

## **Collaborative Testing and Test Anxiety**

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*Abstract.* Prior research concluded that collaborative learning reduces test anxiety. Examination of the evidence used in that research, however, calls into question those conclusions. The present study used an empirical measure of test anxiety and an experimental design to provide an improved estimate of the effect of collaboration in an evaluative context on test anxiety. The findings show no significant difference in test anxiety between students who collaborate on their exam and students who work alone. The ability to organize information is found to have a significant effect on test anxiety and that effect differs between collaborating students and those working alone.

*Keywords:* test anxiety, collaboration, testing, cooperative learning.

### **I. Introduction.**

Among the many areas of research in teaching and learning, the areas of collaborative learning and test anxiety may be among the most studied. Johnson, Johnson, and Stanne (2000) identify over 900 research studies, over a 100 year period, validating cooperative learning and 194 separate comparisons of specific collaborative learning methods. Even more numerous are studies of test anxiety. Pekrun, Goetz, Titz, and Perry (2002) report over 1200 studies of test anxiety for the period 1974-2000 alone. Surprisingly perhaps, given this volume of studies, only a very few studies have examined the relationship between collaboration in an evaluative context and test anxiety. Even fewer attempt an empirical assessment of this association. Rather, conclusions about a collaboration-test anxiety effect are based on student and teacher impressions. In this paper, we address this gap in the research literature. We examine the effect of collaboration in an evaluative situation on levels and changes in a quantitative measure of test anxiety among two groups of undergraduate college students.

### **II. Literature Review.**

#### *A. Collaborative Learning.*

Studies of collaborative learning have documented a range of beneficial outcomes across diverse populations and disciplines. Researchers have documented learning gains among elementary school children (Billington 1994; Fuchs, Fuchs, Karns, Hamlett, Kataroff, and Dutka 1998), developmental students (Ley, Hodges and Young 1995), and college students (Clark 1994; Giraud and Enders 2000; Gokhale 1995; Grzelkowski 1987; Guest and Murphy 2000; Hanshaw 1982; Harris 1993; Helmericks 1993; Muir and Tracy 1999; Nowak, Miller, and Washburn 1996;

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Rau and Heyl 1990; Reinhart 1999; Russo and Warren 1999; Sernau 1995). At the college level, collaborative learning studies have been conducted in courses in sociology (Grzelkowski 1987; Helmericks 1993; Rau and Heyl 1990; Reinhart 1999; Sernau 1995), psychology (Guest and Murphy 2000; Ley et al 1995), business (Nowak et al 1996), statistics (Giraud and Enders 2000), education (Muir and Tracy 1999), science (Hanshaw 1982), industrial technology (Gokhale 1995); and English composition (Russo and Warren 1999).

Among the learning outcomes identified by proponents of collaboration are increased complexity of thinking, increased motivation to learn, improved performance on oral, written, and multiple choice exams, and greater retention of information (Gamson 1994; Johnson, Johnson, and Stanne 2000). Additionally, collaborative learning fosters cooperation and connections with others (Muir and Tracy 1999; Rau and Heyl 1990), develops skills critical workplace success such as team building and teamwork skills (Nowak et al 1996; Russo and Warren 1999), humanizes the learning experiences (Grzelkowski 1987), eliminates cheating (Grzelkowski 1987; Ley et al 1995), is associated with higher levels of student satisfaction (Chickering and Gamson 1991; Fuchs et al 1998; Giraud and Enders 2000; Sernau 1995; Slavin 1980), and lowers test anxiety (Grzelkowski 1987; Hanshaw 1982; Helmericks 1993; Ley et al 1995; Muir and Tracy 1999; Russo and Warren 1999).

The breadth and generalizability of collaborative learning effects across populations, disciplines, and methods of evaluation seems to make a very compelling case for adopting the collaborative learning format. Closer scrutiny of the evidence, though, may temper enthusiasm for employing collaborative learning as a multi-purpose problem solver. Consider the claim that collaborative learning reduces test anxiety. Of the six studies we located that make such a claim, only Hanshaw (1982) employs an instrument to measure test anxiety. The others base their conclusions about a collaboration-test anxiety effect on teachers' and students' impressions. While those impressions and conclusions may be valid, the absence of empirical evidence leaves them on less sure footing than empirical evidence would provide. Further, the absence of a non-collaborative control group and a pre-collaboration test anxiety baseline against which test anxiety under collaboration can be compared make it all the more difficult to accept prior conclusions about the anxiety reducing effect of collaboration.

### *B. Test Anxiety.*

Test anxiety research has primarily focused on the association between test anxiety and academic achievement. Reviews of that literature find strong consensus on the negative association between test anxiety and academic achievement (Hembree 1988; Seipp 1991). Another large body of work has centered on the measurement of test anxiety. This research generally supports the idea that test anxiety is a two-dimensional construct with a cognitive and an emotional component.

Cognitive test anxiety refers to the inability to retrieve information in an evaluative setting. It is characterized by such conditions as task irrelevant thoughts, excessive fear of failure, worry about letting others down, and negative comparisons with others. Emotional test anxiety refers to physiological reactions to evaluative situations. It includes reactions such as dizziness, nausea, and feelings of panic. Meta-analyses and path analyses have concluded that cognitive test anxiety is the more important dimension of test anxiety for explaining difference in academic achievement. It is more strongly and more consistently associated with test performance (Bandalos, Yates and Thorndike-Christ 1995; Williams 1991).

Two models of the cognitive test anxiety-test performance association have received the most attention. The “interference” model argues that high levels of test anxiety inhibit the ability to recall learned information (Sarason 1986; Wine 1980). The problem is not one of learning, but one of interference with retrieval. Wine (1980) writes that high test anxiety divides the students’ cognitive power between focusing on the task and attention to task-irrelevant thoughts. This both inhibits the power to recall and limits the ability to engage in higher order thinking. These factors may explain why students with high test anxiety generally do better on multiple choice exams than on essay exams where the former may require less recall. The “skills deficit” model claims that high test anxiety students have difficulty learning and organizing material, and that this results in poor test performance (Birenbaum and Pinku 1997; Naveh-Benjamin, McKeachie and Lin 1987; Tobias 1985). Students with high test anxiety deal with anxiety through avoidance (Appelhans and Schmeck 2002). They minimize important differences and miss subtle cues about what is important to learn (Cassady and Johnson 2002). Both avoidance of learning and minimization of attention lead to poor test performance. Their test setting anxiety comes from their realization that they are not prepared. The problem is not one of recall, but rather, a lack of preparation due to poor study skills. They do poorly because there is little learned information to recall.

Rather than constituting alternative explanations, the interference and skills deficit models may be complementary (Birenbaum and Pinku 1997; Tobias 1985). They suggest different types of students with different predicted performance levels. Students with good study skills and good ability to organize information, along with low test anxiety should perform well since they have learned the test material and suffer from no inability to recall. Other students are able to learn the material but suffer from retrieval problems in evaluative settings and when the task asks for more cognitive power than they have available. Still others fail to learn and have difficulty organizing material so that they do poor regardless the test situation or test format.

### *C. Collaborative Testing and Test Anxiety.*

Collaborative testing seems to have implications for both interference and skills deficit on test performance. In the collaborative setting, students share their cognitive power and their archive of learned information. Collaboration should boost the ability to retrieve both directly through lowered test anxiety and indirectly as students discuss, reflect on, debate questions and answers. Collaboration should reduce anxiety due to skills deficit since students know they will have the knowledge of another student to aid them. On the other hand, collaboration may increase anxiety for these students if they become anxious over their lack of preparation being exposed to another student.

We hypothesize that cognitive test anxiety will differ between students who collaborate on an exam and those who do not. Collaborating students will have lower test anxiety than students working alone. We also hypothesize that the effect of the ability to organize information on test anxiety will differ between those who collaborate and those who do not. Collaboration will reduce the effect of information organizing skill on test anxiety.

## **III. Data and Methods.**

Our subjects were 131 undergraduate college students enrolled in four sections of an introductory sociology course. All participation was voluntary and only a few students chose not

to participate. At the beginning of the course, students were told that they would have the opportunity to participate in a research study on learning that would be conducted in class. Informed consent was gained from those who chose to participate.

Three sections of the course were designated as the experimental group where students would have the opportunity to work in same-sex, randomly assigned pairs on a multiple choice test. The fourth section served as the control group. Basic demographic information on these groups is found in Table 1.

**Table 1. Summary of Student and Group Characteristics.**

	All	Experimental Group	Control Group	t-statistic <sup>a</sup>
Sex				
Female	79	54	25	0.131
Male	52	37	15	
Minority				
Minority	10	3	7	-2.12*
Non-Minority	121	88	33	
Class Rank				
Freshman	70	52	18	
Sophomore	45	29	16	-1.06
Junior	10	6	4	
Senior	6	4	2	
IO Test 1 Score				
High	51	33	18	
Moderate	66	47	19	-1.54
Low	14	11	3	
IO Test 2 Score				
High	53	36	17	
Moderate	51	40	11	0.734
Low	27	15	12	

Minority refers to non-white students. IO Test 1 and IO Test 2 refer to self-reported ability to organize information  
 a. t-statistics for the difference between the experimental and control group. \*Indicates a significant difference at the 5% level.

We divided the semester into three approximately equal sections and covered roughly the same amount of material in each section. A multiple choice test was administered at the conclusion of each section. Our present interest is in the changes between tests 1 and 2. All students took the first test individually. Students in the experimental group worked in pairs to completed test 2 while students in the control group continued to work alone.

On the day of the test, and immediately prior to distributing the test forms, we administered a Likert-type test anxiety scale. Scale items are similar to those presented by Cassady and Johnson (2002). We were concerned that students have enough time to finish the test, especially since we anticipated that collaborating would increase completion time, so we used a smaller number of scale items than might otherwise be used.<sup>2</sup> The final seven item scale has an alpha > .84. While the scale includes relatively few items, and that may be a cause of

<sup>2</sup> Test anxiety scales vary in number of scale items. Pekrun et al (2002) report test anxiety scales ranging from 9 to 31 items.

concern, it captures variation sufficient for analysis and for distinguishing different levels of test anxiety. On our scale, the higher the score, the higher the level of test anxiety.

We also collected self-reported information on subject's sex (female = 1 male = 0), minority status (minority = 1 non-minority = 0), and class rank (freshmen = 1 sophomore = 2 junior = 3 senior = 4) to assess within group differences. We would like to have collected information on grade point average (GPA), in order to control for ability, but many of our students were entering freshmen who had not yet earned their first GPA.

Lastly, we measure a student's ability to organization information (IO) as their self reported agreement or disagreement to the two questions "I frequently feel that I have studied the 'wrong' things for the test" and "The harder I work at taking a test or studying for one, the more confused I get". The data were reverse coded and summed so that the higher the sum of their scores on these questions, the higher their ability to organize information.

#### IV. Analysis and Discussion.

The summary data reported in Table 1 show no significant differences between our experimental and control groups except for minority status. There was a significantly greater percentage of minorities in the control group. This difference should be kept in mind when evaluating any other group differences. Most of our students were female, white, and predominantly either freshmen or sophomores. Although there were no significant differences in the level of IO between our groups, it is interesting to note that in both groups students are more likely to rate their information organization skills as moderate or high than as low.

As shown in Table 2, we find no significant difference in test anxiety between our groups at either test 1 or test 2. There is also no significant difference in the change in anxiety level between test 1 and test 2. Our results do not support the argument that collaborative testing reduces test anxiety. Rather than reduce test anxiety, anxiety is apparently higher at the time of the second test than the first, though not significantly so.<sup>3</sup> While these tests fail to show a significant effect of collaboration on test anxiety, closer examination of the distribution of test anxiety change shows an interesting outcome.

**Table 2. Test Anxiety Levels and Change.**

	All	Experimental Group	Control Group	t-statistic <sup>a</sup>
Test 1: Anxiety Average	18.10	18.04	17.78	0.770
Test 1: Anxiety Average	18.20	18.13	18.20	-.100
Test 1: Anxiety Average	0.09	0.18	-0.01	0.632

a. t-value for the difference between the mean scores of the experimental and control groups.

The evidence presented in Table 3 shows that while most students in both groups experienced either an increase or a decrease in test anxiety between test 1 and test 2, students in the experimental group were less likely than those in the control group to experience an increase in test anxiety. Whereas test anxiety increased 36 percent of experimental students, it increased for almost 43 percent of control group students. Collaborative testing may not affect the overall amount of test anxiety, but it appears to affect the distribution of changes in anxiety.

<sup>3</sup> t values are not reported.

**Table 3. Distribution of Test Anxiety Score Changes by Group.**

Experimental Group			Control Group		
Change <sup>a</sup>	Percent	Cumulative Percent	Change	Percent	Cumulative Percent
-6			-6	2.5%	2.5%
-5	3.3%	3.3%	-5	2.5	5.0
-4	4.4	7.7	-4	2.5	7.5
-3	2.2	9.9	-3	10.0	17.5
-2	11.0	20.9	-2	10.0	27.5
-1	15.4	36.3	-1	15.0	42.5
0	17.6	53.8	0	20.0	62.5
+1	17.6	71.4	+1	7.5	70.0
+2	15.4	86.8	+2	12.5	82.5
+3	6.6	93.4	+3	12.5	95.0
+4	5.5	98.9	+4	2.5	97.5
+5	1.1	100.0%	+5	2.5	100.0%

A Calculated as anxiety at test 1 minus anxiety at test 2. Negative values indicate an increase in anxiety from test 1 to test 2.

The top half of Table 4 presents the results of regressing test 1 anxiety level on four predictors for both groups. The bottom half of that table presents the corresponding results for test 2 anxiety level. In all four equations, IO has a significant negative effect on test anxiety. It also has the largest effect on test anxiety except on test 1 for the control group where class rank has the largest effect. These results suggest that information organizing skills are important for improved test performance not only because they lead to better preparation for a test, but also indirectly because they reduce the cognitive test anxiety that others have shown to be detrimental to test performance.

The effect for class rank is not consistently significant, but the effect in all equations is in the direction one might hypothesize. Given their greater experience with examinations, their greater likelihood of having learned to cope with test anxiety, the greater probability that they have developed study skills, it is probably not surprising that more senior students have lower levels of test anxiety compared to newer students.

The effect of minority status is interesting. Again, although the effect is generally not significant, the sign of the effect is stable across equations. Minority students express lower levels of test anxiety than majority students. This is perhaps surprising given the generally lower standardized test scores of minority students. To the extent that those scores reflect ability, one would expect their test anxiety scores to be higher since other research shows that high test anxiety is correlated with low ability. Alternatively, minority students may receive more emotional support from family versus peers. This mode of support has been shown to significantly lower test anxiety (Orpen 1996). Whatever the explanation, it appears that collaboration may boost the effect of minority status on test anxiety, net of the other independent variables. Additional research is needed to verify and explain this association.

A final contrast of interest is the change in the size of the effect of IO for the experimental group. While the change in IO for the control group is minimal, there is a substantial decrease in the experimental group. Collaboration may be responsible for this reduction. Students with poor information organizing skills, who might otherwise be anxious

about the test, may feel less cognitive test anxiety knowing that they will have the knowledge of another student to call upon. Further study on the reaction of students with poor IO skills to collaboration could help us better understand how collaborative testing affects test anxiety.

**Table 4: Regression Results: Test Anxiety on Subject Characteristics.**

	Experimental Group	Control Group
Test 1 Anxiety		
Sex	+0.696	+1.090
Class Rank	-0.279	-2.090**
Minority	-3.000	-1.590
IO Test 1	-2.120**	-2.570**
Adj. R <sup>2</sup>	0.150***	0.372***
Test 2 Anxiety		
Sex	+0.995	-0.120
Class Rank	-0.321	-1.855**
Minority	-3.920*	-1.660
IO Test 2	-1.610**	-2.760**
Adj. R <sup>2</sup>	0.148***	0.442***

The experimental group took test 2 in same-sex pairs.

\*\*Significant at the 5% level.

\*\*\*Significant at the 1% level.

## V. Conclusion.

Collaborative learning is one of the most commonly used and studied teaching techniques with researchers finding collaboration leading to increased complexity of thinking, increased motivation to learn, improved performance on oral, written, and multiple choice exams, and greater retention of information (Gamson 1994; Johnson, Johnson, and Stanne 2000). Collaborative learning enhances behavioral outcomes such as fostering cooperation and connections with others (Muir and Tracy 1999; Rau and Heyl 1990), team building and teamwork skills (Nowak et al 1996; Russo and Warren 1999), and eliminates cheating (Grzelkowski 1987; Ley et al 1995). In the affective realm, collaboration creates a more humane learning environment (Grzelkowski 1987), is associated with higher levels of student satisfaction (Chickering and Gamson 1991; Fuchs et al 1998; Giraud and Enders 2000; Sernau 1995; Slavin 1980), and lowers test anxiety (Grzelkowski 1987; Hanshaw 1982; Helmericks 1993; Ley et al 1995; Muir and Tracy 1999; Russo and Warren 1999).

Our review of the evidence for one of these outcomes, namely test anxiety, finds that conclusions about the effect of collaboration may be premature. Of the collaboration-test anxiety

studies we found, the evidence on which those conclusions were based is generally weak for reasons we outlined above. While no one study is adequate for drawing a final conclusion, we believe the present study employs a more rigorous design than earlier studies and begins to bring us closer to that conclusion.

We find no significant difference in test anxiety between students who collaborate and those who do not. Our findings are based on comparisons between two tests when students did not also engage in prior collaborative learning or get to know their test partners prior to the collaborative test. Additional research comparing changes in anxiety across multiple exams, not just between two, that examines alternative testing formats, or that examines difference in test anxiety when students engage in collaborative learning in addition to collaborative testing may lead to different conclusions.

Interestingly, collaboration may have an effect on the distribution of test anxiety changes that is not apparent when comparing group means. Understanding the distribution of change may help identify which students most benefit from collaborative testing. This is another area where additional research is needed. We also find that information organizing skills are important for reducing test anxiety and that the effect of those skills on anxiety depends on whether students collaborate or work alone on their test. Students with poor information organizing skills, who might otherwise be anxious about the test, may feel less cognitive test anxiety knowing that they will have the knowledge of another student to call upon. Further study of the reaction of students with poor IO skills to collaboration could help us better understand how collaborative testing affects test anxiety.

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