SELF EFFICACY AND BACKGROUND MUSIC ON MATHEMATICS TEST ANXIETY AMONG SECONDARY SCHOOL STUDENTS

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Abstract

The study investigated the role of self -efficacy and background music on mathematics test anxiety. One hundred and four (104) students were randomly selected as participants from Nnamdi Azikiwe University High School, Awka, Anambra State, Nigeria. Participants ages ranged from 12 to 17 years old (Mean age = 14.82; Standard Deviation = 1.47). Self-efficacy and mathematics anxiety were measured with self-efficacy scale (SES) and mathematics anxiety rating scale -revised (MARS-R), respectively. Results of data analysis using a 2 factor analysis of variance indicated a significant main effect of self-efficacy ($p < .05$). Background music showed no significant main effect. There was also no significant interaction effect of the factors. These findings have implication for parents and educators on guiding school-age adolescents to overcome excessive worries towards mathematics tasks.

Keywords: Avoidance behaviour, Background music, Calculation performance, Math anxiety, Self-efficacy.

Mathematics test anxiety is a multifaceted construct with affective and cognitive dimensions. Personality, self-concept, self-esteem, self-efficacy, learning style, parental attitudes, high expectation of parents, negative attitudes toward mathematics, avoidance of math, teachers' attitudes, ineffective teaching styles, negative school experiences and low degree of achievement in mathematics are among the concepts and constructs related to mathematics anxiety (Bursal & Paznokas, 2006; Cook, 1998; Hadfield & McNeil, 1994; Hopko, McNeil, Lejuez, Ashcraft, Eifert, & Riel, 2003; Ma & Xu, 2004; Norwood, 1994; Reynolds, 2001; Thomas& Furner, 1997; Williams, 1994; Woodard, 2004). Mathematics anxiety is an "anxious state" induced by fear of failing when attempting to learn or demonstrate one's learning of mathematics (Tobias, 1991). Mathematics anxiety usually arises from the lack of confidence when working in mathematical situations (Stuart, 2000).

Lang (1968) stated that math anxiety is like any other phobia, which influence individuals on three different levels. All three differential effects of math anxiety were confirmed independently, physiological reactions (i.e., sweating or high pulse rate) as frequent accompanying symptoms of math anxiety were described by Faust (1992), cognitive effects of math anxiety (worrisome thoughts) were demonstrated by Richardson and Woolfolk (1980), and avoiding behaviour concerning number processing and calculation was first systematically analysed by Hembree (1990).

More extensive research on the link between math ability and math anxiety began only ITI the 1990s (Ash craft& Faust, 1994; Hembree, 1990; Hopko, Ashcraft, Gute, Ruggiero, & Lewis, 1998). According to popular behaviouristic models, anxiety emerges as an obligatory response to an aversive stimulus (Watson & Rayner, 1920). Thus, it is plausible to speculate that frequent poor math performance or failure to understand math concepts (despite investing high efforts) leads to negative emotions such as math anxiety, which in turn provokes avoidance behaviour (Miller, 1948; Mowrer, 1947). There is also evidence that the negative evaluation of failure in mathematics might be mediated by cultural influences and educational factors (i.e., parents' expectations of performance or attribution of success (Stevenson, Hofer, & Randel, 2000).

The association between math ability and math anxiety may not be unidirectional. Rather, it has been suggested previously that emotional factors might generally influence cognitive abilities (e.g., Easterbrook, 1959). Concerning the possible impact of math anxiety on calculation ability, some authors state that the avoidance behaviour caused by math anxiety will most probably lead to a vicious cycle being characterized by less calculation practice, which will cause a lag in learning and therefore even more disappointment and emotional problems (Ashcraft, 2002; Dowker, 2005). The assumption that math anxiety influences math ability is strongly supported by a meta-analysis showing that successful treatment of math anxiety in adults leads to significant improvement of their calculation performance, even though math ability was not trained explicitly

(Hembree, 1990).

Beyond the long-term effects of avoidance behaviour, worrisome thoughts are also known to have a direct negative impact on calculation performance. Worrisome thoughts are very hard to inhibit and therefore will absorb working memory and attention resources ("deficient inhibition mechanism": Hopko et al., 1998). The assumptions of the deficient inhibition mechanism are based on two theories-namely, the inhibition theory proposed by Hasher and Zacks (1988) and the processing efficiency theory purported by Eysenck and Calvo (1992). The first theory postulates

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general decreases in cognitive performance during the presence of distracting stimuli (Hasher & Zacks, 1988). The second theory states that experiencing anxiety will draw on working memory capacities and therefore will compromise cognitive performance. When combining these two theories, Hopko, et al. (1998) suggested that poorer calculation abilities of individuals with high math anxiety are not a direct consequence of their worrisome thoughts but rather are due to an inability to withdraw attention from these thoughts. They also reported empirical evidence for the negative impact of math anxiety and its accompanying worrisome thoughts on cognitive performance: In three groups of college students with low, medium, and high math anxiety, individuals with low anxiety were better able to inhibit distractors while reading texts compared to the other two groups. Furthermore, Ashcraft and Kirk (2001) found that relative to college students with low math anxiety, those with higher math anxiety displayed lower working memory spans for numerical tasks and moreover exhibited longer reaction times and higher error rates in addition and number trans-coding tasks when asked to simultaneously solve tasks drawing on working memory capacities.

Mathematics anxiety affects students from kindergarten through college. However, parents or teachers might give children mixed messages (Thomas & Furner, 1997) about mathematics. They might emphasize how difficult mathematics is or how mathematics skills are of essential importance for future achievements. Negative school experiences can contribute to the development of mathematics anxiety (Bursal & Paznokas, 2006). For example, teachers' threatening and authoritarian attitudes lead to fearsome classroom climate in which student might hesitate to ask questions or answer the teachers' questions. Students who are afraid of mathematics teacher often have a conditioned reaction to mathematics. Teachers who give mathematics homework as punishment could also cause students perceive mathematics as unpleasant (Thomas & Furner, 1997). Because punishment is inherently negative, extra mathematics assignments as punishment play a role in cultivating negative attitude toward mathematics in students who receive the punishment as well as those who witness it. Low grades or failure in mathematics also lead to mathematics anxiety or exasperate students' existing levels of anxiety for mathematics (Ma & Xu, 2004; Norwood, 1994; Reynolds, 2001; Satake & Amato, 1995; Townsend, Moore, Tuck, & Wilton, 1998). Failure in mathematics, fear and anxiety about it cause extreme feelings of dislike about mathematics. Indeed, Hopko, et.al. (2003) observed that persons with mathematics anxiety make more mistakes in dealing with mathematics problems. Such mistakes lead to lower grades in mathematics which in turn increases anxiety about math. As such, the vicious cycle of anxiety, failure and anxiety is perpetuated.

Poor performance in mathematics has been linked to an increase in mathematics anxiety (Furner& Duffy, 2002; Hopko, et. al., 2003). Belief and expectations to perform poorly on mathematics problems also lead to mathematics anxiety (Ozer, 1997; Reglin, 1990) or intensify students' existing anxiety. Mathematics anxiety can be experienced to a degree that children perceive their performance in mathematics as a measure of their self-worth and a reason for losing value in the eyes of parents and teachers. Thus, students with these excessive worries develop negative attitudes toward mathematics which are expressed as "I can't do mathematics" or "I hate mathematics." However, since the students do have to deal with mathematics, their beliefs lead to a great deal of distress and uneasiness (Gierl & Bisanz, 1995; Kazelskis, 1999; Townsend, et. al., 1998).

The degree to which a student believes that he/she is capable of performing specific tasks is referred to as self-efficacy, which particularly has been argued to have powerful effects on achievement behaviour (Bandura, 1986). Those with higher self-efficacy are proposed to have higher aspirations, stronger commitments to their goals, and recover more quickly from setbacks than those lower in self-efficacy. Beliefs in one's efficacy can vary across academic subjects (e.g. reading vs. writing) and self-efficacy for mathematics has received close attention. Students with higher math self-efficacy persist longer on difficult math problems and are more accurate in math computations than those lower in math self-efficacy (Hoffman & Schraw, 2009). Math self-efficacy is also a stronger predictor of math performance than either math anxiety or previous math experience (Pajares & Miller, 1994; Pajares & Miller, 1995, respectively) and influences math performance as strongly as overall mental ability (Pajares & Kranzler, 1995).

The demonstrated importance of self-efficacy in academic achievement has provoked widespread interest in specific factors that affect a student's self-efficacy beliefs. Bandura's (1997) social-cognitive theory proposed that self-efficacy is most strongly affected by one's previous performance and research largely supports this (Chen & Zimmerman, 2007). The social-cognitive theory suggests that self-efficacy is affected by observing others (e.g. watching peers succeed at a task), verbal persuasion (e.g. encouragement from parents and teachers), and interpretation of physiological states (e.g. lack of anxiety may be a signal that one possesses skills).

Moreover, taking examination can cause great anxiety for many mathematics students. Although, research has found that altering the classroom environment during an examination can reduce this anxiety (Bushnell, 1978). The use of soft background music is one method used to change the academic environment during exams. Hardie (1990) studied the effect of music on mathematics anxiety and achievement. Two different environments were used while students took an Intermediate Algebra exam. One group took the exam in silence, while the other group listened to background music during the exam. There was a significant increase in anxiety for the students tested in silence.

While Hardie examined only two different environments for test-taking, Stanton (1975) investigated three environments. Students were asked to read a 1500 word passage for ten minutes and take a 20-question exam on the passage. The first group entered the room to silence, the second group entered to background music that was turned off once the activity began, and the third group listened to music for the entire activity. Stanton concluded that having background music on while the student enters the room, settles into a seat, and is given the directions for the task would seem sufficient.

Studies conducted to learn about the effects of musical distraction on cognitive task performance supported the idea of music improving performance (Graziano, 1999), but there has also been research contradicting those findings (Manthei & Kelly, 1993) where music distracted participants on a paragraph comprehension test Research involving noise as a distraction factor has illustrated the same mixed results as studies concerning background music. Murphy, Craik, Li, and Schneider (2000) examined the effects of background noise, instead of music, in short-term memory performance. Murphy, et al. (2000) found that older adults in a quiet area performed the same as younger adults in an environment with noise, and younger adults in a noisy setting performed poorly compared to those in a quiet location. In contrast, Pool (2002), observed the distraction effects of background television on homework performance, where she found that television-induced distraction did not make any significant difference on students working on an easy homework assignment

This study attempts to answer the following questions: would there be any significant differences between students with high self-efficacy and those with low self-efficacy on mathematical test anxiety? Would there be any significant differences between listening to music and not on students' mathematical test anxiety? Answers to these questions will help to a greater extent in proper conceptualization and appreciation of self-efficacy and role of background music on students' mathematical test anxiety. Self-efficacy and background music seem to be an influential variable in students' mathematical test anxiety. The overall purpose of this study is to explore and explain the effects of self-efficacy and noise distraction (such as one induced by music) in relation to students' mathematical test anxiety. It is hypothesized that participants with low self-efficacy will report greater mathematics test anxiety than ones with high self-efficacy, and that participants in the no music condition will show less mathematics test anxiety than participants in the music condition.

Method

Participants

One hundred and four (104) senior secondary school students of Nnamdi Azikiwe University High School, Awka, Anambra State, Nigeria, were randomly selected from a population of one hundred and twenty (120) SS l students to participate in the study. The participants were randomly assigned into two treatment conditions of music and no music conditions. Their ages ranged from 12 to 17 years old (Mean age =14.82; Standard deviation =1.47)

Materials

Two test materials were used to measure self-efficacy and mathematics anxiety; they include:

(i). Self-Efficacy Scale (SES) (Sherer, Maddux, Mercadante, Prentice-Dunn, Jacobs& Rogers, 1982) Self-efficacy scale (SES) bye Sherer, Maddux, Mercadante, Prentice-Dunn, Jacobs and Rogers (1982) Self Efficacy Scale (SES) is a 30 item inventory designed to measure the social components of self-efficacy from both interpersonal and intrapersonal perspectives. The concept of self-efficacy is predicated on the assumption that an individual's deep rooted expectation of his or her capabilities directly affects the cognitive, affective and the psychomotor components of the individual's abilities, and the outcome of the performance in relation to the self and others within a social matrix. The scale has the direct, reverse and inert score items. The direct score items include the following: 2,4,10,12,15,16,19,23,27,28. And, the reverse score items are: 3,6,7,8,11,14,18,20,22,24,26,29,30. While, the inert items that should not be scored are: 1, 5,9,13,17,21,25. Sherer, et al. (1982) reported a Cronbach’s alpha internal consistency reliability coefficient of 0.86. The data generated from a pilot study conducted with sixty five (65) students from Capital City Secondary School, Awka yielded a Cronbach's alpha reliability coefficient of .71.

(ii) Mathematics Anxiety Rating Scale - Revised (MARS-R) (Plake & Parker, 1982). The mathematics anxiety rating scale-revised (MARS-R) was developed by Plake and Parker (1982). Plake and Parker (1982) MARS-R is a 24 item inventory designed to measure anxiety about mathematics. Plake and Parker (1982) reported a Cronbach's alpha reliability coefficient of 0.98, the data generated from a pilot study conducted with sixty five (65) students from Capital City Secondary School, Awka yielded a Cronbach's alpha reliability coefficient of .74. The test material used in the manipulation of background music was LG electronics home theatre equipment. This material was used to introduce/play background music to the participants in the music condition.

Procedure

One hundred and four (104) copies of the Self Efficacy Scale SES and Mathematics Anxiety Rating Scale-Revised (MARS-R) were administered to the participants. The researchers made it clear to the participants that participation in this experiment was voluntary, and that they are free to withdraw from the experiment at any point without penalty. They responded to the materials while sitting comfortably in the experimental classrooms.

Background music was manipulated by randomly assigning participants into 2 treatment conditions (music condition and no-music condition) with the restriction that there were equal number of males and females in each group. Each of the 2 conditions of background music consists of 52 participants, 26 males and 26 females. The participants in both conditions were tested simultaneously in 2 classrooms; each of the classrooms has a seating capacity of 60 students. Using the LG home theatre music equipment, background music (Mr. President - African China) was played low-tuned to participants in the music condition. No music was played in the classroom where other participants responded to the other materials.

Design/Statistics

A 2 x 2 quasi-experimental design was employed in the study. The factors were Self efficacy (High vs. Low) and background music (Music vs. No-music conditions). 2-Way-ANOVA was employed to test the hypotheses.

Results

The results showed that participants with low self-efficacy (M = 60.63, SD = 7.13) reported greater mean mathematics test anxiety than the ones with high self-efficacy (M = 55.72. SD = 8.24). Participants in the no music condition (M = 56.90, SD = 8.22) reported less mathematics test anxiety than participants in the music condition (M = 59.92, SD = 7.55). The results of the two-way ANOV A performed on the data were presented in Table I below.

Table 1.
Summary of Self-efficacy X Noise Distraction on the Mean Mathematics Anxiety Scores

Source of Variation	SS	df	MS	F	d^2
Self-efficacy(A)	510.50	1	510.50	8.88*	.08
Back. Music (B)	83.36	1	83.36	1.45	.01
A X B					
A X B	119.33	1	119.33	2.08	.02
Error	5746.48 100	57.47			
Total	6593.22 103				

a. * = significant, $p < .05$
b. R Squared = .128 (Adjusted R Squared = .102)

In the summary table above, a significant main effect for self-efficacy was observed, F (1, 100) = 8.88, P < .05). The table showed no significant main effect for background music, F (1, 100) = 1.45, p > .05). The analysis also showed no significant interaction effect between self-efficacy and noise distraction on mathematics test anxiety.

Discussion

The result of the present study reveals a significant main effect of self-efficacy on mathematics test anxiety. The first hypothesis which stated that participants with low self-efficacy will report greater mathematics test anxiety than the ones with high self-efficacy was not rejected. The result indicated that self-efficacy has positive and direct impact on students' mathematics test anxiety. This finding is in line with Hoffman and Schraw (2009) who observed that students with higher math self-efficacy persist longer on difficult math problems and are more accurate in math computations than those lower in math self-efficacy. However, poor performance in mathematics has been linked to an increase in mathematics anxiety (Furner & Duffy, 2002; Hopko. et al., 2003). Belief and expectations to perform poorly on mathematics problems could also lead to mathematics anxiety (Ozer, 1997; Reglin, 1990) or intensify students' existing anxiety.

Mathematics anxiety is experienced to such a degree that children that their performance in mathematics as a measure of self-worth and a reason for losing value in the eyes of parents and teachers. Thus, students with these excessive worries develop negative attitudes toward mathematics which are expressed as "I can't do mathematics" or "I hate mathematics." However, since they do have to deal with mathematics, these beliefs lead to a great deal of distress and unease (Gierl & Bisanz, 1995; Kazelskis, 1999; Townsend, et. al., 1998). Moreover, the result of the present study does not reveal any significant effect of background music on mathematics test anxiety, so the second hypothesis that participants in the music condition will report greater mathematics test anxiety than those in the no music condition was rejected. This study is in line with Pool (2002) who observed the distraction effects of background television on homework performance. Pool found that television-induced distraction did not make any significant difference in students working on easy or difficult homework assignments.

Research has found that altering the classroom environment during an examination can reduce anxiety (Bushnell, 1978). Two different environments were used while students took an Intermediate Algebra exam. One group took the exam in silence, while the other group listened to background music during the exam. There was a significant increase in anxiety for the students tested in silence. Murphy, Craik, Li, and Schneider (2000) examined the effects of background noise in short-term memory performance. Murphy, et al. (2000) found that older adults in a quiet area performed the same as younger adults in an environment with noise, and younger adults in a noisy setting performed poorly compared to those in a quiet location. This study contributed in the convergence of students' mathematics test anxiety, the link between theory and practice that was demonstrated in this study is a crucial implication of the study. Theoretical assertion that self-efficacy and background music has effect on mathematics test anxiety has been tested and the finding has given practical support to an earlier proposition (e.g., Graziano, 1999; Murphy, et al., 2000). However, this study is severely limited by the fact that participants were not tested on real mathematics tasks that would make its results more useful. It is therefore suggested that future study in this area should use purely experimental design to serve the needs of educators and parents.

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