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Depressed mood in individuals with schizophrenia: a comparison of retrospective and real-time measures

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Abstract

Depressed mood is prevalent among individuals with schizophrenia, leading to difficulties in functioning. Typically, depressed mood is evaluated using retrospective assessments during which individuals are asked to recall their mood during the past week or month. However, as individuals with schizophrenia may display memory difficulties, the results of such assessments may be biased, potentially leading to inaccurate clinical characterizations and/or suboptimal treatment. Our aim was to assess the potential impact of long-term memory on depressed mood in individuals with schizophrenia. Employing an Experience Sampling Method (ESM) approach, 51 individuals with schizophrenia and 22 healthy controls rated their momentary emotions up to 10 times/day over a two-day period, along with retrospective measures of depressed mood, long-term memory, quality of life, social functioning, and symptoms. ESM assessment of real-time depressed mood demonstrated discriminant and convergent validity. Among the schizophrenia group, there was a significant correlation between the real-time and retrospective measures of depressed mood. However, once variance due to long-term memory was controlled, the relationship between the real-time and retrospective measure was no longer significant. The findings suggest that a real-time measure of depressed mood may allow overcoming some of the limitations associated with long-term memory difficulties common among individuals with schizophrenia.

Keywords

experience sampling method (ESM); schizophrenia; depression; long-term memory

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1. Introduction

Schizophrenia is a chronic illness that brings significant and long-lasting health, social, and financial burdens (Knapp et al., 2004). Further adding to this cost, is the high rate of psychiatric comorbidity common to this disorder (Buckley et al., 2009). In particular, depressive illnesses have been found in up to 75% of individuals with schizophrenia, and are associated with greater disability, recurrence of illness, demoralization, as well as an increased risk of suicide (Baynes et al., 2000). Likewise, sub-syndromal depressive symptoms are present in over 80% of individuals with schizophrenia, contributing significantly to functional difficulties (Zisook et al., 2006).

1.1 Assessment of Depression Among Individuals with Schizophrenia

Depressive symptoms in individuals with schizophrenia are most commonly assessed using measures such as the Hamilton Rating Scale for Depression, the Calgary Depression Scale for Schizophrenia, or the Beck Depression Inventory, which have been shown to be highly correlated and reported to have good validity and test-retest reliability (Niv et al., 2007). However, these measures are retrospective in nature, asking participants to recall experiences from the past week or two weeks, thus vulnerable to long-term memory impairments and biases. This is particularly relevant for assessments of individuals with schizophrenia, given the well-documented prevalence of long-term memory difficulties in this population (Ranganath et al., 2008) which have been found to adversely impact real-world functioning (Fett et al., 2011; Zhornitsky et al., 2012). Additional limitations of retrospective assessments include lack of information about fluctuations in symptoms (Kimhy et al., 2006), as well as difficulties distinguishing between depressive and negative symptoms (Stahl and Buckley, 2007). Of note, social withdrawal, anhedonia, and lack of energy, are particularly problematic when attempting to differentiate between negative and depressive symptoms (Green, Canuso, Brenner, and Wojcik, 2003). Taken together, retrospective assessments of depressive symptoms among individuals with schizophrenia may potentially have limited ecological validity, hindering the identification of symptoms and delivery of effective treatments.

To overcome some of these limitations, researchers have used the Experience Sampling Method (ESM) - a time-sampling self-report methodology developed to study the dynamic process of person-environment interactions (Delespaul, 1995). Recent technological advances have allowed ESM to be used with mobile electronic devices (Kimhy et al., 2006, 2010, 2012). Typically, participants are provided with a mobile device, which is preprogrammed to randomly beep throughout the day. Upon hearing beeps, participants are instructed to answer questions on the device's screen about their current mood, thoughts, activities and/or social context. Thus, ESM allows *in vivo*, *in situ* ("real time, real world") ambulatory assessment of experiences with limited need for long-term memory input. In recent years, ESM has been successfully used with many psychiatric populations, including individuals with schizophrenia (Swendsen et al., 2011; Kimhy et al., 2012), bipolar disorder (Kwapil et al., 2011), depression (Ben-Zeev et al., 2012a), schizotypy (Kwapil et al., 2012), as well as individuals at high-risk for psychosis (Kimhy and Corcoran, 2008).

While an extensive literature suggests that many individuals with schizophrenia experience depressed mood, a number of important gaps in the literature remain unaddressed. Most importantly, it remains unclear whether deficits in long-term memory impact recollection of depressed mood during retrospective assessment. Additionally, while negative symptoms and retrospective measures of depressed mood tend to show a strong association, the relationship between negative symptoms and real-time measures of depressed mood has not yet been explored.

1.2 The Present Study

Our primary aims were: 1) to confirm findings from previous studies supporting the discriminant and convergent validity of real-time depressed mood in individuals with schizophrenia and healthy controls 2) to assess the association of real-time and retrospective ratings of depressed mood in individuals with schizophrenia and the putative impact of long-term memory on this association; and 3) to examine the association between real-time and retrospective ratings of depressed mood and negative symptoms in individuals with schizophrenia in order to determine if a real-time measure of depressed mood could better differentiate depressed mood from negative symptoms.

2. Methods

2.1. Participants

Individuals with schizophrenia were recruited from patients treated at the New York State Psychiatric Institute (NYSPI) at the Columbia University Medical Center (CUMC). Healthy participants were recruited via advertisements posted at CUMC. For all participants, the inclusion criteria were ages 18-50; English speakers; have an IQ>80 (assessed using WAIS-R), and able to give informed consent. For the schizophrenia group, the inclusion criteria were a DSM-IV diagnosis of schizophrenia or related disorders; and moderate positive symptoms (score of ≥ 3 on the hallucination or delusion items of the Scale for the Assessment of Positive Symptoms). Individuals with a history of a severe cardiac condition (assessed via self-report) were excluded, as this study was part of larger protocol assessing cardiac reactivity. Individuals with a recent use of illegal drugs (assessed by urine toxicology tests) were also excluded. For healthy controls, the exclusion criteria were a personal or family history of psychosis and a diagnosis of any DSM-IV Axis-II Cluster A personality disorder. The DSM-IV diagnoses in the schizophrenia group were: Schizophrenia (68%), Schizoaffective Disorder (24.5%), Delusional Disorder (2.5%), and Psychosis NOS (5%). The study was approved by the NYSPI's Institutional Review Board and all subjects provided written informed consent. See Table 1 for sample description.

2.2. Measures

Retrospective Measure of Depressed Mood was assessed using the Beck Depression Inventory –Second Edition (BDI-II). The BDI-II is a 21-item inventory assessing intensity of depressive symptoms. Each item is rated on a 0-3 scale with total scores ranging from 0-63. The scale has been found to have high internal consistency in healthy controls and outpatients (.92, and .93, respectively; Dozois et al., 1998).

Real-Time Measure of Depressed Mood was assessed using ESM with mobile devices (MoD). Samples of mood, thoughts, and environmental contexts were collected using self-report questionnaires completed on the MoD. The self-report questionnaires were derived from previous ESM studies with individuals with schizophrenia and psychosis using ESMp (Delespaul, 1995; Kimhy et al., 2006, 2010). Depressed mood was indexed by the question, "I feel sad."

Long Term Memory was assessed using The Logical Memory II (LM-II) subtest of Wechsler Memory Scale – Revised (WMS-R). The Logical Memory subtests ask participants to recall semantic material in paragraph form (Wechsler, 1987). The LM-II total score has previously been used to measure long-term memory in individuals with schizophrenia (Toulopoulou et al., 2003).

Social Support was assessed using the Provision of Social Relations Scale (PSRS). The PSRS is a 15-item scale measuring the perception of social support from family and friends, which uses a 5-point Likert scale whereby lower scores indicate higher perception of social support. The PSRS has good internal consistency (alpha coefficients of .75-.87; Turner, 1983).

Quality of Life was assessed using the Quality of Life Scale (QOLS). The QOLS is a 16-item self-report questionnaire that measures an individual's satisfaction with different aspects of their life, with lower scores indicating higher quality of life. It has a solid test-retest reliability (.78 -.84), and is internally consistent (.82-.92; Burckhardt and Anderson, 2003).

Positive and Negative Symptoms were assessed using the Scales for the Assessment of Positive and Negative Symptoms (SAPS/SANS). The SAPS is a 34-item interview-based measure designed to assess positive symptoms. Items are rated from zero (symptoms are not present) to five (symptoms are severe). The SAPS has been found to have an intraclass correlation coefficient of .82 (Andreasen, 1982). The SANS is a 30-item interview-based measure designed to assess negative symptoms, and has been found to have solid intra-class correlation coefficients (.86-.92; Andreasen, 1989). On both measures items are rated from zero to five with higher scores indicating more severe symptoms.

2.3. Assessment Procedures

Diagnoses were established using the Diagnostic Interview for Genetic Studies (DIGS). The DIGS is a semi-structured diagnostic interview used to gather diagnostic and course of illness information for the mood, psychotic, and substance use DSM-IV Axis I disorders (Nurnberger et al., 1994). All participants who satisfied inclusion/exclusion criteria completed an evaluation, which included diagnostic and clinical assessments. Participants' real-time depressed mood was evaluated using ESM with Palm computers as part of an ambulatory assessment of momentary mood, symptoms, activities and social context over a 36-hour period. Retrospective depressed mood was typically assessed the day following the completion of the real-time depressed mood assessment.

The ESM assessments have been described in detail elsewhere (Kimhy et al., 2006, 2010). Briefly, participants initially completed an introductory session on operating the mobile devices and were provided with a Palm Tungsten T³ handheld computer to carry throughout the assessment. The iESP software (version 3.3; Intel Research Center, Seattle, WA) was used to present questions and collect responses on the mobile devices. The mobile devices were pre-programmed to beep randomly ten times/day (between 10am-10pm). Upon hearing the beep, participants were asked to respond to a questionnaire about current mood, along with psychotic symptoms, stress, and social context. For each mood/symptom question, participants were asked to indicate the quality of their current experience on a graphical slider similar to a visual analog scale (from “not at all” to “very much”). Responses were represented in the output as a value between 1 (“not at all”; leftmost extreme) and 100 (“very much”; rightmost extreme). Each questionnaire took about five minutes to complete.

2.4. Statistical Analyses

In accordance with previous studies, participants' ESM data was included in analyses if the participants completed at least 30% of the ESM samples (Kimhy et al., 2006, 2012). ESM data was averaged within participants, so as to create a single, global value allowing comparisons to the BDI-II total score. Since our sample had non-normal distributions, a Mann-Whitney U test was used to compare groups for continuous variables. Chi-Squared tests were used to compare categorical variables. Zero-order and partial correlations were used to examine relationships between measures of depressed mood and to establish concurrent and discriminant validity. Data analysis was only undertaken for participants with complete data, which accounts for the varying sample size for different analyses.

3. Results

The samples demographic and clinical information are presented in Table 1. The individuals with schizophrenia were significantly older than the healthy controls. No other significant differences were found.

One participant with schizophrenia was excluded from data analysis due to insufficient number of ESM responses. Out of the 20 ESM samples elicited over the two-day period, the participants from the schizophrenia and healthy control groups provided on average 14.85 ($SD=4.17$, $range=6-20$) and 17.73 ($SD=2.09$, $range=14-20$).

Based on published norms, the individuals with schizophrenia displayed significant long-term memory impairments, with 55% of participants having age-normed standard scores that are at least one standard deviation below the mean and 30% with scores that were two standard deviations below the mean. Only 18% had long-term memory scores within normal range. In contrast, 96% of healthy controls had long-term memory scores within normal range. Findings indicated that long-term memory scores were significantly lower for individuals with schizophrenia compared to the healthy controls ($U=65.50$, $z=-3.47$, $p<0.001$).

3.1. Discriminant and Convergent Validity of Real-Time Measures of Depressed Mood

Our first aim was to confirm the validity of real-time measures of depressed mood. To assess the discriminant validity, we compared the real-time (ESM) and retrospective (BDI-II) depressed mood ratings in individuals with schizophrenia and healthy controls. Results indicated that the schizophrenia group ($Mdn=36.96$) reported significantly higher real-time depressed mood than the healthy controls ($Mdn=7.56$; $U=76.00$, $z=-4.23$, $p<0.001$). Likewise, comparison of the schizophrenia ($Mdn=17.00$) and control groups ($Mdn=2.00$) on the retrospective depressed mood measure indicated significantly higher depressed mood in the former group ($U=75.50$, $z=-4.40$, $p<0.001$), suggesting that both indices are valid measures of depressed mood. In order to establish convergent validity, we also evaluated within the schizophrenia group the associations of between real-time and retrospective measures of depressed mood with variables known to be associated with depressed mood – social support and quality of life. Both measures of depressed mood were significantly correlated with social support and quality of life (see Table 2), suggesting solid convergent validity of the depressed mood measures.

3.2. Association of Real-Time and Retrospective Measures of Depressed Mood

Our second aim was to determine the association between real-time and retrospective measures of depressed mood among individuals with schizophrenia. There was a significant correlation between real-time and retrospective measures of depressed mood ($r(40)=0.606$, $p<0.001$). However, once variance due to long-term memory was controlled, the correlation between the two depressed mood measures exhibited only a trend ($r(34)=0.313$, $p=0.09$). Similarly, when a single item (“sadness” item) from the retrospective measure was compared to the real-time measure of depressed mood there was a significant correlation. However, once variance due to long-term memory was controlled, the correlation between the two depressed mood measures exhibited only a trend ($r(34)=0.313$, $p=0.09$).

3.3. Association of Real-Time and Retrospective Measures of Depressed Mood with Negative Symptoms

Our final aim was to examine the relationship between retrospective and real-time ratings of depressed mood and negative symptoms in individuals with schizophrenia. Total negative symptom scores were associated with retrospective measure of depressed mood, but were not significantly correlated with the real-time measure of depressed mood (see Table 3). Similarly, domain-specific measures of negative symptoms were significantly correlated with the retrospective measure of depressed mood, including avolition, anhedonia, and inattention, but not with the real-time measure of depressed mood.

4. Discussion

To the best of our knowledge, this is the first study to directly examine the impact of long-term memory on real-time and retrospective measures of depressed mood in individuals with schizophrenia. Our findings indicate that long-term memory difficulties among individuals with schizophrenia may bias retrospective assessments of depressed mood in this population.

The comparison of depressed mood between the schizophrenia and healthy control groups support the discriminant validity of real-time depressed mood assessment among individuals with schizophrenia. Specifically, we found significant relationships between our real-time depressed mood measure and measures known to be associated with retrospective depressed mood (quality of life and social support) in individuals with schizophrenia. These findings are consistent with previous reports linking depression and measures of quality of life and social support in psychiatric populations (Sim et al. 2004). Additionally, our findings are consistent with results from previous ambulatory studies of individuals with affective disorder (Ben-Zeev and Young, 2010; Ben-Zeev et al., 2009), suggesting that ambulatory real-time assessment is an effective and informative way to assess depressed mood among individuals with schizophrenia.

The most important finding was the impact of long-term memory on assessment of depressed mood. The real-time and retrospective measures of depressed mood displayed significant but moderate correlations. However, when we controlled for long-term memory, no significant relationship between these was found, suggesting that long-term memory impairments in individuals with schizophrenia may account for the difference between these two measures. This is consistent with the finding the participants with schizophrenia in our sample displayed substantial long-term memory impairments. Our findings suggest that real-time measures assess a different aspect of depressed mood that is not accounted for by the retrospective measure. Specifically, the real-time assessment is measuring in-the-moment feelings of depression, whereas the retrospective measurement relies on the individual's past recollection, which is potentially biased by long-term memory deficits. These results are consistent with previous findings in ESM studies of clinical populations where significant differences were found between retrospective and real-time measures of depression (Ben-Zeev and Young, 2010; Ben-Zeev et al., 2009).

4.1. Depressed Mood and Negative Symptoms

The comparison of negative symptoms to real-time and retrospective measures of depressed mood indicates that the real-time measure of depression is able to differentiate negative symptoms from depressed mood in individuals with schizophrenia. These findings contrast with retrospective measures of depressed mood in schizophrenia that tend to show significant overlap between negative symptoms and depressive symptoms (Lako et al., 2012). Our results suggest that among individuals with schizophrenia, the recollection of experiences associated with negative symptoms are less sensitive to bias by long-term memory difficulties compared to recollection of mood-related experiences. Thus, such measures may be advantageous to retrospective measures when attempting to discriminate depression from negative symptoms.

4.2. Clinical Implications

Our findings have important clinical implications for treating individuals with schizophrenia. The results highlight some of the limitations associated with using popular retrospective symptom measures in a clinical population with prevalent long-term memory difficulties (Zierhut et al., 2010). As such measures require individuals with schizophrenia to provide retrospective information, clinicians need to be aware that information obtained

using such measures may be biased by long-term memory deficits. This finding is consistent with research that has found that individuals with schizophrenia have a tendency to inaccurately report retrospective symptoms of depression (Ben-Zeev et al., 2012b). Thus, supplementing retrospective mood and symptoms measures with ambulatory ones may provide valid clinical information that is not biased by memory deficits. Additionally, real-time data are clinically rich, and provide information not typically available to clinicians including variability in a patient's mood, as well as momentary social and environmental correlates of changes in mood. For example, ambulatory real-time data can let us know if mood worsens at a particular time of day, or with a specific type of activity, which allows the clinician to more specifically tailor the treatment intervention.

Our results also lend further support to the need to screen for depressive symptomology in individuals with schizophrenia. In this study, the clinical population reported clinically significant rates of depressed mood on both measures of depression, which is consistent with the high prevalence of untreated depressive symptomology in schizophrenia (Buckley et al., 2009). This is important given that relatively effective treatment exists for depression in schizophrenia, and a significant barrier in delivering treatment is the appropriate diagnosis (Buchanan, 2010; Englisch, 2010).

4.3. Future Directions

As this is the first study focusing on the role of long-term memory in comparing “real time, real world” (*in vivo, in situ*) and retrospective measure of depressed mood in individuals with schizophrenia, our findings should be considered preliminary until replicated. Additionally, future studies should compare real-time measurements and retrospective ratings from an equivalent period of time, as well as compare other retrospective measures of depression (i.e., Ham-D, CDSS) to real-time measures in order to further assess its validity. This is particularly timely given the body of literature that has found a positive relationship between ESM measures of depression and retrospective measures (Bylsma et al., 2011; Starr and Davilla, 2012). Furthermore, depression is a complex illness characterized by physical and emotional symptomology. Our real-time measure employed a single question, and focused only on depressed mood (“I feel sad”). While depressed mood is relevant for gauging the presence or absence of depression, more specific questioning is needed for diagnosis and treatment. Accordingly, in order for a real-time measure to be employed in a clinical context it should be used in combination with more traditional measures of depression. Future studies should also examine the feasibility of using ambulatory assessments in a clinical practice – preliminary work in this area already began (Kimhy and Corcoran, 2008). As this study demonstrates, two days of data can provide valuable information, especially when used to complement standardized assessment tools. However, studies should be done to formally assess the optimal amount of time over which real-time data would need to be collected in order to accurately assess for depressive mood. Finally, studies should also be conducted to assess the use of real-time assessments in other clinical domains such as anxiety and stress in individuals diagnosed with schizophrenia.

4.3. Limitations

Our sample size was moderate in size so our findings should be considered preliminary. While the retrospective measure looks at a period of two weeks we were only able to collect real-time data for two days. Accordingly, the comparisons made between the real-time and retrospective measures cannot be considered fully equivalent, and may explain why the correlation between these measures, although significant, was only moderate. Additionally, the moderate correlations should be interpreted with caution.

An additional weakness of this study was the manner in which long-term memory was measured. While the WMS-R Logical Memory II subtest is a reliable measure of long-term memory, the test only assesses objective long-term memory, whereas a patient's ability to report on depressive symptomology relies on more subjective experiences, which are affectively influenced (Ivnik et al., 1992). Accordingly, future studies should consider using an assessment instrument such as the autobiographical memory interview (AMI), which uses interviewees autobiographical memories as a basis for measuring memory, thereby eliciting a more subjective measure of long-term memory (Corcoran and Frith, 2003).

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Article Highlights

- We assessed the impact of long-term memory on depressed mood in individuals with schizophrenia.
- We utilized an ESM approach.
- There was a significant correlation between ESM and retrospective measures of depressed mood.
- The relationship between the ESM and retrospective measure was no longer significant when long-term memory was controlled for.
- An ESM measure of depressed mood may overcome the limitations associated with long-term memory difficulties.

Table 1
Demographic and Clinical Information

	Schizophrenia	Healthy Controls	<i>U/χ²</i>	<i>p</i>
Age	30.14 (SD = 7.28)	23.90 (SD = 4.68)	273.000	< 0.001
Years of Education	14.39 (SD = 4.19)	15.24 (SD = 2.86)	454.000	0.312
Gender, <i>N</i> (%)			1.400	0.237
Male	32 (62.7%)	10 (47.6%)		
Race			1.353	0.852
White	27 (52.9%)	12 (57.1%)		
Black	5 (9.8%)	3 (14.3%)		
Asian American	7 (13.7%)	2 (9.5%)		
American Indian	1 (2.0%)	1 (4.8%)		
Multiracial	11 (21.6%)	3 (14.3%)		
Ethnicity -			0.823	0.364
Hispanic/Latino (% Yes)	15 (29.4%)	4 (19%)		
Marital Status			0.059	0.971
Single	46 (90.2%)	19 (90.5%)		
Divorced/Separated	2 (3.9%)	1 (4.8%)		
Married/Partnered	3 (5.9%)	1 (4.8%)		
Primary Language			0.303	0.582
English	35 (68.6%)	13 (61.9%)		
Bilingual	16 (31.4%)	8 (38.1%)		
Schizophrenia			Mean	S.D.
Positive Symptoms (Scale for Assessment of Positive Symptoms)			31.20	18.87
Negative Symptoms (Scale for Assessment of Negative Symptoms)			36.10	18.92
Retrospective Depressed Mood (Beck Depression Inventory)			17.44	10.89
Real-Time Depressed Mood (Experience Sampling Method)			41.67	23.17

Note: *N*=73 (schizophrenia=51, healthy controls=22)

Table 2
Correlations Among Measures of Depressed Mood, Quality of Life, Social Support, and Long-Term Memory

	Real-Time Depressed Mood (ESM)	Retrospective Depressed Mood (BDI-II)	Social Support (PSRS)	Quality of Life (QOLS)	Long-term Memory (LMM II)
Real-Time Depressed Mood	--	0.61**	0.59**	0.57**	-0.41*
Retrospective Depressed Mood	0.31	--	0.57**	0.41*	-0.043*
Social Support	0.52	0.38	--	0.71**	0.23
Quality of Life	0.47	0.41	0.61	--	-0.25

N= 42;

* >.05;

** >.01;

Zero-order correlations are presented above the diagonal. Partial correlations are presented below the diagonal (controlling for long-term memory); QOLS—Quality of Life Scale; PSRS—Provision of Social Relations Scale; BDI-II—Beck Depression Inventory – Second Edition; ESM—Experience Sampling Method; LMM II – Logical Memory II

Table 3
Association of Real-Time and Retrospective Measures of Depressed Mood with Negative Symptoms

	Real-Time Depressed Mood (Experience Sampling Method)	Retrospective Depressed Mood (Beck Depression Inventory)
Total Scale for the Assessment of Negative Symptom	0.31	0.36*
Affective Flattening	0.18	0.24
Alogia	0.18	0.25
Avolition	0.25	0.38*
Anhedonia - Asociality	0.33	0.35*
Inattentiveness	0.18	0.43**

N=36;

*
>.05,

**
>.01