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THE EFFECTS OF SOMATIZATION ON MEMORY PERFORMANCE IN
OLDER ADULTS

By

Saw-Myo Tun

A THESIS

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ABSTRACT

THE EFFECTS OF SOMATIZATION ON MEMORY PERFORMANCE IN OLDER ADULTS

By

Saw-Myo Tun

The aim of the investigation was to explore the advisability of considering somatization of depression as a masked depression that warrants treatment similar to depression in studies on memory. Three demographic variables, age, education, and gender, were included for comparative purposes. A sample of 227 community dwelling older adults with the age range of 54 to 87 years old ($M = 70.21$) was recruited. To assess depression, Beck Depression Inventory (BDI) and Geriatric Depression Scale (GDS) were used. Memory measures were California Verbal Learning Test (CVLT), Logical Memory, Benton Visual Retention Test (BVRT), and Spatial Span. The results indicated that the total and affective scores on the BDI were negatively correlated with performance on the Spatial Span ($r = -.15$, $p < .05$, $r = -.16$, $p < .05$, respectively). However, a high level of somatization did not predict performance on the memory measures. Findings regarding age, education, and gender were presented.

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Introduction

Although numerous studies have confirmed the clinical tales of age-related memory decline in older adults, age alone has been insufficient in explaining wide variations in the level of decline typically exhibited in elderly populations. For example, a few studies have pointed to a marked decrease in episodic memory abilities with increasing age (Naveh-Benjamin, 2000; Smith, 1996), whereas age appears to have been of little or no consequence for a sample of very old adults (Hassing, Wahlin, & Backman, 1998). To account for such differences in the extent of decline, a number of factors, such as level of education and lifestyle variables, have been studied. Of these factors, depression in its various forms, has received much attention as a possible significant contributor to disparate findings in memory performance (e.g. La Rue, Sawn, & Carmelli, 1995; McBride & Abeles, 2000).

Notably, however, one manifestation of depression, called somatization, has been given little research attention to determine its potential impact on memory performance. Somatization has been suggested to be a form of depression in which individuals express their distress through somatic complaints rather than through psychological complaints. The lack of research in the area is pertinent given the following two suggestions by previous reports: 1) older adults are more likely to somatize their depression, decreasing the chances of it being correctly diagnosed and treated (Kirmayer, 1993; Muller-Spahn & Hock, 1994; Small, 1991) and 2) unrecognized depression may be a causal factor in

deterioration of memory performance, as in the case with pseudodementia (Kim & Rovner, 1994; Small, 1991).

The purpose of the present study is to explore the validity of considering somatization of depression as a form of masked depression that deserves treatment similar to depression in the studies of memory performance. To do so, a review of the literature will be presented assessing the relevance of recognizing the effects of depression as well as masked depression on memory performance in older adults. In evaluating the appropriateness of equating somatization with depression in its effects on memory performance, three unrelated variables are employed to serve as a frame of reference for the degree of variance explained. Thus, the effects of the three variables, age, level of education and gender, on memory performance will also be reviewed.

Depression and somatization of depression in older adults

Depression is a debilitating disorder with pervasive influences across several domains of an individual's life, including cognitive functioning. In the general population, the lifetime prevalence of depression is estimated to be between 5.8%-9.7% (Katon, 1987). However, in the elderly population, the clinical picture of depression becomes more complex. In an epidemiological study by Blazer and colleagues (1987) on depression in community residents over the age of 60, 19% endorsed mild depression, while 4 % had symptomatic depression,

and only 0.8% had major depression. Of interest are the relatively high rates of mild depression as well as symptomatic depression.

Despite the relative high rates of mild and symptomatic depression found in the study, recent research warns that prevalence rates are likely to be an underestimation of the actual rates due to a high percentage of undetected psychological disorders in the geriatric population. In one such study, it is estimated that only about 24% to 67% of the psychiatric disorders are recognized in the primary care setting (Kirmayer et al., 1993). In particular, the likelihood of geriatric depression being undiagnosed is estimated to be as high as 40% (Small, 1991).

Research has shown that this under-recognition of depression in elderly populations can be attributed to a number of factors. A study by Rapp and Davis (1989) showed that frequently, physicians were unfamiliar with diagnostic criteria for depression, and would rarely screen for depression. Moreover, in primary care settings, older adults may present with overwhelming physical and cognitive complaints, which often shifts the focus away from the assessment of psychological distress (Small, 1991).

In addition to the above-mentioned factors, the high rate of somatization contributes significantly to under-detection of the disorder in elderly populations. Studies have supported the notion that geriatric populations present depressive symptoms in a way as to render identification using the normal criteria for depression diagnosis inappropriate (Muller-Spahn & Hock, 1994). In particular, older adults have a much higher tendency than younger adults to report somatic

symptoms of psychological distress while denying the involvement of psychological causes (Kirmayer, 1993; Muller-Spahn & Hock, 1994; Small, 1991). Typically, somatic complaints seen in such cases without clear medical bases are chronic pain syndromes, sleep disturbances, fatigue, palpitations, gastrointestinal-related problems, and sexual dysfunction (Akiskal et al., 1982; De Wester, 1996; Lesse, 1983; Razali & Hasanah, 1999). Also, the somatic pattern of presentation is distinguishable by the fact that unlike typical depressed patients, there is a distinct lack of dysphoria or guilt (Weiss, Nagel, & Aronson, 1986), compounding the difficulty of diagnosis. Taken together, the propensity of the patient to focus exclusively on the physical symptoms rather than the psychological symptoms is termed somatization.

It should be noted, however, that not all cases of somatization could be accounted for by depression (Lipowski, 1988). Additional factors such as personality traits, socio-cultural influences, and psychological distress other than depression (e.g. anxiety) may contribute to the tendency to somatize (Kellner, 1990; Lipowski, 1988). Nevertheless, there is a strong consensus in the field that depression is liable for significant cases of somatization (Collins & Abeles, 1996; Fisch, 1987; Lesse, 1983; Lipowski, 1988). In fact, somatization is often known as a form of masked depression or depressive equivalent (Kellner, 1990).

Progress in our understanding of somatization as a form of depression in geriatric populations, however, has not been effortless. The formulation of somatization as a form of depression has been met with some degree of skepticism (Kellner, 1990). Yet, despite the lingering debate over its

conceptualization, only a handful of studies have been conducted to address the issue. In one such study, REM latencies in individuals with probable masked depression were compared to those diagnosed with major depression (Akiskal et al., 1982). The findings demonstrated the REM latencies of those with probable masked depression to be more closely matched with those of individuals with primary depression ($51.1 \text{ min} \pm 15$) than those of individuals with secondary depression ($75.9 \text{ min} \pm 24.7$) or the control group ($91.1 \text{ min} \pm 19$). In a separate study by Akiskal and colleagues (1997), individuals with masked depression were also found to respond positively to treatment with antidepressants. Moreover, a report from Leventhal and coworkers (1996) suggested that negative mood state was a good predictor of future somatic complaints, further suggesting the correlation between somatic complaints and depression.

Despite the suggestive trends seen in these studies in support of masked depression, further research is critical to the development of a more complete conceptualization of this elusive syndrome. At present, a number of etiological models, as summarized by Fisch (1987), have been proposed. In one cognitive formulation, a masking of depression is attributed to patient's inability to verbalize psychological distress. A socio-cultural model, on the other hand, implied that expression of emotions is dictated by cultural norms, and thus, an individual's manner of conveying distress is rooted in his or her culture and values. Using this model, it is probable that older adults who may have instilled the personal acculturation of the early 20th century, would reject psychological symptoms of depression as an admission of weakness. Unlike the socio-cultural

model, a familial model of masked depression entailed that familial influences are the major determinants for shaping one's responses to emotional stimuli.

Therefore, it is believed that in some families, expression of physiological problems is more acceptable than problems of emotional nature. So far, there is some evidence to support a familial model of somatization. A study by Terre and Ghiselli (1997) reported that some aspects of family life increase the likelihood of somatic complaints in youths, which make them more susceptible to somatization later in life.

Although the available etiological models provide some clues into the psyche of the masked depressed, they still failed to explicitly account for a particularly high percentage of masked depression seen in geriatric populations. It is estimated that between 7.9% and 28.6% of older adults fit the criteria for masked depression (Barret et al., 1988; Collins & Abeles, 1996; Lesse, 1983). Such a high rate of masked depression is of concern given the possibility of severe consequences resulting from a delay in treatment. It has been suggested that unrecognized depression in geriatric populations could ultimately be responsible for a decreased quality of life, social isolation, increased risk of suicide, and physical illnesses (Muller-Spahn & Hock, 1994; Small, 1991). In fact, one research finding estimated the decreased functioning due to depression to be as debilitating as, or worse than, those of chronic illnesses such as diabetes (Schonfeld et al., 1997; Wells et al., 1989). Furthermore, the economic impact of masked depression can be quite substantial due to a particularly high percentage of medical facility usage by the somaticizers (Kellner, 1990; Lipowski, 1988;

Smith et al., 1986). Thus, further investigation to obtain a better understanding of masked depression in elderly populations is warranted.

Depression and memory performance

In the last two decades, research has begun to accumulate on the role depression plays in memory decline. Several studies have confirmed depression as an influential factor on memory performance, albeit with the extent of influence varying according to the study (e.g. Collins & Abeles, 1996; La Rue, Sawn, & Carmelli, 1995; McBride & Abeles, 2000; Rohling & Scognin, 1993; Salzman & Gutfreund, 1986). One line of research in support of the proposed relationship between memory and depression comes from findings with regards to pseudodementia. Pseudodementia refers to a medical phenomenon in which individuals, experiencing a significant decline in memory abilities due to depression, are mistakenly given the diagnosis of dementia. It is estimated that 10% to 15% of dementia cases are actually cases of depression (Small, 1991). Unlike true cases of dementia, individuals with pseudodementia return to normal cognitive functioning after the underlying cause of depression has been resolved (Kim & Rovner, 1994). Therefore, the reversible nature of dementia, seen after treatment for depression, is taken as an indication of a link between memory functioning and depression.

However, the research has not been unidirectional in findings. For instance, a few studies have suggested that there is little to no obvious relationship

between depression and memory (Bieliauskas, 1993; Luszcz, 1992). Several factors may be responsible for the apparent inconsistencies in results. Firstly, it has been noted that memory deficits are more likely to be seen in severely depressed than in mildly depressed individuals (Rohling & Scogin, 1993). Second, research has indicated that the effects of depression on cognitive abilities are unevenly distributed across the age ranges. Stoudemire and colleagues (1989) reported that depressed older adults are more likely to be adversely affected in the cognitive domains than younger adults. Therefore, the age of the group studied will have an influence on the outcome of the study. Third, in the depressed state, some types of memory processing are more likely to be affected than others (Christensen et al., 1999; Gainotti & Marra, 1994; McBride & Abeles, 2000; Rohling & Scogin, 1993). For example, as reviewed by Salzman and Gutfreund (1986), some of the memory processes that are negatively impacted by depression are recall of new information, increased error of omission, use of less effective strategies for coding and recall, and decreased attention. However, it is unclear whether the relationship seen between depression and memory can be taken as a true association or as an artifact of decline in concentration commonly observed in depression. Bearing these findings in mind, severity of depression, age, and type of memory process studied should be considered, in research looking at memory deficits and depression.

Somatization and memory performance

Research on memory complaints indicates that there is no necessary correlation between memory complaints and memory performance (Collins & Abeles, 1996; Larrabee & Levin, 1986). Somatic complaints, on the other hand, have received too little attention in research to clearly delineate its relationship with memory functioning. If one were to suppose that somatization is a form of masked depression, a natural conclusion would be that memory performance of individuals with somatic symptoms of depression would be similar to performance of individuals with depression. However, in studying the possible effects of somatization on memory performance, certain issues should be addressed. Firstly, it has been suggested that in older adults, an increase in somatic complaints may signal less severe depression (La Rue, 1992). Similarly, a lack of dysphoric mood associated with somatic depression may suggest that the residual effects of the disorder would be less pronounced than in the case of fully symptomatic depression. At this juncture, it should be acknowledged that the decline in memory performance due to somatization might be less severe than that of fully symptomatic major depression. Nevertheless, if the hypothesis that somatization is a form of masked depression is valid, then it would follow that the effects of somatization on memory performance will more closely correlate with the effects of depression than the effects of the other variables studied.

Effects of age, level of education, and gender on memory performance

The goal of the present study is to assess the extent to which depression and somatization of depression contribute to the variance associated with memory decline in the elderly. In analyzing these two variables, an inclusion of unrelated variables that have been shown to influence memory may serve as a frame of reference. Therefore, three unrelated variables that are commonly tested in memory research are included in the study.

The first variable to be considered is age. The association of aging and memory decline has been reported by numerous studies (e.g. Christensen et al., 1997; Luszcz, Bryan & Kent, 1997; Titov & Knight, 1997). A meta-analysis conducted by Verhaeghen and coworkers (1993) reported age as a significant predictor of memory performance in the elderly population. The study estimated the memory functioning of older adults to be in the range of 3rd to 38th percentile of the general population.

As with the effects of depression on memory, aging appears to impact memory processing selectively. Although the findings are somewhat inconsistent on the exact domains affected, some studies have identified a decline in performance on working memory tasks (Salthouse, 1991), cued-recall tasks (Park et al., 1990), free-recall tasks (Smith, 1979), and categorization of list tasks (Verhaeghen, Marcoen, & Goossens, 1993). To explain the decline in memory performance, processing speed (Luszcz, Bryan, & Kent, 1997; Salthouse, 1996; Titov & Knight, 1997), a combination of speed and working memory (Park et al.,

1996), associative deficits (Naveh-Benjamin, 2000), and changes in prefrontal cortical system (Trott et al., 1999) have all been suggested as the culprits. So far, there is some support for each of these theories, suggesting the possibility that multiple pathways may serve to exert the influence of aging on memory.

A second variable to consider in the study is the effect of education on memory abilities. A number of studies have suggested that high level of education may serve as a protective factor against the potential decline in memory performance (Grober et al., 1998). In one meta-analysis, older adults with lower level of education were found to show greater age differences on some tasks (Verhaeghen, Marcoen, & Goossens, 1993). On the other hand, a higher level of education was found to be correlated with a decreased variability in cognitive performance (Christensen et al., 1999). Moreover, in a study involving a sample of college faculty, higher education and continual intellectual stimulation lessened the age associated decline in cognitive functioning (Compton, Bachman, & Logan, 1997). It has been proposed that extraneous variables, such as type of occupation and life style differences associated with a higher level of education, may play a role in the apparent protective effect of education on memory (Avolio & Waldman, 1994; Christensen et al. 1996). Regardless of how education serves to prolong the health of memory functioning, it should be mentioned that there is some suggestion to the effect that the predictive value of education on memory performance lessens in adult over the age of 70 (Hassing, Wahlin, & Backman, 1998).

The third variable to be included in the study is gender. Some findings have suggested that in old age, men are at an increased risk for experiencing a decline in some domains of cognitive functioning, such as episodic memory (Herlitz, Nilsson, Backman, 1997). One possible explanation for the findings comes from research on sex differences in brain aging. It has been found that aging in men is associated with more notable decrease in brain volume, which may partially account for the sex differences in cognitive decline (Gur et al. 2002).

Depression, somatization, age, level of education, and gender

In light of the preceding discussion, the goal of the present study is to assess whether variance explained by somatization of depression on memory tasks is more similar to that of depression or to that of age, education or gender. Two memory domains of interest in the current study are verbal and visual memory. Since previous findings on these domains have been highly discrepant, two measures of each memory domain were used to test for a possible differential effect between the measures.

To test for verbal memory, California Verbal Learning Test (CVLT) and Logical Memory were used. These two particular verbal measures were chosen because they assess a wide range of different aspects of verbal memory such as immediate recall, delay recall and encoding strategies. Visual memory was measured by Benton Visual Retention Test (BVRT) and Spatial Span. The

rationale behind the inclusion of these two visual measures is that there have been some suggestions in the literature for the level of task demand influencing the effects of depression on memory (Jorm, 1986; Weingartner, 1986). In the present case, Spatial Span is believed to require a higher level of attention and concentration than the BVRT. Hence, if the task demand view is accurate, we may observe a difference in the degree of effect between the BVRT and the Spatial Span.

It is hypothesized that:

1. A significant negative relationship will be found between depression and memory performance. Operationally, this will be tested by assessing the relationship between the depressive scores of those who endorse both affective and somatic symptoms on the BDI and GDS, and their performances on four memory measures: CVLT, Logical Memory, BVRT, and Spatial Span.
2. A significant negative relationship will be found between somatization of depression and memory performance. Operationally, this will be tested by studying the relationship between the somatic scores of those who endorse a high level of somatic symptoms on the BDI, and their performances on the CVLT, Logical Memory, BVRT, and Spatial Span.
3. A significant negative relationship will exist between age and memory performance. Operationally, this will be tested by measuring the relationship between age and the scores on the CVLT, Logical Memory, BVRT, and Spatial Span.

4. A significant positive relationship will exist between a higher level of education and memory performance. Likewise, a positive correlation will exist between female gender and memory performance. Operationally, this will be tested by studying the relationship between level of education and gender, and performances on the CVLT, Logical Memory, BVRT, and Spatial Span.
5. Somatization of depression and depression will account for a significant level of variance in memory performance. The variance explained by somatization of depression will more closely resemble that attributed to depression than that attributed to age, education, or gender.

METHOD

Participants

The participants will be drawn from an ongoing Michigan State University Psychological Clinic Aging Research Project. Participants are community dwelling older adult volunteers who were recruited from senior citizen groups, faculty and staff retiree groups from MSU and other mid Michigan locations. Advertisements and flyers were used for recruitment. In order to be included in the study, the individuals have to score 24 or greater on the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975) with no report of significant history of severe neurological and medical problems. Severely depressed individuals, however, are included in the study. This sample of 227 participants contained protocols of older adults ranging from 54 to 87 years old ($M = 70.21$; $SD = 8.78$). Of the 227 participants, 132 were women and 95 were men. The group had a mean education of 15.28 years ($SD = 3.00$)

Measures

1. Beck Depression Inventory (BDI)

BDI is a self-rating instrument which was developed to assess depression and its severity. It consists of 21 items, which were designed to measure symptoms commonly associated with depression such as guilt, feeling of failure,

loss of motivation, loss of energy, and somatic complaints. A cutoff score of 10, as recommended by Beck and colleagues (1979), has been found to reliably detect the presence of depression (Olin et al., 1992). Using customary BDI cutoff scores, misclassification rate was found to be approximately 16-17% (Gallagher, Nies & Thompson, 1982; Gallagher et al., 1983). Furthermore, previous studies have indicated that BDI has high internal consistency and stability when used with older adult population, thus making it appropriate for use with this particular population (Spitzer, Endicott & Robins, 1978). Overall, BDI is deemed to be an appropriate measure of depression, including for use with the older adult population.

In addition, it has been suggested by Collins and Abeles (1996) that BDI loads on two distinct factors: somatic and affective. It was found that items 1 through 14 measured affective components of depression whereas items 15 through 21 correlated with somatic components of depression. Therefore, in the present study, the first 14 items were used to assess affective depression while the last 7 items were used as indicators of somatic depression.

2. Geriatric Depression Scale (GDS)

The GDS, consisting of 30 true/false items, was developed to measure depression specifically in older adult population (Yesavage, Brink & Rose, 1983). This second measure of depression was chosen to be included in the battery due to the fact that it is a more pure measure of depression and does not contain somatic items. Thus, incorporation of GDS may allow for observation of a differential impact between somatic and affective components of depression. This measure is

believed to be a reliable scale with a test-retest reliability of 0.85 ($p < .01$) for 20 participants given the measure twice, one week apart (Yesavage et al., 1983). The authors also reported that the GDS has a respectable convergent validity with the Zung Self-Rating Scale for Depression ($r = 0.84$), and with the Hamilton Rating Scale for Depression ($r = 0.83$). Moreover, given its high internal consistency of 0.94 and its respectable stability (Yesavage et al., 1983), the GDS seemed to be an appropriate measure for use with older adult population.

3. California Verbal Learning Test (CVLT)

CVLT (Delis et al., 1987) is an objective measure of verbal memory functioning, which requires the participant to repeat a list of 16 shopping items (List A) orally presented by the clinician. After 5 trials of the List A immediate recall, a second list of shopping items (List B) is presented as an 'interference'. Free and category-cued recall of List A are tested immediately after List B recall and again after a 20-minute delay. Hence, the task tests total recall, short delay free recall, long delay free recall, and cued recall.

In a study by Cellucci and colleagues (2001), it was reported that total recall on CVLT has a stability coefficient of 0.64 when the test was re-administered a year later in a normal older adult population. Also, the study found that recall performance on CVLT was moderately correlated with subjective memory abilities. Thus, it appears that CVLT is appropriate for testing memory functioning in older adult population.

4. Logical Memory

Logical Memory I and II from the Wechsler Memory Scale (Wechsler, 1987) are frequently used measures of verbal memory in clinical settings (Tremont et al., 2000). The task requires the participant to recall two short stories that are presented verbally. The scores on the task are based on the extent to which the participant is able to recall the exact wording of the prose and they can range from 1 to 22 points. In a study of its psychometric properties, test-retest reliability over a period of 4 to 6 weeks was found to have been 0.79 (Bowden & Bell, 1992). Furthermore, previous research has suggested that Logical Memory is sensitive to age related changes in memory (Haaland, Price, & Larue, 2003).

5. Benton Visual Retention Test (BVRT)

The Benton Visual Retention Test (Benton, 1983) consists of a set of ten stimulus cards with different geometrical figures that are presented visually for a ten-second interval each. After the presentation of each stimulus card, the participant is asked to draw the design on the card from memory. A point is given for each correct response and the participant can score from 0 to 10 points. In a large psychometric study of the BVRT, it was found that older age is associated with a decline in BVRT scores whereas higher education is correlated with an increase in performance (Youngjohn, Larrabee, & Crook, 1994).

6. Spatial Span

Spatial Span is a measure from the Wechsler Memory Scale (Wechsler, 1987) designed to assess visual recall and it contains two parts. In the forward condition, the examiner taps a series of cubes and the participant is required to tap

the series in the exact order as the examiner. In the backward condition, however, the participant taps in the reverse order as the examiner. The scores on the test can range from 0 to 32. Previous research suggests that scores on the BVRT can be successfully differentiated between normal, mild dementia and severe dementia (Orsini et al., 1989).

Statistical Methods

Hypotheses for the study will be tested using a number of statistical methods. To test for the relationship between memory performance and each predictor, multivariate multiple regression methods will be used. Also, multiple regression methods will be utilized for determining the variance explained by each predictor. In order to examine the weight of each factor in predicting memory performance, all variables will be inserted simultaneously. The mutual dependency of predictors will then be considered by examining the tolerance scores. Individual contributions made by each predictor will be evaluated by comparing the coefficients of each predictor.

Procedure

For the larger study, volunteer participants who met selection criteria were given weekly workshops on memory and relaxation training. Participants were also administered assessment of mood and memory pre and post training. The assessment requires between one-and-a-half hours and two hours to complete. In

this particular study, only the scores from the pre-workshop testing will be utilized. Tests will be scored by the investigator.

RESULTS

Results from the present study are subdivided into three sections. First, an analysis of the group's level of depressive symptomology on the BDI and GDS will be presented. Second, findings on the study's hypotheses are presented. Lastly, post hoc analyses were conducted to further elucidate the roles of affective and somatic symptoms of depression on memory performance.

Level of depressive symptomology

In the literature, it was often noted that the degree of severity of depression is critical in determining whether depression has an influence on cognitive abilities. Therefore, it was deemed necessary to first analyze the level of depression in the group by looking at the means and the standard deviations of the scores on the two measures of depression, the BDI and the GDS (see Table 1).

According to previous research, scores of 10 to 15 out of the possible score of 63 on the BDI are considered to be in the minimally depressed range, whereas scores of 16 to 19 indicate mild to moderate depression. Scores above 20 are categorized as moderate to severely depressed. On the GDS, scores of 10 to 20 is recognized as mildly depressed whereas scores above 20 are placed in the severely depressed range. Overall, the present data suggest that the level of depression for the group as a whole is in the non-depressed range with the means

of 6.87 (SD = 5.35) on the BDI and 5.86 (SD = 4.68) on the GDS. Nevertheless, examination of the range of scores does indicate that the data include individuals in the severely depressed range. Therefore, it was judged feasible to conduct data analyses on the entire group initially and to perform post hoc analyses on the segment of the group that endorsed depression to delineate the role of depression on cognitive abilities.

Table 1

Group Means and Standard Deviations for the BDI and the GDS

	<u>N</u>	Minimum	Maximum	<u>M</u>	<u>SD</u>
BDI	203	0	27	6.87	5.35
GDS	202	0	23	5.86	4.68

Hypotheses:

Hypotheses regarding the relationship between depression and memory performance

Based on the previous findings, it was predicted that higher depressive scores on the BDI and GDS would negatively correlate with performances on the CVLT, Logical Memory, BVRT and Spatial Span. However, as can be seen in Table 2, this hypothesis was not supported. In this group with minimal depressive symptoms, it was found that higher overall scores on the BDI_{total} and the GDS did

not impact performance on the CVLT, Logical Memory, and Spatial Span. As for the BVRT, its data collection was initiated at a later point than the other measures, and thus the number of participants who completed the task is much lower. In order to retain a higher N for the MANOVA analyses, the scores from the BVRT were omitted from all the analyses.

Table 2

MANOVA findings on the Relationship between Depressive Scores and the Memory Measures

<u>Source</u>	<u>Dependent variable</u>	<u>df</u>	<u>F</u>	<u>Sig</u>
BDI _{total}	Logical Memory	173	.089	.77
	CVLT	173	.329	.57
	Spatial Span	173	.888	.35
GDS	Logical Memory	198	.473	.49
	CVLT	194	.349	.56
	Spatial Span	197	3.00	.09

CVLT = California Verbal Learning Test, total items recalled from trials 1-5; Logical Memory, scores on Stories I and II; Spatial Span, total correct responses; BDI_{total} = Beck Depression Inventory, total score comprising of both affective and somatic symptoms of depression; GDS = Geriatric Depression Scale, total score.

Hypotheses regarding the impact of somatic symptoms of depression on memory performance

Given the important role somatic symptoms appears to play in the manifestation of depression in older adults, it was predicted that somatic symptoms, as assessed by items 15 through 21 of the BDI, would associate negatively with performances on memory measures. However, this hypothesis was not supported in the present study (see Table 3). It appeared that somatic symptoms of depression as a unique variance have a negligible role in predicting memory performance in older adults.

Table 3

MANOVA findings on the Relationship between Somatic Scores and the Memory Measures

<u>Source</u>	<u>Dependent variable</u>	<u>df</u>	<u>F</u>	<u>Sig</u>
BDI _{somatic}	Logical Memory	173	.001	.97
	CVLT	173	.713	.40
	Spatial Span	173	.389	.53

BDI_{somatic} = Somatic factor on the BDI comprising of items 15-21.

Hypotheses regarding the effects of age on memory performance

Based on previous literature, it was predicted that age would have a significant negative relationship with memory performance. The findings from the present study partially supported the hypothesis (see Table 4). It was found that age adversely affects performance on the Logical Memory, $F(1,173) = 7.53$, $MSE = 227.66$, $p < .01$. That is, older age is associated with lower performance on the Logical Memory. Additionally, it was found that age has a negative relationship with scores on the Spatial Span, $F(1,173) = 19.154$, $MSE = 116.39$, $p < .01$. In other words, the older the age, the more likely it is that the performance on the Spatial Span will be poorer. However, as can be seen in Table 4, age does not appear to have a statistically significant effect on the CVLT performance.

Hypotheses regarding the effects of education and gender on memory performance

Research has indicated that a higher level of education may serve as a protective factor against age-associated decline in memory. Therefore, it was predicted that a higher level of education would be correlated with higher scores on the three measures of memory. This hypothesis was partially supported as seen in Table 4. The results indicated that higher educational level has a positive association with scores on the Logical Memory, $F(1,173) = 14.44$, $MSE = 436.68$, $p < .01$. That is, the more education a participant has had, the higher his or her performance is on the Logical Memory task. In addition, there is a positive association with performance on the CVLT and a higher level of education, F

(1,173) = 5.07, MSE = 6.70, $p < .05$. The present study showed no statistically significant relationship between education and performances on the Spatial Span.

The study also predicted that being a female would be another protective factor for minimizing the age related decline in memory performance. This hypothesis was not supported (see Table 4). In fact, the results suggested that being male has protective effects on the performance on the Spatial Span, $F(1,173) = -.16$, $p < .05$. That is, being a male is found to have been associated with higher scores on the Spatial Span.

Table 4

MANOVA findings on the Relationship between Demographic Variables and the Memory Measures

<u>Source</u>	<u>Dependent variable</u>	<u>d.f.</u>	<u>F</u>	<u>Sig</u>
Age	Logical Memory	173	7.53	.01*
	CVLT	173	.354	.55
	Spatial Span	173	19.15	.00**
Education	Logical Memory	173	14.44	.00**
	CVLT	173	6.70	.03*
	Spatial Span	173	.964	.33
Gender	Logical Memory	173	2.79	.10
	CVLT	173	1.17	.28
	Spatial Span	173	9.90	.00

* $p < .05$, ** $p < .01$

Hypotheses regarding the variances explained by the demographic variables, depression and somatization

In order to confirm the earlier findings on the roles of depression and somatization in memory assessment, variances explained by these two variables are compared to the variances accounted for by the demographic factors. It was predicted that in comparison to the demographic variables, depression and somatic symptoms of depression would account for a similar level of variance on memory performance in older adults. This hypothesis is tested by initially performing simple regressions on depression, somatization, age, years of education, and gender with the three measures of memory performance as dependent variables. In the first sets of regressions, scores on the BDI served as an independent variable. For this set of regression, there was no statistically significant parameter. In addition, the set of regressions with somatization as an independent variable did not produce statistically significant parameter. Thus, it appears that neither depression nor somatization serve to predict any significant variances in memory functioning.

As for regressions with regard to the three demographic variables, age yielded two statistically significant parameters. It was found that scores on the Logical Memory were significantly predicated by age with age accounting for 11% of the variances in scores (see Table 5). Additionally, scores on the Spatial Span were significantly predicated by age with age accounting for 12 % of the variances in scores.

In addition to age, years of education yielded two statistically significant parameters and gender yielded one statistically significant parameter (see Table 5). The results indicated that years of education accounted for 7% of the variances on Logical Memory performance and 3% of the variances on CVLT performance. Furthermore, it was found that gender accounted for 3% of the variances on Spatial Span performance. All other regressions with regard to demographic factors failed to yield any significant parameter. Given the lack of significant linear parameters for most variables with the exception of age, an analysis of data using multiple regression method was omitted.

Table 5

Regression Analyses of the Depression, Somatic Depression, and Demographic Variables on the Memory Measures

	Standardized Beta	t	Sig. t	R ²
<u>Depression</u>				
Logical Memory	.085	1.191	.235	.007
CVLT	-.043	-.591	.555	.002
Spatial Span	-.123	-1.731	.085	.015
<u>Somatic Depression</u>				
Logical Memory	-.008	-.106	.916	.000
CVLT	.034	.466	.642	.001
Spatial Span	-.068	-.935	.351	.005
<u>Age</u>				
Logical Memory	-.333	-5.191	.000**	.111
CVLT	-.066	-.958	.339	.004
Spatial Span	-.334	-5.215	.000**	.112
<u>Education</u>				
Logical Memory	.256	3.821	.000**	.066
CVLT	.178	2.571	.011*	.032
Spatial Span	.108	1.563	.120	.012
<u>Gender</u>				
Logical Memory	.055	.806	.421	.003
CVLT	.038	.550	.583	.001
Spatial Span	-.159	-2.388	.018*	.025

*p < .05, ** p < .01

Post hoc analyses

In order to further explore the relationship between depression and memory performance, and to examine the differential impact of affective and somatic symptoms of depression on memory functioning, three post hoc analyses were conducted. For the first post hoc analysis, initial results regarding the level of depression in the sample were reconsidered. It was indicated that although the data contains individuals who fall into the severe range of depression, the group as a whole did not endorse depression. Thus, it is conceivable that non significant findings on the measures of memory when testing the association between depression and memory might have been due to the group's non-depressed status. In order to ascertain this, a subgroup of individuals who scored 10 or above on the BDI was identified. The total number of individuals who fell in the depressed category was 43. For the depressed group, the mean on the BDI was 15.17 with a standard deviation of 4.00.

It was expected that due to the presence of depression in this group, their memory functioning would be more noticeably impacted by depression than the original group. T-tests were conducted to examine whether performances on memory measures differed between the depressed group and the non-depressed group (see Table 6). On Spatial Span, the depressed group performed worse than the original non-depressed group ($t(197)=-2.78$; $p<.01$; depressed group mean=15.22). Thus, it does appear that on Spatial Span task, the higher degree of depressive symptomology affects the level of performance. However, there were

no statistically significant differences between the depressed group and the non-depressed group on the CVLT and the Logical Memory tasks.

Table 6

T-tests Analyses on Depressed and Non-Depressed Groups

Measure	Group	Mean	t	Sig
Logical Memory	Depressed	17.96	1.00	.317
	Non-depressed	16.92		
CVLT	Depressed	.13	.370	.711
	Non-depressed	.06		
Spatial Span	Depressed	14.04	-2.78	.01**
	Non-depressed	15.22		

** $p < .01$

In the second post hoc analysis, the unique influence of affective symptoms of depression on performances on CVLT, Logical Memory, and Spatial Span is considered. It was found that affective scores on the BDI negatively correlated with performance on the Spatial Span, $r(190) = -.16$, $p < .05$. That is, older adults who endorse a high level of affective symptoms of depression on the BDI performed worse on the Spatial Span tasks. Affective symptoms of depression did not have a statistically significant effect on the CVLT, and the Logical Memory (see Table 7).

Table 7

Correlations between Affective Symptoms of Depression and the Memory Measures

	CVLT	Logical Memory	Spatial Span
BDI _{affective}	.11	.03	-.16*

* $p < .05$; BDI_{affective} = BDI items 1-14

In the third segment of post hoc analysis, the aim was to study the effects of affective and somatic depressive symptoms on memory in individuals who manifest these symptoms more definitively. Therefore, two groups of individuals who endorse these symptoms more unequivocally were identified. In the affectively depressed group, individuals with scores of eight or higher on the affective items of the BDI and scores of five or lower on the somatic items of the BDI were selected. The cut-off scores were based on the observation of the scatter of depressive scores in the sample. Through this method, fifteen individuals who met the criteria were identified. Of the 15, 7 were men and 8 were women. The mean age for the group was 69.93 with a standard deviation of 9.40. Mean level of education for the group was 14.2 years with a standard deviation of 2.83. Thus, the affectively depressed group did not differ significantly from the original group in terms of demographic variables.

For the somatically depressed group, individuals were included if they scored seven or less on the affective items of the BDI and scored six or higher on

the somatic items of the BDI. Using this selection method, 12 individuals were identified, of which 4 were men and 8 were women. The mean age for the group was 72.12 with a standard deviation of 7.81. The group had a mean educational level of 15.17 years and a standard deviation was 2.95. Again, the demographic characteristics of the somatically depressed group did not differ significantly from the original group.

It was believed that by conducting data analyses on the affectively depressed and somatically depressed groups in isolation from the original group, the possible effect of affective and somatic depression on memory performance can be more clearly delineated. However, results from the t-test analyses did not yield any statistically significant differences between the affectively depressed and the somatically depressed groups (see Table 8).

Table 8

T-tests Analyses on the Affectively Depressed and Somatically Depressed Groups

Measure	Group	<u>Mean</u>	<u>t</u>	<u>Sig</u>
Logical Memory	Depressed	16.07	-.091	.929
	Non-depressed	16.27		
CVLT	Depressed	-.18	-.385	.704
	Non-depressed	.016		
Spatial Span	Depressed	14.47	-.654	.519
	Non-depressed	15.09		

** $p < .01$

DISCUSSION

The discussion of the findings of the current study considers the outcome of the hypotheses on depression and memory functioning posited at the outset. The discussion also includes the findings from the post hoc analyses that pertain to the impact of depression. Findings regarding the effects of somatization on memory functioning will also be considered. Furthermore, the discussion incorporates an assessment of the usefulness of separating affective and somatic components when thinking about depression. This will be followed by an evaluation of the results regarding the influence of age, higher education, and gender on memory functioning. In conclusion, limitations of the study as well as possible directions for future research are explored.

Findings regarding the relationship between depression and memory performance

In previous research, an emphasis has often been given to the severity of depression as playing a crucial role in determining depression's influence on cognitive abilities. For example, studies by Rohling and Scogin (1993) and by Burt and colleagues (1995) have independently asserted that literature showing deficits in memory performance due to depression mainly utilized severely

depressed inpatients whereas research with null findings relied on outpatients or individuals who had not sought help for depression. On the other hand, Austin and colleagues (2001) reviewed the available literature and reported inconsistent findings with regard to the role of severity of depression. The authors noted that there have been nine studies which found no association between performance and severity of depression, and that there have been eleven that did find such an association.

Hence, in the light of these reports, the initial step in the current study was to observe the sample's characteristics with regard to severity of depression. Examination of the data revealed that the group as a whole fell in the non-depressed range. It was also noted that the sample does contain individuals with endorsement for moderate to severe level of depressive symptoms. At this juncture, it was decided that it would be informative to run two separate analyses of memory performance with one for the group as a whole, and the other for a subgroup of individuals with symptoms of depression.

First, data were analyzed on the entire group, which as a group showed no notable sign of depression. In this group, the results suggested that depression, as measured by the BDI and the GDS, has no association with performance on any of the memory measures. This finding is supportive of previous reports in the field (Bieliauskas, 1993; Luszcz, 1992; Rohling & Scogin, 1993). The results, however, are inconsistent with some other reports in the literature (King et al., 1991; La Rue, 1989). It should be noted that the studies that reported significant findings were performed on psychiatric inpatients.

In order to clarify the relationship further, additional data analyses were conducted on a segment of the population that endorses a certain degree of depressive symptoms. In this group, the results revealed that depression appears to have a selective impact on memory performance in the elderly population. In particular, it was found that depression had an adverse effect on older adults' ability to perform well on Spatial Span task, which required the use of attention as well as visual memory. This finding is in congruence with a long-standing assertion in the field (e.g. Miller, 1975) that one of the most likely targets of depression on cognitive functioning is attention. Furthermore, the results support previous research that depression can contribute to a decline in visual memory (Austin et al., 1999; Boone et al., 1995).

However, a more interesting finding of the study is that it did not provide support for a detrimental impact of depression across all measures of memory. In the present inquiry, the findings showed no association between depression and the two measures of verbal memory. This selective nature of decline in memory performance due to depression is consistent with previous literature (Christensen et al., 1999; Gainotti & Marra, 1994; Hertel & Hardin, 1990; Ilsey et al., 1995) which reported varying domains in which depression appears to unfavorably influence memory performance. Some of the cognitive domains believed to be affected by depression are episodic memory, verbal recall, word generation, visuoconstruction, information processing, and processing speed (e.g. Boone et al., 1995; Palmer et al., 1996).

There are several possible explanations for interpreting the variability in results seen in the current study. One speculation for the findings is that verbal memory is less susceptible to the effects of depression than visual memory. Another possible explanation proposed for the variation in cognitive abilities affected is the level of effort the task requires (Hasher & Zacks, 1979; Jorm, 1986; Weingartner, 1986). It has been suggested that the higher the task demand, the more likely that the effects of depression on performance will be discernable.

Yet another possible explanation for diverging results seen across the measures relates to level of depression in the group. Although previous findings on verbal performance per se in depressed samples have been inconsistent (Palsson et al., 2000; Roy-Byrne et al., 1986), it was expected that immediate recall aspect of the measures would lead to a decline in performance. A potential explanation for the null finding of this prediction is the lack of notable depressive symptoms in the group as a whole. It appears that the presence of the severely depressed individuals within the group was not significant enough to lend support for the hypothesis.

Here once again, the controversy over whether the severity of depression affects the outcome of memory performance comes into play. Although the depressed group was selected based on an endorsement of some symptoms of depression, the group mean for depression scores still fell in the mildly depressed range. In previous research, there are some suggestions that in order to more clearly distinguish the effects of depression on memory, the study's sample should involve inpatients with severe level of depression (Burt et al., 1995;

Rohling & Scogin, 1993). According to Rohling and Scogin (1993), psychiatric hospitalization and psychotropic medications are more significant predictors of memory performance than depression *per se*. Therefore, it is questionable whether the mild degree of depression seen in our depressed sample is considerable enough to impact memory performance.

However, when placing the current findings in the larger context of evaluating whether depression affects memory, severity of depression alone does not seem to fully account for the high degree of inconsistency in results seen in studies across the field. One possible contributor to the diverging results seen in the field may lie in the underlying cognitive domains the measures are assessing. Several studies have hinted that the cognitive tests rarely are pure measures of the cognitive domains under investigation, making the identification of the affected domain difficult (Austin, Mitchell, & Goodwin, 2001). Compounding the difficulty, occasionally, as it is the case with Spatial Span, there is a disagreement as to what the test is actually measuring. According to Wilde and Strauss (2003), Spatial Span did not correlate very highly with visual memory or working memory in their study. It was suggested that a more appropriate use for Spatial Span would be to assess processing speed.

Moreover, Lichtenberg and colleagues (1995) had pointed out that inconsistencies in results seen in depression and memory performance research might be attributable to the measures used in the studies. The authors reported that some measures are more sensitive to detecting the depression than others. As an example, they mentioned Benton Visual Retention Test as one of the measures

that were less sensitive for differentiating between normal and depressed individuals. Thus, it is conceivable that a lack of consistency in results between the measures can be attributed to the underlying constructs the measures were assessing and their sensitivity to the depressive effects.

Overall, despite the existence of possible explanations for the inconsistencies in results, the current findings suggest that depression has a limited impact on cognitive abilities in this healthy, high functioning sample of older adults. To the extent that depression does impact memory, it affects visual memory when the severity of depression falls in the mild to moderate range. Given these findings, therefore, depression appears to play a minor role in predicting memory performance of high functioning older adults.

Findings on somatization and memory functioning

Although some researchers have supported the view that somatization deserved to be treated as a depressive equivalent (De Wester, 1996; Kirmayer & Robbins, 1996; Stone & Folks, 1992), there has been little inquiry done into determining whether somatization has a similar impact on one's functioning as depression. If one were to favor the line that somatization is just a variation in the manifestation of depression, it would follow that somatization will have a comparable impact on any given functioning. Therefore, the current study looked at the relationship between somatization and depression by comparing their relative impact on memory performance.

Contrary to prediction, however, the results showed that there is no association between somatization of depression and memory performance in the present sample. The findings suggested that somatization as a unique variance did not account for much of the variance in explaining memory performance. This finding is similar to the finding on depression in that neither total depressive scores nor somatic scores were significant in predicting memory performance.

To delineate the relationship further, additional analyses were completed on the affective component of the BDI. The goal of this set of analyses is to determine if the affective component has more predictive power on memory performance than somatization scores. The results indicated that there is a negative relationship between affective scores on the BDI and the performance on the Spatial Span. This finding is similar to the findings regarding the Spatial Span performance of the depressed group in Hypothesis 1. Hence, it suggests that unlike somatic depression, affective depression may have some impact on visual memory performance, just as mild to moderate depression does.

In order to determine whether the lack of findings regarding somatization were due to a low level of somatic symptoms endorsed in the sample, subgroups with high somatic depression and high affective depression were identified. It was believed that assessing the two ends of the spectrum would allow for a clearer pattern to emerge. Nevertheless, memory performance was not related to either somatic depression or affective depression in these select samples.

Given the null findings across the board on the impact of somatization on memory functioning, it raises the question of how useful it is to incorporate

somatic complaints when assessing memory functioning in older adults. The present results suggest that the presence of somatization will not be a significant consideration in memory assessment of older adults. To the extent that depression does impact visual memory performance, it seems that it would be more advisable to take into account the overall depressive scores or affective scores. One cautionary note, however, is that there have been some reports of somatization as a milder form of depression (La Rue, 1992). Therefore, although somatic complaints do not affect memory performance, one cannot rule out the possibility that a mild form of depression is present in the patient.

Findings on effects of age on memory functioning

As hypothesized, older age is associated with a decline in selective domains of memory functioning. In particular, older age is associated with poorer performance on the Logical Memory and the Spatial Span. These results are consistent with reports in the literature (Christensen et al. 1997; Compton et al. 1997; Lichtenberg et al., 1995; Luszcz, Bryan & Kent, 1997; Orsini et al., 1986; Titov & Knight, 1997).

Although results obtained for the effects of age on verbal memory differed between the two measures, there are several possible explanations for the apparent inconsistency. First, a study conducted by Delis and colleagues (1988) have shown that correlation between the Logical Memory and the CVLT can vary significantly based on the type of memory strategy used on the CVLT task. For instance, it was found that when participants engaged in a more active strategy for

recall on the CVLT, performance on the task is comparable to performance on the Logical Memory. On the contrary, if the participant approached the CVLT task with a more passive recall strategy, such as recalling only the most recent items, scores on the CVLT was negatively correlated with scores on the Logical Memory. Therefore, variance in recall strategies used by the participants in the present study may have contributed to the lack of consistency in results between the two measures of verbal memory.

Second, a study done by Tremont and colleagues (2000) has raised the question of the advisability of using the Logical Memory and the CVLT measures interchangeably to predict verbal memory. In their study, individuals with executive dysfunction performed significantly worse on the CVLT when compared to the control group whereas performance on the Logical Memory did not significantly differ between the two groups. Thus, the study concluded that the general practice of using these two measures interchangeably may not be appropriate in neuropsychological testing.

Yet another possible explanation for differences in results across the measures relies on the theory of crystallized and fluid intelligence as originally proposed by Horn and Cattell (1966a, b). According to this theory, fluid intelligence (G_f), which refers to innate abilities, and crystallized intelligence (G_c), which includes learned abilities, have differential impact on one's cognitive functioning depending on the age. This view has been supported by findings from a number of studies (Anstey, Luszcz, & Sanchez, 2001; McArdle et al., 2000; McArdle et al., 2002; Stankov, 2000). The general trend of functioning suggested

by these studies is that with an increase in age, both *Gf* and *Gc* rise upward at different rates. However, around the age of 18, *Gf* begins to descend in its slope and continues to do so throughout the life span. As for *Gc*, approximately around 20 years of age, the initial upward trend begins to level off and remains relatively stable at that stage. Therefore, it appears that applying the *Gf-Gc* theory to the current study may help explain some of the results.

In the present study, performance on the Spatial Span is dependent upon the visual-spatial and processing abilities that are generally considered to be components of fluid intelligence. According to the Horn and Cattell's theory, these fluid abilities are in the state of decline in older adults. Thus, the results indicating a drop off in performance on the Spatial Span with age are in alignment with the predictions of the *Gf-Gc* theory.

Explaining the findings on the Logical Memory using the *Gf-Gc* theory proves to be more challenging, however. As a measure of verbal memory, Logical Memory appears to rely on the crystallized abilities. Hence, based on the theory, one would expect no notable decline in performance on the Logical Memory as one reaches older adulthood. The results of the study are inconsistent with the trend found in previous studies. A number of explanations are possible to elucidate the findings. First, Logical Memory may not be a completely pure measure of crystallized intelligence. It is quite conceivable that the measure incorporates abilities such as short term memory. In such case, short term acquisition and retrieval aspects of memory have been identified by McArdle and

colleagues (2002) as components of fluid intelligence. Thus, a decline observed on the Logical Memory performance may be less surprising.

A second possible explanation for the apparently discrepant findings is that although fluid abilities are purported to undergo more significant changes in older adults, there have been suggestions that it does not completely explain the deterioration of memory functioning associated with age. In a report by McArdle and colleagues (2000), there are supports for hypotheses on “general memory loss” and “general slowing”, in addition to the *Gf-Gc* hypothesis. In other words, regardless of the type of ability, there appears to be a more general weakening of the cognitive functioning with advancing age. This particular suggestion is in support of the finding on Logical Memory.

Findings on the effects of education and gender on memory performance

As predicted, higher education appears to serve as a protective factor against a decline in verbal memory. This finding is in accord with previous literature (Christensen et al., 1999; Compton, Bachman, & Logan, 1997; Grober et al. 1998). As for spatial memory, it appears that there is a trend toward spatial abilities being affected by the level of education. However, the relationship did not reach the level of statistical significance. This finding is contrary to reports by Orsini and colleagues (1986) in which a positive relationship between spatial memory and higher level of education was found. One difference that has been noted between the study by Orsini and the current study is the measures used. In Orsini’s study, Corsi’s block-tapping test was used to test spatial memory. Due to

the fact that Coris's blocking-taping test is a predecessor of Spatial Span, the measures may not be comparable.

As for gender, being a female is negatively correlated with poorer performance on the Spatial Span. This finding is consistent with findings by Orsini and colleagues (1986). Furthermore, the framework of *Gf-Gc* is applicable to the present results. Previous findings in relation with the *Gf-Gc* theory have suggested that there is a gender difference in terms of fluid and crystallized intelligence (Ackerman et al., 2001). The study suggested that men perform at a higher level than women on tasks that require fluid abilities. This proposition is in accord with the results observed in the current study.

On the other hand, gender did not have significant impact on verbal memory performance. Similar results relating to verbal memory and gender have been found by Orsini and colleagues (1986). Here again, the findings are in agreement with the *Gf-Gc* framework in that research in this area had reported no notable gender differences on tasks of crystallized abilities.

Summary of the findings

In reviewing the overall findings of the study, a few notable trends were found. Firstly, most of the significant results of the study related to the performance on the Spatial Span. It was observed that the performance on the Spatial Span was negatively impacted by depression as assessed by the BDI total in the depressed group, the affective scores on the BDI, age, and being a female.

A second notable finding was that protective effects of education on memory were particular to the verbal memory.

In viewing these findings collectively, the theory concerning fluid and crystallized intelligence emerged as a strong possible underlying mechanism for interpreting the results. As noted previously, fluid intelligence has been found to deteriorate with age (Anstey, Luszcz, & Sanchez, 2001; McArdle et al., 2000; McArdle et al., 2002; Stankov, 2000). Therefore, the prevailing trend observed in the study of a decline in Spatial Span performance can perhaps be attributed to the downward trajectory of fluid intelligence associated with advancing age. It is speculated that this possibility may have even been an overriding factor across all the independent variables and that it explains the findings in regard to depression and affective depression. This suggestion is supported by the fact that age accounted for the greatest degree of variances in memory performance.

As for the results on verbal memory, it appears that with the exception of findings on age, verbal memory was found to be well preserved in this highly educated sample. Once again, Gf-Gc theory emerged as an overarching framework, applicable to our understanding of the results. Based on the theory, crystallized intelligence, which underlies verbal memory, is expected to remain relatively intact even in older age. This prediction up holds our findings that a decline in verbal memory was not seen for most of the verbal memory measures. In fact, with a higher level of education, which contributes to crystallized intelligence, a higher level of performance on verbal memory measures was noted, again signaling a possible role of the Gf-Gc theory.

Limitations of the study

The current study has several limitations. First and the most critical limitation of the study was the population used. In a study examining the relationship between depression and memory performance, perhaps a population with a more severe endorsement of depression would have been more appropriate. However, it was felt that being able to identify the relationship in the general, non-psychiatric patient population would be informative. Another potential weakness of the sample population is that it consisted of individuals who were more highly educated and were of higher SES than the average population. Therefore, the generalizability of the findings from the study is limited to individuals with an above-average level of education and SES. Third limitation of the study was the measures used. It would have been instructive to employ specific measures that were known to be sensitive measures for distinguishing between the memory performances of non-depressed and depressed populations.

Suggestions for future research

The aim of the current study is to explore the concept of somatization and its possible impact on the elderly population. Given that somatic complaints are commonly encountered in the elderly population, null findings between it and memory performance should not foreclose the discussion of its effects on older adults. Perhaps what the findings of this study call for is reexamination of our understanding of somatization. It is conceivable that somatization is an expression of some other psychological distress such as anxiety (Kellner; 1990; Lipowski,

1988). Therefore, an evaluation into how well somatization correlates with psychological disorders other than depression is warranted.

In studying somatization and its relationship to depression, an important issue that was encountered in the study was the severity of depression. Thus, if future research indeed finds somatization to be an expression of masked depression, it would be appropriate to assess the severity of depression associated with it. In the past, there has been some research to indicate that somatization is a milder form of depression (La Rue, 1992). However, it is not yet known how mild the depression is in individuals who endorse somatic complaints. More clarification on this front is needed.

Although the role of somatization on memory performance was not confirmed in the present investigation, many questions surrounding the concept of somatization remain unanswered. For instance, despite the lack of a relationship between somatization and memory functioning, it is conceivable that, in terms of daily functioning, somatization and depression have comparable effects. Given the subtle impact depression has on memory performance (Lichtenberg et al., 1995), perhaps memory performance was not an ideal candidate for comparative purposes. Hence, it might be potentially more illuminating to do a similar investigation on a function that is more clearly defined and observable.

Furthermore, if research is to continue in the area of somatization, better tools for assessing somatic complaints are much needed (Collins & Abeles, 1996). So far, the only scientific method available for measuring somatization is through the use of BDI Somatic items as suggested by Collins and Abeles (1996).

Apart from clarifications that are needed in studying somatization, this investigation highlights the need for further research in depression and its impact on memory functioning. A review of the literature clearly indicated that the field is divided on at what level of severity, depression starts to impact memory performance. This needs further illumination. Moreover, issues surrounding the measures, which are sensitive enough to detect the effects of depression, need resolving. Lastly, the findings from the present study were best conceptualized through the *Gf-Gc* framework. Therefore, further application of the *Gf-Gc* theory in future research on memory performance may be warranted.

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