Women in Math and Science: Examining Psychological Barriers to Learning

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This summer, with support from the Center for Teaching and Learning, we conducted research on psychological barriers to learning in Agnes Scott math and science students. The goals of our project were: 1) to examine psychological factors that influence student performance in science and math courses, and 2) to create teaching tools and techniques based on this research that might help to improve performance. We identified several factors that influence, either directly or indirectly, performance in math and science classes, as measured by final grades. In this report, we briefly describe our research methods and present the results from our study. We also present ideas for teaching tools and directions for future research.

Participants and Measures

Participants for this study were Agnes Scott students from spring and summer 2006 semesters who were enrolled in one of four classes: Fundamental Concepts of Matter (Chemistry), Calculus I, Elementary Statistics, or Research Statistics (Psychology). A total of 57 students completed Time 1 of the survey. Of those 57 participants, 34 completed the survey again at the end of the semester, also referred to as Time 2. The results presented in this report are for the 34 participants who completed both sessions of the survey. For all measures, higher numbers indicate greater levels or endorsement of the construct. In addition to the measures described below, course instructors provided final grades for each student.

Perceptions of the Future (PF). We asked participants how likely it was that they would: 1) pursue a graduate degree in the subject area of the class, and 2) major in the subject area of the class. These items were combined to create an index of future perceptions.

Math and Science Performance. We measured participants' evaluations of their own math and science performance in the class.

Collective Self Esteem (CSE). We used the Private Collective Self-Esteem subscale from Crocker & Luthaten (1989) to measure CSE. We adapted the items so that each item related to participants' gender group. The Collective Self Esteem items measure personal judgments of how good one's gender group is.

Gender Identification. We used the Importance to Identity subscale from Crocker & Luthaten (1989) to measure gender identification. The items measure the importance of one's gender group to one's self-concept.

Self-Esteem. We measured self-esteem using the 10-item Rosenberg scale of self-esteem.

Emotions. We asked students to report the extent to which they felt various negative (e.g., anger, fear) and positive (e.g., happiness, joy) emotions when thinking about the class.

Gender Stereotypes. Participants were given a list of gender stereotype-relevant words (e.g., emotional, better at verbal skills) and asked to rate the extent to which each word was "more true or men" or "more true of women". Based on their responses, we created an index of endorsement of stereotypes about women.

Results

The intercorrelations among variables are shown in Tables 1 and 2. As can be seen from the tables, at both Time 1 and Time 2, emotions and self-esteem are correlated. Specifically, higher levels of self-esteem are associated with less negative emotions and more positive emotions. Similarly, students' evaluation of their math and science performance is associated with emotions, such that more positive evaluation of one's performance is significantly associated with less negative and more positive emotions. As expected, Time 1 collective self-esteem was positively associated with gender identification and self-esteem. Somewhat unexpectedly, these same correlations were not significant at Time 2, suggesting there was some change in the pattern of participants' responses over the semester.

The means and standard deviations for the variables at Time 1 and Time 2 are presented in Table 3. We conducted a series of paired-sampled t-tests and of the eight variables we tested, we found a significant difference for just one variable; negative emotions. Specifically, there was a significant increase in the amount of negative emotions reported by participants from Time 1 to Time 2, $t(33) = -3.27$, $p < .01$. So, participants reported feeling more negative emotions at the end of the semester compared to the beginning, which is not surprising given the added stress and pressure associated with the end of the term.

Finally, we wanted to examine which variables would predict students' final grades. By identifying variables that can predict grades, then we can develop teaching tools that specifically relate to these predictors. Based on previous research and on the intercorrelations among variables, we tested a regression model with negative emotions and self-esteem at Time 1 predicting final grades. The overall model was significant (see Table 4), although the standardized betas for each predictor were not. These results suggest that by knowing a student's level of self-esteem and negative emotions at the beginning of the semester, a professor could have a better idea of which students might be at risk for performing poorly in her or his class. We preformed a similar regression analysis using self-esteem levels and negative emotions at Time 2 as predictors of final grades. Again, we found this model to be significant, and the standardized betas for each predictor were higher than those at Time 1, suggesting an even stronger relationship between grades, self-esteem and emotions when measured near the end of the semester.

As a supplemental analysis, we also examined variables that might influence students' desire to continue in the field of math and science as either a major, or as a career. We hypothesized that Perceptions of the Future (PF) at Time 1 would be a significant predictor of PF at Time 3, given that the means were similar across the semester. We also hypothesized that Self-Esteem and Math and Science Performance at Time 1 might predict PF at Time 2. We preformed a regression analysis using Perceptions of the Future, Self-Esteem, and Math and Science Performance at Time 1 as predictors of Time 2 PF. As expected, Time 1 PF was a significant predictor of PF at Time 2 (see Table 4). In addition to Time 1 PF, Time 1 Self-Esteem was also a significant predictor of Time 2 PF. Time 1 Math and Science Performance was not a significant predictor. Similar to the results for student grades, self-esteem appears to be an important variable in predicting whether or not students will want to continue on in math and science.

Even though the results presented in this report are promising, there are several limitations to this study. The most significant limitation is the size of our sample. With any longitudinal study, attrition is expected. But, because we started out with a fairly small sample size at Time 1, our final sample size was less than ideal. The small sample size limits our ability to detect significant effects in the population, and our ability to generalize the results to other samples. We would like to continue our study, perhaps with some modifications, and collect more data.

The second limitation which is related to sample size has to do with additional analyses. Agnes Scott College is a diverse community, and in the future we would like to look at similarities and differences based on racial or ethnic characteristics. Previous research has found that African American women, in general, have higher levels of self-esteem than their European American counterparts. Perhaps self-esteem is not as strong a predictor of grades and future ambitions for African American students. With a larger sample size, we will be able to conduct analyses such as these.

Classroom Applications

Given the connection between self-esteem and performance, the next question is how to increase students' self-esteem, and that is the second part of the project. (This part is also still ongoing, and probably will be indefinitely.) We collected techniques both from experts (in psychology, learning theory, and education) and from practitioners (math and science teachers). We were aware of some of the techniques before, of course, but the perspective gained from the research in the first part of our project made it much easier to judge whether the techniques might be useful for our purposes. (Many of them seemed aimed simply at making the class more fun; an important goal, but perhaps not as directly useful.)

Some examples are: Having students tutor other students in lower-level classes; giving easier tests (or at least including more easy problems on the test); discussing examples of successful female professional scientists/mathematicians; discussing examples of successful female former students (the Math Learning Center can be very helpful for this); giving easy weekly quizzes; allowing students to redo missed questions on quizzes and exams. Having students work in groups is also useful, partly because it allows them to get help from each other, but perhaps more importantly because it gives them the experience of helping someone else.

One of the most common techniques is group projects. (A list of websites with some of the most useful projects is attached to the bibliography.) Almost all of the successful assignments involved at least some choice by the students about the topic, which gives a sense of investment and ownership. An important issue with projects is the timing; the usual end-of-semester project is clearly not as useful for purposes of building self-esteem throughout the course. Another issue is the amount of class time that the group presentations (an important part of the process) take, so some experts suggest a poster session instead of Powerpoint or similar presentations

Many sources suggest assigning projects that involve a creative component, or allow the students to relate math/science to their other interests. This can be very helpful in reducing anxiety. The danger in this, however, is that it might actually reinforce negative feelings ("I can draw pictures and write essays *about* math/science, but I still can't do *real* math/science problems"). Thus it is important that any projects at least involve a component that is clearly related to the core material of the course.

Of course, it is certainly not clear that increasing self-esteem will improve math and science performance; perhaps the students have low self-esteem because of their poor performance, and not the other way around. (Most of the literature suggests that it works both ways, so that increasing self-esteem should have at least some effect.) It would be interesting to follow up this study by testing the effect of self-esteem-building methods in classes. This would be a hard experiment to conduct rigorously, since each class is unique, but one approach might be for the same professor to teach two sections of the same course the same semester, and use self-esteem-building methods in one but not the other.

Table 1

Intercorrelations Among Variables at Time 1

	Perceptions Future	M/S Perform	CSE	Gender ID	Self-Esteem	Positive Emotions	Negative Emotions	Stereotypes-Women
Perceptions of Future	--							
M/S Performance	.31	--						
Collective Self-Esteem	.13	.28	--					
Gender Identification	.10	.11	**.45****	--				
Self-Esteem	.22	.29	**.64****	**.44****	--			
Positive Emotions	**.40***	**.58****	**.39***	.20	**.47****	--		
Negative Emotions	-.23	**-.43***	**-.56****	-.21	**-.66****	**-.49****	--	
Stereotypes-Women	.12	.17	.05	.13	.14	.19	-.01	--

**p* < .05. ***p* < .01

Table 2

Intercorrelations Among Variables at Time 2

	Perceptions Future	M/S Perform	Private CSE	Gender ID	Self-Esteem	Positive Emotions	Negative Emotions	Stereotypes-Women
Perceptions of Future	--							
Math/Science Performance	.10	--						
Collective Self-Esteem	.23	.32	--					
Gender Identification	-.01	.08	.26	--				
Self-Esteem	**.37***	.29	**.52****	.28	--			
Positive Emotions	.23	**.39***	.33	.12	**-.34***	--		
Negative Emotions	-.18	**-.50****	-.09	.11	**.45****	**-.52****	--	
Stereotypes-Women	.28	-.18	-.03	.16	.23	.33	-.02	--

**p* < .05. ***p* < .01

Table 3

Means and Standard Deviations of Survey Measures at Time 1 and Time 2

	Time 1		Time 2	
Measure	Mean	*SD*	Mean	SD
Perceptions of Future	2.63	1.82	2.57	1.91
Math/Science Performance	4.32	1.30	4.22	1.33
Collective Self-Esteem	6.10	1.04	6.00	0.99
Gender Identification	4.62	1.08	4.44	3.32
Self-Esteem	3.79	0.81	3.75	0.83
Positive Emotions	4.15	2.09	3.81	2.15
Negative Emotions	**2.12**	**1.39**	**2.96**	**1.79****
Stereotypes-Women	6.93	4.38	6.33	4.47
Grade	--	--	78.39	13.86

$^{**}p < .01$

Table 4

Regression of Final Grade on Time 1 and Time 2 Independent Variables

Independent Variable	R^2	β	P
1. Time 1 Negative Emotions	.231*	-.315	*ns*
2. Time 1 Self-Esteem		.206	*ns*
Independent Variable			
1. Time 2 Negative Emotions	.463**	-.645	<.001
2. Time 2 Self-Esteem		.076	*ns*

N =31
*p < .05. **p < .01

Table 5

Hierarchical Regression of Time 2 Perception of Future (PF) Scores on Independent Variables

Step/Independent Variable	R^2	R^2 Change	β	P
1. Time 1 PF	.603	.603**	.777	<.0001
2. Time 1 Self-Esteem	.669	.066†	.264	.02
Time 1 MS Performance			-.126	*ns*

Betas and p values are from the final regression equation; R2 change and R2s are from the step at which the particular variable entered the equation.
N =34, *p < .05, **p < .01, †p < .07

References

Ben-Zeev, T., et al. (2005). “Math is hard!” (Barbie, 1994): responses of threat vs. challenge-mediated arousal to stereotypes alleging intellectual inferiority. In Gallagher, A.M., & Kaufman, J.C. (ed.), *Gender differences in mathematics: an integrative psychological approach* (pp. 189-206). New York: Cambridge University Press.
Discusses girls’ reactions to the stereotype of their inferiority in mathematics. It is “designed to help understand the theoretical underpinnings of stereotype threat, as well as to help stigmatized students overcome its effects by enhancing resilience to stereotypes and turning threat into challenge.”

Bianchini, J. A., Whitney, D. J., Breton, T. D., & Hilton-Brown, B. A. (2002). Toward inclusive science education: University scientists' views of students, instructional practices, and the nature of science. *Science Education*, *86*, 42-78.
This study examined the perceptions and self-reported practices of 18 scientists participating in a year-long seminar series designed to explore issues of gender and ethnicity in science. Through questionnaires and semi-structured interviews, the authors explored participants' (a) rationales for differential student success in undergraduate science education; (b) self-reports of ways they structure, teach, and assess courses to promote inclusion; and (c) views of androcentric and ethnocentric bias in science. This article highlights ways to increase the number of women college students in science

Blickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender & Education, 17,* 369-386.
Women are under-represented in science, technology, engineering and mathematics (STEM) majors and careers in most industrialized countries around the world. This paper explores the broad array of explanations for the absence of women in STEM put forth in the literature of the last 30 years. It is argued that some proposed explanations are without merit and are in fact dangerous, while others do play a part in a complex interaction of factors. It is suggested that the very nature of science may contribute to the removal of women from the academic pipeline. Recommendations for reform in science education to address this problem are also provided.

Brush, L.R. (1980). *Encouraging girls in mathematics: the problem and the solution.* Cambridge, Mass.: Abt Books.
Discusses the results of a longitudinal study conducted on high school students in the late 1970’s, measuring their attitudes toward and abilities in mathematics, with the goal of understanding why so few women study advanced mathematics. Suggests changes in the teaching of mathematics to increase female participation. Much of the discussion is relevant to college students as well.

Datta, D. (1993). *Math Education at its Best: The Potsdam Model*. Framingham, MA: Center for Teaching/Learning of Mathematics.
Discusses the "Potsdam miracle": the enormous success SUNY Potsdam had in producing and educating math majors, particularly women. They rejected the idea that only the very gifted can be math majors, instead, their approach was "based on the premise that the study of pure mathematics can be undertaken successfully by a large number of students if they are provided with a supportive environment including: careful and considerate teaching by a well-trained and dedicated faculty, continual encouragement, successful (student) role models, enough success to develop self-esteem, enough time to develop intellectually, recognition of their achievement, and the belief that the study is a worthwhile endeavor."

Downing, R. A., Crosby, F.A., & Blake-Beard, S, (2005). The perceived importance of developmental relationships on women undergraduates' pursuit of science. *Psychology of Women Quarterly, 29*, 419-426.
Using a survey of women science majors, we tested the assumption that women mentors and other women guides help women students pursue the sciences. The survey explicitly distinguished among three types of guides: mentors (who provide psychosocial support), sponsors (who provide instrumental support), and role models (who act as examples) encountered before and during college. The authors found that over 90% of the women had a guide of one type or another, that mentors were most influential to women's pursuit of science, and that guides during college were more influential than guides prior to college.

Fennema, E., & Leder, G.C. (ed.) (1990). *Mathematics and gender*. New York : Teachers College, Columbia University.
A collection of chapters, by different researchers, on gender differences in mathematics. Many are about trying to identify actual differences in ability and so are not relevant to our project, but there are several about differences in attitude and self-confidence. Focus is on understanding, not addressing, the differences.

Fox, L.H. (1981*). The problem of women and mathematics: a report to the Ford Foundation*. New York: Ford Foundation.
A report commissioned "as part of an investigation into the reasons for the limited participation of women in advanced mathematics and related scientific fields. Our objective was to identify the particular problems of women in these field and to determine what steps might be taken to meet them." Discusses gender differences in mathematics as well as social and psychological factors, and makes some very vague suggestions for change.

Gilbert, J. & Calvert, S. (2003). Challenging accepted wisdom: looking at the gender and science education question through a different lens. *International Journal of Science Education, 25,* 861-878.
This article reports on a research project designed to explore a group of women scientists' understandings of themselves and science. The project uses a mixture of conventional qualitative research methods and techniques developed for use in psychotherapy. Its

preliminary results appear to contradict some of the assumptions on which much of past work on girls and science education is based. The women interviewed were focused on professional actions and achievements rather than feelings about their careers.

Greenberg-Lake--the Analysis Group (1994). *Shortchanging girls, shortchanging America: executive summary: a nationwide poll that assesses self-esteem, educational experiences, interest in math and science, and career aspirations of girls and boys ages 9-15, commissioned by the American Association of University Women*. Washington, D.C.: American Association of University Women Educational Foundation.

Just what the title says. A key finding is that girls' self-esteem drops much more dramatically than boys during adolescence, and that as they get older, girls see their struggles with math and science as personal failures, while boys see them as a problem with the subject itself.

Greene, B. A. & DeBacker, T. K. (2004). Gender and orientations toward the future: Links to Motivation. *Educational Psychology Review 16,* 91-120.

Literature on future orientation and motivation was examined for gender differences. Research revealed gender differences from five theoretical orientations: achievement motivation, future time orientation, possible selves, expectancy-value, and social-cognitive. Some of those differences seemed best explained in terms of generational differences in gender role expectations. Gender differences were found in extension and density of future goals. Men had further extension but fewer goals than women. Evidence suggested that women's future expectations have become more similar to men's in the career realm, although women also have maintained their focus on interpersonal goals.

Handelsman, J., Cantor, N., et al. (2005). More women in science. *Science 309*, 1190-1191.

The article reports that, although there have been major advances, academic institutions in the United States are still not fully utilizing the pool of women scientists they have produced. Recently, much has been made of biological differences between men and women that might affect their representation in science. Although there is a substantive body of evidence indicating that overall intelligence does not differ between men and women, controversy persists as to whether specific aspects of cognitive ability differ. Men and women may differ, on average, in some of these abilities, but that is not a basis on which one can predict success because different mixtures lead to diverse, yet successful, approaches and styles in science. The low number of women trained in certain fields is partially to blame for the paucity of women on the faculty.

Hanson, S. L. (2004). African American women in science: Experiences from high school through the post-secondary years and beyond. *NWSA Journal, 16*, 96-115.

This article uses data from the National Education Longitudinal Survey (NELS) to provide information on the science achievement, access (course-taking), and attitudes of young African American women at various points in the science education system. In addition, it uses recent data from the NELS 2000 panel to examine these young women's entry into science occupations in the early adult years. In one of the most extensive

studies of young African American women's science experiences from the early high school years to the early adult years, findings show that there is a continued interest and involvement in science, often more so than that for young white women.

Inzlicht, M. & Ben-Zeev, T. (2000). A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science, 11,* 365-371.

Examines whether females in environments in which they have contact with males cause deficits in their problem-solving performance. Participants completed a difficult math or verbal test in 3-person groups, each of which included 2 additional people of the same sex as the participant (same-sex condition) or of the opposite sex (minority condition). Female participants in the minority condition experienced performance deficits in the math test only, whereas males performed equally well on the math test in the two conditions. Further investigation showed that females' deficits were proportional to the number of males in their group. Even females who were placed in a mixed-sex majority condition (2 females and 1 male) experienced moderate but significant deficits. Findings are discussed in relation to theories of distinctiveness, stereotype threat, and tokenism.

Jones, R. A. (2005). How many female scientists do you know? *Endeavour, 29,* 84-88.

The stereotypical scientist wears a lab-coat, is often eccentric and is usually male. Images of female scientists in popular culture remain rare. Some of the first portrayals of women in science occurred in a handful of British films made during the 1950s and 1960s. These films reflected the difficulties experienced by women in science at the time, but they might also explain why representations of female scientists in film continue to downplay their role as scientists and emphasize their identity as women.

Katz, J., Joiner, T. E., & Kwon, P. (2002). Membership in a devaluated social group and emotional well-being: Developing a model of personal self-esteem, collective self-esteem, and group socialization. *Sex Roles, 47,* 419-431.

First, some members of devalued groups may internalize negative stereotypes about their group, which negatively impact personal self-esteem. Second, being devalued simply on the basis of one's group membership could lead to emotional distress independent of one's own personal self-esteem. Third, some members of devalued groups may be socialized to develop attitudes and behaviors that increase their risk for emotional distress. Data were collected from a sample of White, middle-to-upper-class undergraduate women and men with respect to personal self-esteem, collective self-esteem on the basis of their gender group, attitudes and behaviors associated with female socialization, and emotional distress. Results supported the direct effect of each pathway in predicting concurrent depression and partially supported the prediction of concurrent anxiety.

Keller, J. (2002). Blatant stereotype threat and women's math performance: Self-handicapping as a strategic means to cope with obtrusive negative performance expectations. *Sex Roles, 47,* 193-198.

Describes an experiment designed to test the impact of increased salience of negative stereotypic expectations on math performance. Female participants in the stereotype salient condition underperformed in comparison to the control group.

O'Keefe, R. (2000). Successful strategies for teaching math to college women. In Bart, J. (ed.), *Women succeeding in the sciences: theories and practices across disciplines* (pp. 107-114). West Lafayette, Ind.: Purdue University Press.
Discusses her successes in teaching elementary mathematics to math-phobic college students, particularly women. She says the key is the atmosphere of the class, and that the pedagogy is "more a function of structure and class environment than it is of content." As a result, a lot of it isn't necessarily applicable to our intro classes, where we do need to cover a set amount of material.

Rayman, P. & Brett, B. (1995). Women science majors. *Journal of Higher Education, 66,* 388-414.
Examines the underrepresentation of women in the field of science. The authors provide an overview of the research on the effects of psychological factors, self-efficacy, family backgrounds, affiliation activities, institutional, and cultural factors on the decision for women to pursue science degrees.

Roedel, T. D. & Schraw, G. (1994). Validation of a measure of learning and performance goal orientations. *Educational & Psychological Measurement, 54,* 1013.
Investigated the psychometric properties of the Goals Inventory (GI), which measures learning and performance goal orientations as described by C. S. Dweck and E. S. Leggett's model. Comparisons to measures of test anxiety and of hope of goal attainment suggested that the GI has a high degree of convergent and divergent validity. All theoretically explicit predictions of Dweck and Leggett were supported. Used as a measure in the Agnes Scott study.

Schmader, T. (2002). Gender identification moderates stereotype threat effects on women's math performance. *Journal of Experimental Social Psychology, 38,* 194-201.
This research applies a social identity perspective to situations of stereotype threat. It was hypothesized that individuals would be more susceptible to the performance-inhibiting effects of stereotype threat to the extent that they are highly identified with the group to which a negative stereotype applies. A quasi-experimental study with male and female college students revealed that individual differences in gender identification (i.e., importance placed on gender identity) moderated the effects of gender identity relevance on women's (but not men's) math performance. When their gender identity was linked to their performance on a math test, women with higher levels of gender identification performed worse than men, but women with lower levels of gender identification performed equally to men. When gender identity was not linked to test performance, women performed equally to men regardless of the importance they placed on gender identity.

Schmader, T., Johns, M., & Barquissa, M. (2004). The costs of accepting gender differences: The role of stereotype endorsement in women's experience in the math domain. *Sex Roles, 50,* 835-850.

Two studies were designed to examine the costs of stereotype endorsement for women's sell- perceptions, career intentions, and susceptibility to stereotype threat in the math domain. Study 1, a survey of women majoring in math-related fields, revealed that women who believe that status differences between the sexes are legitimate were more likely to endorse gender stereotypes about women's math abilities, which in turn predicted more negative sell- perceptions of math competence and less interest in continuing study in one's field. In Study 2, women who tended to endorse gender stereotypes were found to be more susceptible to the negative effects of stereotype threat on their math test performance.

Smoot Hyde, M., and Gess-Newsome, J. (2000). Factors that increase persistence of female undergraduate science students. In Bart, J. (ed.), *Women succeeding in the sciences: theories and practices across disciplines* (pp. 115-137). West Lafayette, Ind.: Purdue University Press.
Studies successful female math/engineering/science (MES) students, rather than those who don't make it through, "allowing for the understanding of success factors in education and retaining female MES majors." The emphasis is on the entire program, not the individual classroom.

Steele, J., James, J. B., & Barnett, R. C. (2002). Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly, 26,* 46-50.
This study examined the perceptions of undergraduate women in male-dominated academic areas. First-year and final-year female undergraduates in a male-dominated academic area (i.e., math, science, or engineering) reported higher levels of discrimination and stereotype threat than women in a female-dominated academic area (i.e., arts, education, humanities, or social science), and men in either a male- or female-dominated academic area. Moreover, women in a male-dominated academic area were most likely to report thinking about changing their major. These findings suggest that female college students majoring in math, science, and engineering continue to perceive additional gender-based obstacles in their field.

Tobias, S. (1978). *Overcoming math anxiety*. New York: Norton.
Chapter 3 ,"Mathematics and sex," begins "Men are not free to avoid math; women are." She concludes that while there may be some innate differences in men and women's mathematical abilities, most differences are social, and that anyway the most important factors in the ability to learn math are not talent but motivation, temperament, attitude, and interest. The bulk of the book is about ways to change negative attitudes about math into positive ones.

VanLeuvan, P. (2004). Young women's science/mathematics career goals from seventh grade to high school graduation. *Journal of Educational Research, 97,* 248-267.
The author examined changes in the educational and career goals of 66 young women who completed surveys in Grades 7 and 12. Participants identified desirable versus undesirable aspects of mathematics- and science-based careers to better understand the

characteristics that do or do not attract women from these fields. Over time, participants' degree aspirations and interest in science, engineering, and mathematics (STEM) careers decreased. Young women liked the learning and discovery and using mathematics, and they reported enjoying STEM careers. Conversely, some of the women disliked doing the mathematics and the hard work required and reported a lack of interest in STEM fields.

Webpages with useful calculus projects/resources:

http://www.math.lsa.umich.edu/~glarose/courseinfo/calc/calcprojects.html
http://www.math.unl.edu/~jorr1/calculus/projects.html
http://www.wheatonma.edu/academic/academicdept/MathCS/Faculty/tratliff/writing/home.html
http://server1.fandm.edu/departments/Mathematics/writing_in_math/writing_index.html
http://comet.lehman.cuny.edu/sormani/teaching/CalcIIProjects.html
http://www.brynmawr.edu/math/people/donnay/vjdwebpage/Teaching/vjdmath201webf05/admin/201ProjectInfof05.pdf#search=%22calculus%20projects%22
http://users.dickinson.edu/~richesod/math161-04.html