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Expectancies, Ability Values, and Attributions for Performance in Math in Junior High

Draft

While in elementary school, boys and girls typically do not differ on scores in math achievement tests, by adolescence, sex differences in math achievement begin to emerge, with boys usually outperforming girls. Many of the relevant studies, however, have failed to control for the number of mathematics courses taken, so that boys who have taken more mathematics courses are often compared with girls who have taken fewer courses.

The purpose of the research project that I'm going to discuss was to study those factors that might influence the decision to take mathematics when it becomes an option. While we are interested in the processes affecting the participation of both boys and girls in advanced high school math, our focus was on sex differences since it is typically the gi rls who choose not to take math.

One factor that we hypothesized to influence course selection was expectancies for success. Research in achievement attribution has shown that expectancies for success are linked to both behavioral choice and task persistence. In addition, sex differences in expectancies for success are frequently found on a variety of tasks, with girls having lower expectancies for success than boys. The question that I would like to address is: how might teachers influence students expectancies for success in mathematics?

The effects of teachers' expectancies on their students' performance have been extensively studied since the publication of Rosenthal and Jacobson's Pygmalion in the Classroom. While their results have been difficult to replicate, research by Brophy and Good has shown that teachers' naturally occurring expectancies for students in their classrooms affect the kinds

of interactions teachers have with their students. For example, students for whom the teacher has high expectancies are more likely to have their correct responses praised, are more likely to be repeatedly questioned until they can answer correctly, and are less likely to be criticized than students for whom the teacher has low expectancies. While girls are rated by teachers as being more effective learners and more hardworking than boys, it is the boys who have the most interactions of all kinds with their teachers. In fact, it is the boys for whom the teacher has high expectancies who have the most favorable interactions with their teachers, and the low expectancy boys who are criticized the most, while girls of all achievement levels are treated more similarly. Thus, teachers treat girls for whom they have high expectancies in ways that are less facilitative of achievement than comparable groups of boys.

Another mechanism that may explain girls lower expectancies for success has been proposed by Dweck and her colleagues. Their model emphasized the importance of the types of praise and criticism used by the teacher and its relation to students' academic behaviors. Boys who receive frequent criticism for academic as well as nonacademic behaviors such as conduct or neatness can discount these negative evaluations as indicants of their own abilities. Rather, the teachers' criticism of the boys can be interpreted as a characteristic or enduring attitude of the teacher. In contrast, girls receive less criticism than boys, and it is usually not directed to their conduct or nonintellectual aspects of their work. Criticism, therefore, is most likely directed to the quality of their work.

Because it is used quite specifically, it is more informative about girls' levels of ability. The same line of reasoning applies to the use of praise. Thus, it is the proportion of specific to generalized feedback that is important in this model. The teacher need not have differential expectancies for boys and girls to behave in ways that adversely affect girls' expectancies for success. Strong support was found for this model in an observational study of three fourth and fifth grade classrooms. Less than one third of the criticism directed to boys was contingent on academic performance while more than two thirds of the criticism directed to girls was aimed at the quality of their work. Boys also received more praise contingent on the quality of their work than did girls. In addition, the teachers were more likely to attribute failure to a lack of effort for boys than for girls.

Based on this research, there were two questions we wanted to address: First, are there sex differences in teachers' expectancies for their students and teacher-student interactions in math classrooms? Second, what is the relation between teachers' expectancies, teacher-student interactions, and students' expectancies in math?

The subjects in this study included students and their math teachers in eight seventh grade classrooms, and seven ninth grade classrooms. We chose these grades because previous research identified the junior high school years as those in which sex differences in attitudes toward math and achievement in math begin to emerge.

Students' expectancies and teachers' expectancies were measured by questionnaires. The items and results are shown on Tables 1-3. On the student questionnaire, items were divided into those assessing expectancies for familiar tasks and those assessing expectancies for unfamiliar tasks. Previous research has shown that sex differences are more likely to occur in expectancies for unfamiliar tasks. As you can see, our results supported this pattern. In addition, we found no sex differences for teachers' expectancies for their students (items 1 and 2 on the teacher questionnaire). The one sex difference on this questionnaire was item 4. Teachers did rate girls as trying harder than boys.

The observational system we used was a modified version of both Brophy and Good and Dweck's systems. Observers coded interactions between teachers and individual students during 10 classroom sessions. An overview of the observational system is shown on Table 4. Sequences of teacher-student interactions were coded during a variety of setting, such as question and answer periods in which the teacher asked a question and a student responded. They were also coded when students initiated questions and during private teacher-student interactions. In addition, all instances of praise and criticism were coded as well as attributions to ability, effort, and task difficulty.

An analysis of variance was done on the 51 classroom variables listed on Table 5. The independent variables were sex, grade, and teacher expectancies, which were based on items 1 and 2 of the teacher questionnaire, coded as either high or low. In all analyses of variance, the classroom was the unit of analysis,

since individual teacher-student interactions are not independent.

Of the 51 variables, significant effects were found on only 15 of them. Most were main effects due to sex and the only consistent pattern was that girls tended to get less criticism in various situations than boys. If you look at Table 5, variables 17, 21, 25, 44 and 50 all showed significant sex differences. We did not replicate past research in which high expectancy boys had the most favorable interactions nor did we replicate any of Dweck's findings. The variables relevant to Dweck's model are numbers 45-49 on Table 5. As you can see the percentages of types of praise and criticism given to boys and girls did not differ. In addition, there were no sex differences in teachers' attributions to effort, ~~ability, or task difficulty~~.

To answer the question concerning predictors of students' expectancies, stepwise regressions were done to select the variables that best predicted students' expectancies for success. Predictor items included sex of student, most recent report card grade, teachers' expectancies for their students and several of the teacher-student interaction variables. For expectancies for familiar tasks, only teachers' expectancies accounted for a significant amount of the variance (31%). For expectancies for unfamiliar tasks, teachers' expectancies and sex of student were significant predictors (21%). Contrary to prediction, then, none of the classroom interaction variables were significant.

It is puzzling that teachers' expectancies as expressed on a questionnaire were related to students' expectancies but that

their expectancies were not expressed in their behaviors. Most likely, one reason that teachers' expectancies are related to students' expectancies is that they are both strongly associated with students' actual achievement. Teachers' expectancies, therefore, do not necessarily reflect a bias by the teachers, but a natural response to the behaviors of their students. This, however, is not the only explanation for the relation between teachers and students expectancies. In our study, although the correlation between report card grades and teachers' expectancies was high (.66), teachers' expectancies accounted for a significant amount of variance in students' expectancies, even after the effect of report card grades was partialled out. Interesting evidence concerning the relation between students' achievement and teachers' expectancies comes from other research as well. Teachers have been found to form expectancies early in the school year before they have had the opportunity to become fully acquainted with their students' and their capabilities. For teachers whose expectancies do not change over the school year, their attitudes toward their students are probably based on such things as school records, other teachers' reports, and knowledge of siblings. One longitudinal study by Crano and Mellon directly investigated the direction of causality between teachers' expectancies and students' achievement through cross-lagged panel analyses. They found that teachers' expectancies were more likely to affect students' achievement than for achievement to affect teachers' expectancies. It seems likely, therefore that teachers' expectancies are related to students' expectancies in ways that cannot be totally accounted

for by their common association with students' achievement.

In conclusion, I would like to propose two possible explanations for the absence of a relationship between students' expectancies and teacher-student interactions. First, I think it is unlikely that the effects of teachers on students will be similar across all classrooms. Some evidence suggests that a teacher's influence is strongest when the teacher is perceived as extremely negative or extremely positive. If we could categorize the teachers in our sample on the basis of some dimension, such as effectiveness or charisma, it is possible that a relation between expectancies and classroom behaviors would be present in one group of classrooms but absent or different in another group.

The second explanation for the absence of a relation between students' expectancies and teacher-student interactions involves the nature of the behaviors coded. While the observational system included diverse types of interactions in varied settings, it does not emphasize those interactions that are important or critical and those that are more mundane. For example, the teacher who says "good" every time students respond to a question would show a high frequency of praise directed toward work. Yet the students' perception of this teacher's feedback would probably be similar if the teacher were simply saying "okay" which, of course, is not considered praise. More important, is the need to identify those critical events in which teachers' feedback might be more influential. For example, teachers' attributions given to students concerning report card grades or important tests might be attended to more or

perceived as more important by students than attributions given to homework assignments or every day classroom work. It is the infrequent behavior of the teacher, rather than the common interactions stressed in our observations, that may play an important role in students' perceptions of their ability and expectancies.

Table 1

Items Assessing Expectancies for Familiar Tasks

Item	Means	
	Boys	Girls
How well do you think you'll do in your mathematics course next year?	5.29*	4.90
Compared to other students in your class, how well do you expect to do in mathematics this year?	4.80	4.73
How well do you expect to do on your next math test?	5.19	4.80
How well do you think you will do in your math course this year?	5.22	4.75
Total Scale	5.12	4.80

*$p < .05$.

Responses are based on a seven-point scale.

Table 2

Items Assessing Expectancies for Unfamiliar Tasks

Items	Means	
	Boys	Girls
How successful do you think you'd be in a career which required mathematical ability?	5.28**	4.58
How well do you think you will do in advanced high school math courses (like advanced algebra or calculus)?	4.95*	4.51
Total Scale	5.12*	4.54

*$p < .02$. **$p < .001$.

Responses are based on a seven-point scale.

Table 3

Items on the Teacher Questionnaire

Item	Means	
	Boys	Girls
** How well do you think ____ would do in advanced high school math?	4.41	4.73
** How well is ____ doing in math this year?	3.65[a]	3.85
How much mathematical aptitude or ability do you feel ____ has?	5.28	5.26
How hard do you believe ____ tried to do well in math?	4.93*	5.42
How well is ____ doing in math compared to how well you believe he or she could do?	5.33	5.64

[a]Responses are based on a five-point scale.

*$p < .01$.

**Items used to assess teachers' expectancies.

Table 4

Overview of Observational System

I. Response Opportunities: Situation in which teacher publicly questions students in the class

A. Type of Question
1. Discipline -- teacher calls on student to redirect student's attention
2. Direct -- teacher calls on student who has not volunteered
3. Open -- teacher calls on student who has raised his/her hand
4. Call-out -- student calls out the answer without permission

B. Level of Question
1. Response -- questions that have a right or wrong answer
2. Self-reference -- questions that ask for opinion or prediction

C. Type of Student Response
1. Answer
2. Don't know
3. No response at all

D. Teacher's Feedback
1. Praise or criticism directed to quality of the work
2. Praise or criticism directed to the form of the work
3. Praise or criticism directed to conduct
4. Affirm
5. Negate
6. No feedback
7. Give answer
8. Ask other -- calls on another student to answer the question
9. Sustaining feedback -- gives the student another opportunity to answer the question.
10. Attributions to ability, effort and task difficulty

II. Student-Initiated Questions

A. Type of Question
1. Content
2. Procedural

B. Teacher's Feedback

III. Dyadic Interactions: Situations in which teacher interacts privately with student.

A. Initiator of interaction
1. Teacher
2. Student

B. Feedback

Table 5

Mean Scores for Boys and Girls on the Classroom Interaction Variables

Variable	Girls	Boys
1. Discipline Questions	.094*	.036
2. Direct Questions	.031	.038
3. Open Questions	-.014	.026
4. Call-Outs	.107	.016
5. Response Opportunities	.022	.024
6. Student Gave Answer	.016	.023
7. Student Said "Don't Know"	.062	.014
8. Student Gave No Response	-.070	.079
9. Praises during Response Opportunities	-.041	.023
10. Criticisms during Response Opportunities	-.005	.188
11. Self-Reference Questions	.061	-.093
12. Student-Initiated Content Questions	.194	-.132
13. Student-Initiated Procedure Questions	.212	-.148
14. Student-Initiated Dyadic Interactions	.050	-.041
15. Teacher-Initiated Dyadic Interactions	.025	.032

Table 5 (continued)

Variable	Girls	Boys
16. Praises during Dyadic Interactions	.175	-.102
17. Criticisms during Dyadic Interactions	-.240	.200
18. Praises for Work	-.015	-.006
19. Praises for Form	-.096	.063
20. Total Praise	-.026	.004
21. Criticism for Work	-.180	.116
22. Criticism for Form	-.077	.054
23. Criticism for Conduct	.018	.030
24. Total Criticism	-.026	.044
25. Criticism for Work and Form	-.127	.083
26. Student-Initiated Interactions	.157	-.097
27. Teacher-Initiated Interactions	.062	.015
28. Teacher-Student Interactions	.148	-.082
29. % of Discipline Questions	.128	-.032
30. % of Direct Questions	-.015	.018
31. % of Open Questions	.021	-.021
32. % of Call-Outs	.162	-.012
33. % of Response Opportunities	-.126	.151
34. % of Self-Reference Questions	-.006	-.059
35. % of Times Student Gave Answer	.112	-.123
36. % of Times Student Said "Don't Know"	-.112	.123

Table 5 (continued)

Variable	Girls	Boys
37. % of Responses Praised	-.036	-.072
38. % of Response Opportunities and Self-Reference Questions	-.092	.112
39. % of Content Questions	-.106	.135
40. % of Procedural Questions	.106	-.135
41. % of Dyadics that were Student-Initiated	.035	-.058
42. % of Dyadics that were Teacher-Initiated	-.035	.058
43. % of Dyadics Praised	.200	-.162
44. % of Dyadics Criticized	-.239	.212
45. % of Criticisms to Work	-.116	.148
46. % of Criticisms to Form	-.019	-.016
47. % of Criticisms to Conduct	.082	-.063
48. % of Praises to Work	.260	-.185
49. % of Praises to Form	-.230	.238
50. % of Interactions Criticized	-.091	.084
51. % of Interactions Praised	-.086	.017

*Scores are in standard score form.

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