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Do Restrictions in Working Memory Capacity Account for Decrements in Cognitive Performance of Highly Test-Anxious Individuals? A Study among Selected Ghanaian University Students

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Abstract This study investigated overly test-anxious students with non-test anxious in selected Ghanaian Universities. Findings suggest that states of anxiety and emotional arousal within and among students distract available working memory from current task leaving insufficient capacity to attend to task demands at hand. In this respect, Working Memory Capacity becomes impoverished because resources needed to perform concurrent task become insufficient indicating relationship between anxiety, cognition and students' academic performance. These were interpreted to mean students' academic assessment is not unrelated to how academic institutions help overly test anxious students to cope with strategies of stress. This gives plausibility to debate that school-based service delivery may need to migrate from traditional system of assessment to more comprehensive assessment that takes into consideration multiplicity of factors including response to interventions that are prevention-focused.

Keywords Test anxiety, Emotional arousal, Working memory capacity, Impaired performance

1. Introduction

Effective learning and operational performance of any individual is critically related to the person's ability to be fully engaged cognitively with the given task as well as one's capability to access and process relevant information from the Working Memory (Neubauer et al, 2012). Cognitive fatigue has dominated research studies in human cognitive architecture. Indeed, ways in which deviations from information processing and storage access in human cognition occur have been explored for more than a decade since the time Yerkes & Dodson raised this issue (Yerkes & Dodson 1908). These diversions from enhanced performance have consistently been shown to be the consequence from workload and arousal levels deemed to be overly high or too low (Pattyn et al, 2008).

Investigations into what actually account for overly anxious individuals to perform abysmally in perceived difficult content areas, such as mathematics, for example, have been conducted for decades by educational and cognitive psychologists. Most research findings do not see any link between anxiety and performance skill especially in content area such as mathematics. However, this hardly explains the entire story. One plausible explanation offered for overly anxious individuals' to perform poorly in examination is that such individuals were never proficient in the first place. Ashcraft and Kirk (2001) findings suggest that part of the explanation for highly math-anxious individuals' poor performance can also be explained from anxiety-induced depletion of the cognitive resources needed to support complex tasks.

Mathematics has always been one of the content areas that has received much attention with respect to Working Memory failure. Research findings suggest that even individuals who are mathematically capable are likely to be susceptible to being stressed up when confronted with difficult test. Studies have shown consistently that this underperformance is the result of anxiety-induced depletion of cognitive resources especially in working memory capacity (Beilock, Kulp, Holt, & Carr, 2004; Gimmig, Huguet, Caverni, & Cury, 2006). Indeed, being choked under difficulty examination is not only typical to problem solving content area such as mathematics alone. Studies have also shown that anxiety-induced depletion in Working Memory Capacity can be present in grammatical reasoning tasks as well (MacLeod & Donnellan, 1993), reading comprehension (Calvo & Eysenck, 1996; Rai, Loschky, Harris, Peck, & Cook, 2011).and listening comprehension in second-language learners as well (Chen &Chang, 2009; cf.

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Clevinger, 2014;
http://scholarworks.gsu.edu/psych_theses/123).

Anxiety is not only distracting. It can also be disruptive, and incapacitating especially when it is extreme. It can induce poor performance in spatial and verbal Working Memory when cognitive resources such as spatial attention and executive functions reserved for goal-directed behaviors become overly choked by anxiety. Text anxiety is prevalent among students of all academic levels in Ghanaian institutions and it tends to undermine the validity and reliability of assessing students learning outcomes. Most students underperform, not because of an inherent inability, but because of excessive anxiety leading to make school very unpleasant and intimidating to students' self-esteem. Students with severe test anxiety typically display a lack of self-efficacy and motivation in the classroom (Bembenutty, 2008). Test anxiety may also cause students to avoid studying which results in poor test scores.

Kessler et al (2009) make the submission that anxiety disorders compared to other mental health disorder appears to be more prevalent. They constitute the highest number in mental health disorders across the globe. With this as backdrop, the study of Working Memory related anxiety becomes not only a critical public health issue, placing undue emotional, social as well as financial stress, but cognitively, it also sets limit and constraints on the capacity of Working Memory resources needed to perform goal-directed tasks (Eysenck and Calvo, 1992; Eysenck, 1998; Shackman et al., 2006; Vytal et al., 2012). Anxiety-related cognitive disruption is also partially perceived to be a reflection of an attentional bias. This is especially so when anxiety overly controls some sensory, perceptual, and attentional processes. When it happens like this, instead of processing potentially important information, the threatening information is rather preferentially processed (cf. Bar-Haim et al., 2007). Decrements in cognitive performance are likely to be precipitated by high levels of test anxiety (Hembree, 1988) even though the negative outcome of test anxiety performance is equally moderated by task complexity since individuals who are highly test-anxious generally tend to underperform mostly in complex tasks (see Mueller, 1992; Zeidner, 1998).

The processing efficiency theory of Eysenck and Calvo, (1992) sees task-irrelevant responses and task-relevant responses (Mandler & Sarason, 1952) in connection with working memory; while the processing efficiency theory adds a cognitive factor to the previous test anxiety theory with the explanation that individuals who take test and are overly anxious generally tend to be concerned about the likely aversive effects of abysmal performance on their self-concept and social during examinations. These feelings of worry occupy mental resources in the working memory system. They can diminish the human cognitive capacity connected with information processing and temporary storage. It is in this respect, that test takers, with high level of anxiety reduce storage and processing capacity as compared to test takers without high level of anxiety. However, the processing efficiency theory equally makes the submission also that highly anxious test takers, could also use anticipation of aversive outcomes, as basis for motivation to improve performance level. Motivated test takers with high test anxiety can increase effort, and time devoted to a reading task to obtain similar levels of comprehension to their low anxious counterparts. In this respect, test anxiety does not necessarily deteriorate effectiveness, but may ameliorate efficiency (Kareem, 2010).

2. Statement of Problem

The 1987 Educational Reform in Ghana put emphasis on students' formative assessment. The focus is on the learner. Teachers' are required to monitor students' learning progression periodically, as opposed to the previous summative assessment in Ghanaian institutions of higher learning. It is in this sense that test anxiety is not inconsequential in assessment validity and reliability. This notwithstanding, almost three decades since students' formative assessment became mandatory in Ghanaian institutions of higher learning, (taking 40% of students' total assessment score, and 60% for summative assessment), not many studies have been conducted to investigate the correlation between high level test anxiety individuals on one hand, and the extent to which high anxiety can precipitate decrements in cognitive performance due to restrictions in Working Memory Capacity. In other words, when students are overly anxious especially in a perceived difficult examination, they are less likely to perform well. This inability to do well is not because they are inherently low ability performing individuals. It is because these individuals cognitively, tend to focus on task-irrelevant issues which may include worries, concerns about self-efficacy and self-esteem and other self-evaluative aspects of failure. These may occupy memory capacity. In so doing, their capacity for effective cognitive processing of the requisite information becomes limited. The relationship between Working Memory decrements, and test anxiety among students which can impair assessment validity and reliability, has not received the much needed attention in Ghanaian research studies and in other geographical areas such as the United Kingdom.

Yet, the reality is that results of tests and examinations generally constitute the basis of students' self-judgments, aspirations and fears for their future. For some, test anxiety can be formidable obstruction, not only to demonstrating academic achievement, but can also precipitate mental health difficulties. This study is meant to fill this gap in research in Ghanaian higher institutions between test anxiety and students' assessment. Secondly, globally numerous studies have been conducted in other places on test anxiety, yet there are still some gaps in the specific role of test anxiety in test performance. For example, is it test anxiety that influences test performance, or rather it is test performance that precipitates anxiety level or that both variables are affected by other factors? The underlying assumption of this study

then is that, the inability of high level anxiety individual to perform well in perceived difficult examination, is the result of their inability to process information because of decrements in Working Memory Capacity due to anxiety that impairs information processing.

Research Objectives

The following two main objectives guided this paper

1) To gauge the level of test anxiety of students' who take part in paper-based mid-semester and end of semester university examinations;
2) To investigate the link if any between test anxiety and performance of students.

Research Questions

Based on the above named objectives, this paper attempted to find some answers to the subsequent two questions:

1) What is it that determines the level of test anxiety of students who take part in paper-based mid-semester and end of semester examination paper?
2) What is the link between test anxiety and students examination performance?

Significance of the Study

Students' test scores are used by teachers and university lecturers, undergraduate and graduate college admission boards as well as employers to make critical decisions likely to have long term consequences on the life and career for most young people. This places onus on educators to ensure that their instruments for assessing students' academic achievement are valid and reliable to accurately measure what these instruments claim to measure. Most students are of the opinion that their academic efforts do not always link with their assessment scores for a variety of reasons among which has always been the issue of high test anxiety. Many educational psychologists are of the view that test anxiety for most of the time critically obscures students' real performance. It debilitates and interrupts students' academic performance especially their thought processes and inhibits working memory capacity. Based on this, it is hoped that the findings of this paper will be significant to all education stakeholders especially examiners, college admission boards, educational psychologists, employers, as well as students themselves to understand the psychological precursors of test anxiety and how to manage it.

3. Literature Review

Working Memory and decrements in test-anxious individuals

Contemporary interest in Working Memory in relation to overly test-anxious individual in test performance has grown considerably. This in part has to do with educational psychologists' interest in ensuring student assessment reliability and validity. Previous studies focused mainly on different types of demands such as divided attention, emotional arousal as well as anxiety and their roles in precipitating concurrent load on the Working Memory and so limiting the Working Memory Capacity space in other task (Mangels, Good, Whiteman, Maniscalco, & Dweck, 2012; Matthews & Campbell, 2010; Beilock, Rydell, and McConnell, 2007). Emotional states with respect to anxiety, worry, emotional arousal within and among individuals can distract available working memory away from current task and thereby leave insufficient capacity to attend to task demands at hand (Ilkowska & Engle, 2010). When this happens to reduce Working Memory Capacity, task performance can become impoverished because resources needed to perform concurrent task become insufficient. In a study, conducted by Mattarella-Micke and collaborators (2011), their findings suggested that anxiety in mathematics for example, acted as load on Working Memory Capacity (WMC) and consequently was the cause of poor performance on modular arithmetic task (Mattarella-Micke, Mateo, Kozak, Foster, & Beilock, 2011). The findings of similar studies conducted in foreign language show anxiety as the cognitive load reducing Working Memory (WM) resources for test performance. Similarly, in an investigation into the effect of stereotype threat of minority groups such as women and Latinos on performance in mathematics, Schmander and Johns (2003) findings indicated that stereotype threat was responsible for poor performance. This was the result of temporary reduction in WMC. The conclusion of these authors was that when stereotype is induced, it can constitute extra cognitive load for labeled minority groups, and this de facto, can reduce cognitive resources and its concomitant poor performance.

Eysenck (1979; 1985; Eysenck & Calvo, 1992) was one of the influential theorists to explain the relationship between working memory restrictions and decrements in cognitive performance in test-anxious individuals. This is due to the fact that in test situations, these individuals tend to deal with task-irrelevant thoughts which may include worries and concerns on self-evaluation and the possibility of failure which in turn tends to occupy space in working memory capacity. When tasks are less demanding, the remaining memory capacity may be sufficient to fulfill task requirements which are not likely to be so in complex and more demanding task. This explains why in complex task, individuals typically known to be overly anxious will show performance decrements primarily in complex tasks (Duke, S., & Stöber, J. (2001).

Working Memory Capapcity: Baddley's Model

Baddeley (1986) conceptualizes the working memory to be a constituent of different modality-specific and active storage subsystems such as for example, a subsystem for maintaining acoustic input ('phonological loop') and another subsystem for storing visual input ('visuo-spatial sketch pad') and a supervisory attentional system, referred to as 'the central executive'. It is this central executive which coordinates the information within and between the other two subsystems. This conceptual framework of Baddeley

(1986) takes into account both storage and information processing as opposed to the conventional short-term memory concepts postulated by Atkinson and Shiffrin (1968).

This conceptualization of working memory with different modality-specific and active storage systems has been confirmed by research studies on test anxiety such as Darke (1988) which measured digit and reading spans. The digit span represented storage capacity, while the reading span was symbolic of both storage and processing. On digit and reading span, individuals known to be overly anxious, compared to low-anxious individuals were known to exhibit lower values in both digit and reading span. The reading span difference was however found to be much greater. In both studies of Derakshan and Eysenck (1998) as well as that MacLeod and Donellan (1993), in which participants tasked to perform complex verbal reasoning in conditions of low or high concurrent memory load, similar results were found. Attention control of the entire system is provided by the central executive, and the episodic buffer permits communication to take place between Working Memory system components as well as the long-term memory, and then puts information together into chunks (Baddeley, 2003). The visuo-spatial-sketch-pad (VSSP) and the phonological loop (PL) are known as the "slave systems".

These two have the special function of processing of specific kinds of information. For example, the VSSP functions primarily to store and manipulate visual and spatial information; the PL is responsible essentially to linguistic processing (Baddeley, Gathercole, & Papagno, 1998). The PL can again be divided into the phonological store, and this stores phonological information temporarily as well as a rehearsal process, which delays the deterioration of information in the phonological store (Baddeley, et al., 1998). Besides this rehearsal process is responsible for taking in visual information (i.e., text) and translating it into a phonological code capable of being processed by the storage component (Baddeley, 2003; Coltheart, 1993). In short, attention controlled by the central executive in this model of Working Memory Capacity (WMC) is critical to both the VSSP or the LP and highly test anxious students are more likely to have decrements in attention due to the fact that resources needed to get focused on goal-directed behavior get choked by anxiety.

Cowan's Embedded processes theory of Working Memory

Cognitive processes have also been conceptualized as readily accessible (Cowan, 1999). Cowan (1999) in his Embeded Processes Theory postulates the limited-capacity concept with focus on attention interacting with the long-term memory as opposed to other views that perceive WM and attention control in the context of short term storage processes. According to this later view, information processing for any given task is contingent upon attention. Attention also inhibits information that are not relevant as well as distracting information (Engle & Kane, 2004; Engle et al. 1999). In language comprehension, the Capacity Constrained Comprehension Theory, by Just and Carpenter (1992) postulate that the accuracy as well as speed of information retrieval from text is based on Working Memory Capacity (WMC). Thus the common denominator that underlies all these models of Embedded Working Memory is that of executive control with particular reference to attention. This leads us to consider in the next section the link between cognitive load and attention.

Cognitive Load and Attention

The possible link between Working Memory Capacity and performance in respect of load has also been attributed to one's ability to allocate attention between maintaining relevant information, and simultaneously suppressing non-relevant distractors. Individuals predicted to be high in Working Memory Capacity (WMC) compared to those with Low Working Memory Capacity (LWMC) show higher performance (Engle & Kane, 2004; C. Amanda, 2014). The difference between the two groups is not that of attention resources amount as in the ability to flexibly allocate attention resources efficiently especially during interference or higher demands on Working Memory Capacity, and the former have the tendency to demonstrate higher performance. Eysenck, Derakshan, Santos, and Calvo (2007) are of similar view that anxiety and performance are inversely related. This relation has to do with individual differences in attention control and that those persons with high treat tendencies showing attention bias to internally or externally threat-induced items.

This implies that the ability to selectively pay attention to relevant information as opposed to irrelevant distractors is critically contingent on the level of difficulty of the task at hand and the type of information. Focusing attention is said to improve under task that have high level of perceptual load but deteriorates when there is high load on cognitive processes. In an examination of the correlation between cognitive control and working memory from a more neuropsychological perspective, recent research has shown that cognitive control and working memory are dependent from the statistical point of view even though they not compete and thus giving support to the view that that cognitive control and working memory are more likely to be encoded within the same brain network and hence giving some plausibility to the thesis of the human brain's capability of adaptive behavior across varied tasks (Ian, et al, 2016).

Arousal as a load

For some people, a high level of arousal at task performance can constitute a load on the Working Memory Capacity. Studies conducted to examine effects of physiological stress response such as the level of cortisol, mathematics treat anxiety and the Working Memory Capacity on mathematics performance showed that those with high anxiety rate had higher levels of cortisol and performed poorly in comparison with those who had low

anxiety and low cortisol. This relationship between physiological stress and performance is not unrelated to Working Memory Capacity. Those with Low Working Memory Capacity irrespective of cortisol level and level of difficulty of task at hand remained constant. On the other hand, when confronted with difficult mathematics problems those with High Working Memory Capacity(HWMC) and high Mathematics anxiety performed abysmally compared with HWMC persons who had less mathematics anxiety with high levels of cortisol (Mattarella-Micke et al 2011). Similar results of the relation between performance and stress have been identified by Francisco Hernando-Gallego and Antonio Art´es-Rodrıguez (2015; http://arxiv.org/pdf/1507.03482.pdf)

Current Study

The literature reviewed above on highly test anxious vis-vis-à-vis the human Working Memory underscores the following important points: a) a person's ability to be fully engaged cognitively with a given task is critically contingent upon one's ability to access as well as to process relevant information from Working Memory; b) cognitive fatigue and arousal are likely to cause deviations in selective attention by increasing mental load, and de facto, restricting Working Memory Capacity in test-anxious people. Based on the above, this current study examined whether or not there are links among cognitive test anxiety and perceived threat of test, performance level and students' attributions for test performance. The underlying hypothesis that this study tested was this: compared to students with low cognitive test anxiety, those with high cognitive test anxiety are more likely to demonstrate poor performance across all three phases of the learning-testing cycle (preparing for examination, students' performance level during test administration and students reflection on examinations).

4. Research Methodology

Sample

This study used a total random sample size of three hundred and twenty (320) university students from both undergraduate and postgraduate levels in four (4) selected universities in two (2) out of the ten (10) administrative regions of Ghana: the Ashanti and the Brong Ahafo regions. Two (2) of the universities were public and the other two (2) were private. Participants were initially selected randomly from a volunteer pool in perceived difficult upcoming end of semester examinations in the following disciplines: Mathematics, Statistics, Physics, Chemistry, C++ in Computer Science, Psychometrics and Econometrics, after which demographic indicators such as sex, age, socio-economic status and students' academic performance were determined. The indicators showed the following demographic characteristic of participants: one hundred and ninety two (192, constituting some 60%) were males, while the remaining one hundred and twenty eight (128, that is, 40%) were females. Aged ranged between 20 (8.2%) and 30 (1.8%). Parental/home background of students ranged as follows: 60% from middle class (public service university graduate parentage; 20% from trading and marketing parentage and the remaining 20% from rural farming parentage. Cumulative Grade Point Average (CGPA) of students' academic performance records fell between 3.5 and 1.5, majority (65%) between 2.5 and 1.5.

Materials and Designs

The material used to measure students Test Anxiety was an adapted version of the English variant of the original German Test Anxiety Inventory (TAI-G) developed by Hodapp and Benson in 1997. This instrument is deemed to be reliable from the psychometric perspective and other psychometric instruments validate its reliability and efficacy. Besides, this study also used an adapted version of Liebert and Morris (1967) Worry and Emotionality dimensions of Test Anxiety. The following four (4) variables were tested among these three hundred and twenty (320) students: Worry, Emotionality, Interference, and Lack of Confidence. The first experiment of this study was designed to investigate these students amenability to test anxiety especially perceived difficult examinations. The inventory was in the form Likert scale and participants were required to circle numbers from one through to five, one indicating strong disagreement and five representing strong agreement. Response bias was controlled through the use of statements that both suggested test anxiety as well as those of lack of test anxiety. Students were assured that their responses had nothing to do with their grading and that their responses would be analyzed in the selected universities after their grading were calculated. This approach was adopted as means to control social desirability bias. The second and third experiments consisted of two mid-semester quizzes and final end of semester written examinations, respectively, in the respective disciplines mentioned above.

Journaling

To test the other two phases of the learning-test cycle before the final written examinations in these disciplines, students were given two quizzes. In these quizzes they were prompt to write what was currently on their minds, their motional states, the stress they were experiencing.

Assessments

Four mid-semester examinations (quizzes) were the means used to analyze the above prompt journaling. These quizzes were made up four (4) questions in each of the disciplines and each question had a total score of 10 marks. The final exams were comparatively much longer and a bit more difficult so that differences between these and the quizzes could be analyzed to identify pre-test and post text anxiety. These quizzes together with the final examinations included prompts that helped students to rate their anxiety scale from 1 to 10 just before and after each exams.

Data Collection

The data for the test anxiety inventory were collected on same day after students had completed answering them to

forestall the possibility of student communication having any bias on the responses. The journaling prompts were undertaken by respondents just before the mid-semester quizzes (assessments) and were immediately collected after the journaling to prevent possible mental distraction during the writing of these quizzes. These journal entries were not made available to anyone except this researcher himself. To ensure validity and reliability of the findings of this study, marking and scoring were done by one person in order to avoid inter-rater reliability differences, while grading of respondents was done prior to compiling any data on anxiety.

Analysis of Data

Participants' scores in the test anxiety inventory, pre-tests anxiety in quizzes as well as post-tests anxiety ratings were compiled after these students' grades were recorded to prevent possible bias. The following contrasts were followed: first, scores of both pre-test anxiety and that of assessments were each contrasted with that of quizzes that followed journaling and quizzes without journaling. Then pre-test anxiety scores before final end of semester were compared to that of post-test anxiety scores. Secondly, journaling effect on test-anxious individuals' anxiety and performance was differently analyzed from that of those with no test anxiety. All scores were computed into mean scores and standard deviations.

Experiment 1

This first experiment was pretesting phase and the purpose was to assess whether or not the random sample of the three hundred and twenty (320) students from the selected universities had test anxiety and if there were, to find out if in fact there was any statistical difference between them in terms of the level of anxiety.

Methods & Participants

All the three hundred and twenty (320) participants were asked to rate a Likert's type of scale inventory in this pretest. They were required to circle numbers from one through to five, one indicating strong disagreement and five representing strong agreement. Response bias was controlled through the use of statements that both suggested test anxiety as well as those of lack of test anxiety.

Materials

The test anxiety inventory used to measure data in this first experiment consisted of thirteen (13) statements requiring participants to rank level of agreement: seven (7) were test anxiety and the remaining six (6) were on lack of test anxiety. A score of three (3) was deemed to be a neutral response. Seven of these statements suggested test anxiety and the remaining six statements suggested a lack of test anxiety. A rating of three (3), represented neutral response to a statement, such that, if any given student's ratings of pro-anxiety statements summed up to 21, the said student would seem to be anxiety-neutral. In the same way, ratings of anti-anxiety statements totaled up to 18, such student was deemed to be anxiety-neutral.

Procedure

The data collection procedure was done on the same day.

Results

Table 1. t-test on participants' Test-Anxiety in Experiment 1

	Participants (N=320)	Mean	Standard deviation	t-value	p-value
Score for test anxiety & non-test anxiety of students	Non-test anxiety students	51.76	5.364	-21.271	0.000
	Test anxiety students	82.02	8.420		

The results of this pretest inventory of the random sampling of students from the selected universities for this study as in Table 1 indicate that a mean score of 51.76 with a standard deviation of 5.364 were non-test anxiety students, while those with test anxiety traits had a mean score of 82.02 with standard deviation of 8.420. These standard deviations indicate test anxiety students' scores were rather more dispersed compared to the non-test anxiety students. To test whether or not their mean scores were statistically significant, an independent samples t-test run at an alpha level of 0.05 was run. The result as indicated in Table 1 shows a significant difference [t=-21.271, p=0.00].

Experiment 2 Methods and Participants

The sample was the same as in Experiment 1. All the three hundred and twenty (320) participants were asked to do the same rating, this time through journal prompting just before writing each quiz in their respective universities. In these journal prompts, students were asked to score their level of anxiety ranging from a scale of 1 through to 10 before and after each quiz.

Materials

The instruments used to assess and analyze the impact of journal prompting included four (4) quizzes in the respective subject areas perceived to be difficult in the universities, such as Mathematics, Physics, Chemistry, etc. Each of the quiz had five (5) questions, and each question was scored over eight (8), totaling 40 point mark which constituted two-fifth of over-all summative assessments.

Results

Students test anxiety was measured during mid-semester exams (quizzes) along the following three main variables: worry, emotionality, interference and lack of confidence. It can be seen that students with no test anxiety did better (in that they scores less) than those with test anxiety on all the variables that were tested. Again, on all the variables when the independent sample t-test was tested at 0. 05 to determine whether or not there were statistically significant differences in the mean scores of the two groups the indication was that the differences were significant. For example, on the measure of interference whereas test-anxiety students scored

a mean of 76.47 with a standard deviation of 3.985, non-test anxiety had a mean score of 43.32 and standard deviation of 9.464. The standard deviation of the two groups indicates that the scores of the non-test anxiety students were more spread than that of the test anxiety students. The comparison of these means with the t-test gave a t-value of -31.039 8, p-value of 0.000 indicating a significant difference in these mean scores.

Table 2. Test anxiety as function of worry, emotionality, interference and lack of confidence during quizzes in Experiment 2

	Participants (N=320)	Mean	Std. Deviation	t-value	p-value
Worry	Non-test anxiety students	41.81	10.733		
	Test-anxiety students	85.120	19.023	-13.113	0.000
Emotionality	Non-test anxiety students	40.62	8.032		
	Test-anxiety students	73.90	12.117	-17.319	0.000
Interference	Non-test anxiety students	34.32	9.464		
	Test-anxiety students	76.47	3.985	-31.039	0.000
Lack of Confidence	Non-test anxiety students	29.95	9.077		
	Test-anxiety students	67.78	6.225	-26.626	0.000

Experiment 3

Methods and Participants

The sample was same as in Experiment 1 and Experiment 2.

Materials

All the three hundred and twenty (320) participants took the end of semester examinations from their respective universities. This end of semester examination was used as the material to assess student's level of test anxiety. These final examinations were much more difficult and longer than each of the previous quizzes. This made it possible for this researcher to do some comparative analysis of the differences between pre-test anxiety as well as post-test anxiety. This end of semester examination consisted of two parts: Part A was objectives, consisting of twenty (20) questions each of which had A-E possible answers with a high level of distractors. Part B was the theoretical part which called for analytical, synthesis and application skill to answer such questions. Two hours before this final examination, students were assessed through prompts to rate their level of anxiety from 1 to 10 before and after each assessment.

Results

Table 3. Test anxiety as function of worry, emotionality, interference and lack of confidence during end of semester examination

	Participants (N=320)	Mean	Std. Deviation	t-value	p-value
Worry	Non-test anxiety students	51.83	4.581		
	Test-anxiety students	75.53	8.087	-19.751	0.000
Emotionality	Non-test anxiety students	44.27	5.544		
	Test-anxiety students	77.43	6.052	-31.301	0.000
Interference	Non-test anxiety students	31.52	3.352		
	Test-anxiety students	69.78	4.088	-56.065	0.000
Lack of confidence	Non-test anxiety students	26.47	4.188		
	Test-anxiety students	64.68	3.202	-56.149	0.000

5. Discussion

The pre-test data on test anxiety and non-test anxiety in Experiment 1 show that test anxiety symptoms are real among Ghanaian students in the universities. There was a considerable statistical variance in the students who participated in this study with those who responded as having symptoms of test anxiety scoring higher on the inventory test. This of course does not mean, that all those who indicated as having test anxiety symptoms have the same level of anxiety. The test anxiety varied greatly and ranged from mild to severe with some becoming almost incapacitated, explaining in the inventory that they could perform abysmally and experience panic attacks before and during examination. Three main symptoms of test anxiety were reported by those who were identified as having test anxiety: a) physical symptoms such as shaking, palpitation, and sweating; b) cognitive and behavioral symptoms such as avoiding testing situations, fidgeting and c) emotional symptoms as low self-image, anger and a sense of worthlessness. The pre-testing data in the above Table 1 showing a mean score of 51.76 with a standard deviation of 5.364 as non-test anxiety students, while those with test anxiety traits had a mean score of 82.02 with standard deviation of 8.420 corroborate the findings of studies such as Mattarella-Micke et al 2011 indicating the link between physiological stress especially arousal and working memory capacity in perceived difficult test such as mathematics.

This phenomenon of academic anxiety be it physical, cognitive and behavioral as well as emotional act as mental loads and they have the potential to decrease the capacity of the Working Memory leading to negative consequences of test failure. This is because high level test anxiety is more likely than any other variable to interfere with selective attention, information recall on task that students are given and this de facto set limits on effective performance. This finding corroborates other recent research that suggest that test anxiety is correlated with impaired academic performance, and has the tendency to lower students course grades, decrease students' motivation level as well as increasing stress (Nathaniel P. E., Emma, C.S., & Stephen P. K. 2013). This gives weight to the debate that school-based service delivery may need to migrate from the traditional system of assessment to a more comprehensive assessment that takes into consideration multiplicity of factors including response to interventions that are prevention-focused (Riley-Tillman, Burns, & Gibbons, 2013; Nathaniel P. E., Emma, C.S., & Stephen P. K. 2013).

Again the findings from Experiment 2 are consistent with the idea that anxiety is the predicting factor for intrusive thoughts likely to interfere with task-related thinking and thus reducing Working Memory capacities**.** These data suggest a possible correlation between test anxiety and actual test perceptions, thereby giving some plausibility to other studies that support the link between these two variables **(**Schutz & Davis, 2000; Schwarzer & Jerusalem, 1992). In other words, perceived test anxiety reported by test-anxious students in this second experiment underscores the likelihood of 'self-deprecating ruminations' a cognitive phenomenon observed in students with high level of test anxiety (Sarason et al., 1996). Results in (this session) suggest that anxiety and especially worry constitute significant problem of intrusion interfering with thoughts and undermining attention and impairing efficient execution of given tasks of students with high level of test anxiety As can be seen in the table above in the case of test anxiety students with a mean of 85.120 (SD=19.02) as compared to non-test anxiety mean score of 41.83 (SD=1-.733), worry constitutes recurring experience of negative apprehension of possible failure thus confirming what has been reported as one of the leading thoughts intrusions in high anxiety test students and thus giving support to Hayes, Hirsch & Matthews (2008) that one distinguishing characteristics of Generalized Anxiety Disorder is chronic worry.

In Experiment 3, students tested two hours prior to final examinations through prompts to rate their respective levels of anxiety before and after each assessment on the variables above indicated that on all variables, test anxiety students scored more than non-test anxiety. Independent samples t-tests at 0.05 significant levels showed a statistically significant differences in the mean scores of the two groups. For example, on the measure of interference, Non-Test anxiety students scored a mean of 31.52 (SD= 3.352) while test anxiety students scored a mean of 69.78(SD=4.088). On lack of confidence, while Non test anxiety students scored 26.47 (SD=4.188) test anxiety students scored a mean of 64.68 (SD=3.202), The comparison of these means with the t-tests indicated a t-value of -56.065 and -56.149 respectively at –value of 0.000 indicating significant difference in these means scores.

This experiment corroborates the thesis that anxiety by itself tends to absorb portion of the cognitive processing and this leads to reduced amount especially in the amount of attention likely to be devoted to task demand. This is especially so when task demands are high such as the end of semester examinations in perceived difficult disciplines. Test anxious students compared to non-test anxious students before and after assessments in each of the disciplines during the evaluative process appeared to have been more preoccupied with concerns that were off-target and such preoccupation might have absorbed greater part of the Working Memory and thus confirming other studies (Lavie et al, 2004; Foster & Lavie 2016; Engle & Kane, 2004).

The over-all findings of this paper suggest that there is a correlation between anxiety and cognition, giving support to other studies that confirm that mental resources such as attention, executive control, etc. which should focus on relevant task at hand are rather consumed by anxiety. Besides, the findings indicate that test anxiety such as worry, lack of confidence, interference, emotionality, etc. all contribute as cognitive load impairing Working Memory Capacity (Katherine et al, 2013) and thus corroborating other studies that found a link between students' academic performance and their test anxiety levels (Mangels, Good,

Whiteman, Maniscalco, & Dweck, 2012; Matthews & Campbell, 2010; Beilock, Rydell, and McConnell, 2007). Emotional states and arousal can act as cognitive load distracting the overly test anxious students from focusing on goal-directed activities. Such emotional states and arousal precipitate decrements in Working Memory Capacity.

If the findings of this study that appear to be consistent with similar studies on the link between anxiety and cognition are anything to go by, they raise implications for students' academic assessment generally, especially questions about reliability and validity of real performance of overly test anxious students. Consistent research evidence suggests that there is a relationship between students who are overly test anxious and impaired performance especially among female students (Mataroria et al, 2014). The first implication from this study is that if students are exposed to coping strategies to confront stress and anxiety, their performances are likely to be enhanced. Secondly, it is evident from this study that overly test anxious students impaired performance was the result of different types of demands such as, divided attention, emotional arousal as well as anxiety which precipitated concurrent load on the Working Memory and thereby limiting the Working Memory Capacity space in relevant task at hand. Based on this, the argument could therefore be made that, anxiety-induced depletion obscures overly test anxious real performance as indicated on academic assessments reports in most Ghanaian Higher institutions.

6. Conclusions

Overly test anxious students impaired academic performance for most of the time is the result of additional cognitive demands such as divided attention, emotional arousal as well as anxiety. These additional demands exert load on cognitive processing which sets limits on the capacity of the Working Memory. Emotional states with respect to anxiety, worry, and emotional arousal within and among individuals can distract available working memory away from current task and thereby leave insufficient capacity to attend to task demands at hand. When this happens to reduce Working Memory Capacity, task performance can become impoverished because resources needed to perform concurrent task become insufficient. These decrements in Working Memory Capacity caused by emotional states underscore the fact that there is a relationship between anxiety and cognition. Additionally, students' academic assessment is not unrelated to how academic institutions help overly test anxious students to cope with strategies of stress. This gives plausibility to the debate that school-based service delivery, may need to migrate from the traditional system of assessment to a more comprehensive assessment that takes into consideration multiplicity of factors including response to interventions that are prevention-focused.

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