The following are the three subdimensions of the scale: (a) social derogation (items 1–8); (b) cognitive obstruction (items 9–17); and (c) physical tenseness (items 18–23). Respondents were asked to judge the degree to which statements reflect their self image (i.e., ranging from *Extremely Not Like Me* to *Extremely Like Me* on a six-point scale).

Finally, a demographic sheet asking for the following information was administered to all study participants: (a) age; (b) sex; (c) education level and major/minor; (d) self-rating of performance on the math test (seven-point Likert scale, ranging from *Extremely Poor* [1] to *Extremely Good* [7]); (e) rating of perceived transfer of math skills to learning context (seven-point Likert scale, ranging from *Extremely Poor* [1] to *Extremely Good* [7]); and (f) rating of perceived meaningfulness (utility) of learned math skill for conducting everyday activities (seven-point Likert scale, ranging from *Extremely Poor* [1] to *Extremely Good* [7]).

Procedure

Tested in groups of up to five people, participants were first told that the purpose of their participation was to review a new self-study three-page math review handout for user friendliness and to take an associated math skills test. Study participants were told that they would receive their math test scores prior to leaving the study. Next, the group was given a consent form to read silently as the researcher reads it aloud to them, and participants were instructed to sign if consenting to participate. Those consenting continued with study instructions.

Questionnaire #1 of baseline measures was administered at this time and collected upon completion. Next, the math review handout was distributed and participants were asked to record on the Record Sheet the amount of time needed to review the manual for the up-coming test. The Record Sheet was then collected. Participants were instructed to review the three-page math review handout until they are ready to take the test, indicated by placing the study handout face down on the desk. Using a stopwatch designated for each examinee, the researcher recorded the actual studying times for each participant on the corresponding Record Sheets. After collecting the math review handout, the math skills test was administered. Participants were instructed to turn over their tests when completed. Completed tests were collected and participants were told that they were scored. Participants were told that the following personality test was given as a time filler until the scores could be determined.

Participants were given Costa and McCrae's NEO FFI – Form S scale. After the scale was collected, participants were given Questionnaires #2–#3 consecutively to complete.

Next, a demographic sheet was given to the participants to answer. Following collection of the demographic sheet, the researcher asked participants about the process or strategies used to study the math review handout, perceptions of personal learning capabilities in a math testing situation, and recollections of significant math role model(s) that affected his/her life. A tape recorder was used to record the responses for later coded transcription. Finally, study participants were fully debriefed on the purpose of the study, and any questions regarding the study were answered. At the time of study debriefing, each participant was interviewed by the researcher and his/her reactions to the math-learning task were discussed, with a corresponding discussion of ways to alleviate disruptive test anxiety reactions. In addition to this discussion during debriefing, all study participants were offered a two-day informational and skills training session—after completion of the study—on ways to reduce test anxiety.

RESULTS

The resultant study sample was diverse in terms of race/ethnicity (refer to Table 1). The first section of results will present the results of individual-difference measures regarding participants' general testing and math ability perceptions. Across measures presented, please note that higher scores indicated higher levels of anxiety and negative reactions unless otherwise indicated. Refer to Table 2 for this first section of results.

The first individual-difference factor assessed was examinees' general feelings of evaluation apprehension. There were no significant

Table 2. Means (*M*), standard deviations (*SD*), and effect sizes (*d*) of math-related scores by age level across gender

Score	Younger *M* (*SD*)	Older *M* (*SD*)
Math test	25.6 (7.2)	25.3 (7.7)
Evaluation apprehension	18.2 (2.2)	21.8 (3.6)
Math self-efficacy	17.7 (4.1)	20.2 (2.6)
Math anxiety	18.2 (2.8)	20.8 (2.3)
Math study time (estimated)	5.1 (0.6)	5.0 (0.5)
Math study time (actual)	3.2 (0.7)	3.8 (0.7)

Table 3. Means (*M*), standard deviations (*SD*), and effect sizes (*d*) of aging-related evaluation anxiety and associated scores by age level across gender

Score	Younger *M* (*SD*)	Older *M* (*SD*)
Overall test anxiety	24.2 (2.2)	27.2 (1.9)
Social derogation	25.6 (1.9)	31.5 (1.4)
Physical tenseness	19.0 (1.1)	22.1 (3.5)
Cognitive obstruction	29.7 (1.4)	29.0 (1.5)
Stereotype threat belief	11.6 (1.6)	12.4 (1.7)
Malleability of intelligence belief	4.8 (1.1)	4.1 (3.5)

gender differences across age levels ($p > .05$). Interesting patterns by age-level and gender emerged. Overall age level differences were significant at the .001 level ($t(118) = -4.23$, $p < .001$). (See Table 3 for more age-level comparisons) Further, there were significant age-level differences within gender for both women ($t(65) = -3.10$, $p < .01$) and men ($t(51) = -2.91$, $p < .01$). Within age level comparisons yielded nonsignificant differences between women and men in actual study time ($p > .05$).

A second individual-difference factor examined was math self-efficacy. With this measure, higher scores indicated lower levels of math-related self-efficacy and associated negative reactions. There were no significant gender differences across age levels ($p > .05$). Overall age-level differences indicated significant differences in math self-efficacy ($t(118) = -3.77$, $p < .01$). Both women and men were significantly different, to different degrees, on this measure. Within gender, older women were significantly higher in score at the .05 level ($t(65) = -2.64$, $p < .05$), while older men were significantly higher in score at the .01 level ($t(51) = -2.92$, $p < .01$). Within age-level comparisons yielded nonsignificant differences between women and men in math self-efficacy scores ($p > .05$).

A third and final individual-difference factor examined was math anxiety. There were no significant gender differences across age levels ($p > .05$). Overall age-level differences were significant at the .01 level ($t(118) = -3.11$, $p < .01$). Only women exhibited significant differences within age-level groups. Women were significantly different at the .01 level ($t(65) = -2.92$, $p < .01$), while men were not significantly different ($t(51) = -1.96$, $p > .01$). Within age level comparisons yielded nonsignificant differences between women and men in math anxiety scores ($p > .05$).

The second subsection presents the results of hypothesized dependent variables: (a) participants' math-related studying behavior (estimated, actual); (b) participants' math test performance; and (c) participants' posttesting reactions to the math-testing process.

There were no significant differences between or within the age-level groups based on estimated study time needed to review the math study hand-out prior to testing ($p\text{s} > .05$). However, there were significant differences in actual recorded study time, both across and between genders within age-level groups. Overall age level differences in actual time spent study for the math test was significant at the .001 level ($t(118) = -4.20$, $p < .001$). Both men and women within age-level groups were significantly different in time spent at the .01 level. Older women spent significantly longer studying than younger women ($t(65) = -2.89$, $p < .01$), and older men also showed a similar tendency in studying behavior in comparison to younger men ($t(51) = -3.17$, $p < .01$). Within age level comparisons yielded nonsignificant differences between women and men in estimated study time (in minutes) ($p > .05$).

Interestingly, there were no significant differences in actual test performance across and within age-level groups by gender ($p\text{s} > .05$) (e.g., overall: $t(118) = .18$, $p > .05$). Further, there were no significant within-gender differences across age levels ($p > .05$). This is important to understand in light of the proceeding test reaction outcomes (i.e., beliefs about actual test performance).

A first measure of evaluative anxiety, in response to the math testing, was assessed in terms of overall feelings of testing anxiety after taking the math test. There were no significant gender differences across age levels ($p > .05$). Overall age level differences were significant at the .01 level ($t(112) = -2.89$, $p < .01$). Both older women and older men exhibited significantly higher test anxiety. In comparison to younger examinees within gender, older women were significantly higher on this measure at the .05 level ($t(60) = -1.15$, $p < .05$), while older men were significantly higher on this measure at the .01 level ($t(50) = -3.23$, $p < .01$). Within age level comparisons yielded nonsignificant differences between women and men in overall test anxiety scores ($p > .05$).

A second evaluative anxiety measure assessed one's perceptions of social derogation from personal testing performance. There were no significant gender differences across age levels ($p > .05$). There was a strong age-level difference, with older adults indicating significantly higher evaluative anxiety in this focus at the .001 level ($t(114) = -3.60$, $p < .001$). Conducting within-gender comparisons, older women ($t(62) = -2.28$, $p < .05$) and older men ($t(50) = -3.00$, $p < .01$) were significantly higher on social derogation anxiety from testing performance. Within age level comparisons yielded nonsignificant differences between women and men in social derogation scores ($p > .05$).

A third measure examined one's perceived physical tenseness in response to testing. There were no significant gender differences across age levels ($p > .05$). As with the other outcomes, there was a significant difference by age level ($t(118) = -3.93$, $p < .001$). In comparison to younger participants within gender, older women ($t(65) = -2.04$, $p < .05$) and older men ($t(51) = -3.76$, $p < .001$) reported significantly higher feelings of physical tension as a testing reaction. Within age level comparisons yielded nonsignificant differences between women and men in physical tenseness scores ($p > .05$).

The final measure of evaluative anxiety assesses one's feelings of cognitive obstruction (thought disruption) due to testing involvement. There were no significant gender differences across age levels ($p > .05$). Interestingly, this measure did not show any significant age-level differences; this was because most respondents indicated a heightened level of anxiety in this category ($t(116) = 1.05$, $p > .05$). There were no significant gender differences by age level for either women ($t(63) = .48$, $p > .05$) or men ($t(51) = .93$, $p > .05$). Within age level comparisons yielded nonsignificant differences between women and men in cognitive obstruction scores ($p > .05$).

In addition to evaluation anxiety measures, participants' beliefs in stereotype threat and the malleability of intelligence (i.e., degree of rigidity in intelligence over time) was assessed. There were no significant gender differences across or within age levels ($p > .05$). However, there was a significant difference by age level with both stereotype threat belief ($t(115) = -2.26$, $p < .05$) and for belief in malleability of intelligence ($t(118) = 3.14$, $p < .001$). Older adults in the study exhibited more negative stereotype threat reactions and less positive belief in later-life learning ability. Belief in the malleability of intelligence (i.e., higher score indicated belief in increasing rigidity in intelligence) was significantly related to math-related social derogation ($r = .44$, $p < .001$); physical tenseness ($r = .29$, $p < .01$); overall test anxiety ($r = .37$, $p < .001$); and actual test performance ($r = -.29$, $p < .01$).

A final individual-difference measure examined was participants' personality characteristics. The personality factors assessed relate to the "big five" personality factors (i.e., neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness). Across and within age level comparisons yielded nonsignificant differences between women and men in belief in all five personality scores ($p > .05$).

Across groups, as would be expected, neuroticism was related to perceived social derogation anxiety ($r = .21$, $p < .05$), but there were no other significant results ($p > .05$). Interestingly, none of the personality factors were related to actual math test scores ($p > .05$).

Early Math-Related Social Role Models (Qualitative)

The qualitative analysis of participants' posttesting descriptions of studying behavior and relevant math role models were conducted using two trained "blind" student raters. Using the thematic content analysis guidelines of Gubrium and Sankar (1994), the trained raters reviewed typed coded transcripts of participants' responses for underlying themes and concepts.

Qualitative analyses of the open-ended responses yielded a strong gender pattern. Across age levels, a majority of the college women (76%) indicated that a teacher, at sometime in their education (e.g., middle school), had indicated that males were better at math. Comparing these results with other study outcomes, these examinees were also more likely to self-report feelings of general evaluation apprehension and negative math reactions (e.g., low math self-efficacy scores). There was no apparent gender-by-age-level interaction evident in the interview responses. This suggests a more universal issue of gender socialization that needs to be addressed in learning and socialization contexts.

Across age levels, men were much less likely to report recalling any significant math-related social role model (91%). Of the 9% of men who did report a significant role model, it was typically an early teacher, coach, or family member who communicated the belief that males were innately better in math performance. Interestingly, as with the women, there was no apparent gender-by-age-level interaction evident in the interview responses.

DISCUSSION

From a life-long learning perspective, educators and practitioners related to the field of aging need to reexamine the perceived issues of accessibility, motivational factors, and quality of learning opportunities for nontraditional older learners (e.g., Kaufman, Agars, & Lopez-Wagner, 2008; Lyons, 2006; Principi & Lamura, 2009). Peterson (1983) suggested more than 25 years ago that educators need to focus on designing learning environments that effectively reduce a "sense of fear of failure" and "the chance of being made to look foolish'' (p. 87) for older learners. Perceived barriers to learning and the perceived ability to learn new concepts can significantly impact older adults' academic performance, their willingness to engage in life-long learning, and their general quality of life and coping ability (e.g., Bertera, Bertera, Morgan, Wuertz, & Attey, 2007). More than 10 years ago, Sogruno (1998) raised the issue of better understanding factors underlying older learners' evaluative anxieties, and their impact on their motivation level and performance in educational settings. For most people, access and participation in education across the life span is related to quality of life and is the key for advancement in society and one's career. This is because such access and participation are inextricably linked to financial security, access to resources, and aspects of mental health (Principi & Lamura, 2009).

Results of the present study do not suggest the strong gender-by-age interaction explored. Specifically, between-gender comparisons suggested a pattern of comparable evaluation anxiety levels for both older women and men. Within-gender analyses did yield predominantly significant differences in the attitudinal measures, but there was no support for a double jeopardy issue for nontraditional college women. It may be that the selective nature of the relatively homogeneous sample (i.e., enrolled undergraduate college students) may have negated any interaction effect (e.g., a segment of nontraditional female learners experiencing learning and math-related self-efficacy did not volunteer for this research). Follow up research will recruit comparison age groups from outside the university community to examine these possible confounding factors Follow up research will also assess more real world math tasks.

Overall study results, however, do support the idea of an aging- and/or cohort-related decrement stereotype threat belief about performance capabilities in these types of evaluative tasks (e.g., Hertzog, 2008). In general, the nontraditional participants tended to exhibit less efficacious beliefs about performance capability about testing and specific math ability and associated behavioral outcomes (i.e., significantly higher study time spent). This negative evaluation of performance concerns amongst the nontraditional learners indicates a stereotype threat reaction. This supposition is further substantiated by the results that these older students in the present study were also likely to score significantly higher (more negative) in stereotype threat belief and aging perceptions scores. This finding of preliminary support for the existence of a decrement stereotype threat phenomenon is especially interesting when there were no significant differences in actual math test performance, which by extension may be reflected in other performance domains with older adults (e.g., balancing a checkbook).

As already noted, there was a lack of correspondence between older learners' ability perceptions and actual performance. This apparent disassociation between emotional reactions and cognitive processes during task performance may belie a less effective *meta-cognitive* self-awareness among older learners (Daniels, Toth, & Hertzog, 2009; Hines, Touron, & Hertzog, 2009; Justice & Dornan, 2001). In a related line of reasoning, it is important to remember that older learners in the present study were significantly higher in test-specific anxiety reactions, except for cognitive obstruction. This was interesting because it may explain why these participants performed comparably on the math test, regardless of self-beliefs. To educators, it may suggest the need to expose older learners to learning activities that promote feelings of enactive self-mastery and more effective self-regulatory processes in different cognitive task contexts (e.g., career training). If not addressed, this is an ethical concern from an aging public policy perspective as unfounded performance anxiety may generalize and create barriers to life-long learning and growth in many quality of life contexts (e.g., Rodarte-Luna & Sherry, 2008; Sterns & Huyck, 2001). Further follow-up research will assess if this is confounded by cohort-specific characteristics (i.e., Baby Boom cohort).

It is important to acknowledge that there were no apparent gender differences, but there was evidence of trait linkages and aging-related issues (i.e., more negative stereotype threat reactions and less positive later-life learning ability perceptions). This is important to acknowledge and address in educational design for life-long learners. It is equally important to focus on the internal barriers to life-long learning opportunities as it is to focus on the external barriers (e.g., physical accessibility) (e.g., Willis, 1985). With these same efforts toward positive educational design, early socialization and associated life-long adaptation issues for aging nontraditional learners (e.g., older womens' perceived math ability) need further investigation to identify positive messages in education settings (e.g., Peterson, 1983).

SUMMARY AND CONCLUSION

Educational opportunities and involvement both have benefits of continued cognitive and social activity. Educational opportunities also contribute to the resources available to maintain one's physical health through continued workforce participation (e.g., insurance benefits to defray healthcare expenses in middle and later life). Workforce participation past traditional retirement age is increasingly a normative expectation for workers of all ages, and one's receptivity to learning and maintenance of one's job skills (e.g., knowledge of statistics in a job) is a key part of that aging-related adaptation process.

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