MBA Students' Quantitative Attitude: Confident or Anxious?

Crina O. Tarasi
Central Michigan University

J. Holton Wilson
Central Michigan University

Cheenu Puri
Central Michigan University

Upon analyzing the symptoms and the potential causes for quantitative anxiety, we test a twenty-item scale for measuring quantitative anxiety in MBA students. The scale was administered to a sample of MBA students at four U.S. universities. The 20-item scale yielded a four-factor solution: confidence, usefulness, enjoyment and perceived value. The findings suggest that in general, MBA students, though aware of the value and usefulness of quantitative methods, have low levels of confidence in their ability to use quantitative tools.

INTRODUCTION

In a fact driven business environment, being comfortable with statistics, interpreting their meaning and devising ways to collect meaningful data are skills required of most business professionals. Therefore, understanding the anxiety related to quantitative aspects of MBA students, and how to overcome it, is of foremost importance if we, as educators, want to contribute to the development of highly qualified professionals.

Anxiety is defined as the fear developed due to a perceived non-specific threat (Barlow, 1988; Rachman, 1998). "Math Anxiety" is often defined as "the feeling of tension and anxiety that interferes with the manipulation of numbers and solving of mathematical problems in a wide variety of life and academic situations" (Richardson and Suinn, 1972). "Statistical Anxiety" is often defined in the literature as distinctive from "Math Anxiety," in the respect that statistical anxiety also includes components of fear of interpreting statistical data and results (Cruise et al., 1985). Because in the business world, the use of mathematics and statistics relies on the ability to interpret data and results, for the purpose of this paper we will use the term "quantitative anxiety" to include all forms of anxiety stemming from any type of quantitative subject matter.

In the remainder of the paper we discuss briefly the extant literature on math and statistical anxiety; then we discuss the instruments available for measuring math and statistical anxiety, and propose a parsimonious scale for measuring quantitative anxiety as it pertains to MBA students. In the conclusion of the paper we propose some measures for alleviating quantitative anxiety.

LITERATURE REVIEW

Quantitative anxiety manifests as fear of quantitative problems (Legg and Locker, 2009). This anxiety is often initiated at the high school level and can continue at the university level. It can be defined as a general fear or tension or timidity associated with anxiety provoking situations that involve interactions with quantitative issues. Quantitative anxiety is one of the factors identified that can affect a person's problem solving performance (Tsui and Mazzocco, 2007). In a data driven business environment this is a potential problem for MBA students.

"Statistics anxiety" or fear that occurs as a result of encountering statistics in any form and at any level is noticeably common among students whose academic background includes little previous mathematical or statistic training (Onwuegbuzie, DaRos, and Ryan, 1997). As expected, statistical anxiety affects students' performance in courses with statistical content, causes feelings of inadequacy or low self-efficacy (Blalock 1987; Dillon 1982) and it is a significant factor that impacts students' ability to finish their degrees (Onwuegbuzie, 1997).

Symptoms of Quantitative Anxiety

Many psychological and physiological symptoms can be observed in those who suffer from quantitative anxiousness. Psychological symptoms may include panic, nervousness before a quantitative class, feeling blank in an exam, or feeling helpless doing homework. Having sweaty palms, a fast heartbeat or an upset stomach are some of the physiological symptoms of quantitative anxiety (Ruffins, 2007). Pan and Tang (2005) indicate that factors contributing to quantitative anxiety include but are not limited to mathematics phobia, a lack of connection to daily life, the pace of instruction, and the instructor's attitude. Their results make it evident that utilizing multidimensional instructional methods and instructors' being attentive to students' anxiety are helpful strategies to reduce students' anxiety. Having quantitative anxiety is not reflective of a person's capability in performing tasks, but it can inhibit the person's ability to learn, or to successfully apply what they know (Freiberg, 2005). This could be quite damaging in a business career in which decisions are increasingly data driven.

Reasons for Quantitative Anxiety

There can be many causes for symptoms related to quantitative anxiety. It can often be related to past classroom experiences, parental influences, remembering poor past performance, the attitudes of teachers, inadequate curriculum, and/or faulty pedagogy. Mainstream thinking concerning quantitative anxiety has assumed that it is related to the ability of a person to deal with quantitative situations. However, a growing body of research shows a much more complicated relationship between ability and anxiety (Ruffins, 2007).

Many students who lack confidence in their ability to do mathematics may leave high school feeling apprehensive about encountering simple mathematical tasks (Scarpello, 2007). When students do not view quantitative based courses as useful to their careers, they are more likely to miss classes. Gaps in students' prior education (also called "dropped stiches") hold them back from learning more-complicated concepts. From a professor's perspective, dropped stitches can be annoying. Sewing up gaps in students' knowledge takes time and effort for both the professors and the students (Farrell 2006).

A "snowball effect" can develop in which students are afraid to ask questions about concepts they feel they should know already. This can cause a student to fall further behind increasing his/her confusion with each new concept. In a vicious circle, catching up seems like an insurmountable task to some students (Farrell, 2006). This is a major concern, for success in education, for a student's future employment and for our economy. "Creating a country of 'mathophobes' does not bode well for us in the uncertain global economy of the future" (Geist, 2010, p. 29).

The style of testing and grading quantitative assignments can influence the anxiety levels in students. Denying partial credit for simple miscalculations might be discouraging: the negative feedback, in spite of effort, increases the negative feelings about the subject. Also, exams and tests are often a source of anxiety, partly because the students are pressured to perform under high stress on the tests. Having poor

test results further limits the students' curiosity and inventiveness (Farrel, 2006). Teachers who use ineffective instructional practices generally find their students lagging behind in their learning when compared to students who have been taught with effective instructional practices (Scapello, 2007).

Research on the relationship between the length of the course and the level of anxiety discovered that the shorter the course, the higher the anxiety levels. "Students taking beginning statistics in an accelerated format, either in an intersession or during a summer session, score significantly higher on the anxiety scale, indicating more anxiety, than students taking beginning statistics during the regular semester" (Bell, 2001, p.713). Since many courses in MBA programs are in accelerated formats, similar to the summer classes they might have a role in increasing anxiety.

Measuring Quantitative Anxiety

Rating scales have been established to measure various forms of quantitative anxiety among students having varying levels of mathematical skill. Two relatively long rating scales are the "Math Anxiety Rating Scale" (MARS) and "Statistics Anxiety Rating Scale" (STARS). MARS was developed in 1972 by Richardson and Suinn and has 98 items. Hopko et al. (2003) developed a more parsimonious MARS scale, called The Abbreviated Math Anxiety Scale (AMAS), with only nine items and two factors. This scale, however, is specifically adapted towards measuring the anxiety in the math classrooms and less applicable in the business classroom setting. The STARS scale (Cruise, Cash, and Bolton, 1985) is a relatively widely employed scale with 65 items and six factors: *Worth of statistics* (perceived usefulness and relevance of the statistical course, "fit" with their personality and general attitude towards the course); *Interpretation anxiety* (anxiety that arises from interpreting statistical results); *Test and class anxiety* (anxiety resulting from simple enrolment in a statistics class and having to take statistics tests)*; Computation self-concept* (feelings of inadequacy when working with and interpreting statistics); *Fear of asking for help* and *Fear of Statistics Teachers.*

Based on a qualitative study, Pan and Tang (2005) have shown that there are four main factors that contribute to quantitative anxiety. One is a general phobia related to math and statistics. A second factor is that students do not see a connection of quantitative concepts to their daily lives. Third, the pace of instruction increases anxiety if instruction is too fast. And fourth, the attitude displayed by instructors can influence the anxiety level of students.

Using items designed to capture all factors using in MARS, STARS and the more recent qualitative study (Pan and Tang, 2005), we have developed a scale with only 20 items (but which shows strong reliability) to capture the quantitative attitude of MBA students.

METHODOLOGY

We constructed an instrument (see Table 1) that was administered to 152 MBA students at four universities. Approximately 36% of the overall sample were female. The students surveyed were enrolled in either full time (57%) or part time programs, traditional (69%) or executive / professional programs, taking classes face-to-face (85%) or in blended formats (online and in person).

Using Principal Component Analysis (PCA), we extracted a four-factor solution. The solution was robust, the variables loading the same way when using several factor extraction methods (i.e., generalized least squares, principal axes factoring), and various rotation methods (e.g., Varimax, Oblimin). The four factors we identified are *Confidence, Usefulness, Enjoyment* and *Perceived Value* (see Table 1 for factor allocation and loadings). None of the variables loaded heavily on multiple factors. The highest loading on a secondary factor was .392. The item "The "truth" or falsity of a research question has to be tested by empirical data" loaded .593 on the *Perceived Value* factor, and .392 on the *Usefulness* factor. The solution presented was rotated using Varimax with Kaiser normalization.

The overall reliability of the scale (Cronbach's Alpha) is 0.945, higher than the suggested reliability proposed by Cronbach (1951), of 0.7. The reliability factor for the sub scales were .913 for *Confidence*, 0.902 for *Enjoyment,* .870 for *Usefulness* and 0.858 for *Perceived Value*.

TABLE 1
DESCRIPTIVE STATISTICS AND FACTOR LOADINGS

	Factor Loadings	Mean
Factor: Confidence		
I know which statistical procedure to use to test my hypothesis.	0.792	3.83
I have a thorough understanding of quantitative research methods.	0.764	3.94
I understand the interrelations among measurement, statistics, and research design.	0.732	4.28
I understand the basic principles of hypothesis testing and statistical inference.	0.728	4.31
Compared to others I know, I am very good in quantitative subjects.	0.676	4.41
I am confident in my quantitative ability.	0.621	4.52
I understand the basic principles of classical test theory.	0.614	4.6
Factor: Perceived Value		
Any theory 'worth its salt' has to be subjected to data-based quantitative tests.	0.769	5
A sound methodology is essential for quality research.	0.767	4.89
A good researcher must have a strong background in quantitative methodology.	0.726	5.13
Statistical tools are valuable for understanding and interpreting one's data.	0.71	5.03
The 'truth' or falsity of a research question has to be tested by empirical data.	0.593	4.59
Factor: Usefulness		
Knowledge of quantitative research methods is useful for my job.	0.783	4.78
I need to keep up with quantitative developments to do my job well.	0.745	4.16
Quantitative research methodology is useful for my career.	0.696	4.61
I need to know research methodology in order to do my own research.	0.614	4.53
I see the usefulness of quantitative research methodology in my life.	0.531	4.42
Factor: Enjoyment		
I enjoy working with numbers.	0.867	4.76
I am good with numbers.	0.852	4.9
Math has been one of my favorite subject in school.	0.825	4.58

DISCUSSION

The four-factor solution proposed is robust and the instrument provided is reliable and less cumbersome to administer than previous instruments for assessing quantitative anxiety. The four factors, that we labeled *Confidence*, *Enjoyment, Perceived Value* and *Usefulness* provide useful titles for assessing the cause, and the potential measures to alleviate anxiety. It is interesting to note that in our sample *Confidence* scores were significantly lower than the scores on any of the other three factors ($p<.001$).

Besides the scale, we asked students additional questions regarding demographics, undergraduate and graduate GPA and participation in specific courses. It was interesting to note that participation in some quantitative courses had no statistical significant effect on any of the factors of the scale, some reduced enjoyment, and others increased confidence in students' quantitative abilities. It is possible that the style of the professors, and the way they covered the material are responsible for these effects, however, since no specific questions were asked in this regard no further conclusions could be drawn ($p<.05$).

Male students reported higher confidence than female students. Students majoring in science programs in their undergraduate studies scored higher on all four factors than students majoring in business or other subjects. Ethnic background also influenced students *Enjoyment, Confidence* and *Perceived Usefulness*. Students of Asian background scored higher on all these factors as compared to white students. Interestingly, full-time MBA students scored higher on *Confidence* and *Perceived Usefulness* than part-time MBA students, but students participating in online or blended programs scored higher on *Confidence* and *Perceived Usefulness* factors compared to students attending face-to-face programs. No difference was observed in terms of work experience, or between students enrolled in traditional MBA programs versus executive/professional MBA programs. All these results are reported based on t-tests ($p<.05$), without controlling for other possible influences.

CREATING A MORE POSITIVE ATTITUDE

There are curricular and pedagogical alternatives that can lessen the extent of quantitative anxiety and increase confidence among MBA students. Faculty may be able to use different teaching methods. In order to alleviate math anxiety faculty can try to portray a positive, enthusiastic, helpful attitude, which communicates the usefulness of quantitative methods of data analysis. MBA courses can be designed in a practical, engaging, and fun way. Pedagogy needs to be implemented so that the thinking shifts away from the explain-practice-memorize to strategies that stress reasoning and understanding. There is a need for a classroom culture that prompts student inquisitiveness, discovery, learning and the exploration of ideas to replace the structured, rigid atmosphere usually associated with quantitative classes. It may also be desirable for assessment to be conducted in a variety of ways (Shields, 2005).

According to Ruffins (2007) the following are few methods that faculty can implement as part of their curriculum to help their students overcome quantitative anxiety:[1]

1. *Highly qualified women or minority faculty can be role models for the students*. Women scored worse on one of the four factors (*Confidence*) but not better than men on the other three. Maybe having successful women business professionals visit classes can increase the confidence of women.
2. *People of importance who have implemented quantitative data analysis can be introduced when relevant to course material*. Often we may be able to find such professionals who are willing to talk with classes about the usefulness of data analysis and how they use data and quantitative techniques to solve important business problems.
3. *Real life examples may be given to help students visualize a problem in more concrete terms*. We have observed that the use of "real" problems with companies and other organizations generates student interest and enthusiasm. We have many opportunities to accomplish this by using "live cases" as part of our courses.
4. *Simple words or pictures may be useful when discussing quantitative problems*. Presenting data in visual format has been proven to help people understand relationships (Tufte, 1983). The old

saying that "a picture is worth a thousand words" seems applicable here. Encouraging students to display results in graphic forms can enhance their understanding of the studied phenomenon.

5. *Problems may be first presented descriptively and then presented in quantitative terms*. Presenting a logical description of a problem before diving in the quantitative aspects provides a base of understanding upon which we can then build the quantitative exercise. Otherwise, we run the risk of losing students right from the start.

CONCLUSION

Our study contributes to the MBA education literature by providing a framework for assessing and dealing with the problem associated MBA students and their quantitative anxiety. Though our study uses a sample of students from four universities only, we believe that the results provide bases for understanding the quantitative anxiety of MBA students in general.

ENDNOTE

[1]Ruffins original items are in *italic* while our additions are in the normal font.

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