Depression and Its Effects on a Cognitive Performance Test

C. Noi-Okwei

Abstract—In this study, participants with adjustment disorder with depressed mood (aged 18-54 years) with mild depression (N=18), severe depression (N=12) were compared with healthy controls (N=20) on the Multidimensional Aptitude Battery (MAB) a cognitive performance test. Using One Way Analysis of Variance and Matched Sample t-test. The results of the analysis shows that severely depressed participants performed poorly on the cognitive performance test relative to controls, however there were no significant differences on the cognitive performance test scores between the severely depressed and the mildly depressed. In addition, performance on the non-verbal performance subtest was poorer than that of the verbal subtest, suggesting that depression affects the executive functions of the person.

Keywords—adjustment disorder, cognitive performance test, Depression,

I. INTRODUCTION

ACCORDING to the [1] depression is a common mental disorder that affects millions of people worldwide. It is among the leading causes of disability with sociological and economic implications. Thus depression brings about a loss of productivity as well as high cost of medical bills. Research has shown that depression has a significant influence on ones decision making, judgment and other cognitive processes [2], [3]. It has also been found to contribute significantly to grade point average of college students [4], [5].

There are several subtypes of depression and certain dichotomies in classification have been widely accepted because of their clinical utility. The subtype of depression being examined for this study is the depressed mood associated with adjustment disorder. It denotes a depression that follows an environmental event that is particularly stressful for reasons idiosyncratic to the individual and without biological aetiology.

A growing body of evidence indicates that early intervention in depression does go a long way to bringing an individual back to normalcy. Thus whenever the performance of depressed patients at the beginning of therapy has been compared to that of matched non-depressed controls, the former have usually scored significantly worse than the latter [6].

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A. Statement of the Problem

The concept of depression is a multifaceted phenomenon; its impact on an individual affects every sphere of his or her life. Majority of patients reporting at hospitals have been known to seek treatments for physiological symptoms of depression, namely insomnia, headaches, abdominal aches, back aches, loss of appetite and the like [7]. Thus depression brings about a loss of productivity as well as high cost of medical bills. Students have also been known to perform poorly in their academic work due to depression. Statistics at the Counselling Centre of the University of Education,Winneba (UEW) for the year 2009 showed that out of 23 students seen by the researcher 4 were as a result of clinical depression and 13 were depression resulting from challenges such as broken relationships, unplanned pregnancy, poor exam results, marital distress, and hospitalization of a family member [8].

II. PURPOSE OF THE STUDY

The purpose of the study is therefore to examine the effects of depression on cognitive performance, specifically to

1. Determine whether there are differences among the severely depressed, mildly depressed and healthy controls on the cognitive performance test.

2. Examine the effects of depression on Verbal and Non-verbal ability.

III. SIGNIFICANCE OF THE STUDY

Understanding how psychosocial stressors can result in depression and subsequently affect cognitive functioning maybe especially important, because most of the available literature is on patients with clinical depression. It is hoped that, findings of this research will help deepen the understanding of employers, school administrators, school counselors and clinicians of depression and its effects on the performance of individuals in their jurisdiction. It would also add to the literature on depression and cognitive functioning.

IV. REVIEW OF RELATED LITERATURE

A. Depression and Cognitive Performance

Depression is a condition in which there is a likelihood of some impairment in cognitive performance. Several studies [6], [2] have been carried out in this area by examining the correlation between Hamilton's Depression Scores and Neurocognitive Task Scores. [6] found a correlation between the severity of depression and cognitive performance, often

selectively for the more demanding tasks. [2], [9], also found that cognitive performance decreased with severity of depression.

Other studies [10], [11] however have found no correlation between task performance and depression severity. Reference [10], compared patients suffering from major depression with matched controls on a battery of memory tests. No correlation was found between depression severity and level of memory impairment.

Most of the available literature cited so far refers to depressed inpatients on antidepressant medication. Antidepressant medications have been known to have such side effects as nausea, diarrhea, headaches, loss of libido, failure to reach orgasm, erectile problems, anxiety and weight gain [12]. These side effects are enough to cause a distraction in the performance of a cognitive activity. In fact even among "normal" people, such side effects could make it difficult for any person to concentrate on a given task, thus a depressed state is likely to complicate it. More so, different subtypes of depression (e.g., major depression, bipolar, dysthymia) which have biological aetiologies as against a situational aetiology were investigated. It is for this reason that this study is being carried out on outpatient participants whose aetiology of depression is not biological and further, to find out the differences between severely depressed, mildly depressed and healthy controls on cognitive performance.

B.   Depression and Verbal and Non-verbal performance

Most of the available evidence of depression have mainly been comparisons between verbal sub tests and performance subtests of cognitive tests of depressed and non depressed individuals, with very few between two depressive groups. Also various results on the effect of depression on a specific subtest namely verbal and performance measures have been conflicting.

Reference [13] reported a demonstration of no verbal learning deficits for depressed subjects relative to non-depressed, and [14] in their study found that depression may be associated with impairment on non-verbal tasks that require attention coordination and speed but not necessarily on those that require verbal skills or intelligence. This implies that depression does not affect the knowledge base of a person, rather it affects executive functions. Thus it is expected that depression will not affect the verbal ability of participants. Reference [15] report that depressed patients were especially vulnerable to visual memory impairment, whereas verbal memory and recall by recognition were more often unaffected. One study examining patients who had been drug-free for two weeks showed no difference between patients with non-psychotic major depressive disorder and controls in verbal memory, whereas executive performance (Stroop) was impaired [16].

There have also been a number of studies reporting impairment in verbal cognitive performance among depressed patients. A study by [6] among endogenous, neurotic and healthy controls, found that both groups showed impaired memory functioning on the auditory verbal learning test and recall recognition test, however the endogenous group was more impaired on digit symbol substitution and trail making test. [17] found pronounced deficits in verbal learning, recall and recognition were observed in patients with melancholia compared with controls.

Based on the literature reviewed, the following hypotheses have been stated, that;

Hypothesis 1: Severely depressed participants will perform poorly on the cognitive performance test than the mildly depressed and the healthy controls.

Hypothesis 2: Depressed participants will perform better on the Verbal subscales than on the non-verbal performance subscales.

V.   METHODS

A.   Participants

Fifty participants (N=50) were included in this study. They included mildly depressed (N=18) severely depressed (N=12), and healthy controls (N=20). Participants were divided into two groups. Individuals in group 1(depressed participants N=30) were made up of 21males and 9 females, mean age=31.8, range 18-57 and SD=9.13. They were conveniently and purposively selected at the Clinical psychology unit of the Accra Psychiatric Hospital; the first and biggest psychiatric hospital in Ghana. They were referred from general hospitals and clinics in Ghana as well as from the psychiatrists in the hospital. The criteria for inclusion were a BDI score above 10 and adjustment disorder with depressed mood with no history of psychiatric treatment.

The second group was the healthy participants conveniently and purposively selected from an undergraduate psychology class of the City campus of the University of Ghana. They were made up of 15 males, and 5 females, age=34.5, range=25-46, SD=5.10). The criteria for inclusion were a BDI score below 10 and an absence of a psychiatric history.

B.   Measures

The Structured Clinical Interview [18] served a screening function of identifying the aetiology of the respondents' depression. This instrument begins with an overview section that includes questions about basic demographic information (e.g., age, marital status), followed by questions about (a) the client's chief complaint, (b) the history of the problem,(c) the individual family history, which concerns information about spouse(s) and children, (d) the family background; (e) psychosocial history, (f) Individual and family medical history, (g) family psychiatric and psychological history. The last item is the formulation of a diagnosis, including test results based on the five axes of the DSM IV. The SCI served as a screening method. The interviews ranged from 15-40 minutes for depressed participants and 10-25 minutes for the healthy non depressed participants.

Beck Depression Inventory [19] was used to assess the general level of depression. The Beck depression Inventory consisted of 21 items which are self-rated from 0 (I do not feel

sad) to 3 (I am so sad or unhappy that I can't stand it). The individual questions were also divided into 4 categories: mood, self-reproach, somatic and vegetative characteristics of depression. Participants were required to read carefully and select the statement for each group that best described how they were feeling. Scoring was obtained by taking the score circled for each item and adding the total number of points for all items. The total score ranged from 0 - 63. One item that assessed weight loss is not scored if the individual indicates that he/she has been attempting to lose weight. For the purpose of the study, participants who scored between 11 and 16 were categorised as mildly depressed and those who scored between from 17 onwards were categorised as severely depressed.

The BDI took an average of 13 minutes for the depressed group and eight minutes for the healthy controls. It must be noted that the BDI was used in this study solely as a measure of severity once the diagnosis for adjustment disorder with depressed mood had been made.

Interitem correlations of the BDI among Ghanaian population on Montgomery Asberg Depression Rating Scale (MADRS), Hamilton Depression Rating Scale (HDRS) 0.88, 0.83 respectively, thus showing high validity [20].

The Multidimensional Aptitude Battery [21] was designed as a group-administered alternative to the Wechsler Adult Intelligence Scale-Revised (WAIS-R). It was adapted in Ghana by [22].

The MAB assesses aptitude and intelligence yielding a profile of ten subtest scores, verbal IQ, Performance IQ and Full Scale IQ. Scales on each battery include; Verbal Subtests and Performance subtests.

Subtests on the Verbal Scale are; *Information (*40 items); *Comprehension* (28); *Arithmetic* (26 items); *Similarities* (34 items); *Vocabulary* (46 items) and that of the Performance Subtests are *Digit Symbol* (35 items); *Picture Completion* (35 items) *Spatial* (50 items) *Picture arrangement* (20) *Object assembly* (20).

The MAB employs a five-point likert scales for all subtests and participants are required to identify, among five choices, the one best or most correct answer. The entire test takes 100 minutes but each subtest can be individually or group administered and the time limit for each test is 10 minutes.

The Cronbach alpha for the adapted MAB ranged from 0.58 to 0.88[22].The alpha coefficient for the present study sample ranged from 0.65 to 0.84.

C. Procedure

The depressed participants were selected by making contact with the Accra Psychiatric Hospital authorities, and although the researcher at the time of data collection was working in the Psychology Unit as an intern, a letter of introduction from the Department of Psychology, University of Ghana was sent to the Hospital Administrative Secretary to seek permission for the collection of the data. After approval for the data collection had been granted by the hospital authorities, the Psychiatrists referred patients who fit the criteria for the study to the clinical psychology unit for the data to be collected. Some patients who were referred from other general hospitals and clinics as well as self referred ones were given information about the nature of the study and they also consented to participate in the study.

For the control group, initial contact was made with the participants two weeks before the initial data was actually collected. A contact person; a graduate teaching assistant at the Accra City Campus of the University of Ghana helped select the participants, after which their consent for participation was obtained. They were also assured of confidentiality, anonymity and were duly informed that they could withdraw from participating in the study whenever they wished to do so. Participants for this group were individually interviewed using the Structured Clinical Interview to select those who satisfied the study criteria.

One of the consulting rooms at the clinical psychology unit of the Accra Psychiatric Hospital and a lecture hall at the Accra City Campus were used for the depressed and healthy controls respectively. They served as venues for the administration of the measures in the order of the BDI first, and then the cognitive test (MAB). The order of administration of the measures was intended to prevent a reversed causal mechanism where their depressive state might be in reaction to their subjective perception of their cognitive performance deficit on the MAB. Codes rather than names were used on the questionnaires to ensure confidentiality. The measures were administered to participants in the depressed group individually while the healthy controls were group administered. Data collection for the depressed group took four months whereas that of the healthy control took two weeks.

D. Data Analysis

The Statistical Package for Social Sciences (SPSS) was used in analysing the data with the use of frequencies, One Way Analysis of Variance, and the Matched Sample t-test.

VI. RESULT

A. Demography of the Sample

Of the depressed group, 70% were males and 30% were females and the control group had 75% males and 25% females. The mean age group was 31.8 for the depressed group and 34.5 for the control group. On their level of education, 20% of the depressed group and 30% of the control group had secondary school education and Vocational School education respectively, Eighty percent of the depressed group and 70% of the Control group had a Tertiary education (Polytechnic, Teacher Training College, University).

B. Depression severity, healthy controls and cognitive performance

Hypothesis one stated that severely depressed participants will perform poorly on the cognitive performance test than the mildly depressed and the healthy controls. The One Way Analysis of Variance was used to test the hypothesis.

TABLE I
SUMMARY OF MEANS AND STANDARD DEVIATION AND ONE WAY ANOVA RESULTS FOR THE MAB SCORES
OF THE DEPRESSED AND CONTROL GROUP

MAB subtest scores	Severe depression (N=12)		Mild depression (N=18)		Control (N=20)		F	P<
Verbal subscales	Mean	SD	Mean	SD	Mean	SD		
Information	42.17	10.75	44.67	9.00	56.25	12.81	7.93	0.001*
Comprehension	35.83	7.95	40.28	8.78	50.40	14.87	6.97	0.002*
Arithmetic	40.83	19.72	49.94	14.81	50.80	14.97	1.61	0.211
Similarities	50.08	12.51	54.39	7.44	62.80	11.49	6.21	0.004*
Vocabulary	40.67	8.07	41.78	9.40	52.40	1.04	8.40	0.001*
Total verbal scale	209.58	47.06	231.06	37.72	272.65	12.71	15.26	0.001*
Performance subscales								
Digit symbol	31.08	18.67	33.78	15.36	46.20	18.29	3.71	0.032*
Picture completion	27.33	8.46	29.28	7.18	38.05	10.16	7.28	0.002*
Spatial	34.75.	5.38	31.22	8.09	42.80	7.11	13.10	0.001*
Picture arrangement	35.58	13.34	34.17	15.71	41.60	9.57	1.73	0.189
Object assembly	36.58	4.23	40.56	9.56	48.35	10.37	7.25	0.002*
Total performance Scale	165.33	42.71	169.00	40.44	217.00	34.55	9.81	0.001*
Summary Full scale	375.92	88.3	400.06	68.7	489.65	36.30	15.21	0.001*

*P<0.05 sig.

The results shown in Table 1 above indicate significant differences on the full scaled score for the three groups of participants, namely mildly depressed, severely depressed and the control group $F_{(2,47)}=15.21$, $p<.001$. The Bonferroni multiple comparison tests used for the analysis showed that the non-depressed group had significantly higher scores than the mildly and severely depressed group. However no significant difference was observed between the mildly depressed and the and the severely depressed participants.

Further examination using ANOVA, of the subtests of each of the two subscales of the test namely the verbal and performance scales showed significant differences $F_{(2,47)}=15.27$, $p<.001$, $F_{(2,47)}=9.81$, $p<001$ respectively. From Table 1 above, apart from the arithmetic subtest $F_{(2,47)}=1.61$, $p=.21$, significant difference was observed on the remaining subtest of the verbal ability measures of the MAB-II (information, comprehension, similarities and vocabulary). The post hoc comparison using the Bonferroni multiple comparison test revealed significant differences between the scores obtained by the control group and the mildly depressed on one hand and the severely depressed participants on another hand. The only exemption was the similarities subtest which showed a significant difference between the control (non-depressed) group and the severely

depressed group only but not between the mildly depressed. On the subtests of the non-verbal Performance Subscale, significant differences were observed in four of the five subtest(digit symbol, spatial, picture completion and object assembly),only picture arrangement scores revealed no significant difference for that of the of the three groups of participants $F_{(2,47)}=1.72$, $p=.19$. The post hoc test using the Bonferroni multiple comparison test showed no significant differences among the three groups on the digit symbol subtest, although the ANOVA test result was significant $F_{(2,47)}=3.706$, $p<05$). Significant differences were however found on the object assembly, picture completion and spatial subtest. On the whole, the control (non-depressed) group had significantly higher scores than that of the mildly depressed and the severely depressed participant with no significant difference between the mildly depressed and the severely depressed. The hypothesis was in part confirmed for the difference between the severely depressed group but not confirmed for differences between the mildly depressed and the severely depressed group.

C. *Depression and performance on Verbal and Non-Verbal Subscales*

Hypothesis two stated that depressed subjects will perform

better on the verbal subscales of the MAB than the Performance subscales. This hypothesis was tested by comparing the scaled scores of the verbal subscales and that of the non-verbal Performance subscale, using the Paired Sample test.

TABLE II
SUMMARY OF MEANS, STANDARD DEVIATION AND PAIRED SAMPLE T-TEST RESULT OF VERBAL AND PERFORMANCE SCALED SCORES OF DEPRESSED PARTICIPANTS

Variables	N	Mean	SD	t	df	p
Verbal scaled score		92.7667	13.4284			
	30			6.753	29	0.001*
Performance Scale score		78.5000	10.5561			

*P<0.05 significant

This hypothesis was tested by comparing the scaled scores of the verbal subscales and that of the non-verbal Performance subscale, using the Paired Sample t- test. The hypothesis was supported. As shown in Table 2 above, the verbal scores (Mean=92.76, SD=13.428) was more than the performance scores (Mean=78.500, SD=10.5561), t (30) =6.753, $p<.05$.

VII. DISCUSSION
A. Depression Severity, Healthy Controls and Performance on the Cognitive Test

The results demonstrate the impact of depression on cognitive performance as measured by Beck Depression Inventory, and the Multidimensional Aptitude Battery. Results comparing the control group and the severely depressed group are consistent with previous studies by [2], [9], [23], [24] who reported significant differences between depressed subjects and healthy controls. However post hoc analysis between the mildly depressed and the severely depressed was not significant, although there was a difference in the means. This means finding suggest that irrespective depression severity, cognitive performance will be impaired. This finding is consistent with previous studies by [10] who reported no relation between task performance and depression severity. It is however inconsistent with previous studies [25], [6] who found such a correlation.

The inconsistencies in the findings of the severity of depression and cognitive performance could be attributed to mis-diagnosis in that depression, and for that matter psychiatric diagnosis is a subjective area. The inconsistency could further be explained in terms of the depression subtype. Further explanation on the reason for the discrepancy in this study with other studies could also be the fact that depressed patients tend to be non-disclosing during the initial contact [26] with people outside their immediate family and therefore did not put down their real feelings. This was noticed by the researcher as there was a discrepancy between the subjective observations of some of the depressed participants (such as tears, suicidal ideation and non verbal characteristics like slowed manner of speech and avoidance of eye contact) and that of the objective measure of the Beck Depression Inventory. It is possible a somatic depression inventory would have given a better result than that of the BDI since non-western cultures such as the Chinese, Japanese, Nigerians and Hispanics have been known to manifest psychological disorders including depression in somatic forms [27] and the Ghanaian sample has similar characteristics. For example [28], found in their study in Zimbabwe that somatic complaints like headaches and fatigue were the most common presentation of depression. The unmedicated status of the patients could also be a reason for such results, because studies that revealed correlations between severity of depression and cognitive performance were performed on patients on antidepressants.

B. Depression and Performance on Verbal and Non-Verbal Performance Subscales

The hypothesis that depressed subjects will perform better on the verbal subscales than the performance subscale of the cognitive performance test was supported. This is consistent with earlier studies by [29] who found impairment in performance task using Card Sorting Test among the depressive. Reference [30] also found that depressed patients showed deficits in performance of a spatial task but no deficits in verbal tasks when compared with healthy controls. However it differs from that of [3] study, in which depressed subjects were impaired on verbal recall while performing normally on verbal recognition. Similarly, [17] found that depressed patients were impaired on the cued recall task, a verbal task but did not differ from that of controls in a word-step completion task-a non-verbal task.

The inconsistency of the study with other studies that differ from it may be attributed to the educational background of the depressed participants as the mean educational standing was Senior Secondary School Certificate Examination (SSSCE), thus it can be inferred that they have acquired a store of information over the years and therefore did not have much difficulty in recognizing information they have been familiar with over the years. This is also coupled with the fact that verbal performance which is synonymous with crystallized intelligence according to [31], is resistant to change following any kind of central nervous system stressor in contrast to non verbal performance such as visuospatial tasks, psychomotor activity and non-verbal tasks which are susceptible to central nervous system stressor. Furthermore, the subtype of depression that was used in the other studies could have accounted for the inconsistency. For example, [16] reported that patients with psychotic major depression were deficient in learning new material (as required in non performance subtests) and yet have normal retention for learned material an hour and a half earlier. It is possible that the mechanism involved in short term retrieval of information is different from that of long term retention of information thus resulting in such results.

C.   Implications of the Study

Given the negative impact depression has on individuals' cognitive functioning and subsequently their academic work (for students) in terms of poor performance in examination as well as in work output (for employees), employers, teaching staff, counselors and clinicians stand to benefit from an increased understanding of depression. It would be useful for these people to consider the effect depression has on performance and productivity seriously and find ways to help individuals in their jurisdiction. For example, employers can refer to appropriate mental health professionals, specifically clinical psychologists to help their clients. School counselors who cater for depressed learners will need to include the explorations of academic challenges faced by these learners and incorporate individualized treatment strategies to serve the needs of their learner/clients. Furthermore, counselors can institute school-based prevention and remedial programs that could address the combined issue of academic challenges and mental health problems as well as help students cope with stressful events in their lives.

D.   Limitations of the Study

The sample size for the study was quite small, although enough for a clinical study, and it was done in the Greater Accra Region which is located in Southern Ghana and therefore cannot be generalized to the rest of the clinical population in Ghana. Also there was a male preponderance, a very interesting phenomenon, since it has been widely accepted that females are more likely to report for depression than males.

D.   Recommendation

It is recommended that further studies among unmedicated depressed outpatients take into consideration the gender balance to offset the effect of a larger sample size of a particular sex. Further the gender differences in accessing mental health in particular cultures could be examined. A somatic depression inventory; a measure which will be possibly appropriate for a non-western sample should be used and finally, a shorter test that also assesses all the domains in cognitive functioning should be used to reduce boredom in the answering of the cognitive performance test.

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