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Authors

Perez, Michelle
Tercero, Bianca
Durand, Fiorella
et al.

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Revisiting how People with Schizophrenia Spend Their Days: Associations of lifetime milestone Achievements with Daily Activities examined with Ecological Momentary Assessment

Michelle M. Perez[a], **Bianca A. Tercero**[a], **Fiorella Durand**[b], **Felicia Gould**[a], **Raeanne C. Moore**[c], **Colin A. Depp**[c,d], **Robert A. Ackerman**[e], **Amy E. Pinkham**[e,f], **Philip D. Harvey**[a,g]

[a]Department of Psychiatry and Behavioral Sciences, Miller School of Medicine, University of Miami, 1120 NW 14th Street, Suite 1450, Miami, FL 33136 USA

[b]Immaculata- La Salle High School, Miami, FL, USA

[c]Department of Psychiatry, University of California, San Diego, California, USA

[d]VA San Diego Healthcare System, San Diego, California, USA

[e]School of Behavioral and Brain Sciences, The University of Texas at Dallas, Richardson, TX, USA

[f]Department of Psychiatry, University of Texas Southwestern Medical School, Dallas, TX, USA

[g]Research Service, Miami VA Healthcare System, Miami, FL, USA

Abstract

Milestone achievements are reduced in people with schizophrenia and are lower in comparison to people with bipolar disorder. However, it is not clear what the implications are for engagement in momentary activities based on milestone achievements. Further, some recent research has suggested that psychotic symptoms are associated with challenges in self-assessment of activities, but there is less information about the correlations of milestone achievements and ongoing psychotic symptoms. We examined momentary activities and symptoms as a function of lifetime milestone achievement in 102 individuals with schizophrenia and 71 with bipolar disorder. Ecological Momentary Assessment (EMA) was used to sample daily activities and concurrent symptoms 3 times per day for 30 days. Each survey asked the participant where they were, who they were with, and what they were doing, as well as sampling the concurrent presence of psychotic symptoms. Not being financially responsible for their residence was associated with engaging in fewer productive activities. Participants who never had a relationship were more commonly home and alone and engaged in fewer social interactions. A lifetime history of employment was correlated with engaging in more productive activities, including at home. More common momentary psychosis was seen in participants who failed to achieve each of the functional milestones. Lifetime milestone achievements were associated with greater frequencies

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Corresponding Author: Philip D. Harvey, PhD, Miller School of Medicine, University of Miami, 1120 NW 14th Street, Suite 1450, Miami, FL 33136 US (telephone: 305-243-4094; fax: 305-243-1619, philipdharvey1@cs.com).

of productive behaviors and with fewer momentary experiences of psychosis, suggesting that psychotic symptoms may have importance for sustaining disability that would be challenging to detect without momentary information.

Keywords

Schizophrenia; Schizoaffective Disorder; Bipolar Disorder; Daily Functioning; Milestone Achievements; Ecological Momentary Assessment; psychosis

1. Introduction

Schizophrenia (SCZ) continues to be a leading cause of disability worldwide (Charlson et al., 2018). Milestone achievements are an integral aspect of conceptions of recovery in severe mental illness with achievements defined across various domains, including vocational, residential, and social functioning (Murray and Lopez, 1997). Living independently, being financially responsible, obtaining competitive employment, or having social relationships are different definitional elements of successful outcome (Gould et al., 2013; Harvey et al., 2012). In participants with schizophrenia, rates of milestone achievements are commonly low, especially when examining the achievement of concurrent multiple milestones. As for people with bipolar disorder, their impairment in achievement functional milestones is generally less than that of people with schizophrenia (Huxley and Baldessarini, 2007; Iasevoli et al., 2015) and participants with bipolar disorder tend to have better residential and vocational outcomes across the lifespan (Strassnig et al., 2017). Still, bipolar patients, in comparison to healthy individuals, tend to have a lower quality of life, as evaluated by impairment in the domains of physical health, psychological health, social relationships, and environmental activities (Islam et al., 2020).

As noted by Harvey and Bellack (2009), assessment of efforts directed at eventual achievement of personally and societally relevant milestones are also important, as some milestones are determined by external factors (Rosenheck, et al., 2006) such as disability compensation. Current assessment methods with widely separated assessments have been recognized to be inadequate to assess daily functioning of participants with schizophrenia (Ben-Zeev et al., 2012). The current methods commonly require the individual to retrospectively self-report and recall their behaviors from the past. However, some studies have found that the correlation between participant retrospective reports and impressions of high contact clinicians can have a correlation close to zero (Durand et al., 2015). Further, this problem is exacerbated when participants are asked to make judgments about their capabilities and not just their activities (Gould et al., 2013; Durand et al., 2015).

People with schizophrenia, and to an extent bipolar disorder, have wide-ranging challenges in self-assessment of their abilities (Harvey and Pinkham; 2015). Previous work has compared judgments of abilities generated by people with these conditions and compared those results to similar ratings generated by informants, including clinicians and caregivers. Discrepancies between objective performance, which commonly converges with informant reports, and self-reports in global ratings of neurocognitive abilities have been commonly reported (e.g., Keefe et al., 2006; Gould et al., 2015; Jones et al., 2021) as have

discrepancies between self assessments of social cognitive abilities, informant reports, and performance based data (Silberstein et al. 2019). Further, participants with schizophrenia have long been reported to manifest over-confidence in their momentary cognitive performance (Moritz et al., 2014). In three recent papers based on a different dataset, we demonstrated that overconfidence in social cognitive decision making is quite substantial and highly correlated with social dysfunction (Pinkham et al., 2018), is present across all levels of social cognitive performance (Jones et al., 2019), and correlates with poor performance in neurocognitive as well as social cognitive domains (Perez et al., 2020). Also, participants with schizophrenia and bipolar disorder were both found to overestimate their momentary performance on a modified Wisconsin Card sorting test (WCST), but participants with bipolar disorder generated global judgments of their performance that were related to the actual number of correct sorts (Tercero et al., 2021). In contrast, participants with schizophrenia generated self-assessments of their global ability on the task that were correlated only with their momentary judgments and confidence and unrelated to the feedback about performance guides successful performance on the WCST. In a machine learning analysis of the data from the Jones et al. (2019) study, it was found that excessively high levels of momentary confidence, but not accuracy of performance or indices of deliberate effort, was the sole domain of discrimination between participants and with schizophrenia and healthy controls in a series of judgments regarding performance (Badal et al., 2021).

An alternative method for assessing everyday functioning is that of capturing participant's daily activities and moods on a momentary basis. Ecological momentary Assessment (EMA, also referred to as the Experience Sampling Method (ESM) can give us insight on what people with severe mental illness are doing and feeling on a momentary basis (Myin-Germeys, et al., 2018; Cohen et al., 2021). It provides real time information on performance in multiple domains of behaviors, including educational, employment, socialization, leisure and self-care activities (Schneider et al., 2017), in addition to providing information on momentary mood states (Jones et al., 2021) and psychotic symptoms (Postma et al., 2021). As all of these behaviors can vary throughout the day in concert with each other, momentary assessments can also examine convergence across domains of functioning and experience. Prior studies utilizing EMA have shown that people with schizophrenia are less likely than healthy controls to engage in productive activities during daytime hours (Granholm et al., 2020) and are more likely to engage in activities such as sleeping, smoking, or "nothing" (Strassnig et al., 2021b). This behavior stream is consistent with the negative symptom known as avolition, which involves the lack of motivation or ability to do activities that have an end goal (Strauss et al., 2021). Additionally, participants with schizophrenia are more likely than healthy controls to be engaged in predominantly seated activities (Strassnig et al., 2021a) and to be engaged in only a single activity since their previous survey (Strassnig et al., 2021b). The results of paging-based studies of EMA activities have also been validated using global positioning strategies, confirming that participants' reports of their location and social context can be confirmed with fully objective geolocation information (Depp et al., 2019; Raugh et al., 2020).

In this paper, we present a study that used data previously collected with EMA strategies to systematically examine daily activities and symptoms and then subsequently relate them

to lifetime milestone achievements. In a sample of people with Schizophrenia and Bipolar Disorder, our goal was to examine the relationship between momentary daily activities including location (home vs. away) social context (alone vs with someone) and current activities: "What are you doing?". Thus, the intersection of these simple questions allows for assessment of social engagement and motivation, social isolation, quality of on-going behaviors, and avolition. We also collected momentary self-report ratings of the occurrence of symptoms of psychosis. Activities were classified into three broad categories based on previous research by us and others: (productive, passive recreational and unproductive).

Although achievement of certain milestones such as employment would clearly suggest that participants would be more likely to be away from home, it is still possible that employed and unemployed participants would engage in different numbers of productive vs. unproductive behaviors when at home. We already know that social context does not necessarily determine the nature of daily activities, in that we found that the presence of another person was not necessarily associated increased likelihood of engaging in social interactions (Strassnig et al., 2021b). Momentary psychotic experiences may be very relevant to milestone achievement and there is little information to date on the correlation between momentary psychotic experiences and the likelihood of both concurrent and long-term functional achievements.

In our analyses of these data, we hypothesized that we would see that participants who were unemployed or not responsible for their residence would engage in more unproductive behaviors while at home than participants who achieved the milestones. Also, we expected that participants who had never achieved a sustained interpersonal relationship would be more frequently home and alone and that they would not behave differently in terms of social or productive activities when others were present or not. Finally, in one of the first examinations of this topic, we tested the hypothesis that momentary psychotic experiences would be more common in participants with failures to achieve all three milestones.

2. Methods

2.1. Participants

Participants who met DSM-V criteria for Schizophrenia, Schizoaffective Disorder, Bipolar Disorder (I or II), with or without current or previous psychotic symptoms participated in this study. They were recruited at three different sites: The University of Miami Miller School of Medicine (UM), the University of California, San Diego (UCSD), and The University of Texas at Dallas (UTD). The study was approved by each University's respective Institutional Review Board, and all participants provided written informed consent. Diagnostic information was collected by trained interviewers using the Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) and the psychosis module of the Structured Clinical Interview for DSM Disorders-5 (SCID-5; First et al., 2015) and a local consensus procedure was used to generate final diagnoses.

2.2. Inclusion/Exclusion Criteria

To be eligible, participants had to meet criteria for one of the disorders mentioned above. Individuals with bipolar disorder also had to meet a staging model severity of 3 or higher, indicating at least one mood episode recurrence or incomplete remission from a first-episode (Frank et al., 2014). Participants were also required to be clinically stable (i.e. no hospitalizations or extended ER visits) for a minimum of 6 weeks and to be on a stable medication regimen (including no prescribed medications) for a minimum of 6 weeks with no dose changes >20% for a minimum of 2 weeks. All antipsychotics or antipsychotic combinations were accepted.

For participants in both diagnostic groups exclusion criteria included: (1) history of or current medical or neurological disorders that may affect brain functioning (e.g., CNS tumors, seizures, or loss of consciousness for over 15 minutes), (2) history of or current intellectual disability (IQ<70) or pervasive developmental disorder according to the DSM-5 criteria, (3) (4) history of a of substance use disorder at a level of severity of moderate or greater not in remission for at least six months, (5) visual or hearing impairments that interfere with assessment, and (6) lack of proficiency in English. Additional details on the full study have been previously published (Harvey et al., 2021; Strassnig et al., 2021b), although the current analyses have not been presented before.

2.3. Assessment of Milestone Achievements

At the time of the diagnostic assessment, we collected information on three different functional milestones, one social (ever having had a relationship equivalent to marriage), currently financially responsible for payment for their residence, and unemployed for more than one year. We collected extensive information on all of these domains, using strategies for assessing outcomes that we had employed before in previous studies: Employment (Fundora et al., 2021) and financial responsibility and relationship status (Harvey et al., 2012). In order to ascertain the validity of information, particularly regarding employment histories, we collected detailed information such as supervisors, salary, and working hours on current, most recent, and best ever occupations.

Social relationships did not have to be monogamous in order to be counted as occurring and there was no duration requirement for sustaining the relationship. Participants who were responsible for their residence could obtain the funds for their residence from any source (employment, disability compensation, support from relatives), as long as they were the responsible party for paying bills and maintaining the stability of the residence. Finally, in the domain of employment, a one year period was selected because in our prior study (Fundora et al., 2021), where two years of unemployment defined long-term unemployment, there were no participants who were unemployed for periods between 1 and 2 years.

2.4. EMA Procedures

A Samsung smartphone with Android OS was used to deliver EMA surveys. A device was provided by the investigators to participants who did not have their own smartphone or did not wish to use their own device. Participants received text messages with weblinks to EMA surveys 3 times daily for 30 days, with data instantly uploaded to a cloud-based data

capture system. The signals occurred at stratified random intervals that varied from day to day within, on average, 2.0-hour windows starting at approximately 9:00AM and ending at 9:00PM each day. The first and last daily assessment times were adjusted to accommodate each participant's typical sleep and wake schedules. All responses were time-stamped and were only allowed within a 1-hour period following the signal, although participants had the option of silencing alarms for 30-minute intervals (e.g., driving, naps, classes). An in-person training session (typically <20 min) was provided on how to operate and charge the device and respond to surveys, including the meaning of all questions and response choices.

EMA activity surveys (see Table 1) were check-box questions asking about behaviors performed since the previous survey. The first question in each survey sequence asked about the participants' location (home vs. away), then whether the participant was alone or with someone. If respondents indicated that they were with someone, they were next queried as to with whom and given the choice to respond with more than one response, including friends, family members, partners, pets, healthcare providers, other known people, and unknown people. The subsequent screens were then customized to deliver home alone, home with someone, and away queries tapping potential activities within the respondent determined social context, including activities ranging from working for pay, cleaning the house, watching television, or doing "nothing". Queries were structured such that the first survey of the day queried "Today" and subsequent surveys queried "since the last survey".

2.4.1.   Quality of Activities.—Some activities are clearly easy to characterize as unproductive, particularly if they were the only activity since the previous survey. As such, smoking, sitting alone, and sleeping were designated as unproductive. Productive activities could be performed both home and away, but home and away productive activities are not overlapping. As noted in Table 1, there are several passive recreation activities that are sampled, with our previous analyses (Strassnig et al., 2021a) finding that their occurrence was not different across healthy people and participants with schizophrenia (e.g., watching TV and listening to music). We thus separated them from clearly productive vs. clearly unproductive activities. The designations of these activities were based on discussion among the primary investigators and included feedback from previous reviewers of our EMA studies and grant proposals. Each of the three activities were converted to proportion scores at each survey, such engaging in a single unproductive activity at a survey would be coded as 1.0 for unproductive and 0 for passive and productive. Engaging in one productive and one passive activity would be coded as .50 for those two and 0.0 for unproductive.

2.4.2   EMA of Psychosis.—Following the activity questions a brief series of questions regarding psychotic symptoms was presented. Participants were asked to rate the severity of their current experiences in domains of hallucinations, having paranoid ideas, and three delusions: mind reading, receiving messages, and having special powers or abilities. These severity scores were scaled from 1–7 and were sampled in the same time frame as the activity surveys. Thus, there was a severity score for all 5 symptoms at each EMA assessment which included other survey responses, which allowed for examination of momentary correlates of symptoms and creation of aggregated scores across all observations for each participant.

2.5. Data Analyses

We compared the two participant groups on demographic factors and overall symptom severity rated with clinical rating scales, as well as functional milestones, with t-test or X^2 tests. We then performed longitudinal analyses of the association between lifetime milestone achievements and current activities and psychotic symptoms, using Hierarchical Linear Modeling (HLM) with the SPSS (Version 28; IBM, 2021) Generalized Liner Models module. As this is a repeated measures analysis, we entered day (1–30) and survey (1–3) as the repeated factors and diagnosis as the between-subjects factor, entering subject as a random intercept. Sex and age were used as covariates in all analyses and we created EM means after adjustment for all repeated measures factors and covariates. For each model, we used the omnibus test to determine that the fitted model improved on the intercept-only (participant level) model. In the first analyses, we performed three analyses, predicting each of three functional milestones with the proportion of surveys over the EMA period endorsed as being home, being alone, and their interaction, as well as the severity of the psychotic symptoms at each of the of 3×30 surveys. The location and symptom variables were treated as dynamic covariates because they were repeated at each assessment.

In the next analysis, we predicted the proportion of the activities in each survey that were productive, unproductive, and passive recreation. We again used the same repeated measures design, entering day and time of day as repeated factors, subject as a random intercept, entering diagnosis, age, and sex as between subjects' variables, and adding the three milestones variables as non-repeated between subjects' factors.

For prediction of dichotomous milestones, we used the GLM binary logistic regression module of SPSS 28 and for prediction of continuous activity scores, we used the MMRM modeling strategy. All analyses considered subject as a random intercept. We used full information maximum likelihood procedures to address missing data and had excluded all participants who did not complete baseline and endpoint in person assessments. As we were entering around 5 variables per analysis, we considered p<.01 (.05/5) to be the lower boundary for statistical significance for each predictor variable across analyses.

3. Results

Descriptive information on the individuals with bipolar disorder (n=71) and schizophrenia (n=102) patient samples is presented in Table 2. Medications that were prescribed for all participants are presented in supplemental Table 1. Participants with bipolar disorder had more education and higher WRAT-3 reading scores than the participants with schizophrenia. In terms of functional milestones, participants with bipolar disorder were more likely to have ever been married or equivalent and less likely to be unemployed for one year or more, with no significant differences in financial responsibility for current residential status. Significance tests for these diagnostic differences were conducted in the HLM analyses in order to control for other variables. There were a total of 11,611 surveys with activity data available and symptom reports completed, with 6,814 coming from people with schizophrenia and 4,797 from bipolar participants. Overall adherence to the surveys was 75%, with no differences in the participants with either diagnosis (see Jones et al., 2021 for detailed analyses of adherence in this sample). For mind reading, special powers, and

receiving messages, the mean severity score across surveys was 1.2 or less on all three for the bipolar participants and the prevalence of all three of these symptoms was less than 7% of the surveys. As paranoid ideation was present on 10% of the surveys, hallucinations and paranoia were retained for predictive analyses.

The results of the analyses of the three functional milestones are presented in Table 3. For all three analyses, the omnibus effect was statistically significant, but there were no covariate effects of age after entry of diagnosis. Females were more likely to have had a long-term relationship, but sex was not associated with other milestones. For relationships and employment status, the HLM analyses found that participants with bipolar disorder were more likely to achieve the milestones. For all three milestones, failure to achieve the milestones were associated with being home or alone on more of the surveys. Being more commonly home alone was significantly associated with unemployment and no lifetime relationships. For the psychotic symptoms, the severity of hallucinations was more substantial in cases who did not achieve all three milestones. Paranoid ideation also was more commonly present in cases who did not achieve all three functional milestones.

Table 4 presents the results of the prediction of three activity types across the surveys. For two of the three analyses, the omnibus effect was statistically significant, with unproductive activities not being significant at the corrected level of significance. There were no statistically significant repeated-measures effects of day for any activities. For productive activities, the effect of diagnosis was not significant, but achievement of all three functional milestones was associated with a greater likelihood of engaging in productive activities across the up to 90 surveys. Passive recreation did manifest an effect of diagnosis, with passive recreation being more common in participants with schizophrenia and in participants who were not financially responsible and unemployed for more than a year at the time of assessment. Lifetime relationship status did not correlate with the likelihood of engaging in passive recreational activities.

4. Discussion

This study used data collected from EMA strategies to systematically examine daily activities and symptoms as a function of lifetime milestone achievements. We examined the relationship between momentary daily activities including location, social context, and current activities and momentary reports of symptoms of psychosis in people with either schizophrenia or bipolar disorder. Momentary psychotic experiences had not been previously examined in the context of milestone achievement within these 2 patient populations. Our analyses targeted psychotic symptoms and momentary activities as a function of three different types of milestone achievements. Our results indicated that milestone achievements were associated with greater frequencies of productive behaviors, including at home, and fewer momentary experiences of psychosis

Specifically, we hypothesized that momentary psychotic experiences would be associated with failures to achieve all three milestones and, as hypothesized, more common momentary psychosis was seen in these participants. In our analysis of psychotic symptoms, the severity of hallucinations was more substantial in with failures to achieve all three milestones.

Paranoid delusions were also more commonly present in participants who did not achieve all three milestones. These results are consistent with those of Schneider et al. (2017). Their group also used EMA to analyze functioning in a sample of participants with psychosis and found they spent more time home, alone, and doing nothing relative to healthy controls. It is possible that participants who are chronically suspicious or mistrustful may find it more difficult to engage with the community and therefore, seek a job or find a spouse, and they fail to achieve such milestones.

We additionally hypothesized that we would see that participants who were unemployed or not responsible for their residence would engage in fewer productive and more unproductive behaviors overall than participants who achieved the milestones. Our results supported this hypothesis, as a lifetime history of employment was correlated with engaging in more productive activities, including at home. Accordingly, unemployed participants, as well as those who were not responsible for their residence, engaged in fewer productive behaviors than participants who had achieved those milestones. These findings are consistent with previous research, which has found that patients with schizophrenia with the poorest achievements in functional milestones of everyday living were most likely to be unemployed and highly dependent on others for their support (Iasevoli et al., 2016). It is important to mention that these two milestones can be related in some studies, as unemployed participants often cannot afford to live independently. However, our definition of residential independence does not require that the money used to pay bills comes from work.

Achievement of a reciprocal interpersonal relationship is another important milestone examined by the present study. Consistent with our hypotheses, participants who never had such a relationship were more commonly home and alone and engaged in fewer social interactions when with others. However, previous research by Schneider et. (2017) has found that patients with psychotic disorders did not differ from healthy-controls in their enjoyment of solitude, suggesting that being alone is not always maladaptive (much like watching television or doing schoolwork). Additionally, research by Brown et al. (2007) suggested that while patients with schizophrenia spectrum disorder had increased social anxiety, suggesting that the cause of social deficits may not always be social anhedonia. For instance, in an EMA study with a different sample, Parrish et al (2021) reported that preparing to leave home was associated with more negative affect in participants with schizophrenia than healthy people, while returning home reduced this experience. Although decreased social engagement such as observed in this study may reflect avolition, which has been well known to predict social dysfunction in both people with schizophrenia and bipolar disorder (Harvey et al., 2017; Strassnig et al., 2021b; Strauss et al., 2016), there may be other contributors.

We previously reported that participants who were routinely home and alone reported better social functioning than participants who spent more time with others, as well as notable reductions in sad moods (Jones et al., 2021). Participants with schizophrenia and bipolar disorder displayed a disassociation between the occurrence of momentary activities and their global self-assessments at the end of the EMA period (Durand et al., 2021). Positive schizophrenia symptoms have been associated with the overestimation of various skills (Gohari et al., 2022), particularly reporting high levels of competence in activities that were

never performed during the EMA period (e.g., scoring yourself as "superior" at taking public transportation while never leaving home over a 30-day period). These findings are also consistent with previous studies suggesting that people with schizophrenia are found to be more confident about their decisions, correct or not, than healthy people (Moritz et al., 2014; Perez et al., 2021).

The present study had several limitations. First, the participant groups are not of equal sizes and different in demographics which particularly impact on employment opportunities. Another limitation in the present study was the use of only two participant groups and no healthy controls, although it is not clear what healthy controls would control for studies such as this (Granholm et al., 2020). Third, definitions of milestone achievements do not have a truly objective nature: is unemployment for 12, 24, or 6 months more important? Is a "marriage-equivalent" social relationship more meaningful than other types of relationships? Are the differences in rates of disability compensation (59% for participants with schizophrenia and 32% of the bipolar participants) responsible for differences in employment outcomes? It would be expected that bias with respect to participant recruitment for studies such as this would lead to over-inclusion of unemployed or people otherwise unengaged in full time activities. This was found in healthy controls as well in the Granholm et al. (2020) study.

In conclusion, reduced milestone achievement was associated with poorer momentary functioning and more symptomatic experiences in patients with both schizophrenia and bipolar disorder despite diagnostic differences across functional domains. These findings go beyond the expected differences in being home more for unemployed vs. unemployed participants. Not having financial responsibility was associated with hearing voices and more paranoid ideation as well as engaging in fewer productive activities even at home. Never attaining a significant relationship in one's life was associated with being more commonly home and alone and engaging in fewer social interactions even when in the immediate presence of others. There were domain specific correlations, in that long term social deficits predicted more social isolation, while lifetime achievements in domains of residential independence and employment status predicted more productive activities, home or away or alone vs. with someone. Momentary psychosis was more common in participants who failed to achieve all functional milestones.

EMA enables the ability to sample present moods, attitudes, and actions throughout the day, rather than depending on recall of general experiences that occurred long enough ago for recollection to be difficult or inaccurate. This underscores the need for EMA in order to provide more accurate data and provide insight for future treatment. It is hoped that this type of research will enable more focused interventions that more accurately reflect the realities of everyday life such as increasing social skills, socialization and supporting milestone achievement such as employment as much as possible.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

References

Badal VD, Depp CA, Hitchcock PF, Penn DL, Harvey PD, Pinkham AE, 2021. Computational methods for integrative evaluation of confidence, accuracy, and reaction time in facial affect recognition in schizophrenia. Schizophr. Res. Cogn, 25, 100196. 10.1016/j.scog.2021.100196 [PubMed: 33996517]

Ben-Zeev D, Morris S, Swendsen J, Granholm E, 2012. Predicting the occurrence, conviction, distress, and disruption of different delusional experiences in the daily life of people with schizophrenia. Schizophr. Bull, 38(4), 826–837. 10.1093/schbul/sbq167 [PubMed: 21248277]

Bowie CR, Reichenberg A, Patterson TL, Heaton RK, Harvey PD, 2006. Determinants of real-world functional performance in schizophrenia subjects: correlations with cognition, functional capacity, and symptoms. Am. J. Psychiatry, 163(3), 418–425. 10.1176/appi.ajp.163.3.418 [PubMed: 16513862]

Charlson FJ, Ferrari AJ, Santomauro DF, Diminic S, Stockings E, Scott JG, McGrath JJ, Whiteford HA, 2018. Global Epidemiology and Burden of Schizophrenia: Findings From the Global Burden of Disease Study 2016. Schizophr. Bull, 44(6), 1195–1203. 10.1093/schbul/sby058 [PubMed: 29762765]

Cohen AS, Schwartz E, Le TP, Cowan T, Kirkpatrick B, Raugh IM, Strauss GP, 2021. Digital phenotyping of negative symptoms: the relationship to clinician ratings. Schizophr. Bull, 47(1), 44–53. 10.1093/schbul/sbaa065 [PubMed: 32467967]

Depp CA, Bashem J, Moore RC, Holden JL, Mikhael T, Swendsen J, Harvey PD, Granholm EL, 2019. GPS mobility as a digital biomarker of negative symptoms in schizophrenia: a case control study. NPJ digital medicine, 2, 108. 10.1038/s41746-019-0182-1 [PubMed: 31728415]

Durand D, Strassnig MT, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD, 2021. Self-reported social functioning and social cognition in schizophrenia and bipolar disorder: Using ecological momentary assessment to identify the origin of bias. Schizophr. Res, 230, 17–23. 10.1016/j.schres.2021.02.011 [PubMed: 33667854]

Durand D, Strassnig M, Sabbag S, Gould F, Twamley EW, Patterson TL, Harvey PD, 2015. Factors influencing self-assessment of cognition and functioning in schizophrenia: implications for treatment studies. Eur. Neuropsychopharmacol, 25(2), 185–191. 10.1016/j.euroneuro.2014.07.008 [PubMed: 25104226]

First MB, Williams JBW, Karg RS, Spitzer RL, 2015. Structured Clinical Interview for DSM-5—Research Version (SCID-5 for DSM-5, Research Version; SCID-5-RV). Arlington, VA, American Psychiatric Association.

Frank E, Nimgaonkar VL, Phillips ML, Kupfer DJ, 2015. All the world's a (clinical) stage: rethinking bipolar disorder from a longitudinal perspective. Mol. Psychiatry, 20(1), 23–31. 10.1038/mp.2014.71 [PubMed: 25048003]

Fundora C, Cruz M, Barone K, Penn DL, Jarskog LF, Pinkham AE, Harvey PD, 2021. Lifetime employment in schizophrenia: correlates of developing long term unemployment after being employed before. Cogn. Neuropsychiatry, 26(2), 95–106. 10.1080/13546805.2020.1865896 [PubMed: 33380266]

Gohari E, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD 2022. Momentary severity of psychotic symptoms predicts overestimation of competence in domains of everyday activities and work in schizophrenia: An ecological momentary assessment study. Psychiatry Res. 310, 114487. 10.1016/j.psychres.2022.114487 [PubMed: 35245835]

Gould F, McGuire LS, Durand D, Sabbag S, Larrauri C, Patterson TL, Twamley EW, Harvey PD, 2015. Self-assessment in schizophrenia: Accuracy of evaluation of cognition and everyday functioning. Neuropsychology, 29(5), 675–682. 10.1037/neu0000175 [PubMed: 25643212]

Gould F, Sabbag S, Durand D, Patterson TL, Harvey PD, 2013. Self-assessment of functional ability in schizophrenia: milestone achievement and its relationship to accuracy of self-evaluation. Psychiatry Res, 207(1–2), 19–24. 10.1016/j.psychres.2013.02.035 [PubMed: 23537844]

Granholm E, Holden JL, Mikhael T, Link PC, Swendsen J, Depp C, Moore RC, Harvey PD, 2020. What Do People With Schizophrenia Do All Day? Ecological Momentary Assessment of Real-World Functioning in Schizophrenia. Schizophr. Bull, 46(2), 242–251. 10.1093/schbul/sbz070 [PubMed: 31504955]

Harvey PD, Bellack AS, 2009. Toward a terminology for functional recovery in schizophrenia: is functional remission a viable concept?. Schizophr. Bull, 35(2), 300–306. 10.1093/schbul/sbn171 [PubMed: 19126634]

Harvey PD, Pinkham AE, 2015. Impaired self-assessment in schizophrenia: Why patients misjudge their cognition and functioning. Current Psychiatry. 14(4), 53–59.

Harvey PD, Sabbag S, Prestia D, Durand D, Twamley EW, Patterson TL, 2012. Functional milestones and clinician ratings of everyday functioning in people with schizophrenia: overlap between milestones and specificity of ratings. J. Psychiatric Res, 46(12), 1546–1552. 10.1016/j.jpsychires.2012.08.018

Huxley N, Baldessarini RJ 2007. Disability and its treatment in bipolar disorder patients. Bipol. Disord, 9(1–2), 183–196. 10.1111/j.1399-5618.2007.00430.

Iasevoli F, Giordano S, Balletta R, Latte G, Formato MV, Prinzivalli E, De Berardis D, Tomasetti C, de Bartolomeis A, 2016. Treatment resistant schizophrenia is associated with the worst community functioning among severely-ill highly-disabling psychiatric conditions and is the most relevant predictor of poorer achievements in functional milestones. Prog. Neuropsychopharmacol. Biol. Psychiatry, 65, 34–48. 10.1016/j.pnpbp.2015.08.010 [PubMed: 26320028]

Islam MK, Islam MS, Kibria SM, Rahman MM, Algin S, Mullick MS, 2020. Quality of Life among Patients with Bipolar Disorder. MMJ, 29(3), 601–608. [PubMed: 32844800]

Jones SE, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD, 2021. Daily Ecological Momentary Assessments of happy and sad moods in people with schizophrenia and bipolar disorders: What do participants who are never sad think about their activities and abilities? Schizophr. Res..Cognition, 26, 100202. 10.1016/j.scog.2021.100202

Jones MT, Deckler E, Laurrari C, Jarskog LF, Penn DL, Pinkham AE, Harvey PD, 2019. Confidence, performance, and accuracy of self-assessment of social cognition: A comparison of schizophrenia patients and healthy controls. Schizophr. Res.. Cogn, 19, 002–2. 10.1016/j.scog.2019.01.002 [PubMed: 31832336]

Kay SR, Fiszbein A, Opler LA, 1987. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr. Bull. 13(2), 261–276. [PubMed: 3616518]

Keefe RS, Poe M, Walker TM, Kang JW, Harvey PD, 2006. The Schizophrenia Cognition Rating Scale: an interview-based assessment and its relationship to cognition, real-world functioning, and functional capacity. Am. J. Psychiatry, 163(3), 426–432. 10.1176/appi.ajp.163.3.426 [PubMed: 16513863]

Mahmood Z, Keller AV, Burton CZ, Vella L, Matt GE, McGurk SR, Twamley EW, 2019. Modifiable Predictors of Supported Employment Outcomes Among People With Severe Mental Illness. Psychiatric Serv, 70(9), 782–792. 10.1176/appi.ps.201800562

Montgomery SA, Asberg M, 1979. A new depression scale designed to be sensitive to change. Br. J. Psychiatry 134, 382–389. [PubMed: 444788]

Moritz S, Ramdani N, Klass H, Andreou C, Jungclaussen D, Eifler S, Englisch S, Schirmbeck F, Zink M, 2014. Overconfidence in incorrect perceptual judgments in patients with schizophrenia. Schizophr. res. Cogn, 1(4), 165–170. 10.1016/j.scog.2014.09.003 [PubMed: 29379749]

Myin-Germeys I, Kasanova Z, Vaessen T, Vachon H, Kirtley O, Viechtbauer W, Reininghaus U, 2018. Experience sampling methodology in mental health research: new insights and technical developments. World Psychiatry : 17(2), 123–132. 10.1002/wps.20513 [PubMed: 29856567]

Murray CJ, Lopez AD, 1997. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet, 349(9063), 1436–1442. 10.1016/S0140-6736(96)07495-8 [PubMed: 9164317]

Parrish EM, Depp CA, Moore RC, Harvey PD, Mikhael T, Holden J, Swendsen J, Granholm E 2020. Emotional determinants of life-space through GPS and ecological momentary assessment in schizophrenia: What gets people out of the house? Schizophr. Res. 224:67–73. doi: 10.1016/j.schres.2020.10.002. [PubMed: 33289659]

Perez MM, Tercero BA, Penn DL, Pinkham AE, Harvey PD, 2020. Overconfidence in social cognitive decision making: Correlations with social cognitive and neurocognitive performance in participants with schizophrenia and healthy individuals. Schizophr. Res. 224, 51–57. 10.1016/j.schres.2020.10.005. [PubMed: 33097367]

Pinkham AE, Harvey PD, Penn DL, 2018. Social Cognition Psychometric Evaluation: Results of the Final Validation Study. Schizophr. Bull, 44(4), 737–748. 10.1093/schbul/sbx117 [PubMed: 28981848]

Postma MR, van Amelsvoort T, Myin-Germeys I, Gayer-Anderson C, Kempton MJ, Valmaggia L, McGuire P, Murray RM, Garety P, Wykes T, Morgan C, Reininghaus U, 2021. Across the continuum: Associations between (fluctuations in) momentary self-esteem and psychotic experiences. Schizophr. Res, 238, 188–198. 10.1016/j.schres.2021.09.010 [PubMed: 34785480]

Raugh IM, James SH, Gonzalez CM, Chapman HC, Cohen AS, Kirkpatrick B, Strauss GP, 2020. Geolocation as a Digital Phenotyping Measure of Negative Symptoms and Functional Outcome. Schizophr. Bull, 46(6), 1596–1607. 10.1093/schbul/sbaa121

Rosenheck R, Leslie D, Keefe R, McEvoy J, Swartz M, Perkins D, Stroup S, Hsiao JK, Lieberman J, CATIE Study Investigators Group., 2006. Barriers to employment for people with schizophrenia. Am.J. Psychiatry, 163(3), 411–417. 10.1176/appi.ajp.163.3.411 [PubMed: 16513861]

Schneider M, Reininghaus U, van Nierop M, Janssens M, Myin-Germeys I, GROUP Investigators., 2017. Does the Social Functioning Scale reflect real-life social functioning? An experience sampling study in patients with a non-affective psychotic disorder and healthy control individuals. Psychol. Med, 47(16), 2777–2786. 10.1017/S0033291717001295 [PubMed: 28534464]

Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, Hergueta T, Baker R, Dunbar GC, 1998. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. J. Clin. Psychiatry, 59 Suppl 20, 22–57.

Silberstein JM, Pinkham AE, Penn DL, Harvey PD, 2018. Self-assessment of social cognitive ability in schizophrenia: Association with social cognitive test performance, informant assessments of social cognitive ability, and everyday outcomes. Schizophr. Res, 199, 75–82. 10.1016/j.schres.2018.04.015 [PubMed: 29673732]

Strassnig M, Cornacchio D, Harvey PD, Kotov R, Fochtmann L, Bromet EJ, 2017. Health status and mobility limitations are associated with residential and employment status in schizophrenia and bipolar disorder. J. Psychiatric Res, 94, 180–185. 10.1016/j.jpsychires.2017.07.011

Strassnig MT, Harvey PD, Miller ML, Depp CA, Granholm E, 2021a. Real world sedentary behavior and activity levels in patients with schizophrenia and controls: An ecological momentary assessment study. Mental health and physical activity, 20, 10.1016/j.mhpa.2020.100364. 10.1016/j.mhpa.2020.100364

Strassnig MT, Miller ML, Moore R, Depp CA, Pinkham AE, Harvey PD, 2021b. Evidence for avolition in bipolar disorder? A 30-day ecological momentary assessment comparison of daily activities in bipolar disorder and schizophrenia. Psychiatry research, 300, 113924. 10.1016/j.psychres.2021.113924 [PubMed: 33848963]

Strauss GP, Vertinski M, Vogel SJ, Ringdahl EN, Allen DN, 2016. Negative symptoms in bipolar disorder and schizophrenia: A psychometric evaluation of the brief negative symptom scale across diagnostic categories. Schizophr. Res, 170(2–3), 285–289. 10.1016/j.schres.2015.12.014 [PubMed: 26742510]

Tercero BA, Perez MM, Mohsin N, Moore RC, Depp CA, Ackerman RA, Pinkham AE, Harvey PD, 2021. Using a Meta-cognitive Wisconsin Card Sorting Test to measure introspective accuracy and biases in schizophrenia and bipolar disorder. Journal of psychiatric research, 140, 436–442. [PubMed: 34147931]

Table 1

EMA Sampled Activities and Their Overall Frequency (34 Total Activities Sampled)

Unproductive Activities	% of Total Surveys	Passive Recreation	% of Total Surveys
Sit alone	6.2	Watching Television	18.8
Lie down and rest	16.6	Listening to Music	2.8
Nothing	4.9	Social Media	1.8
Smoking	4.1	Reading (not schoolwork)	1.8
Total	**31.8**	Other Nonphysical Leisure	1.2
		Total	**26.4**

Productive Activities

Home based		*Away from Home*	
	% of Total Surveys		% of Total Surveys
Eating or Drinking	5.6	Working/Looking for Work	6.9
Cooking	4.4	Eating Out	4.6
Cleaning the House	2.5	Transportation	3.7
Grooming	2.3	Shopping	2.6
Doing Laundry at Home	1.3	Exercising	2.1
Changing Clothes	1.1	Visiting Family	1.5
Meditating	0.6	Volunteer Work	1.4
Working on a Hobby	0.2	School/School Work	1.3
Paying Bills with computer	0.3	Therapeutic Activities	0.8
Shopping Online	0.2	Movie, Theater	0.8
Gardening	0.1	Religious	0.7
Total	**17.6**	Social Activity	0.6
		Beach/park	0.3
		Doing Laundry Away	0.2
		Total	**24.2**

Table 2

Descriptive and Demographic Information on Participants

	Schizophrenia N=102		Bipolar Disorder n=71		t	p
	M	SD	M	SD		
Age	41.98	10.44	39.22	11.75	1.63	.11
Years of Education	12.53	2.32	14.22	2.64	4.42	<.001
Mothers Education	13.05	3.54	13.67	3.67	1.81	.069
WRAT-3- Standard Score	95.42	11.85	102.13	11.70	3.67	<.001
EMA Psychotic Symptoms (Aggregate Scores Across all surveys)						
Voices	2.24	1.55	1.33	0.76	4.63	<.001
Paranoia	2.54	1.58	1.68	1.35	3.74	<.001
					X^2	p
Sex (% Female)	48		69		8.22	.004
Racial Status (%)						
Caucasian	32		53		15.27	.009
African American	54		25			
Asian	2		3			
Native American, Hawaiian, Alaskan	1		1			
Other, Multiple, Unknown	11		12			
Ethnic Status						
Hispanic	24		29		0.64	.42
Non-Hispanic	76		81			
Ever Married or Equivalent(%)	49		70			
Financially Responsible (%)	71		70			
Unemployed for More than one Year (%)	60		45			
Home (%)	68		64			
Alone (%)	49		40			
Home Alone (%)	40		30			

Table 3

Multi-Level of Modeling of the Correlates of Mile Stone Achievements in Domains of EMA Reported Social Context and Psychotic Symptoms over 30 days and 90 Surveys

	Unemployed For More than 1 year		Financially Responsible for Residence		Relationship Status Never vs. Ever	
	X^2 (df)	p	X^2 (df)	p	X^2 (df)	p
Omnibus	565.52 (41)	<.001	209.93 (41)	<.001	1050.27 (41)	<.001
Intercept	64.77 (1)	<.001	431.225 (1)	<.001	2.47 (1)	.12
Sex	2.01. (1)	.16	2.66 (1)	.10	46.41 (1)	<.001
Age	5.11 (1)	.025	3.68 (1)	.07	115 (1)	.28
Diagnosis	196.06 (1)	<.001	3.21 (1)	.07	397.52 (1)	<.001
Home	262.94 (1)	<.001	10.59 (1)	.001	6.51 (1)	.01
Alone	29.874 (1)	<.001	24.38 (1)	<.001	99.47 (1)	<.001
Home Alone	11.01 (1)	.001	5.18 (1)	.023	19.36 (1)	<.001
Voices	130.55(1)	<.001	17.72 (1)	<.001	72.61 (1)	<.001
Paranoia	193.19 (1)	<.001	31.87 (1)	<.001	21.89 (1)	<.001

EM Means for Outcomes by Home and Alone Status [a]

	Unemployed For More than 1 year		Financially Responsible for Residence		Relationship Status	
	EM	SE	EM	SE	EM	SE
Home Alone	.67	.01	.70	.01	.48	.01 [b]
With Someone	.68	.01	.71	.01	.62	.01
Away Alone	.54	.01 [b]	.79	.01 [c]	.48	.02 [c]
With Someone	.44	.01	.74	.01	.54	.01

[a] Note that unemployed is coded as 1, so higher values are associated with unemployment

[b] Contrast significant at p<.001

[c] Contrast significant at p<.01

Table 4

Multi-Level Modeling of Frequency of Different Types of Daily Activities by Milestone Achievements

	Productive			Passive Recreation			Unproductive		
	X^2	(df)	p	X^2	(df)	p	X^2	(df)	p
Omnibus	172.81	33	<.001	195.42	33	<.001	53.55	33	.013
Intercept	275.86	2	<.001	36.52	1	<.001	145.25	1	<.001
Day	20.69	29	0.77	28.85	29	0.74	35.59	29	0.19
Age	0.50	1	0.48	2.22	1	0.26	2.56	1	0.11
Sex	1.08	2	0.30	2.69	1	0.09	4.98	1	0.03
Diagnosis	1.26	1	0.26	14.61	1	<.001	13.37	1	.001
Residence	27.77	1	<.001	66.24	1	<.001	3.69	1	.055
Employment	121.21	1	<.001	133.78	1	<.001	1.09	1	.30
Relationship	8.53	1	.003	1.29	1	.26	4.30	1	.038

EM Mean (Standard Errors of Measurement)

	Productive		Passive Recreation		Unproductive	
	M	SE	M	SE	M	SE
Financially Responsible						
No	.44	.01[a]	.26	.01[a]	.32	.01
Yes	.50	.01	.18	.01	.30	.01
Unemployed more than 1 Year						
No	.53	.01[a]	.17	.01[a]	.30	.01
Yes	.41	.01	.27	.01	.32	.01
Relationship Status (never/Ever)						
No	.46	.01[b]	.22	.01	.32	.01
Yes	.49	.01	.21	.01	.30	.01

[a]. Contrast significant at p<.001

[b]. Contrast significant at p<.01