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The tripartite model of depression in schizophrenia and bipolar disorder: A secondary analysis

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Abstract

Models of affect, like the tripartite model, suggest that positive affect (PA) and negative affect (NA) are independent between-subjects and negatively correlated within. Correlations may differ in BD and schizophrenia. Using ecological momentary assessment (EMA) and clinical ratings, this secondary analysis evaluated the tripartite model by examining PA and NA. 281 participants with BD or a psychotic disorder completed 30 days of EMA of PA and NA, and clinical raters assessed depression. PA and NA were more related between-subjects and less related within-subjects among participants with schizophrenia. In BD, lower momentary PA was positively associated with clinical ratings of depression, although greater momentary NA was not significantly associated with clinical ratings. In schizophrenia, the inverse was found. These results

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Author Statement

All authors have reviewed and approved the submitted manuscript, as well as the contributions of each author listed below.
Emma M. Parrish wrote the discussion and took responsibility for editing and submitting this manuscript.
Philip D. Harvey developed the analysis plan, helped with interpretation of results, and took primary responsibility for the first draft of this manuscript.
Robert A. Ackerman performed data analysis, provided feedback throughout the process, and contributed to drafts of the manuscript.
Raeanne C. Moore helped with interpretation of results and contributed to drafts of the manuscript.
Colin A. Depp helped with interpretation of results and contributed to drafts of the manuscript.
Marc Gagnier contributed to drafts of the manuscript.
Amy E. Pinkham, the PI of this grant, helped with data analysis, interpretation of results, and contributed to drafts of the manuscript.

Statement of Ethical Considerations

This study has been approved by Institutional Review Boards at all three institutions: University of California San Diego, The University of Texas at Dallas, and the University of Miami.

Disclosures

Dr. Philip D. Harvey has received consulting fees or travel reimbursements from Alkermes, Bio Excel, Boehringer Ingelheim, Karuna Pharma, Merck Pharma, Minerva Pharma, and Sunovion (DSP) Pharma in the past year. He receives royalties from the Brief Assessment of Cognition in Schizophrenia (Owned by WCG Verasci, Inc. and contained in the MCCB). He is chief scientific officer of i-Function, Inc and Scientific Consultant to EMA Wellness, Inc. Dr. Amy E. Pinkham has been a consultant for Roche. Dr. Depp has received consulting fees from WCG Clinical and Boehringer Ingelheim. Dr. Raeanne C. Moore is a co-founder of KeyWise AI, Inc. and NeuroUX Inc. No other authors have conflicts of interest to report.

suggest that the tripartite model was not confirmed in people with schizophrenia or BD. However, PA and NA manifested associations in BD that were more congruent with population studies than in schizophrenia. These findings may have implications for clinical interventions targeting depression, PA, and NA in these populations.

Keywords

positive affect; negative affect; depression; schizophrenia; bipolar disorder

Introduction

The tripartite model, conceived by Watson and Clark, has been used to conceptualize the importance of positive and negative affective mood states, as well as physiological arousal (Watson, 1988). Positive affect (PA) refers to the subjective experience of states like joy, enthusiasm, energy, and interest, while negative affect (NA) refers to general distress, colored by any number of increased negative mood states such as fear, anxiety, anger, and sadness (Watson and Clark, 1984). Diagnostic constructs also overlap with these two domains. Anxiety is a high NA state, whereas depression is typically considered a combined state of high NA and low PA (Burns and Eidelson, 1998; Clark and Watson, 1991). PA does more than reflect one's subjective emotional experience at a given time; indeed, it can also function as an indirect measure of one's meaningful and productive engagement with his or her surroundings, such as activity level, sense competence and well-being, socialization, relationship satisfaction, and general energy level (Costa and McCrae, 1980; Tellegen, 1985; Watson et al., 1988). Despite the long-standing interest in the dimensional nature of positive and negative moods, dating back to Jean Delay (as described by Moussaoui (2002), to our knowledge the tripartite model has not been used to evaluate depression in those who have also been diagnosed with bipolar disorder or schizophrenia, despite the unquestionable presence of alterations in mood states in those conditions.

In the general population, PA and NA are generally orthogonal when examined on a between-persons basis and negatively correlated on a within person basis (see, e.g., Brose et al., 2015; Rush and Hofer, 2014). In the tripartite framework, individuals with depression are believed to experience concurrent decreases in PA states and increases in NA states (Blumberg and Izard, 1986; Tellegen, 1985). The tripartite model has also been tested in young, middle aged, and older adults (Watson et al., 1995), in child and adolescent psychiatric inpatients (Joiner et al., 1996), in culturally diverse populations (Kiernan et al., 2001; Yang et al., 2006), and in nonclinical populations such as caregivers of Alzheimer's patients (Mausbach et al., 2009; Vara-Garcia et al., 2022), including long-term follow-up data. Furthermore, there is data to show that reduced within-person differentiation between PA and NA is associated with decreased depression, and that those who differentiate PA and NA on a state-by-state basis report higher levels of depression (Dejonckheere et al., 2018). Despite this rich literature, the specific relationships of PA and NA in bipolar disorder and schizophrenia have yet to be studied, despite the fact that over 35% of people with schizophrenia experience lifetime major depressive episodes linked to suicidal ideation (Harvey et al., 2018, 2014).

Evaluating the tripartite model in individuals with bipolar disorder and schizophrenia is worthwhile not only because people with these conditions may also suffer from depression and could potentially benefit from a model to guide diagnosis and treatment of depression, but also because there are unique challenges associated with both identifying and treating depression in these individuals. As people with bipolar disorder can experience mixed states, including both PA and NA concurrently (Swann et al., 2009), it is possible that the mood state characteristics in major depression associated with bipolar disorder may not reflect a reliable within-person reciprocal relationship as seen in the general population and in an enhanced way in major depression without bipolar disorder. Indeed, previous research shows that people with bipolar disorder may report that they are equally depressed across variations in their euphoric moods (and vice versa; Malik et al., 2012).

In schizophrenia, assessment of PA and NA may be challenging because of the negative symptom of diminished emotional experience, commonly described with terms such as avolition, anhedonia, or asociality (Blanchard and Cohen, 2005; Strauss et al., 2021). This symptom may lead to alterations in accurate self-assessment of mood states even if they seem apparent to others. In a recent paper, we showed that 18% of a sample of over 100 participants with schizophrenia reported that they were never sad when assessed up to 90 times over 30 days with ecological momentary assessment (EMA; Jones et al., 2021). There are reasons to question these reports because these same participants were home and alone for over 80% of the 90 EMA surveys, despite reporting no NA. It is possible that depression in schizophrenia might be associated with either only reductions in PA or increases in NA, and not reciprocity of mood states.

EMA, or repeated assessments sent via a mobile device, has been used in many recent studies recruiting participants with bipolar disorder and schizophrenia to assess a wide variety of constructs including affect, social activity and interest, psychotic symptoms, and interpersonal risk factors for suicide (e.g., Granholm et al., 2019, 2013; Mote and Fulford, 2020; Parrish et al., 2021). EMA provides a unique opportunity to survey participants about their experiences repeatedly in their current environments, including at home and away, to better understand the dynamics and fluctuations of constructs such as PA and NA. Thus, EMA is a favorable method to collect data and evaluate the dynamic relationship of PA and NA among persons with bipolar disorder and schizophrenia.

In this study we used data from a 30-day, 90 assessment EMA study to examine the convergence between PA and NA and clinical ratings of the severity of depression collected with a structured clinical rating scale. Participants with schizophrenia and bipolar disorder answered daily surveys regarding their moods (2 positive [happy, relaxed] and 2 negative [sad, anxious]) and were rated for depression at both the beginning and end of the EMA period. The baseline and end of study ratings included a commonly used depression rating scale, which was administered by trained examiners. This method is well suited to measuring the persistence and fluctuation of mood states because of the dense sampling involved. First, we hypothesized that average levels of PA and NA would correlate in the expected directions with the severity of depression in the participants with bipolar disorder, although we believed that the common correlation between depression and reduced PA might be attenuated. Second, we hypothesized that reduced experiences of PA would

be correlated with the severity of depression in the participants with schizophrenia, but that the correlation with NA would be significantly smaller than that seen in bipolar disorder because of the suggestions from previous studies that some participants report no depression regardless of their life circumstances. We also expected that between-subjects correlations between NA and PA in participants with schizophrenia would be different from the commonly observed pattern of orthogonality because of tendencies on the part of some participants with schizophrenia to report that they never experience any NA.

Methods

Participants had a brief visit and assessment at the beginning of the study, which included symptom ratings and a diagnostic interview, and then began the 30-day EMA period described below. At the end of the EMA period, a follow-up visit took place, with a repeat of the baseline clinical assessments. Participants also self-reported on their everyday functioning and were assessed by trained raters on their social and neurocognitive abilities. These analyses report on a subset of data from this very detailed assessment. The full methods of the study are presented in previous publications (e.g., Jones et al., 2021; Strassnig et al., 2021). As noted previously, the first 171 participants (as reported on in the previous papers) were recruited prior to a COVID-based research shutdown and the others added after.

Participants

Participants in this study (n = 281) met DSM-V criteria for schizophrenia, schizoaffective disorder, or bipolar disorder (I or II), with or without current or previous psychotic symptoms. Recruitment occurred at three 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 at Jackson Memorial Hospital-University of Miami Medical Center and the Miami Veteran Affairs (VA) Medical Center. UCSD patients were recruited from the UCSD Outpatient Psychiatric Services clinic, the San Diego VA Medical Center, a large public mental health clinic, other local community clinics, and via word of mouth. UTD participants were recruited from Metrocare Services, a non-profit mental health services organization, and other local clinics. The study was approved by the local IRB at each site. 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); a consensus procedure was utilized to generate final diagnosis at each site. Site PIs supervised the collection of diagnostic information and assignment of diagnoses. Bi-weekly case conferences with diagnostic and clinical interviewers were conducted to avoid rater drift. Formal statistics were calculated for reliability of assessment procedures, but not for diagnoses. Cases with ambiguous diagnoses were discussed between at least two of the site PIs and no participants for whom there were unresolvable diagnostic questions were included.

All participants signed informed consent after receiving a complete description of the study.

Exclusion Criteria

Exclusion criteria included: (1) history of or current medical or neurological disorders that may affect brain function (e.g., CNS tumors, seizures, prolonged loss of consciousness), (2) history of or current intellectual disability (IQ<70; assessed via the Wide Range Achievement Test 4 (WRAT-4; Wilkinson and Robertson, 2006) or pervasive developmental disorder as defined in the DSM-5, (3) substance use disorder without remission of at least 6 months, (4) visual or hearing impairments that interfere with assessment, and (5) lack of English proficiency. Participants were also ineligible if they had medication changes or dose changes >20% in the past 6 weeks or had been hospitalized in the past 6 weeks.

Clinical ratings of Mood Symptoms.—Participants were rated at baseline and endpoint on the Montgomery-Asberg Depression Rating scale (MADRS; Montgomery and Åsberg, 1979) and the Young Mania Rating Scale (YMRS; Young et al., 1978). We present baseline and endpoint scores on these measures and relate these scores to EMA measures. Raters were trained to high levels of inter-rater reliability and generated ratings while unaware of the results of the EMA surveys.

EMA Procedures

Participants were given the choice to receive EMA surveys on their own smartphone (Apple of Android OS) or on a lab-provided Samsung smartphone with Android OS. 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.

The first question in each survey sequence asked about the participant's 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". Participants were compensated $1.00 for each survey completed, up to a total of $90.00 and they were also compensated for baseline and endpoint assessments.

EMA Mood Sampling

Questions about momentary moods were also delivered at each survey. Moods were queried in sequence, so that sadness, happiness, anxiety, and relaxation were all queried with a 1 (Completely absent)–7 (Extremely Severe) scale. In line with previous studies of negative affect, we averaged the mood reports for sadness and anxiety into a single "Negative Affect" (NA) index and the mood reports for happiness and relaxation into a "Positive Affect" (PA) index.

Analytic Plan.

We used the R software environment (specifically, the haven, psych [Revelle, 2019], MBESS [Kelley, 2017], MplusAutomation [Hallquist and Wiley, 2018], and labelled [Larmarange, 2022] packages) to conduct preliminary analyses. We first estimated descriptive statistics and zero-order correlations between the primary study variables (i.e., baseline and end-point depression scores and indices of NA and PA averaged across the EMA period) for each diagnostic group (i.e., participants with bipolar disorder vs. schizophrenia) and further evaluated whether the diagnostic groups significantly differed on their means and zero-order correlations. We then proceeded to use multilevel modeling to evaluate the reliability of the NA and PA indices across multiple levels, compute intraclass correlation coefficients, and investigate how within-person convergences between NA and PA and average levels of NA and PA relate to end-point depression scores. These multilevel modeling analyses were specified using Mplus version 8.4 (Muthén and Muthén, 2017) and used maximum likelihood estimation with robust standard errors. Our focal analyses used Multilevel Structural Equation Modeling (with days nested within participants) to investigate: (a) how participants' within-person associations between PA and NA relate to their end-point depression scores (e.g., do participants whose momentary states of PA are strongly connected to their momentary states of NA have lower or higher levels of end-point depression?); and (b) how participants' trait levels of PA and NA may interact to predict their end-point depression scores (see Figure 1). The within-person variables for mood were centered by subtracting participants' average mood score across the EMA period from their mood score on a given day; moreover, the between-person variables for mood were computed by grand-mean centering participants' average mood scores. In addition, participant diagnosis was effect-coded such that −1 = bipolar disorder diagnosis and 1 = Schizophrenia diagnosis. To run this model and specify the desired interaction terms at the between-person level of analysis (see Figure 1), we used the Monte Carlo integration algorithm within Mplus version 8.4.

Results

Table 1 presents demographic information on the participants. Overall, participants with schizophrenia (mean age=41.06) were older than participants with bipolar disorder (mean age=38.65; t=2.26, p=.026). Additionally, the groups differed in sex (χ^2 = 8.05, p=.02) and race (χ^2 = 22.24, p< .001). Furthermore, participants with bipolar disorder had, on average, more years of education (mean=14.30 years) than participants with schizophrenia (mean=12.62 years; t = 5.89, p< .001), and more participants with schizophrenia were unemployed (70%) than participants with bipolar disorder (49%; χ^2 = 14.07,p < .001).

There were 21,019 surveys sent, and 15,423 answered (73%) with all the needed information. The proportion of surveys answered was not correlated with MADRS scores at baseline or end of study for either the participants with schizophrenia, *r*'s =−.04, *p*=.63 and *r*=.05, *p*=.54, or participants with bipolar disorder, *r*'s =−.08, *p*=.36 and *r*=−.05, *p*=.57.

Table 2 presents descriptive statistics and zero-order correlations between the study variables for each diagnostic group. Although participants with bipolar disorder were rated as being more significantly depressed on the MADRS than participants with schizophrenia at both the beginning (d = −0.31, 95% CI [−0.54, −0.07], t[288] = 2.61, p = .01) and end (d = −0.26, 95% CI [−0.51, −0.00], t[235] = 1.99, p = .048) of the EMA period, the groups did not significantly differ on EMA derived aggregated positive affect (d = 0.16, 95% CI [−0.07, 0.40], t[282] = −1.37, p = .17) or negative affect (d = −0.10, 95% CI [−0.33, 0.13], t[282] = 0.86, p = .39). Table 2 further shows that endpoint MADRS scores were negatively correlated with average PA and positively correlated with average NA. Nevertheless, the negative correlation between PA and endpoint MADRS scores was significantly smaller in participants with schizophrenia than it was in participants with bipolar disorder, z = 2.02, p = .04. YMRS scores were significantly higher in the participants with bipolar disorder compared to schizophrenia: schizophrenia Mean =0.98; SD= 3.27; Bipolar Mean =3.09, SD=4.85, t= 3.48, p<.001. At the same time, no participants with bipolar disorder had a YMRS score over 18 and 80% of the scores were in the range considered in remission from euphoric symptoms.

Reliability and Baseline Variance Partitioning Analyses for Positive and Negative Affect

Given the hierarchical structure of the EMA derived data (i.e., surveys [3] nested within days [30] nested within participants [281]), we first computed reliability indices for our momentary mood measures at each level. To obtain the required variance estimates to compute reliability (see Schönbrodt et al., 2022), we specified three-level confirmatory factor-analytic models for PA and NA separately wherein factor loadings for the two respective mood indicators at each level ("relaxed" and "happy" for PA, and "sad" and "anxious" for NA) were unit-weighted and the residual variances were constrained to equality.

The reliability of within-person change across surveys within days was rather low for both PA (.50) and NA (.41). In contrast, the between-person reliabilities (.99 for PA and NA) and the reliabilities of within-person change across days (.78 for PA and NA) were much more acceptable. To ensure adequate reliability of our mood measures, we therefore averaged the two respective mood items at each session and further averaged those means across sessions within days. A baseline two-level model wherein mood composites for PA and NA were nested within days within participants revealed that the Intraclass Correlation Coefficients for PA (.70) and NA (.72) were quite large. We further found that the average within-person association between PA and NA was r = −.44, p < .001, and that the average between-person association between PA and NA was r = −.57, p < .001.

Effects of PA and NA (and their cross-temporal covariance) on End-Point MADRS Depression Scores

Within-person associations between PA and NA.—As shown in Figure 1, interindividual differences in the strength of the within-person association between momentary states of PA and NA were captured via a corresponding random effect at the between-person level ("Within-person effect of PA on NA"). As expected, the average within-person association between these mood states was negative and statistically significant, $b = -0.40$, $SE = 0.03$, $p < .001$. Moreover, participants significantly varied in these within-person associations, $\sigma^2 = 0.14$, $SE = 0.01$, $p < .001$. The average strength of these within-person associations between PA and NA also significantly differed between diagnoses, $b = 0.07$, $SE = 0.03$, $p = .006$, such that the within person association of PA and NA was significantly stronger for participants with bipolar disorder ($b = -0.47$, $SE = 0.03$, $p < .001$) than it was for participants with schizophrenia ($b = -0.33$, $SE = 0.04$, $p < .001$; see Figure 2).

Figure 1 further shows that we regressed participants' end-point clinically-rated MADRS depression scores on their within-person associations between PA and NA and evaluated whether participant diagnosis moderated this association. Participants' within-person associations between PA and NA were a significant negative predictor of their end-point depression scores, $b = -6.29$, $SE = 1.87$, $p = .001$. This indicates that participants were rated as less depressed when their momentary reports of the intensity of PA were less predictive (i.e., correlated), in a generally negative direction, of their corresponding momentary reports of NA throughout the EMA period. This association was not moderated by diagnosis, $b = -0.41$, $SE = 1.84$, $p = .824$.

Between-person associations between PA and NA.—Figure 1 also shows that participants' trait levels of PA and NA and the two-way interaction between these variables could be used to predict end-point depression scores. Participants who reported higher average levels of PA across the EMA period were rated as being less depressed, $b = -2.62$, $SE = 0.54$, $p < .001$. Moreover, participants who reported higher average levels of NA were rated as being more depressed, $b = 2.61$, $SE = 0.58$, $p < .001$. The effect of participants' average levels of PA on clinical ratings of their depression with MADRS, however, did not significantly depend upon participants' average levels of NA, $b = -0.01$, $SE = 0.33$, $p = .98$.

We further evaluated whether participant diagnosis moderated any of these relations. Participant diagnosis by itself did not significantly predict clinical ratings of depression with the MADRS, $b = -0.25$, $SE = 0.91$, $p = .785$. However, the effect of participants' average levels of NA on ratings of their depression was significantly moderated by participant diagnosis, $b = 1.53$, $SE = 0.58$, $p = .008$. Whereas greater average levels of NA for participants with bipolar disorder were not significantly associated with ratings of depression ($b = 1.09$, $SE = 0.76$, $p = .153$), greater levels of NA significantly predicted greater ratings of depression for participants with schizophrenia ($b = 4.14$, $SE = 0.87$, $p < .001$). Similarly, the effect of participants' average levels of PA on ratings of their depression was significantly moderated by participant diagnosis, $b = 2.00$, $SE = 0.54$, $p < .001$. Whereas greater average levels of PA for participants with bipolar disorder were

significantly associated with lower ratings of depression ($b = -4.61$, $SE = 0.80$, $p < .001$), greater average levels of PA for participants with schizophrenia were unrelated to ratings of their depression ($b = -0.62$, $SE = 0.73$, $p = .396$). The two-way interaction between PA and NA was not significantly moderated by participant diagnosis, $b = 0.44$, $SE = 0.33$, $p = .184$. Thus, lower momentary reports of PA were the best predictor of higher MADRS depression scores for the participants with bipolar disorder, while higher momentary reports of NA were the best predictor of higher MADRS severity in participants with schizophrenia.

See Table 3 for a high-level summary of our main take-home points.

Discussion

This study sought to investigate the utility of the tripartite model, used to conceptualize mood states in terms of PA and NA, in a sample of individuals with schizophrenia and bipolar disorder by examining the relationship between momentary levels of PA and NA collected by EMA. First, our hypothesis was confirmed in that EMA-measured PA and NA were found to be generally reciprocal, both between-person and within-person. The significant between-person correlation of PA and NA diverges from data in healthy people (see, e.g., Brose et al., 2015). Additionally, we found that, for the group as a whole, depression was related to more momentary NA and less momentary PA, consistent with the tripartite model. However, confirming our second hypothesis, we found that PA and NA are less strongly related to one another on a within-person basis among participants with schizophrenia as compared to participants with bipolar disorder. This suggests that the tripartite model may be less applicable to people with schizophrenia than it is to people with mental health conditions that include significant depression as a central feature.

The results of this study may have implications for the interpretation and prediction of affect ratings and clinical diagnoses among people with schizophrenia and bipolar disorder. For instance, the data suggest that the presence of greater average levels of NA may be more related to depression for people with schizophrenia and that overall lower levels of PA may be more related to depression for people with bipolar disorder. Ongoing NA as well as clinically significant depression are common among people with bipolar disorder (Harvey et al., 2022; Judd et al., 2002a, 2002b), and the continuous experience of NA may lead to reduced salience of these experiences in this population compared to people with schizophrenia. Thus, reduced PA may be a stronger signal among people with bipolar disorder, but this interpretation requires further study.

Consistent with prior research reporting that a group of people with schizophrenia report low to no levels of sadness (Harvey et al., 2019, 2017; Jones et al., 2021; Parrish et al., 2023; Siu et al., 2015), the within-person negative correlation between PA and NA was significantly weaker among people with schizophrenia than people with bipolar disorder. This correlation had implications for clinical ratings of depression in the overall sample. Individual momentary self-assessments of NA among people with schizophrenia may be affected either by emotion recognition deficits or a positive self-assessment bias, and consistently relate to an overestimation of functioning (Harvey et al., 2019, 2017; Parrish et al., 2023; Siu et al., 2015). Furthermore, there are several factors that may affect mood

variability and reports of affect among people with schizophrenia, including social context and location factors (Parrish et al., 2020, 2023). This common pattern of responding relating to NA should be taken into consideration when assessing depression among people with schizophrenia.

Clinically, these results point to differential consideration of PA and NA among people with bipolar disorder and schizophrenia. For people with bipolar disorder, who experience lower levels of PA in relationship to depression, interventions that target PA specifically may be helpful (e.g., see Taylor et al., 2020, 2017). However, the effectiveness for PA interventions for people with bipolar disorder requires further study. Additionally, for people with schizophrenia who may report no to low levels of NA, interventions that improve emotion recognition may be helpful to improve insight into unpleasant emotions. Following improvement of emotion identification, people with schizophrenia may be able to engage in interventions that target emotion regulation. Again, interventions based on these models require further study before direct clinical application for this population, but these unique dynamics of PA and NA may inform future intervention development.

In conclusion, the tripartite model, which suggests that high NA and low PA are associated with clinical depression, was consistent with the findings seen in participants with bipolar disorder, but less so in participants with schizophrenia. When NA was considered there was no correlation between lower scores on PA and higher severity ratings for depression. These results are congruent with other studies on self-reported moods in schizophrenia (Harvey et al., 2019, 2017; Jones et al., 2021; Parrish et al., 2023; Siu et al., 2015), but importantly also suggest that in people with bipolar disorder the association between positive and negative moods and clinically rated depression seems consistent with the tripartite model of depression.

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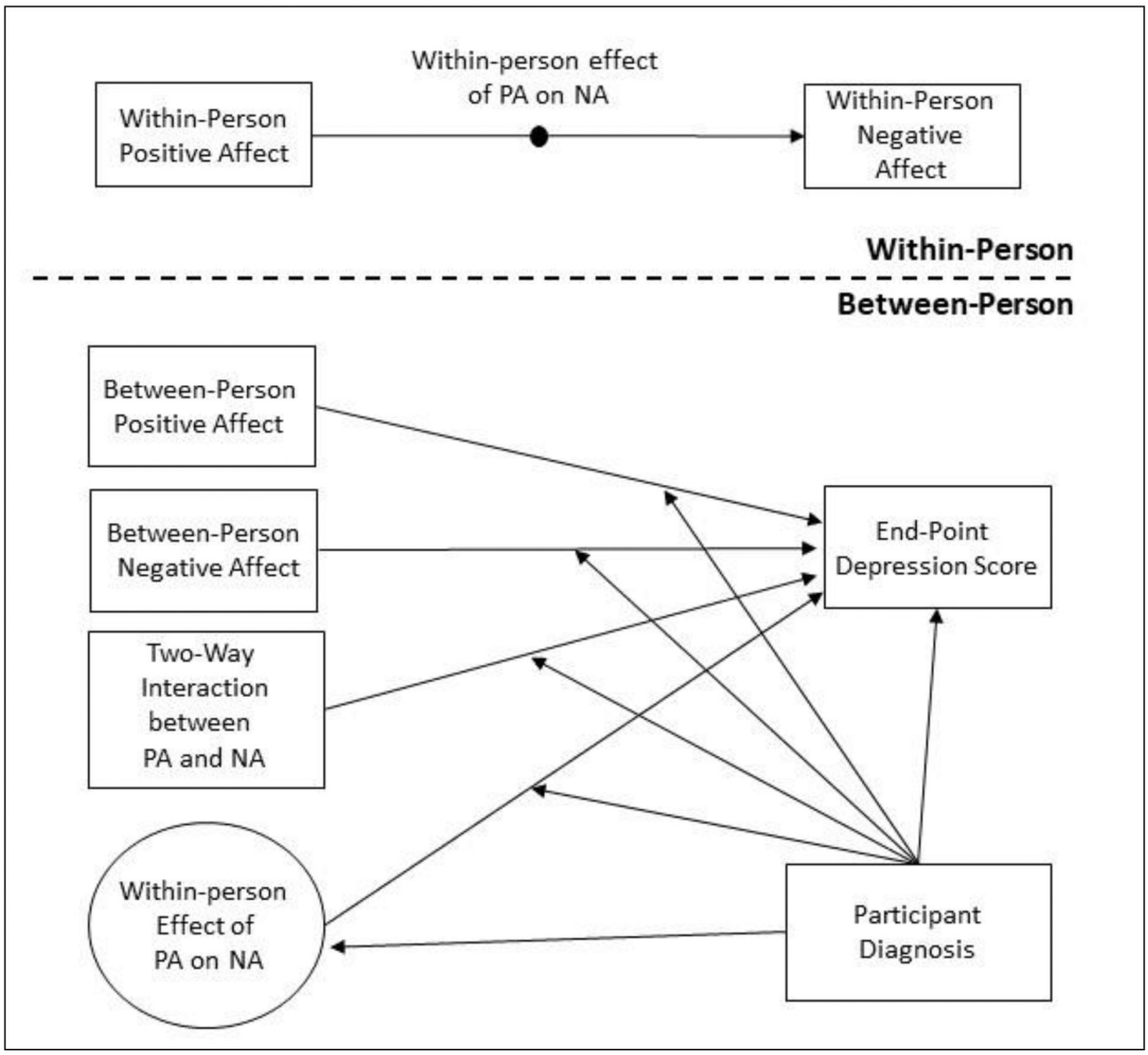

Figure 1.
Multilevel Structural Equation Model investigating links between PA and NA and End-Point Depression Scores.

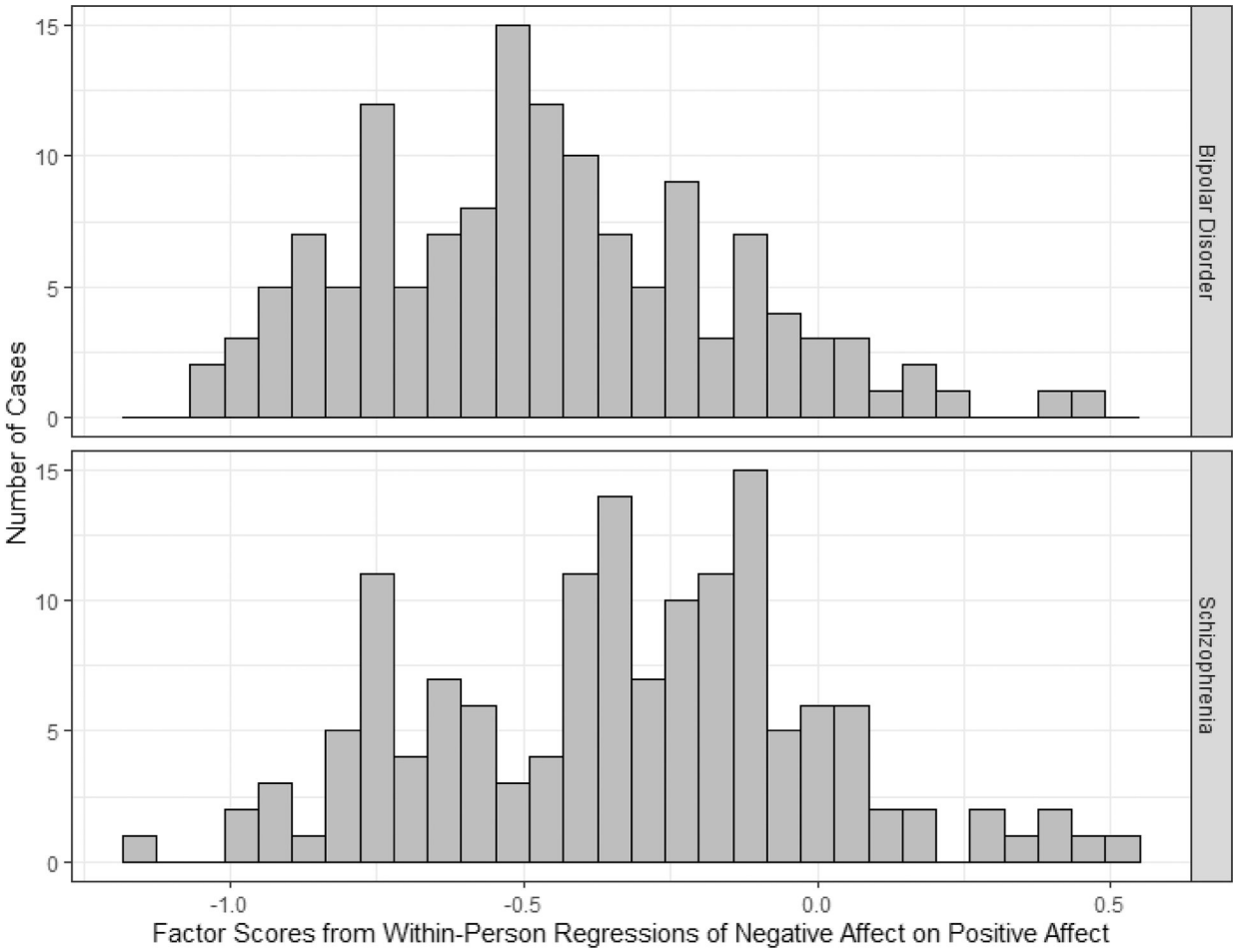

Figure 2.

Histograms of within-person associations between Positive Affect and Negative Affect for participants with bipolar disorder or schizophrenia.

Note. Figure created with ggplot2 package (Wickham, 2016) in R software environment

Table 1.

Participant Demographic and Clinical Information

	Schizophrenia (n = 143)	Bipolar Disorder (n = 138)	Statistics, *p*
Age [*M* (*SD*)]	41.06 (10.74)	38.65 (11.41)	$t = 2.26, .026$
Sex (% Female)	49%	68%	$\chi^2 = 8.05, .02$
Racial status			$\chi^2 = 22.24, < .001$
White (%)	35%	57%	
Black (%)	52%	24%	
Other (%)	17%	19%	
Ethnicity (% Hispanic)	22%	27%	$\chi^2 = 0.62, .43$
Education (years) [*M* (*SD*)]	12.62 (2.39)	14.30 (2.40)	$t = 5.89, < .001$
Mother's education (years) [*M* (*SD*)]	12.61 (3.29)	13.19 (3.23)	$t = 2.00,. 048$
Employment			$\chi^2 = 14.07, < .001$
Full Time (%)	8%	27%	
Part Time (%)	22%	24%	
Unemployed/disabled (%)	70%	49%	
Unemployed for more than 12 months (%)	87%	76%	$\chi^2 = 4.01, .045$

Table 2.

Descriptive Statistics and Zero-Order Correlations between Study Variables for Participants with Schizophrenia (SCZ) and Bipolar Disorder (BD)

Variable	M	SD	1	2	3	5	6	7
1. SCZ MADRS Baseline	9.41	9.77						
2. SCZ Positive Affect	4.22	1.45	−.35					
3. SCZ Negative Affect	2.89	1.37	.56	−.59				
4. SCZ MADRS Endpoint	10.62	10.86	.71	−.38	.57			
5. BD MADRS Baseline	12.55	10.65						
6. BD Positive Affect	4.00	1.16				−.54		
7. BD Negative Affect	3.02	1.27				.53	−.59	
8. BD MADRS Endpoint	13.40	10.57				.61	−.58	.49

Note. MADRS = Montgomery-Asberg Depression Rating Scale. Positive Affect and Negative Affect are aggregated means for each participant across all surveys (9216 surveys for participants with schizophrenia and 8983 surveys for participants with bipolar disorder). All correlations were significant at $p < .001$.

Table 3.

Main Take Home Points

Sample as a Whole
EMA-measured PA and NA were found to be generally reciprocal, between-person and within-person.
The significant between-person correlation of PA and NA diverges from data in healthy people who commonly manifest orthogonality.
Depression was related to more momentary NA and less momentary PA, consistent with the tripartite model.
Group Differences
PA and NA are less strongly related to one another on a within-person basis among participants with schizophrenia as compared to participants with bipolar disorder.
The tripartite model may be less applicable to people with schizophrenia than it is to people with mental health conditions that include significant depression as a central feature.
Lower momentary reports of PA were the best predictor of higher MADRS depression scores for the participants with bipolar disorder, while higher momentary reports of NA were the best predictor of higher MADRS severity in participants with schizophrenia.

Note. PA=Positive Affect, NA=Negative Affect