FEAR OF FAILURE IN MATHEMATICS. WHAT ARE THE SOURCES?

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This paper presents some results of a larger study that concern causes of students’ fear of failure in mathematics. Data were collected from 321 sixth grade students through a questionnaire comprised of five-point Likert-type scales measuring among other constructs students’ fear of failure and self-efficacy beliefs; students’ mathematical performance was measured through a specially prepared test. An observation protocol was developed to identify teachers’ practices fostering students’ fear of failure. Findings revealed that fear of failure is a complicated affective construct based on several sources such as family context, students’ characteristics and teachers’ practices. The implications of these findings for understanding and improving students’ behaviour in the mathematics classroom are discussed.

INTRODUCTION

Research on achievement motivation provides empirical data about the nature and consequences of fear of failure (FF) (Conroy, 2004; Macgregor & Elliot, 2005). Particularly, in Educational Psychology, the achievement motivation theory emphasized FF as determinant of students’ behaviour and performance (e.g. Elliot & Church, 1997), however there is little research on reasons that individuals are fearful of and motivated to avoid failure. In recent studies the origins of FF were found in students’ family context (parental socialization) and in students’ shame (Macgregor & Elliot, 2005).

In mathematics education negative feelings have been reported by researchers such as fear, anxiety and frustration and their relation to students’ mathematics performance (Ho et al., 2000). To the best of our knowledge no study has so far investigated causes of students’ FF in the mathematics classroom.

In this respect the present study investigates variations in students’ inner and family characteristics and focuses on teachers’ practices in the mathematics classroom that may raise students’ FF. Being aware of the negative consequences of students’ FF in mathematics performance and behaviour, we believe that the results of the study will shed some light on factors that may lead to the development of FF in mathematics and inform teachers about desirable and undesirable practices with respect to students’ FF in the classroom.

THEORETICAL BACKGROUND AND AIMS

Fear of failure in Educational Psychology

Motivation research identified the motive to avoid failure or more common fear of failure, as an energizing means for human behaviour (Conroy & Elliot, 2004).
Mcgregor and Elliot (2005, p.219) states that FF is a self-evaluative framework that influences how the individual defines, orients to, and experiences failure in achievement situations. More explicitly, high FF individual perceptually and cognitively orients to failure-relevant information, thus encounters anxiety prior to and during task engagement and seeks to avoid failure by avoiding the situation that is by quitting or withdrawing effort, or by trying hard to succeed and thus avoid failure. The core emotion of FF is most likely shame, a devastating emotion that entails a sense of one’s global incompetence. Other origins underlying students’ FF mentioned by these researchers were students’ parental socialization and parental relation. Specifically, students’ high in FF had mothers who punished failure but reacted neutrally in success or had mothers setting high achievement standards believing that their children could not reach them. Among other causes of students’ FF identified by researchers is the experience of shame and embarrassment, the devaluation of one’s self-estimate, and also the upsetting of important others, Conroy, Poczwardowski and Henschen, 2001 (in Conroy & Elliot, 2004).

In the context of achievement motivation and more explicitly in the hierarchical achievement goal framework proposed by Elliot and Church (1997), motive-based and goal-based variables appeared to be integrated. In this context, FF is asserted to negatively predict adaptive behaviour. Particularly, FF is found to negatively predict mathematics performance and interest directly and indirectly through achievement goals (e.g. Zusho, Pintrich & Cortina, 2005) and it is negatively correlated to self-efficacy beliefs (Pantziara & Philippou, 2006).

**Fear of failure in Mathematics Education**

Fear of failure is met in mathematics education as mathematics anxiety (Ho, et al., 2000). Math anxiety has been investigated as a unidimensional construct, in a two factor model comprised of affective and cognitive dimensions. Affective anxiety refers to emotional component of anxiety such as fear, feelings of nervousness, tensions etc. Cognitive anxiety refers to the worry component of anxiety which is often displayed through negative expectations, preoccupation with and self-deprecatory thoughts (Ho et al., 2000, p.2). The conceptual nature of fear of failure as developed in the realm of Educational psychology we believe is closer to the cognitive anxiety as described above.

Elliot & McGregor, 1999 (in Conroy & Elliot, 2004), found that FF and test anxiety constructs share an affective-motivational structure oriented toward avoiding the threat posed by evaluations of demonstrations of competence. A large percent of common variance was found between trait test anxiety, self-reported FF and projectively-measures FF scores allowing to be captured in one factor due to their similar effects on students’ goals and performance. Similar results have been reported in mathematics education with math anxiety to correlate negatively to students’ mathematics performance and behaviour. Worth noticing are the indirect effects of math anxiety, even in cases when the negative correlation with performance is pure, such as students’ negative attitudes to mathematics, avoidance of math classes and
spending less time in teaching mathematics as elementary school teachers (Ho et al., 2000; Pantziara & Philippou, 2006).

We delimit our attempt to investigate multiple sources underlying FF in mathematics in the context of socio-constructivist perspective on learning (Op’t Eydne, De Corte & Verschaffel, 2006). More specifically Op’t Eydne et al. (2006) in the so-called socio-constructivist perspective on learning recognize the close relation between (meta) cognitive, motivational, and affective factors in students’ learning and problem solving. They believed that students’ understanding of and behaviour in the mathematics classroom is a function of the interaction between who they are (their identity), and the specific classroom context. Students’ identity, their values and what matters to them and in what way is revealed to them through their emotions (Op’t Eynde et al., 2006). In this respect, students’ affect toward mathematics are the outcomes of consciously or unconsciously stimulated personal evaluation of mathematics, students’ self and mathematics learning situations.

Based on this theoretical framework and in an attempt to inform educators as to the factors raising students’ FF, we investigated variables regarding students’ mathematical performance and self-efficacy beliefs, mothers’ and fathers’ educational background, as well as variables referring to the learning context of mathematics (teachers practices) that may influence students’ FF for mathematics.

Self-efficacy beliefs

Friedel, Cortina, Turner, and Midgley (2007) refer to academic self-efficacy as children’s confidence in their ability to master new skills and tasks, often in a specific academic domain such as mathematics. In this study we consider self-efficacy beliefs in relation to broader types of tasks (math tasks) and not to specific ones (e.g. fraction tasks) to attain broader results; yet not as a general competence construct.

Numerous studies have found that students with high self-efficacy beliefs are more devoted, show intense interest, work harder, persist longer and have fewer adverse emotional reactions when they come across difficulties, than students who doubt their capabilities (Zimmerman, 2000). Also self-efficacy beliefs were found to be related to mathematical performance (Zimmerman, 2000; Pantziara & Philippou, 2007).

Students’ self-efficacy beliefs to manage academic task demands were found to influence them emotionally by decreasing their stress, anxiety and depression (Bandura, 1997 (in Zimmerman, 2000). Moreover self-efficacy beliefs were found to be more predictive of mathematical performance than students’ math anxiety, Pajares and Kranzler, 1995 (in Zimmerman, 2000). These results suggest that educators should focus more on fostering positive characteristics in students, like self-efficacy rather than merely diminishing negative characteristics like anxiety and FF.

Instructional practices

Elliot and Church (1997) draw attention on the role of teachers’ practices in the classroom; they note that if the achievement setting is strong enough it alone can
establish situation-specific concerns that lead to different motivational constructs, either in the absence of a priori propensities or by overwhelming such propensities. Earlier studies in the context of achievement motivation and mathematics education specified various classroom instructional practices as contributing to the development of different patterns of motivation and achievement outcomes (e.g. Ames, 1992; Patrick, Anderman, Ryan, Edelin & Midgley, 2001; Stipek, Salmon, Givvin, Kazemi, Saxe & MacGyvers, 1998).

Achievement motivation theorists lying on a large literature on classroom environments proposed six sources that contribute to the classroom motivational environment represented by the acronym TARGET (Task, Authority, Recognition, Grouping, Evaluation and Time). All these sources have been examined in regard to teachers’ specific practices. Several studies in this regard have shown that teachers’ different practices in each of these sources ended in students’ different motivation in the classroom. In the mathematics education domain, Stipek et al. (1998) in a relevant study referring to instructional practices and their effect on learning and motivation found that the affective climate was a powerful predictor of students’ motivation and mastery orientation.

The various and vital consequences of students’ FF in the mathematics classroom together with the absence of studies investigating the sources of these FF obliged us to identify origins of this construct investigating students inner and contextual characteristics. In this respect the purpose of this study was:

- To test the validity of the measures for the factors fear of failure and self-efficacy, in a specific social context.
- To identify students’ characteristics (mathematical performance, self-efficacy beliefs, mothers’ and fathers’ educational background) which affect the level of their fear of failure.
- To identify teachers’ practices that trigger students’ fear of failure, using an observational protocol that includes convergent variables referring to instructional practices in the classroom.

METHOD

Participants were 321 sixth grade students (136 males and 185 females) from 15 intact classes and their 15 teachers. All students-participants completed a questionnaire reflecting among other motivational constructs (achievement goals, interest), fear of failure and self-efficacy beliefs.

We further collected information about the parents of the students, including their educational background and measured their mathematics performance through a specially constructed mathematics test. The mathematics test measured students’ mathematical performance in fractions. Most of the tasks comprising the test were adopted from published research and specifically concerned students’ understanding of fraction as part of a whole, as measurement, equivalent fractions, fraction
comparison and addition of fractions with common and non common denominators (Lamon, 1999).

Herman’s fear of failure scale (Elliot & Church, 1997) was used to measure students’ FF; Herman’s 27-item Fear of Failure scale was revised by Elliot and Church (1997) who tested its reliability (Cronbach’s $a=0.88$) and construct validity. A specimen item from the nine items we used in the study was “I often avoid a task because I am afraid that I will make mistakes”.

Students’ self-efficacy beliefs were measured using the five scale measure of the Patterns of Adaptive Learning Scales (PALS) (Midgley et al., 2000). The items measured students’ perception of their competence to do their work in the classroom. A spice item was “I’m certain I can master the skills taught in mathematics this year” while the researchers reported that its reliability was $a=0.78$. We adjusted the items in the scale to measure students’ perception of competence in the mathematics classroom.

For the analysis of teachers’ instructional practices we developed a protocol for the observation of teachers’ practices in mathematics in the 15 classes. The observational protocol was based on the convergence between instructional practices described by Achievement Goal Theory and the Mathematics education reform literature. Specifically, we developed an inventory of codes around six constructs, based on previous literature (Ames, 1992; Patrick et al., 2001; Stipek et al., 1998), which were found to influence students’ motivation and achievement. These six constructs were: task, instructional aides, practices towards the task, affective sensitivity, messages to students, and recognition.

The construct task included algorithms, problem solving, teaching self-regulation strategies, open-ended questions, closed questions, constructing the new concept on an acquired one, generalizing and conjecturing. We also checked whether teachers made use of instructional aides during their lesson. Practices towards the task included the teacher giving direct instructions to students, asking for justification, asking multiple ways for the solution of problems, pressing for understanding by asking questions, dealing with students’ misconceptions, or seeking only for the correct response, helping students and rewording the question posed. Behaviour referred to affective sensitivity included teachers’ possible anger, using sarcasm, being sensible to students, having high expectations for the students, teachers’ interest towards mathematics or fear for mathematics. Messages to students included learning as students’ active engagement, reference to the interest and value of the mathematics tasks, students’ mistakes being part of the learning process or being forbidden, and learning being receiving information and following directions. Finally, recognition referred to the reward for students’ achievement, effort, behavior and the use of external rewards by the teachers. During two 40 minute classroom observations for each teacher, we were able to identify the occurrence of each code in each structure.
RESULTS

Since we have conducted an exploratory factor analysis involving 302 students concerning the same scales (Pantziara & Philippou, 2006), in the present study we have proceeded with Confirmatory factor analysis using structural equation modelling and the program EQS (Hu & Bentler, 1999) in order to identify the factors corresponding to fear of failure and self-efficacy beliefs. To this end, we followed a process including the reduction of raw scores to a limited number of representative scores, an approach suggested by proponents of Structural Equation Modelling (Hu & Bentler, 1999). Particularly, regarding FF, some items were deleted because their loadings on the factor were very low and some items were grouped together because they had high correlation with each other. The reliability for the factor FF was Cronbach’s a=.726 and for the factor Self-efficacy was Cronbach’s a=.710. The correlation between the factors was -.609.

To assess the fit of a two factor measurement model with correlation between the factors (FF and self-efficacy) we used maximum likelihood estimation method and three types of fit indices: the chi-square index, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). The chi square index provides an asymptotically valid significance test of model fit. The CFI estimates the relative fit of the target model in comparison to a baseline model where all of the variable in the model are uncorrelated (Hu & Bentler, 1999). The values of the CFI range from 0 to 1, with values greater than .95 indicating an acceptable model fit. Finally, the RMSEA is an index that takes the model complexity into account; an RMSEA of .05 or less is considered to be as acceptable fit. The fit indices supported good fit of the model as Figure 1 shows ($x^2 = 68.908$, df= 43, $p<0.000$; CFI=0.961 and RMSEA=0.044).

Fig 1: Two factor measurement model

Concerning the second aim of the study, regression analysis was performed to determine which of the antecedent variables (self-efficacy beliefs, students’ mathematics performance) predicted students’ FF. Multiple regression analysis revealed that self-efficacy beliefs and students’ performance were negative predictors $\beta=4.346$, $F(36.413)$, $p<0.001$ of students’ FF. Specifically, the regression equation was:

Students’ FF = 4.346 -2.18 x self-efficacy -3.52 x mathematics performance.
One-way ANOVA (GLM1) indicated statistical significant difference between students’ FF whose fathers had different educational background, \( F(5, 290) = 2.569, p<0.05 \). Hochberg’s GT2 post-hoc test revealed that students whose father had low educational background (gymnasium) reported higher fear of failure (M=2.584) than students whose father had higher educational background (postgraduate studies), (M=1.996). No statistical significant difference found between students’ FF whose mothers had different educational background.

Investigating the third aim of the study, we used one-way ANOVA (GLM1) to identify possible significant differences between students’ FF placed in different classes. The analysis showed significant differences between classrooms in students’ FF, \( F(14, 300) = 2.545, p<0.05 \). Gabriel post-hoc test identified that students in class 11 and in class 13 had non–significant means. Specifically students in class 11 declared the highest FF in mathematics (Mean=2.93) and students in class 13 the lowest FF in mathematics (Mean=2.06). Worth noticing is that students in class 11 performed better in math (Mean=10.20) than students in class 13 (Mean=9.11).

**Analysis of the teachers’ observations**

To assess teachers’ practices we calculated the mean score of each code for the two observations using the SPSS and creating a matrix display of all the frequencies of the coded data from each classroom. Each cell of data corresponded to a coding structure. Being aware that FF constitutes a complicated construct, a first analysis of the observational data involved isolating the two classes at the highest and lowest extremes of specified motivational construct and comparing the means of each code in the six structures to identify commonalities and differences in teacher behaviours and instructional practices in the two classes. This approach is similar to the one used by Patrick et al. (2001).

T11 (the teacher in class 11 where the highest FF appeared) had 15 years of experience, a strong background in mathematics and a master’s degree in mathematics education. T13 (the teacher in class 13, where the lowest FF appeared) had 29 years of experience, and low background in mathematics. As far as it concerns the task, T11 used more problem solving activities than T13, while T13 used more routine activities than T11. Teacher 11 used less open-ended questions and more closed-ended questions than T13. During the observations teacher T11 taught problem solving strategies, while T13 did not. T11 did not connect the new mathematical knowledge with students’ excising knowledge and he/she did not make connections between the mathematical ideas while T13 did so. T11 did not give the opportunity to students to generalize or conjecture while T13 did so. T11 made use of visual aids in the mathematics lesson, while T13 did not use any. Concerning practices towards the task, T13 observed to give direct instructions to students while T11 did not. T11 asked more than T13 the students to provide reason for their choices and solution plans while T13 observed to ask for multiple solutions of a problem and pressed students for understanding more than T11. Dealing with misconceptions was observed in T11’ class while in many cases T13 accepted the correct responses from
students without any explanation. While both teachers gave individual help to their students, T11 gave more individual help than T13. As far as it concerns practices of affective sensitivity T11 observed to demonstrate, in some instances anger and sarcasm while T13 did not. None of the other positive affective variables were observed. With respect to messages sent to students, both teachers informed students that erroneous answers were part of the lesson with T11 to do so more than T13. Concerning recognition, both teachers rewarded students for their mathematical performance, while T11 rewarded also students’ for their effort. T11 used to make rewards public to students while T13 did not do so.

CONCLUSION

Regarding the first aim of the study, data revealed that factors referred to the two motivational constructs (FF and self-efficacy beliefs) were confirmed in a different social context and with different age sample.

The data referred to the second aim of the study revealed that a source of FF could be traced in students’ family context (Macgregor & Elliot, 2005). This was a discouraging finding as students’ FF is found to be a result of social inequalities supported by differences in fathers’ educational background. These findings may be explained by fathers’ job, social status and all consequences (e.g earnings) or by the help students receive during homework. In addition, students’ mathematics performance and their self-efficacy beliefs found to predict negatively their FF. Numerous studies (Ho et al., 2000; Pantziara & Philippou, 2006, 2007) revealed that students’ mathematics performance predicts students’ FF negatively. Naturally students’ with low mathematics performance may experience more often the feeling of shame and incompetence in the mathematics classroom, both feelings found to lying in students’ FF (Conroy & Elliot, 2004; McGregor & Elliot, 2005). Their FF resulting from low mathematics performance may be strengthen by parental socialization, if the family punishes failures or devalues children’s self-esteem. Moreover, other studies (Zimmerman, 2000; Pantziara & Philippou, 2007) revealed the negative relation between students’ self-efficacy beliefs and their FF. Students’ self-efficacy beliefs to manage academic task demands influence them emotionally and thus decrease their stress, their anxiety and depression. In addition the positive relation between students’ self-efficacy beliefs and their mathematics performance may contribute to the limitation of their FF. Instructional and social influences are found to be the most influential source of students’ self-efficacy (Zimmerman, 2000). In this respect, educators should raise students’ self-efficacy beliefs in a rational extend to help them confront unpleasant situations.

Regarding the third aim of the study, we uncover that students’ FF in mathematics is sensitive to the classroom context, finding statistically significant difference in students’ FF from different classes. We found that teachers’ practices contributed to students’ different motivational constructs (e.g. FF) in line with other studies (Patrick et al., 2001; Stipek et al., 1998). We discuss these practices parallel to the findings of other studies been aware that the identification of teachers’ practices is not an easy
attempt. In this respect, students in the class with the highest FF had higher average maths performance than students in the class with the lowest FF. This complexity may be due to the close interaction between teachers’ practices and students’ other motivational and cognitive factors (Opt’ Eydne et al., 2006).

We may say that affective sensitivity is the most predictive structure for students’ FF in line with the results of Stipek et al. (1998) findings, revealing that teachers’ positive affect was the most predictive variable in students’ positive emotions. Such a conclusion was made based on the observations showing that in class of high FF, the teacher had the knowledge and used practices characterized to raise students’ positive affect (use of problem solving activities, giving help, errors part of the lesson). However even the traces of anger and sarcasm in the classroom might prove to be stronger than these practices in affecting students’ FF. Such practices may bring shame and embarrassment to students, both found to be origins of students’ FF. Similarly, Patrick et al. (2001) described classes characterized by negative motivation in where teachers affronted students. Another practice found to affect students negatively belongs in the category recognition and refers to making rewards public to students. This may raise competition between students affecting them negatively (Ames, 1992). Practices found by researchers (Patrick et al., 2001; Stipek et al., 1998) to raise students’ motivation and observed in class with students low FF, hence may be considered as diminishing students’ FF, were from category task, the use of open-ended questions, making conjectures, and connecting the new knowledge to an existing one. From category procedures towards the task, discussing multiple solutions of a problem and pressing students for understanding was observed in class with low FF. Last giving individual help to students was also a practice observed in low FF class.

Fear of failure is found to be a multiphase and complex structure with various consequences in students’ performance and behaviour. More research is needed to illuminate origins of students’ FF especially in the educational setting. Such information will orient teachers as to avoid certain practices to diminish students’ FF in combination with practices to raise students’ motivation to learn mathematics.

REFERENCES


