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Evidence for Avolition in Bipolar Disorder? A 30-Day Ecological Momentary Assessment Comparison of Daily Activities in Bipolar Disorder and Schizophrenia

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Abstract

Objectives.—Disability is common in bipolar disorder (BD) and predicted by persistent sadness. We used ecological momentary assessment (EMA) to examine daily activities in people with BD and schizophrenia. We classified activities as productive, unproductive, or passive recreation, relating them to momentary sadness, location, and social context.

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contributors

Drs. Harvey, Depp, Moore, and Pinkham designed the study. Dr. Strassnig and Ms. Miller ran the specific analyses in this paper along with Dr. Harvey. They co-wrote the first draft of the paper. All of the other authors have edited the paper and approve of its submission.

Conflict of interest statement

In the last year, Dr. Harvey has received consulting fees or travel reimbursements from Alkermes, Bio Excel, Boehringer Ingelheim, Intra-Cellular Therapies, Minerva Pharma, Otsuka America, Regeneron, Roche Pharma, and Sunovion Pharma. He receives royalties from the Brief Assessment of Cognition in Schizophrenia and the MATRICS Consensus Battery. He has a research grant from Takeda and from the Stanley Medical Research Foundation. Dr. Pinkham has served as a consultant for Roche Pharma. The other authors have no potential Biomedical Conflicts of Interest.

Conflict of Interest

Dr. Strassnig has consulted for Signant Health. Dr. Harvey has received consulting fees or travel reimbursements from Alkermes, Bio Excel, Boehringer Ingelheim, Intra-Cellular Therapies, Minerva Pharma, Otsuka America, Regeneron, Roche Pharma, and Sunovion Pharma. He receives royalties from the Brief Assessment of Cognition in Schizophrenia and the MATRICS Consensus Battery. He has a research grant from Takeda and from the Stanley Medical Research Foundation. Dr. Pinkham has served as a consultant for Roche Pharma. The other authors Dr. Pinkham has served as a consultant to Roche Pharma.

No other authors have reportable activities

The data in this study are being deposited in the NIMH RDOC repository. 6 Months after data lock they will be available for public access. In the interim, the authors are happy to share the data that underlie this paper.

Methods.—71 people with BD and 102 people with schizophrenia were sampled 3 times/day for 30 days with an EMA survey. Each survey asked where they were, with whom, what they were doing, and if they were sad.

Results.—People with BD were home more than 50% of the time. There were no differences in prevalence of activity types across diagnoses. People with BD were less likely to report only one activity since the prior survey, but the most surveys still reported only one. For both groups, sadness and being home and alone since the last survey was associated with less productive activity and more passive recreation.

Conclusions.—Participants with BD and schizophrenia manifested high levels of unproductive and passive activities, predicted by momentary sadness. These activity patterns are consistent with descriptions of avolition and they minimally differentiated people with BD and schizophrenia. Previous reports of negative symptoms in BD may have been identifying these behaviors.

Keywords

Bipolar disorder; sadness; disability; activity; Ecological Momentary Assessment

Despite therapeutic advances and improved rates of syndromal recovery, bipolar disorder continues to be marked by considerable disability, even during periods of remission of mood symptoms (Huxley and Baldessarini, 2007; Rosa et al., 2010; Sanchez-Moreno et al., 2009). This disability has important real-world manifestations, including high rates of unemployment and absenteeism from work, impaired ability to perform household duties, interpersonal stress, and poor quality of life (Altshuler et al., 2006; Thomas et al., 2016; Hirschfeld et al., 2003). It is commonly reported that 40–60% of people with bipolar disorder have disability in domains of employment, social, and residential functioning.

Factors predicting disability in bipolar disorder are similar to those seen in other psychiatric conditions including schizophrenia, which is another population that struggles to perform everyday tasks (Bowie et al, 2006). For example, lower premorbid functioning, including IQ, and lower educational attainment is associated with challenges in performing everyday tasks and poorer outcomes terms of independence and social milestones in bipolar disorder (Coryell et al., 1998), as are neurocognitive impairments after illness onset (Bonnin et al., 2010; Drakopoloous et al., 2020). Better functional capacity, as measured by the University of California San Diego Performance Based Skills Assessment (Patterson et al., 2001) is similarly associated with employment, residential independence, and ability to perform activities of daily living in individuals with bipolar disorder and schizophrenia (Bowie et al., 2010; Mausbach et al., 2010). Neurocognitive deficits predict impairments in functional capacity to an approximately equal extent in both bipolar disorder and schizophrenia (Depp et al., 2012). Further, a study by Harvey and colleagues (2016) suggested that neurocognitive performance and functional capacity are best explained as a single latent trait in people with schizophrenia and bipolar disorder.

Symptomatic features such as psychotic symptoms, both current (Bowie et al., 2018) and lifetime histories (Levy et al., 2012), are associated with greater psychosocial dysfunction in bipolar disorder, including shorter periods of job tenure and decreased productivity (Simon

et al., 2018). Another major predictor of disability in bipolar disorder is persistent sadness at a level that is subthreshold to major depression or even dysthymia, applicable to both Bipolar Type 1 and Type II disorders (Judd et al., 2002; 2003; 2008). However, self-reported sadness has been reported in several very large studies to not be generally unrelated to informant-reported impairments in everyday functioning in schizophrenia (Galderisi et al., 2014; Strassnig et al., 2015). Negative symptoms such as avolition, amotivation, and anergia are well known to predict social dysfunction in schizophrenia (Harvey et al., 2017). However, several studies have reported that negative symptoms are also present in bipolar disorder and correlate with impaired everyday functioning in both illnesses (Bowie et al., 2006; Strassnig et al., 2017; Mahmood et al., 2019). For example, individuals with schizophrenia and bipolar disorder score similarly on measures of asociality, anhedonia, and avolition, and negative symptom severity is unrelated to a history of psychosis amongst individuals with bipolar disorder (Strauss et al., 2016). Thus, there is considerably more evidence of the direct impact of sadness on everyday functioning in bipolar disorder, but it is also not clear if behavioral syndromes that resemble avolition, apathy, and anergia are produced by sadness in bipolar disorder and by other causes in schizophrenia.

Informative research on everyday functioning requires valid assessment strategies. Self-assessment difficulties are common in people with schizophrenia and in bipolar disorder, leading to challenges in assessment of functioning or moods by retrospective report. For example, in a study of participants with schizophrenia and bipolar disorder who were asked to rate their disability with the World Health Organization Disability Assessment Scales, Strassnig et al. (2018) reported that participants with both diagnoses who were unemployed and not financially responsible for their residences did not report higher scores on disability items than participants who were employed and living independently. However, clinical ratings of depression were correlated with self-reported disability in both samples, but were not related to cognitive impairment or with objective indicators of work and residential outcomes. Thus, identifying the determinants of everyday disability and the impact of mood symptoms on functioning requires strategies other than retrospective self-report.

Ecological Momentary Assessment (EMA) offers a feasible alternative for collecting real time information on functional ability, productivity, and disability. Contemporary studies have used real-time assessment of variables such as time spent participating in daily life activities (Granholm et al., 2020), engagement in physical activity (Strassnig et al., in 2021), sustaining positive mood states following positively-valanced experiences (Strauss et al., 2020), and geolocation measured with GPS coordinates (Depp et al., 2019), and multiple-activity related biomarkers (Raugh et al., 2020), in order to quantify functional ability, productivity, and disability. Those studies and others (Cella et al., 2016) found that people with schizophrenia spend more time home and alone, less time with others while engaging in functional, social, and leisure activities and more time resting, and “doing nothing” as compared to healthy people and samples of people with bipolar disorder. Further, a recent study found people with schizophrenia were more likely to report only a single activity in the past hour than healthy people and this activity was commonly unproductive (Strassnig et al., 2021).

Some prior studies using EMA to assess activity in bipolar disorder found that momentary assessments of decreased activity were significantly associated with later sad moods and related on a trend level with prior sad moods (Merikangas et al., 2019). Similarly, momentary assessment of negative affect was associated with less engagement in social interaction, whereas momentary assessment of greater positive affect was associated with more engagement in social interactions in bipolar disorder (Kamarsu et al., 2020). These studies describe a quantitative relationship between momentary moods and levels of activity, functioning, and engagement with others among individuals with bipolar disorder. However, the relationship between sadness and the quantity and variety of activities performed in this population is less clear. Additionally, the relationship between mood and functioning may differ in the context of bipolar disorder versus schizophrenia. Although ratings of sadness collected a single time point are often uncorrelated with objective indicators of functioning in people with schizophrenia, as described above, momentary assessments can address the true nature of this relationship with much more precision.

The current study used EMA to investigate the hypothesis that reduced engagement in productive everyday activities, clinically rated as avolition, in bipolar disorder and schizophrenia would be associated with concurrent sad moods. To do so, the frequency of different types of activities that were measured in real-time 3 times per day for up to 30 days, related to the concurrent presence of sad moods, and compared across diagnoses. We followed up on our previous findings in a completely independent sample that people with schizophrenia were likely to be engaged in only a single, commonly nonproductive, activity for the past hour and expanded that analysis to a sample of people with bipolar disorder. We hypothesized that behaviors associated with avolition would be as common in participants with bipolar disorder as in people with schizophrenia. We further hypothesized that clinical ratings of reduced emotional experience (otherwise known as Avolition-Anhedonia), would correlate with reduced productive activity in both populations and that sad moods would predict reduced activities more strongly in people with bipolar illness than schizophrenia. Further, as we are able to characterize activities measured by EMA as productive or not, we can separate the quality of daily activities from their quantity.

Methods

Participants.

Participants who met DSM-V criteria for Schizophrenia, any subtype, 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). UM participants were recruited from the Jackson Memorial Hospital-University of Miami Medical Center and the Miami VA Medical Center. UCSD participants were recruited from the UCSD Outpatient Psychiatric Services clinic, a large public mental health clinic, the San Diego VA Medical Center, and other local community clinics and by word of mouth. UTD participants were recruited primarily from Metrocare Services, a non-profit mental health services organization in Dallas County, TX, and from other local clinics. 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.

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. Participants with a Wide Range Achievement Test-3rd edition (WRAT-3; Jastak, 1993) grade Equivalent score of less than 8th grade were also not enrolled, in order to assure English competence as well as quality of educational attainment..

Clinical Symptoms Assessment.

Sadness/Depression.—We used a common clinician rated depression assessment, the Montgomery-Asberg Depression rating scale (MADRS; Montgomery and Asberg, 1979). MADRS ratings were generated the day before the first EMA survey and immediately after the 30-day EMA sampling period. Raters were trained to adequate reliability (ICCs>.80) on this assessment.

Schizophrenia Related Symptoms.—Severity of symptoms was evaluated with the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987), which was administered in its entirety by trained raters and on the same days as the MADRS. These raters had extensive experience in other studies of participants with severe mental illness and were trained to high reliability (ICC>.80) by the study PI (Pinkham). The PANSS consists of 30 items with 3 subscales: 7 items were the positive symptoms scale (P1-P7), 7 items were the negative symptoms scale (N1-N7), and 16 items were general psychopathology symptoms scale (G1-G16). Each item was scored on a 7-point Likert scale ranging from 1 to 7.

Negative Symptom Models.—Khan and colleagues (2017) generated a two-factor model of negative symptoms measured by the PANSS, identifying dimensions of expressive deficits and experiential deficits. This model is clinically relevant as the reduced emotional

experience factor has been shown to predict variance in everyday functioning in several different samples (Harvey et al; 2017; Strassnig et al., 2018) and to respond to pharmacological treatment (Harvey et al., 2020). The items in the *PANSS Reduced Emotional Experience* factor are Emotional Withdrawal (N2), Passive/Apathetic Social Withdrawal (N4) and Active Social Avoidance (G16).

EMA Procedures—A Samsung smartphone with Android OS was used to deliver EMA surveys. The device was provided by the investigators to participants. 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 surveys (see Table 1) were predominantly check-box questions asking about behaviors performed since the previous survey. The first question asked about the participants location (home vs. away), then participants were queried about whether the participant was alone or with someone. If with someone, they were next queried as to with whom and given the choice to respond with more than one response. Options for who else was there included, friends, family members, partners, pets, healthcare providers, other known people, and unknown people. The subsequent screens were then customized to deliver home vs. away and alone vs. with someone queries tapping potential activities including an array of different 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". 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. Activities that were productive could be performed both home and away, but these productive activities are not generally overlapping. As noted in Table 1, there are several types of passive recreation that are sampled, with our previous analyses (Strassnig et al., 2021) finding that their occurrence was not markedly different across healthy people and participants with schizophrenia (e.g., watching TV and listening to music). We thus characterized these activities as "passive recreation activities" and examined them separately from clearly productive vs. clearly unproductive activities. The designations of these activities were based on discussion among the primary investigators and also included feedback from previous reviewers of our EMA study studies and grant proposals. Participants were also queried as to whether they had used substances, including alcohol, since the last survey.

Questions about moods during the same time frames as activities were also delivered at each survey. Mood questions included sadness, happiness, anxiety, relaxation, and all mood items

were scaled with a 1–7 scale. The functioning behaviors reported during each survey (up to a total of 90 per participant) were time-linked to the mood questions. In this study we examined sadness only, in order to simplify the analysis strategies and follow up on in specific on cross-sectional reports of self-reports of sadness as they were related to self-reports of everyday functioning. Further, there was considerable redundancy/reciprocity between ratings of being happy and sad: in the entire sample, the MMRM association (adjusting for random intercept, day, and survey) between the [up to] 90 happy ratings and time-linked linked sadness ratings was: $X^2(6) = 3771$, $p = 3.2*10^{-6}$, B=−.48 (Durand et al., 2021).

Data Analyses.

Data analyses were performed using the SPSS edition 26 Generalized Linear Models (GLM) module (IBM Corporation, 2020). In order to perform a sophisticated examination of all of the survey data, we used a mixed model repeated measures analysis of variance (MMRM) where we predicted all individual reports of the three dimensions of survey activities (productive, unproductive, and passive recreation), wherein 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 was used as a covariate in all analyses. For each model, we used the omnibus test to determine that the fitted model improved on the intercept-only model.

When predicting dichotomous outcomes (e.g., productive vs. unproductive activities) we used the binary logistic regression option from the GLM module. We then examined surveys where there was only one activity endorsed to determine the rates of productive, unproductive, and passive recreation responses across the surveys as a function of diagnosis. We made this choice because the majority of the surveys reported only one activity since the last survey. Next, we sequentially added terms to the model, including examining being home vs. away and with someone vs. alone and their two-way interaction as within-subjects variables for each survey. We added the momentary assessments of sad mood to the models and in two final analyses, we added endpoint reduced emotional experience scores and the endpoint MADRS scores.

Cases who did not complete the baseline and endpoint clinical assessments were excluded. Any participants who provided 1 or more EMA reports as well as baseline and endpoint in-person assessments. Missing survey data for cases who met the minimum participation criteria were addressed with maximum likelihood procedures.

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, with no significant differences in current residential or employment status. There were a total of 11,611 surveys with activity data available and

mood reports completed, with 6,814 coming from people with schizophrenia and 4,797 from bipolar participants. Overall adherence to the surveys was 75%. Adherence to surveys was 75% for both participants with SCZ and participants with BPI.

71% of people with schizophrenia reported doing only one thing since the last survey, and 66% of people with bipolar disorder reported doing only one thing since the last survey ($X^2(1) = 34.06$, $p<.001$). Twenty percent of the schizophrenia participants reported a second activity and 7% reported a third, while 25% of the bipolar participants reported a second activity and 8% reported a third. 70 out of 11611 (.06%) surveys reported alcohol use since the last survey. Out of 650 surveys where “eating or Drinking” was reported since the last survey, 11 (2%) also reported drinking alcohol.

For surveys on which more than one activity was endorsed, we compared the proportion of surveys where one of the activities endorsed was a productive activity and compared that proportion to surveys with only one activity. For surveys where 2 or more activities were endorsed, the proportion of productive activities was 45%, which is the same as the proportion of productive activities reported when only one activity was reported since previous survey. 70 out of 11611 (.06%) surveys reported alcohol use since the last survey. Out of 650 surveys where “eating or Drinking” was reported since the last survey, 11 (2%) also reported drinking alcohol.

Table 3 presents the proportions of productive, unproductive, and passive recreational activities reported by the two patient samples for surveys where only one activity was endorsed, as well as momentary ratings of sadness and clinician ratings of depression and reduced emotional experience. As can be seen in the table, there are essentially no differences in activities across the groups.

Participants with schizophrenia reported being home and alone 42% of the time and being home with someone 23% of the time, whereas participants with bipolar disorder reported an almost equal prevalence of being home and alone (34%) or home and with someone (39%). An MMRM analysis predicting diagnosis with being home and being alone across repeated factors of day and time of day found that there were statistically significant effects of both being home ($X^2(1) =41.01$, $p<.001$), being alone, ($X^2(1) =4.60$, $p=.032$), and a two-way interaction of home × alone, $X^2(1) =5.02$, $p=.025$, with all comparisons indicating that schizophrenia patients were more likely to be home, alone, and home alone. The effects of day, ($X^2(29)=1.88$), and time of day ($X^2(2) =2.44$) were both nonsignificant.

MADRS total scores at endpoint were significantly higher in the participants with bipolar disorder ($p=.004$), and ratings of reduced emotional experience were significantly higher in the participants with schizophrenia ($p<.001$). The average momentary rating of sadness was slightly, but not significantly higher in the participants with bipolar disorder (t=1.57, p=.13). Correlations between endpoint MADRS scores and momentary reports of sadness were very similar. The only correlations were different between the groups was that reduced emotional experience in participants with BPI was significantly correlated with momentary sadness reports, but in not the SCZ participants.

MMRM analyses predicting activity types (see Table 4) started with day and time of day as predictors in all models, with sex as a covariate in all analyses. In these analyses, we compared productive vs. unproductive activities and passive recreation to all other activities, finding that the diagnosis-only prediction of activity types did not improve on the random intercept model, $X^2(1) = 3.25$, p=.071. For each activity comparison, there was no significant effect of day over the course of the 30-day assessment period (all X^2 (29) <39.92 all p>.07) and no significant covariate effect of sex for any of the analyses (all $X^2(1) < 2.21$, all p>.34).

Next, we added the social context variables to the model predicting activities, adding home vs away and with someone vs alone and their two-way interaction first. We then added momentary ratings of sadness to the model. For each model there was a significant effect of time of day, with passive recreation activities occurring more likely in the second and third assessments of the day, compared to the first, and productive activities found to be significantly more likely in the mid-day assessment than the morning and evening (all $X^2(2) > 18.12$, all *p*'s<.001).

Being home and alone as compared to being away and with someone significantly predicted reports of productive rather than unproductive activities in every analysis. Also significant in every analysis was the finding that being home was associated with greater engagement in passive recreation, with no main effects of who was there and no two-way interactions of home × alone. Greater momentary sadness ratings were significantly associated with both more unproductive than productive activities and more passive recreation in every analysis. Greater severity of end-point scores on clinical ratings of reduced emotional experience and more severe clinical ratings on the MADRS were associated with more unproductive activities and more passive recreation activities over the course of the 30 days, with adding each of these predictors to the model increasing the level of prediction of activity types.

Discussion

Participants with bipolar disorder as compared to schizophrenia spectrum disorders were minimally more active overall over a 30-day sampling period. They were more likely to be away from home, with someone, and to engage in multiple activities per hour. This is consistent with some very recent studies comparing these two groups (e.g., Raugh et al., 2020). We previously found that individuals with schizophrenia were more likely to report doing only one activity in the past hour as compared to healthy controls (24% vs. 16%). In this study, with a considerably longer sampling period and over twice as many observations, we found that participants with bipolar disorder were less likely to report performing only one activity since the prior sampling period than participants with schizophrenia. They were still home for the majority of the EMA samples collected, although to a lesser degree than the participants with schizophrenia. Amongst individuals with bipolar disorder or schizophrenia who performed only a single activity since the prior survey, there were no diagnostic differences in the occurrence of different types of activities performed (productive, unproductive, or passive recreation). Thus, just like in schizophrenia, there appears to be substantial evidence for a limited quantity and variety of activities over time in participants with bipolar disorder, with several determinants of that reduced activity described below. These patterns of reduced functioning are quite significant: 20% of our

participants in both samples were home alone for more than 75/90 surveys; 21% of the respondents did not endorse a single one of our 25 productive activities at any one of the 90 surveys.

Setting aside diagnosis, several factors such as being away from home or with someone, were identified as predictors of performing productive activities. When home, individuals with bipolar disorder were equally as likely to be alone or with someone, while individuals with schizophrenia were more likely to be alone. This finding may be related to higher rates of marriage among individuals with bipolar disorder versus schizophrenia in this study, as well as in much larger samples (Harvey et al., 2018; Aslan et al., 2020). Being at home was also associated with more engagement in passive recreational activity, regardless of the presence of others. It is also suggested by the present results that both clinically rated reduced emotional experience, possibly associated with reduced anticipated rewards from productive or social activities, and clinical ratings of depression correlated with a decreased likelihood of performing such activities. Globally, this reduction in engagement in these activities would be labeled avolition. Thus, the appearance of avolition is associated with the momentary experience of sadness, with this influence being seen in both bipolar disorder and schizophrenia, and these activities are also detected by clinical ratings as well.

In accordance with our hypothesis that sad moods would predict reduced productive activity in both schizophrenia and bipolar disorder, momentary sadness was associated with more unproductive versus productive activity in both populations, as well as more passive recreation. This is consistent with previous studies in bipolar disorder, which found that sadness predicted poor functional outcomes and disability in individuals with bipolar disorder (Simon et al., 2008; Judd et al., 2002; 2003;2008). Interestingly, in contrast to previous studies of schizophrenia that used one-time ratings of the severity of sadness measured by depression rating scales (e.g. Galderisi et al., 2014; Strassnig et al., 2015; Harvey et al., 2017), sadness was associated on a momentary basis with reduced everyday functioning in people with schizophrenia. These data suggest that previous findings of lack of correlation between sad moods and impairments in functioning may have been biased by the assessment strategies employed.

As in any study, there are limitations in this dataset. The sample sizes are not equal, but the current study is still one of the largest dense-sampling studies of EMA in severe mental illness to date. Because of rates of unemployment and general poverty in the sample, certain activities (eating out; going to movies) may not be feasible. However, multiple productive activities could be performed home and home while alone. Demographic differences in racial/ethnic status, sex distributions, history of marriage, and educational attainment were detected between participants. These same differences are common even in very large-population-based studies (Harvey et al., 2016). Participants were not fully adherent with sampling and missing data could be based being un able to respond to survey invitations while performing certain activities, some of which could have been performed away from home in the company of others (e.g., working). Obviating this concern is the fact that that the participants with the top 20% adherence in this study (3 or fewer missed surveys) answered 35% of the surveys while away and those whose adherence was lowest in the lowest 20% (40 or more missed surveys) answered 40% of their surveys while away from

home. There was no HC sample, although the EMA results for the participants with SCZ in this study were very similar to those seen in participants in previous comparative studies with HC. Studies such as the present are likely to be biased in the direction of recruitment of participants who are not employed or otherwise engaged in full time activities. However, the rates of unemployment in this same are very congruent with large-scale studies of the prevalence of employment in BPI (Huxley and Baldessarini, 2009) and schizophrenia (Leung et al., 2008).

Reporting only a single activity in the domain of working or other related productive activities such as volunteering, would generally be viewed as positive. However, we saw that the participants in this sample reported engaging in work or looking for a job on approximately 7% of surveys, while passive or unproductive activities were reported over 8 times as often, subsuming over 62% of the surveys where only one activity was reported. Finally, avolition could also apply to answering EMA questions, in that it could be argued that certain respondents were not motivated to provide thorough details of their actual experiences. This concern is obviated by the finding that rate of productive activities in participants who reported two or more activities since the last survey was no different than the rate of endorsement of productive activities in participants who endorsed only a single activity.

Conclusions.

This study used EMA in order to compare the quantity, quality, and momentary determinants of activity amongst individuals with bipolar disorder and schizophrenia. These results suggest that momentary sadness is associated with reduced productive and increased passive activity on the part of participants with both bipolar disorder and schizophrenia. The presence of others did not impact on the likelihood of engaging in passive recreation possibly reflecting asocial tendencies. Patterns of activities consistent with those clinically designated as avolition, anhedonia, or anergia are seen in people with bipolar disorder and the majority of activities performed by participants with bipolar disorder were either unproductive or reflected passive recreation. Similar to previous studies using frequent global ratings of mood symptoms and disability in both Bipolar 1 and Bipolar 2 Disorder, the momentary experience of sadness appears to associated with reductions in positive activities and result in a state that could be labeled as “sadness-related avolition”.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- People with bipolar disorder typically have better functional outcomes than people with schizophrenia, but disability is quite common.
- People with bipolar disorder were no more likely to engage in productive activities than people with schizophrenia and momentary sadness was correlated with unproductivity in both samples.
- People with bipolar disorders were more likely to have done more than one activity in the recent past than people with schizophrenia, but most of their Ecological Momentary Assessment Surveys also only indicated one activity.
- Negative symptoms such as avolition have been reported previously in people with bipolar disorder and it seems as though avolition occurs in the context of momentary experiences of sadness.

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
Productive Activities		**Total**	**26.4**
Home based			
Eating or Drinking	5.6		
Cooking	4.4		
Cleaning the House	2.5		
Grooming	2.3		
Doing Laundry at Home	1.3		
Changing Clothes	1.1		
Meditating	0.6		
Working on a Hobby	0.2		
Paying Bills with computer	0.3		
Shopping Online	0.2		
Gardening	0.1		
Total	**17.6**		
Away from Home			
Working/Looking for Work	6.9		
Eating Out	4.6		
Transportation	3.7		
Shopping	2.6		
Exercising	2.1		
Visiting Family	1.5		
Volunteer Work	1.4		
School/School Work	1.3		
Therapeutic Activities	0.8		
Movie, Theater	0.8		
Religious	0.7		
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		Bipolar
Disorder						
				n=102		**n=71**
				M	**SD**	**M**
	SD	**t**	**p**			
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			
		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
		7.14	.007			
Financially Responsible			(%)	71		70
		0.02	.88			
Unemployed for More than one year (%)				60		45
		2.74	.10			

Table 3

Prevalence of Single Activities performed in the past hour:The Location of Activities, and Social Context, Across Schizophrenia and Bipolar Disorder

	Schizophrenia	Bipolar
	%	%
Productive	42	44
Unproductive	34	32
Passive Recreation	24	24
	%	%
Home	66	58
Alone	54	49

	M	SD	M	SD	t	p
Mean Momentary Sadness Rating	2.58	1.40	2.88	1.42	1.57	.13
End Point MADRS Score	10.38	10.93	13.26	11.06	2.87	
.004						
End Point Reduced Emotional Experience	6.48	3.10	4.90	2.28	3.65	
<.001						

Intercorrelations		
SCZ	**MADRS**	**Reduced**
Emotional Experience		
Mean Momentary Sadness	.49***	.22*
MADRS	- -	.18
BPI	**MADRS**	**Reduced**
Emotional Experience		
Mean Momentary Sadness	.58***	.19
MADRS	- -	.45***

Note.

* p<.05;

*** p<.001

Table 4

Multi-Level Modeling Prediction of Different Activities

		Productive Vs. Unproductive Recreation vs. all other		Passive
	p	X^2 (1)	p	X^2 (1)
Diagnosis	.29	0.98	.32	1.13
Home	<.001	484.19	<.001	250.54
Alone	.87	16.47	<.001	2.93
Home × Alone	.29	32.40	<.001	1.10
Diagnosis	.23	1.45	.23	1.45
Home	<.001	509.37	<.001	281.41
Alone	.18	15.44	<.001	1.79
Home × Alone	.26	33.51	<.001	1.26
Momentary Sadness	<.001	20.23	.003	49.26
Diagnosis	.067	0.52	.47	2.23
Home	<.001	482.99	<.001	251.27
Alone	.167	9.59	.002	1.91
Home × Alone	.32	34.06	<.001	.98
Momentary Sadness	<.001	17.31	.008	48.38
Reduced Emotional Experience	<.001	11.63	.001	14.66
Diagnosis	.025	1.93	.17	4.99
Home	<.001	1345.61	<.001	286.67
Alone		3.25	.07	.36

		Productive Vs. Unproductive Recreation vs. all other		Passive
		X^2 (1)	p	X^2 (1)
	p			
	.67			
Home × Alone		31.24	<.001	2.89
	.089			
Momentary sadness		17.04	.009	23.24
	.001			
Reduced Emotional Experience		56.86	<.001	146.64
	<.001			
MADRS Total Score		456.18	<.001	712.74
	<.001			