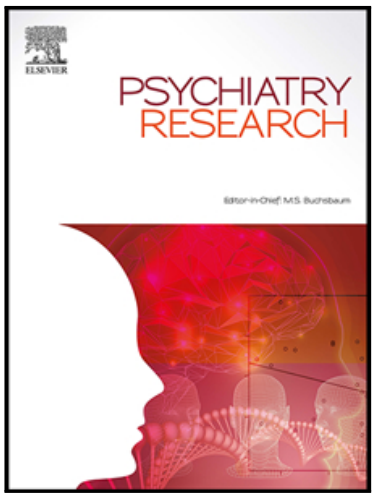

Diagnostic differences in verbal learning strategies and verbal memory in patients with mood disorders and psychotic disorders.

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Highlights

- Differences in verbal learning and memory are examined between diagnostic groups.
- No significant differences in the use of Semantic clustering.
- Differences observed between diagnostic groups in use of Serial and Subjective clustering strategies.
- Use of learning strategies predict learning and recall.

Diagnostic differences in verbal learning strategies and verbal memory in patients with mood disorders and psychotic disorders.

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ABSTRACT

A better understanding of verbal learning strategies can offer insight to the difference in verbal memory performance and learning between patients with schizophrenia and schizoaffective disorders, non-psychotic major depression, and psychotic major depression. To date, a comparison of the use of verbal learning strategies and verbal memory performance amongst these specific diagnostic groups has not been investigated. This study examined differences in verbal learning and memory between psychotic major depression (n=31), nonpsychotic major depression (n=30), and schizophrenia spectrum disorders (n=17) disorders. Verbal learning and memory were assessed through the use of the California Verbal Learning Test-II (CVLT-II). Correlations and multiple regression analyses were conducted to analyze differences in verbal learning and memory amongst these groups. There were no significant differences in the use of Semantic Clustering. Diagnostic differences were observed in the use of Serial and Subjective Clustering. The psychotic major depression group utilized Serial Clustering strategy significantly less than the nonpsychotic major depression group. Learning strategies significantly predicted learning and recall. These findings lend support to the hypothesis that learning strategies predict verbal memory performance across diagnostic groups. The present study contains useful information on diagnostic differences in verbal learning and memory, and a framework by which treatment could be tailored to enhance learning specific to these diagnostic groups.

Key words: neuropsychology, cognition, diagnosis

1. Introduction

Specific deficits in memory and learning are noted in individuals with nonpsychotic major depression (Austin et al., 1992; Brand et al., 1992; Ilsey et al., 1995; Rund et al,. 2006). Research suggests that traits including age of onset of nonpsychotic major depression impact the presence and severity of verbal memory deficits (Bora et al.; 2013, Wang et al., 2006). Patients with nonpsychotic major depression demonstrate similar impairment in both delayed and recognition memory of auditory verbal learning material (Austin et al., 1992). Overall learning capacity and the ability to retrieve material without cues is also impaired (Austin et al., 1992). Findings suggest that there are differences in performance of nonpsychotic major depression participants when compared to healthy control participants on measures of verbal memory, with nonpsychotic major depression participants performing worse on immediate (Hammar and Ardal, 2013) and delayed recall tasks (Ilsley et al., 1995; Lamar et al., 2012). These specific deficits in recall suggest that although the material was encoded, there is impairment specific to the search and retrieval process (Ilsley et al., 1995). Another study showed that while patients with nonpsychotic major depression showed impairment on immediate recall and total score, retrieval and retention remained unaffected on the California Verbal Learning Test (CVLT; Delis, 1987; Kizilbash et al., 2000). With regards to verbal learning functioning, results are mixed. Deficits in verbal learning are reported in nonpsychotic major depression (Beblo et al., 1999; Biringer et al., 2007), while other studies show no significant differences in verbal learning performance when compared to health control participants (Halvorsen et al., 2011; Hammar and Ardal, 2009). Further clarification of verbal learning performance in nonpsychotic major depression may be helpful in understanding verbal memory impairment.

The presence of psychosis in the context of a depressive episode distinguishes major depression with psychotic features from major depressive disorder (Rady et al., 2011). In psychotic major depression, criteria are met for a major depressive episode in addition to the presence of psychotic features such as hallucinations or delusions (Coryell et al., 1984). Psychotic major depression is diagnostically different than schizophrenia, as evidenced by the presence of the mood component during the course of psychotic symptoms (APA, 2004). The importance of detecting psychotic major depression is underscored by the higher reported rates of severity of depression, specifically higher ratings of suicide (Johnson et al., 1991; Roose et al, 1983). Memory impairments are associated with severity of mood disturbance in patients with psychotic major depression, a domain of particular interest when examining cognitive deficits in psychotic major depression (Bornstein et al., 1991). Individuals with psychotic major depression have been found to have more severe symptoms of depression (Keller et al., 2007; Johnson et al., 1991), thus it is likely that individuals with psychotic major depression would also present with more significant memory impairment. Consistent with previous findings, negative symptoms in psychotic major depression contribute more to verbal memory deficits than the severity of depression symptoms (Che et al., 2012). Moreover, negative symptoms are significantly correlated with deficits in verbal memory (Che et al., 2012).

When comparing cognitive functioning in nonpsychotic major depression to psychotic disorders, research suggests that individuals with nonpsychotic major depression perform significantly better than those with psychotic major depression (Fleming et al., 2004; Jeste et al., 1996) and schizophrenia (Reichenberg et al., 2009; Rund et al., 2013) on learning measures. This provides support that there is a similar cognitive pattern of performance in psychotic major depression and schizophrenia (Jeste et al., 1996). Basso and Bornstein (1999) showed that

psychotic major depression participants retain less information than nonpsychotic major depression participants on immediate and delayed trials of the Logical Memory Test (Wechsler, 1987) and on the CVLT (Delis, 1987). No improvement was noted with the provision of cuing on these tests, suggesting that individuals with psychotic major depression may have an acquisition deficit (Basso and Bornstein, 1999).

In an examination of neuropsychological functioning in patients with schizophrenia and schizoaffective disorders, deficits in memory and learning best differentiate these patients when compared to healthy control participants (Bilder et al., 2000). Individuals with schizophrenia and schizoaffective disorder show less effective verbal memory strategies than healthy control participants (Rannikko et al., 2012). The observed performance in poorer memory strategies is associated with longer duration of illness, and a higher use of antipsychotic medication (Rannikko et al., 2012). When compared to schizophrenia, schizoaffective disorder patients are typically indistinguishable in terms of cognitive functioning (Heinrichs et al., 2008; Miller et al., 1996). Because of this, many studies group schizophrenia and schizoaffective patients together when examining cognitive performance (Miller et al., 1996), as done in the current study.

There are psychiatric diagnoses that involve both affective and psychotic features including schizoaffective disorder and major depression with psychotic features. In addition to clinical features, neuropsychological differences can help to distinguish between diagnoses and also provide useful information for tailoring treatment. A better understanding of verbal learning strategies can offer insight to the difference in verbal memory performance and learning between patients with nonpsychotic major depression, psychotic major depression, and schizophrenia spectrum disorders. Comprehension of neuropsychological differences in verbal learning and memory could aid in differential diagnoses, in addition to information on how to tailor treatment

to enhance learning. Furthermore, a comparison of the use of verbal learning strategies between these specific diagnostic groups have not been investigated. Thus, this study examined how verbal learning strategies are related to verbal memory performance in individuals with psychotic major depression, nonpsychotic major depression, schizophrenia spectrum disorders, which to the best of the author's knowledge has not been done before. Specifically, the use of Semantic, Serial, and Subjective Clustering strategies, learning slope, and verbal memory is assessed and compared across these diagnostic groups. The authors hypothesized that learning strategies used in the verbal memory test would predict verbal memory performance in all diagnostic groups, and that there would be differences in verbal memory performance amongst diagnostic groups.

2. Method

The data were collected at the Depression Research Clinic at the Department of Psychiatry and Behavioral Medicine at Stanford University School of Medicine. Data were collected from a study examining the Hypothalamic-Pituitary-Adrenal Axis (Gomez at el., 2006; Keller et al., 2006).

2.1 Participants

Participants were recruited for studies examining the hypothalamic-pituitary-adrenal axis at the Department of Psychiatry and Behavioral Science at Stanford University School of Medicine. All participants signed consent forms to participate in the study. Consent forms were approved by Stanford University's Institutional Review Board for Human Subjects Committee. This study included three groups of outpatient participants: schizophrenia spectrum disorders, nonpsychotic major depression, and psychotic major depression. Participant diagnoses were made by their healthcare providers and confirmed by study staff. Table 1 shows the age, education, and gender breakdown for the diagnostic groups.

Table 1

Participant demographics for psychotic major depression (PMD), nonpsychotic major depression (NPMD), and schizophrenia spectrum (SCZ) groups

	N	Mean	SD	Range
PMD				
Age	49	36.69	12.25	18-66
Education	49	14.94	2.74	9-23
Gender	49			
Male	21			
Female	28			
HDRS Total Score	49	37.51	6.51	25-50
BPRS PSS Score	49	47.67	7.40	34-66
NPMD				
Age	47	41.32	13.58	20-67
Education	47	15.11	1.75	12-21
Gender	47			
Male	14			
Female	33			
HDRS Total Score	47	28.6	4.38	19-38
BPRS PSS Score	47	33.02	3.82	26-46
SCZ				
Age	26	37.46	13.14	18-59
Education	32	14.31	1.925	12-20
Gender	26			
Male	14			
Female	12			
HDRS Total Score	22	18.90	10.1	0-38
BPRS PSS Score	23	36.26	12.87	0-56

Notes. There were no statistically significant group differences in demographics
BPRS PSS= Brief Psychiatric Rating Scale-Positive Symptom Score
BPRS-PSS score total minus 4 because a nonresponse equals 1.
HDRS = Hamilton Depression Rating Scale

Inclusion criteria included: 1) a diagnosis of major depression, major depression with psychotic features, schizophrenia or schizoaffective disorder, 2) a minimum score of 21 on the 21-item Hamilton Depression Rating Scale to ensure diagnostic groups were equated by depression scores (HDRS; Hamilton, 1960), 3) a minimum score of 5 on the BPRS Positive

Symptom Subscale for psychotic major depression participants (BPRS PSS; Overall and Gorham, 1962) which is comprised of four items: hallucinations, delusions, thought disorganization and suspiciousness, 4) a minimum period of three weeks where participants were stable on medications prior to beginning the study procedures, and 5) required participants to be at least 18 years of age, but no older than 75 years of age.

Exclusion criteria for the original study precluded participation from individuals with: 1) serious medical illnesses, 2) abnormal lab tests (e.g. testing positive for use of illicit substances, positive pregnancy, etc.), 3) history of major head trauma or significant neurological history, 4) women who were currently pregnant or lactating, 5) substance abuse problems in the last six months, 6) history of developmental or learning disabilities as assessed through self-report and screening questionnaire, or 7) taking steroids.

2.2 Procedures of the original study

Participant eligibility was first screened by phone, and then later through the structured clinical interview for DSM-IV-TR (SCID; First et al., 1997) and mood ratings to confirm study eligibility. Participants who consented and were determined to be eligible for the study were then administered a neuropsychological battery, mood rating scales, and self-report questionnaires which included quality of life measures, and personality measures (please see Gomez et al., 2006 for a list of complete measures). Not all neuropsychological measures, mood ratings, or self-reports measures were included in the current study. Testing was performed by a neuropsychologist, or a graduate student under the supervision of a licensed psychologist.

2.3 Measures

California Verbal Learning Test, Second Edition (CVLT-II)

The California Verbal Learning Test (CVLT-II) is a widely used verbal learning test (Delis et al., 2000). The test consists of a 16-word list that is read to the examinee and assesses immediate recall, short-delay free recall, short-delay cued recall, long-delay free recall, long-delay cued recall, and long-delay recognition. Examinees are also read an additional word list once, List B, which contains distractor or interference words. Learning strategies are assessed through the examinees grouping of the recalled words (Delis et al., 2001). Recall of the word list is assessed for Semantic Clustering, Serial Clustering or Subjective Clustering (Delis et al., 2001). Semantic Clustering refers to the use of categories to aid in recall, measured by how the examinee consecutively recalls words from the same category (Stricker et al., 2001). Serial Clustering strategy refers to each time two words are recalled in the same sequence in which they were presented on the original list (Stricker et al., 2001). Subjective Clustering refers to the examinees ability to develop their own strategy to remember the words, such as using phonemic features of the word or developing mnemonic strategies that are recalled together from one trial to the next (Delis et al., 2001). Learning slope predicts memory performance through the provision of data on an individuals' retention rate across the 5 learning trials (Delis et al., 2004). Construct validity for the CVLT-II as a learning and memory measure has sufficient empirical support (Baldo et al., 2002).

2.3 Statistical analyses

All analyses were completed using SPSS version 22.0 for Windows. Descriptive statistics were obtained for each diagnostic group included in this study; psychotic major depression, nonpsychotic major depression, and schizophrenia spectrum disorders. Pearson

correlations were used to examine the relationships between the variables of interest. Regression analyses were conducted on learning strategies, diagnostic groups and CVLT-II scores.

Learning strategy scores were predictors in the main analyses, both in predicting differences in performance of the diagnostic groups and in predicting the total verbal memory scores for the CVLT-II Trials 1-5. Learning strategies included Semantic, Serial and Subjective Clustering. Diagnostic groups including psychotic major depression, nonpsychotic major depression, schizophrenia spectrum disorders are also included as predictors. Verbal memory performance total raw scores on CVLT-II Trials 1-5 total, Short-delay Free Recall, Long-Delay Free Recall and Recognition were included as dependent variables. Analysis of variance (ANOVA) was used to determine differences in verbal learning strategies between the diagnostic groups. Age was used as a covariate for the Subjective Clustering, as results showed that age is significantly correlated with Subjective Clustering total raw score (r = -0.20, $p < 0.05$). An analysis of covariance (ANCOVA) was used to determine differences in the use of Subjective Clustering between diagnostic groups.

3. Results

Table 2 shows descriptive analyses for CVLT-II scores for the psychotic major depression, nonpsychotic major depression, and the schizophrenia spectrum disorders group. Scores for the CVLT-II are separated by diagnostic groups. Pearson correlations were calculated between the learning strategies, learning slope for CVLT-II Total Trials 1-5, and age.

Table 2

Descriptive Statistics of CVLT-II scores for psychotic major depression (PMD), nonpsychotic major depression (NPMD), and schizophrenia spectrum (SCZ) groups

	PMD		NPMD		SCZ	
	Mean	SD	Mean	SD	Mean	SD
CVLT-II RawT1	5.54	2.01	5.74	1.71	5.64	2.27
CVLT-II RawT2	7.71	2.48	8.94	2.26	7.80	2.80
CVLT-II RawT3	9.21	3.43	10.64	2.73	8.68	2.85

CVLT-II RawT4	10.40	3.66	11.57	2.64	10.28	3.20
CVLT-II RawT5	10.71	3.53	12.38	2.14	10.80	3.33
CVLT-II Trials 1-5 Total	43.54	13.21	49.30	9.97	43.20	13.03
CVLT-II Trial B	5.00	1.89	5.30	1.86	4.72	1.62
CVLT-II SDFR	9.06	3.77	11.04	3.00	8.68	3.75
CVLT-II SDCR	10.00	3.62	11.91	2.45	9.88	3.03
CVLT-II LDFR	9.23	4.08	11.34	2.83	8.76	3.85
CVLT-II LDCR	9.96	3.59	12.02	2.42	9.80	3.48
Recognition Raw	13.73	3.09	14.85	1.83	13.92	2.00
Semantic Clustering	1.12	1.85	0.85	1.73	0.42	1.19
Serial Clustering	0.70	1.01	1.22	1.27	0.77	0.75
Subjective Clustering	0.90	0.91	1.02	0.82	0.55	0.71

Notes. SDFR = short-delay free recall
SDCR = Short-delay cued recall
LDFR = Long-delay free recall
LDCR = Long-delay cued recall
Trial B=Interference trial

Results showed no significant differences in Semantic Clustering between diagnostic groups; $F(2, 122) = 1.47$, $p = 0.23$ (Table 3). However, there were significant differences in the utilization of Serial Clustering between diagnostic groups; $F(2, 122) = 3.16$, $p = 0.05$. Post hoc comparisons showed that differences between the psychotic major depression and nonpsychotic major depression diagnostic groups were significant, with psychotic major depression group Serial Clustering scores being significantly lower than nonpsychotic major depression scores, meaning nonpsychotic major depression participants used more serial strategies. There was also a significant difference in the use of Subjective Clustering between diagnostic groups; $F(3, 113) = 3.41$, $p = 0.04$), however, only group differences between nonpsychotic major depression and schizophrenia spectrum disorders approached significance ($p = 0.07$).

Table 3

Differences in verbal learning strategies and learning slope for psychotic major depression (PMD), nonpsychotic major depression (NPMD), and schizophrenia spectrum (SCZ) groups

	PMD		NPMD		SCZ		F	Partial Eta Squared
	M	SD	M	SD	M	SD		
Semantic Clustering	1.12	1.85	0.85	1.73	0.42	1.19	1.47	0.02
Serial	0.70	1.01	1.22	1.27	0.77	0.74	3.16*	0.05

Clustering Subjective[a] Clustering	0.90	0.91	1.02	0.82	0.55	0.71	3.41*	0.06
Learning Slope	-0.31	1.41	0.28	0.95	-0.27	1.17	3.28	0.05

*p < 0.05
[a]ANCOVA was used to covary out age

Multiple Regressions were used to examine the relationship between learning strategy, total score for CVLT-II Trials 1-5 Total, Short-Delay Free Recall (SDFR) score, Long-Delay Free Recall (LDFR) score, and Recognition Raw Hits (Table 4). Semantic, Serial, and Subjective Clustering each significantly and uniquely predicted total learning score ($\beta = 0.49$, $p < 0.01$), ($\beta = 0.22$, $p = 0.03$), and (**β** = 0.33, $p < 0.01$), respectively.

Table 4
Multiple Regressions for Learning Strategies explaining verbal memory in entire sample

Variable	B	SE B	β	R^2
CVLT-II Total Score				42.9%**
Semantic Clustering	3.50**	0.70	0.49**	
Serial Clustering	2.40*	1.10	0.22*	
Subjective Clustering	4.90**	1.37	0.33**	
Short-Delay Free Recall Score				30.2%**
Semantic Clustering	1.12**	0.23	0.53**	
Serial Clustering	.84*	0.36	0.26*	
Subjective Clustering	.67	0.45	0.15	
Long-Delay Free Recall Score				32.2%**
Semantic Clustering	1.14**	0.23	0.52**	
Serial Clustering	0.78*	0.37	0.23*	
Subjective Clustering	0.86	0.45	0.19	
Recognition Score				7.4%
Semantic Clustering	0.44*	0.18	0.29*	
Serial Clustering	0.54	0.28	0.24	
Subjective Clustering	0.18	0.35	0.06	

**p < 0.01
*p < 0.05

Multiple Regressions were used to examine the relationship between learning strategy, and the total verbal memory raw score on the CVLT-II Trials 1-5, for psychotic major depression, nonpsychotic major depression, and schizophrenia spectrum disorder participants

(Table 5). Semantic Clustering significantly predicted total score for CVLT-II Trials 1-5 (β = 0.58, $p < 0.01$). For the nonpsychotic major depression group, all three learning strategies explained 45.2% of the variance; $F(3, 46) = 13.67$, $p < 0.01$. Semantic Clustering and Subjective Clustering significantly predicted total verbal memory score for CVLT-II Trials 1-5 (β= .32, $p = 0.03$), and (β= .55, $p < .01$), respectively. For the schizophrenia spectrum group, the three learning strategies explained 47.9% of the variance; $F(3, 25) = 8.65$, $p < 0.01$. Semantic and Serial Clustering significantly predicted total verbal memory score for CVLT-II Trials 1-5 (β= .68, $p < 0.01$), and (β= 0.42, $p = 0.04$), respectively.

Table 5

Multiple regressions of learning strategies explaining CVLT-II Trials 1-5 Total for psychotic major depression (PMD), nonpsychotic major depression (NPMD), and schizophrenia spectrum (SCZ) Groups

Variable	B	SE B	β	R^2
PMD				43.0%**
Semantic Clustering	4.10**	1.31	0.58**	
Serial Clustering	3.02	2.33	0.23	
Subjective Clustering	4.20	2.50	0.27	
NPMD				45.2%*
Semantic Clustering	1.82*	0.83	0.32*	
Serial Clustering	-0.06	1.18	-0.01	
Subjective Clustering	6.81**	1.69	0.55**	
SCZ				47.9%**
Semantic Clustering	7.29**	1.82	0.68**	
Serial Clustering	7.18*	3.35	0.42*	
Subjective Clustering	1.32	3.47	0.07	

**p < 0.01
*p < 0.05

Multiple Regressions were used to examine the relationship between learning strategies, and the total verbal memory raw score for CVLT-II Trials 1-5 on the Short-Delay Free Recall score for all participants. For the psychotic major depression group, all three learning strategies explained 26.2% of the variance; $F(3, 48) = 6.69$, $p < 0.01$. Semantic Clustering significantly predicted total verbal memory score for psychotic major depression participants (β = 0.63, $p <$

0.01). For the nonpsychotic major depression group, all three learning strategies explained 23.6% of the variance; $F(3, 46) = 5.75$, $p < 0.01$. Semantic Clustering significantly predicted Short-Delay Free Recall for the nonpsychotic major depression group ($b = 0.37$, $p = 0.04$). For schizophrenia spectrum patients, the three learning strategies explained 49.2% of the variance; $F(3, 25) = 9.07$, $p < 0.01$. Semantic Clustering significantly predicted total score for CVLT-II Trials 1-5 for schizophrenia spectrum participants ($\beta = 0.67$, $p < 0.01$).

In examining CVLT-II Long-Delay Free Recall score, all three learning strategies explained 30.0% of the variance for psychotic major depression participants; $F(3, 48) = 7.85$, $p < 0.01$. Semantic Clustering significantly predicted Long-Delay Free Recall ($\beta = 0.64$, $p < 0.01$). For nonpsychotic major depression participants, the three learning strategies explained 28.2% of the variance in the total verbal memory score for CVLT-II Trials 1-5; $F(3, 46) = 7.01$, $p < 0.01$. Semantic Clustering and Subjective Clustering significantly predicted total Long-Delay Free Recall score ($\beta = 0.37$, $p = 0.03$), and ($\beta = 0.36$, $p = .03$), respectively. For schizophrenia spectrum participants, all three learning strategies explained 44.0% of the variance; $F(3, 25) = 7.56$, $p < 0.01$. Semantic Clustering significantly predicted Long-Delay Free Recall for schizophrenia spectrum participants.

For the psychotic major depression group, all three learning strategies explained 6.9% of the variance in Long-Delay Recognition Raw Scores; $F(3, 48) = 2.18$, $p = 0.10$. Semantic Clustering significantly predicted Recognition raw score ($\beta = 0.57$, $p = 0.02$). For nonpsychotic major depression participants, all three learning strategies explained 3.3% of the variance in the total verbal memory score; $F(3, 46) = 1.52$, $p = 0.22$. No learning strategy significantly predicted total Recognition score. For schizophrenia spectrum participants, the three learning strategies explained 11.8% of the variance in the total verbal memory score; $F(3, 25) = 2.12$, $p =$

0.13. No learning strategy significantly predicted the total Recognition score for schizophrenia spectrum participants.

Semantic, Subjective and Serial Clustering strategies accounted for 42.9% of the total verbal memory score in CVLT-II Trials 1-5 (Table 6). Semantic and Serial Clustering significantly predicted the Short-Delay Free Recall score and Long-Delay Free Recall scores. Only Semantic Clustering significantly predicted the total Recognition Raw score. All three of the learning strategies significantly predicted the total verbal memory score for CVLT-II Trials 1-5.

Table 6

Multiple Regressions for Learning Strategies explaining verbal memory in entire sample

Variable	B	SE B	β	R^2
CVLT-II Total Score				42.9%**
Semantic Clustering	3.50**	.70	.49**	
Serial Clustering	2.40*	1.10	.22*	
Subjective Clustering	4.90**	1.37	.33**	
Short-Delay Free Recall Score				30.2%**
Semantic Clustering	1.12**	.23	.53**	
Serial Clustering	.84*	.36	.26*	
Subjective Clustering	.67	.45	.15	
Long-Delay Free Recall Score				32.2%**
Semantic Clustering	1.14**	.23	.52**	
Serial Clustering	.78*	.37	.23*	
Subjective Clustering	.86	.45	.19	
Recognition Score				7.4%
Semantic Clustering	.44*	.18	.29*	
Serial Clustering	.54	.28	.24	
Subjective Clustering	.18	.35	.06	

**$p < 0.01$

*$p < 0.05$

Additional analyses were completed to determine if any differences exist in the rate of learning between diagnostic groups, as this could potentially provide more insight related to verbal learning and memory performance in these groups. An ANOVA was used to examine the relationship between Total Learning Slope Trials 1-5, and diagnostic groups. There were

significant differences between the use of the three learning strategies on the total verbal memory score for CVLT-II Trials 1-5; $F(2, 122) = 3.28$, $p = 0.04$. Post hoc comparisons showed significant differences between the psychotic major depression and nonpsychotic major depression diagnostic groups, with psychotic major depression scores ($M = -0.31$, $SD = 1.41$) on average significantly lower than nonpsychotic major depression scores ($M = 0.28$, $SD = 0.95$).

4. DISCUSSION

Differences in depression and psychotic severity may help to explain the differences observed between psychotic major depression and nonpsychotic major depression diagnostic groups. The performance of the schizophrenia spectrum group on total Learning Slope suggests that psychotic severity may contribute to worse overall learning than affective symptoms, as evidenced by the overall performance of the nonpsychotic major depression group. Findings showed statistically significant differences in the use of Serial Clustering strategy and Subjective Clustering strategies between diagnostic groups. Specifically, significant differences were found between the psychotic major depression and nonpsychotic major depression group, with the psychotic major depression group utilizing Serial Clustering strategy significantly less than the nonpsychotic major depression group. The mean for the use of Subjective Clustering strategy was lower in the schizophrenia spectrum group than the other two diagnostic groups. The use of Subjective Clustering strategy is associated with the organization of the items presented in a way that is meaningful to the examinee (Stricker et al., 2001). The lesser use of Subjective Clustering in the schizophrenia spectrum group suggests that their ability to develop their own strategy to remember the words is lower than that of the psychotic major depression and nonpsychotic major depression groups.

Serial Clustering is a relatively passive learning strategy. The lesser use of Serial Clustering strategy by the psychotic major depression group may be related to overall poorer verbal memory performance of this group when compared to nonpsychotic major depression, which is consistent with findings from the current study. Serial Clustering is typically associated with poorer recall than Semantic Clustering. Significant differences in the use of Semantic strategy amongst diagnostic groups were not detected. As previously discussed, Semantic Clustering is associated with the most effective encoding into long-term memory (Delis et al., 1988).

The focus of the current study is on examining differences in verbal learning strategies for individuals with psychotic and affective disorders, and as such, a healthy control group was not included. While other studies have not specifically examined the use of verbal learning strategies between these diagnostic groups, verbal memory differences have been explored. A number of studies showed that verbal memory is impaired in nonpsychotic major depression (Austin et al., 1992; Brand et al., 1992; Illsey et al., 1995). Individuals with psychotic major depression are also shown to demonstrate impairments in verbal memory, and studies indicate that verbal memory impairments are typically worse in psychotic major depression than in nonpsychotic major depression (Basso and Bornstein, 1999; Gomez et al., 2008; Fleming et al., 2004; Jeste et al., 1996).

The three learning strategies significantly predicted the total verbal memory score and Short-Delay Free Recall score on the CVLT-II. The utilization of the strategies explains the differences between diagnostic groups in the correlates of learning strategies and verbal memory performance. This is consistent with the longstanding theory that the increased use of organizational learning strategies is related to an overall higher verbal memory performance

(Stricker et al., 2002). Much of the literature that examines organizational strategies in relation to verbal memory specifically investigates the use of Semantic Clustering strategy (Brebion, et al., 2004; Deckerbach et al., 2000; Kareken et al., 2009; Morimoto et al., 2012; Roth el al., 2004). Consistent with the findings from the current study, Brebion and colleagues (2004) found that Semantic Clustering significantly predicted verbal memory performance in individuals with schizophrenia. Similarly, the lesser use of Semantic Clustering in patients with schizophrenia is associated with decreased verbal memory performance (Kareken et al., 2009). In geriatric nonpsychotic major depression patients, the higher use of Semantic Clustering has also been shown to predict verbal memory performance (Morimoto et al., 2012). However, literature examining the use of Subjective, Serial and Semantic Clustering strategies across these particular diagnostic groups is limited, thus it is difficult to compare the consistency of the findings from the current study to existing literature.

Significant differences were found between diagnostic groups on the total Learning Slope 1-5. Specifically, the score for the psychotic major depression group was significantly lower than the nonpsychotic major depression group. These findings are consistent with the literature that shows that individuals with psychotic major depression have poorer performance in verbal learning than individuals with nonpsychotic major depression (Jeste et al., 1996; Schatzberg et al., 2000). It is possible that the effect of the strategies on memory performance for the psychotic major depression group is magnified because there is less range observed in their overall memory performance. The schizophrenia spectrum group had a lower rate of learning than the nonpsychotic major depression group, and slightly lower rate than the psychotic major depression group. Lower rate of learning in schizophrenia spectrum participants is in line with the previous findings that show impaired learning ability in in these disorders (Hill et al., 2004).

Learning slope on the CVLT-II has been used to assess learning potential in schizophrenia patients in relation to the utilization of verbal learning strategies and verbal learning (Vaskinn et al., 2008). It has been shown that those individuals with higher learning slopes utilize the Semantic Clustering strategy more than other groups, and that the group with lower learning slopes score lower in overall verbal recall (Vaskinn et al., 2008). In the current study, the group with higher learning slope, nonpsychotic major depression, utilized the Serial Clustering strategy the most. Consistent with the previous research, lower learning slope was indicative of overall poorer performance in the nonpsychotic major depression group. This can be explained by poorer encoding through CVLT-II Trials 1-5 Total, from which the total verbal learning score is comprised.

There are limitations that must be considered when interpreting the results of this study. The relatively small sample size of the psychotic major depression, nonpsychotic major depression and schizophrenia spectrum groups has implications on the generalizability of these results. The study included an outpatient sample only, which suggests lower symptom severity and functional impairment than would likely be observed in an inpatient sample. The exclusion of inpatient participants could make it more difficult to detect group differences in the utilization of learning strategies. The mean years of education of included participants across diagnostic groups exceeded a high school education, limiting the heterogeneity of the sample. Although gender was relatively equally represented in both the psychotic major depression and schizophrenia spectrum groups, females outnumbered males by more than 2:1 in the nonpsychotic major depression group, consistent with the reported incidence of higher rates of this disorder in females in the general population (American Psychiatric Association, 2013). There are findings that suggest that females have better verbal memory performance than males

(Geffen et al., 2000) which could potentially impact the results of the current study given the distribution of gender in the nonpsychotic major depression sample. A larger sample with equal gender distribution could provide more insight into gender differences that may exist with regards to verbal learning across diagnostic groups. Another limiting factor of the current study includes the allowance of patients to remain on their current dose of medication for the study period. Controlling for medication, or enrolling pharmacologically naïve participants, may be beneficial in better understanding the diagnostic differences without any potential confounding effects of medication.

Nonetheless, the current study is one of the first studies to examine differences in the use of learning strategies between psychotic major depression, nonpsychotic major depression and schizophrenia spectrum groups, and their relationships with verbal memory performance. Differences in utilization of learning strategies provide further support to literature that posits psychotic major depression is diagnostically different than nonpsychotic major depression, rather than a more severe form of nonpsychotic major depression (Rothschild, 2013; Schatzberg and Rothschild, 1992). Furthermore, the nonpsychotic major depression and psychotic major depression groups utilized Subjective Clustering more than the schizophrenia spectrum group. These findings lend support to evidence that there are diagnostic differences that exist neuropsychologically between psychotic major depression, nonpsychotic major depression and schizophrenia spectrum groups.

These findings may be particularly useful in cognitive remediation, as the use of learning strategies is central in compensatory and restorative models of treatment (Wykes and Reeder, 2005). Meta-analyses have shown that the most significant treatment effects in cognitive rehabilitation are observed when the treatment incorporates an approach based on learning

strategies (Barlati et al., 2013). Clinical implications from the current study emphasize the importance of utilizing verbal learning strategies that most contribute to verbal memory for the given diagnostic group.

The current study found that verbal learning strategies used significantly predict overall verbal memory. Thus, the presentation of material in psychotherapy utilizing the learning strategies that best predict verbal memory performance can be tailored to enhance retention of psychotherapeutic material. Information in psychotherapy could be presented serially, emphasizing the sequence of the information presented to help patients retain the most presented to them, or subjectively, through asking patients to develop and share their own strategies for remembering the information in therapy. Overall, these neuropsychological findings can be beneficial in understanding diagnostic differences in the utilization of Serial and Subjective Clustering strategies, in addition to a greater understanding that all three organizational clustering strategies on the CVLT-II predict verbal memory for these diagnostic groups.

Conflict of interest

There are no known conflicts of interest associated with this publication to disclose.

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