



## A preliminary investigation of paranoia variability and its association with social functioning

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### ARTICLE INFO

#### Keywords:

Persecutory delusion  
Psychiatric disorders  
Fluctuation  
Interpersonal functioning

### ABSTRACT

**Background:** Paranoid ideation is a core feature of psychosis and is associated with impaired social functioning. Severity of paranoia can fluctuate across time as symptoms wax and wane; however, no study has systematically investigated how this intra-individual variability in paranoia may relate to social impairments and social functioning.

**Methods:** Fifty-five patients with DSM-5 diagnoses and recent paranoia were followed for up to one year and completed the suspiciousness/persecution section (P6) of the Positive and Negative Symptom Scale (PANSS) on a monthly basis to monitor fluctuations in paranoia. Categorical changes between paranoid and non-paranoid status were monitored and tallied. Participants self-reported current paranoia and anxiety levels as well as social functioning when demonstrating paranoia changes.

**Results:** Most patients showed changes between paranoia categories (60%). Individuals with no paranoia change showed higher current paranoia and lower independence-competence subscores of the Birchwood Social Functioning Scale (SFS) compared with those with one change. Current paranoia and state anxiety explained significant variance in the prosocial activities subscore of SFS, and importantly, paranoia changes accounted for variance above and beyond these effects. Individuals with higher current paranoia participated less in prosocial activities, however those with higher paranoia variability were more involved in social activities. Similarly, individuals with more paranoia variability demonstrated better overall social functioning as measured by the averaged SFS total score.

**Conclusion:** Paranoia fluctuation is prevalent across time, and both paranoia severity and variability impact social functioning, in that lower levels of paranoia severity and higher levels of paranoia variability are associated with better interpersonal functioning.

### 1. Introduction

Paranoia is the unfounded belief that intentional harm will occur (Freeman and Garety, 2000) and is a hallmark of psychosis that is strongly linked to significant distress and impaired social functioning (Hajdúk et al., 2019; Pinkham et al., 2016). Besides its high prevalence (i.e., 50%–90%) in first-episode psychosis (Moutoussis et al., 2007; Veling et al., 2007), paranoia is also evident in various clinical diagnoses (e.g., bipolar disorder, major depressive disorder, etc.) (Goodwin and Jamison, 2007; Lattuada et al., 1999), suggesting that it is a transdiagnostic symptom that could give rise to social difficulties.

While paranoia has been mostly examined as a stable trait in relation

to social cognitive function and interpersonal outcomes (Combs et al., 2013; Klein et al., 2018; Pinkham et al., 2016), it actually fluctuates across time and demonstrates individual differences in its natural dynamics (Bentall et al., 2001; Bentall and Kaney, 2005; Zubin and Spring, 1977). Early research has reported nonsignificant correlations between paranoia at baseline and follow-up (12 months later) in patients with psychiatric disorders (Podubinski et al., 2012), indicating that paranoia is not static. More compelling evidence supporting the dynamic nature of paranoia arises from recent studies using ecological momentary assessments (EMA). For instance, substantial moment-to-moment fluctuations in paranoia were observed in patients who reported low levels of paranoia with the traditional retrospective measurements (Oorschot

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<https://doi.org/10.1016/j.scog.2022.100258>

Received 1 April 2022; Received in revised form 12 May 2022; Accepted 13 May 2022

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et al., 2012) and a weak correlation was also found between current paranoia and paranoia at the subsequent time point (So et al., 2018). A recent study also identified several behavioral concomitants of daily intra-individual fluctuation in paranoia, such that increased within-person paranoia was, counterintuitively, positively correlated with feeling social and sleeping well in patients with schizophrenia spectrum disorders (Buck et al., 2019). Intriguingly, an early EMA study including individuals spanning across the paranoia continuum found that higher levels of baseline depression and irritability were linked to longer and shorter durations of paranoid episodes, respectively, and that the onset of paranoia was triggered by increased anxiety and decreased self-esteem (Thewissen et al., 2011). These findings indicate that negative emotions and self-esteem may contribute to fluctuations in daily paranoia, which may further influence social functioning in the real world. While the fluctuations in paranoia reported via EMA are likely changes of degree (e.g., shifting from feeling a *little* to *moderately* worried someone may be trying to harm you), these findings point to the high prevalence of paranoia changes in patients with clinical diagnoses. Additionally, this work indicates that such fluctuations may have pronounced impact on real-world functioning and raises the possibility that fluctuations between experiencing clinically significant levels of paranoia vs. no paranoia at all may also occur.

To date, no study has systematically quantified the intra-individual variability in paranoia across time (i.e., changes between paranoid and non-paranoid status), nor have any studies focused on the relationship between the changes in paranoid status and social functioning. While the association between persecutory delusions and interpersonal functioning has been examined using a longitudinal design in previous research (Collip et al., 2013), the variability of persecutory delusions and how it may affect social functioning has not been considered. On the one hand, variability may be beneficial for individuals with high levels of paranoia, as temporary reductions or absence of paranoia may allow for more objective evaluations of the current social contexts and facilitate successful social experiences. However, another possibility is that individuals who are constantly paranoid may have developed certain strategies to cope with daily situations, which compensate for their paranoia. In this case, fluctuations in paranoia could be detrimental and such instability may result in more difficulties and confusion in interpersonal communication. Given these two potentially opposing effects, examining the natural dynamics of paranoia as well as their relationship with real-world social functioning may provide novel insights into understanding how paranoia impacts social functioning.

To address these issues, we utilized archival data from a longitudinal study which followed patients with clinical diagnoses for up to one year and assessed their paranoia on a monthly basis. Paranoid status was determined via clinical interview for each assessment, which was used to operationalize the transition between categories (i.e., paranoid vs. non-paranoid status) as detailed in the Section 2. Current paranoia and anxiety levels as well as interpersonal functioning were also captured. Based on previous literature (Buck et al., 2019; Oorschot et al., 2012; Podubinski et al., 2012; So et al., 2018), we expected to observe that changes between paranoia categories would explain significant variance in social functioning above and beyond the effects of current paranoia and anxiety severity in the one-year follow-up in patients with clinical disorders.

## 2. Methods

### 2.1. Participants

Data from 55 patients were used. All participants provided written informed consent. All procedures relevant to the present study comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Inclusion criteria included: 1) having at least one DSM-5 diagnosis as measured by the Mini-International

Neuropsychiatric Interview (MINI) (Sheehan et al., 1998), and 2) having current or recent (past 6 months) clinically significant levels of paranoia which could not be explained by substance use. Significant paranoia was defined as a score  $\geq 4$  on the suspiciousness/persecution item (P6) of the Positive and Negative Symptom Scale (PANSS) (Kay et al., 1987), consistent with the previous work (Fan et al., 2021; Pinkham et al., 2015). Given that the goal of the current work was to assess paranoia changes, patients were required to either show current or recent paranoia at the time of enrollment/baseline assessment. This was done to prevent inclusion of individuals who have never experienced paranoia. Therefore, participants who did not endorse current paranoia at baseline were asked if they had experienced any paranoia-related thoughts and behaviors in the past 6 months. Those with a positive 6-month history were included. Individuals endorsing head trauma with unconsciousness  $> 15$  min, presence of neurological and/or neurodegenerative disorders, or intellectual disability (IQ  $< 70$ ) were excluded.

### 2.2. Procedure and assessments

#### 2.2.1. Baseline assessments

At the baseline visit, MINI (Sheehan et al., 1998) was performed by trained researchers to confirm the diagnoses. The suspiciousness/persecution section of the PANSS (Kay et al., 1987) was also administered to assess current paranoia status. Scores on P6 range from 1 to 7, and as in previous work (Fan et al., 2021; Pinkham et al., 2015), a score of 4 or above was classified as “paranoid” whereas scores ranging from 1 to 3 were classified as “non-paranoid”.

#### 2.2.2. Quantification of paranoia variability

After the baseline visit, participants completed this section of PANSS on a monthly basis via telephone to monitor fluctuations in paranoia level. A shift between paranoia categories (paranoid vs. non-paranoid) was defined as a change between low (P6 = 1–3) and high (P6 = 4–7) scores. If/when a participant demonstrated a shift, they were invited into the lab for further assessment and neuroimaging (imaging data are presented separately (Fan et al., 2021)). As noted, monthly assessments stopped when the participant had been followed for up to 12 months or showed two shifts between paranoia categories (allowing imaging in both a paranoid and non-paranoid state). Therefore, the amount of time that each participant was enrolled in this study varied and depended on how often their paranoia fluctuated. Accordingly, participants could have 3–12 assessments of paranoia (range = 4–12 in the current sample; included as a covariate). The number of shifts was then counted for each participant (range = 0–2) to represent paranoia stability/variability. More changes between paranoia categories reflect higher paranoia variability and therefore reduced stability.

Additionally, we also dummy coded the first change to specify its direction, which was examined in exploratory analyses. Specifically, individuals changing from paranoid to nonparanoid states were dummy coded as “1,0”, individuals changing from nonparanoid to paranoid states were dummy coded as “0,1”, and those with no change were dummy coded as “0,0”. Second changes were not analyzed due to their limited occurrence.

#### 2.2.3. Assessments of current paranoia severity and social functioning

Current symptom severity and social functioning were assessed when participants showed changes in paranoia status (i.e., from paranoid to non-paranoid status or vice versa) in order to capture the correlates and outcomes associated with such fluctuation. Therefore, there were 2 assessments for participants with 2 changes using exactly the same protocol and measurements, and 1 assessment for individuals with no change or only 1 change throughout the course of 12 months. Notably, the Time 2 data for participants with 2 assessments was used for the subsequent statistical analyses. The measures are detailed below:

**2.2.3.1. Suspiciousness/persecution item (P6) of PANSS.** The suspiciousness/persecution section of the PANSS was performed to examine current paranoia status (i.e., paranoid vs. non-paranoid) of each participant using the same criteria in the baseline assessments.

**2.2.3.2. The Paranoia Scale (PS).** The PS is a self-report measure of paranoia that is sensitive to variation in paranoia across diagnoses (Fenigstein and Venable, 1992). Participants were asked to indicate how strongly each of 20 statements applies to them. Scores range from 20 to 100 and higher scores indicate increased paranoia. The internal consistency of PS is excellent in the current study (Cronbach's  $\alpha = 0.926$ ).

**2.2.3.3. The state portion of the State-Trait Anxiety Inventory (STAI-S).** The STAI-S (Spielberger et al., 1983) was also administered to assess current anxiety as a control variable given that anxiety has been consistently found to be an overlapping construct with paranoia (Martin and Penn, 2001; Startup et al., 2007). This self-report measure includes 20 items, and higher scores indicate more anxiety (range = 20–80). The internal consistency of STAI-S in the present study is also strong (Cronbach's  $\alpha = 0.940$ ).

**2.2.3.4. The Birchwood Social Functioning Scale (SFS).** The SFS is a self-report measure of social adjustment across 7 domains (range = 0–223, Cronbach's  $\alpha = 0.921$ ), including social engagement/withdrawal (range = 0–15; Cronbach's  $\alpha = 0.275$ ), interpersonal communication (range = 0–9; Cronbach's  $\alpha = 0.524$ ), prosocial activities (range = 0–66; Cronbach's  $\alpha = 0.884$ ), recreation (range = 0–45; Cronbach's  $\alpha = 0.611$ ), independence-competence (range = 0–39; Cronbach's  $\alpha = 0.830$ ), independence-performance (range = 0–39; Cronbach's  $\alpha = 0.830$ ), and employment (single item; range = 0–10) (Birchwood et al., 1990). A higher score in each subscale represents better functioning in the corresponding social domain, and a higher total score reflects better overall social functioning.

### 2.3. Statistical analyses

First, Pearson's correlation was performed to assess the preliminary associations among the main continuous variables. Point biserial correlation was used for quantifying the association between one categorical variable and one continuous variable, while Spearman's rank correlation was used between two categorical variables. Then, multivariate analysis of variance was performed to reveal the differences in demographics, symptom severity, and social functioning among the three paranoia change groups (i.e., no change, 1 change, and 2 changes). Finally, hierarchical linear regressions were used to examine the association between paranoia changes and social functioning (including the total score and all subscores of SFS) while controlling for current paranoia and anxiety level as well as the number of monthly assessments. Given that there were no between-group differences in most SFS subscores (except the independence-competence subscore of SFS) as shown in the Section 3, the regression analyses are exploratory. While the Time 2 data for individuals with 2 assessments was used for these analyses, we also computed the mean SFS total score across the 2 visits to generate an estimate of overall social functioning across the duration of study participation. The dummy coded variable reflecting the direction of change was also included in additional hierarchical linear regression models to examine their association with social functioning (controlling for current paranoia and anxiety level as well as the number of monthly assessments).

## 3. Results

### 3.1. Demographics, clinical variables, and correlations

Demographics and clinical characteristics are shown in Table 1.

**Table 1**  
Demographic and clinical characteristics of the patients ( $N = 55$ ).

	Mean/N	SD/%
Age	36.96	11.05
Gender		
Male	25	45.50
Female	30	54.50
Race		
Caucasian	26	47.30
African American	26	47.30
American Indian/Alaskan Native	1	1.80
Asian	2	3.60
Ethnicity		
Hispanic	10	18.2
Non-hispanic	45	81.8
Primary diagnoses		
SCZ	8	14.50
SCZ-A	26	47.30
MDD without psychosis	9	16.40
BP without psychosis	5	9.10
BP with psychosis	5	9.10
ASD	1	1.80
ADHD	1	1.80
P6 of PANSS	2.87	1.83
PS	53.07	17.65
STAI (state)	43.24	13.79
SFS (total)	132.71	26.36
Paranoia changes in 12 Months		
No change	22	40.00
One change	19	34.50
Two changes	14	25.50

Abbreviations: SCZ, schizophrenia; SCZ-A, schizoaffective disorder; MDD, Major Depressive Disorder; BP, Bipolar Disorder; ASD, Autism Spectrum Disorder; ADHD; Attention Deficit Hyperactivity Disorder; PANSS, Positive and Negative Symptom Scale; PS, Paranoia Scale; STAI (state), the state subscale of the State and Trait Anxiety Inventory; SFS (total), the total score of the Birchwood Social Functioning Scale.

Notably, the three levels of variability were mostly evenly-distributed (i.e.,  $n_{\text{no change}} = 22$ ,  $n_{\text{one change}} = 19$ ,  $n_{\text{two changes}} = 14$ ). The three paranoia change groups did not differ significantly in demographics, symptom severity, or social functioning, except for current paranoia as measured by the P6 item of PANSS [ $F(2,51) = 4.51$ ,  $p = .016$ , Partial  $\eta^2 = 0.153$ , Table 2] and the independence-competence subscore of SFS [ $F(2,52) = 3.21$ ,  $p = .048$ , Partial  $\eta^2 = 0.110$ , Table 2]. Post-hoc Tukey tests showed that individuals with no paranoia change showed significantly higher current paranoia ( $p = .022$ ) and lower scores in the independence-competence subscale of SFS ( $p = .050$ ) compared with individuals with one change. Given that there are between-group differences in P6, we included P6 but not PS as the first-level predictor to control baseline paranoia in the subsequent regression analyses. Preliminary correlation analyses (Table 3) revealed that there were moderate-to-strong positive correlations among current P6, PS, and STAI, and these three variables were negatively correlated with SFS. Further correlations with SFS subscales (Table 4) showed that P6 and PS were negatively correlated with most of the SFS subscores and that paranoia changes were most strongly correlated with the prosocial activities subscale, which showed a medium effect size.

### 3.2. Relationship between social functioning and paranoia changes

Hierarchical regression analysis revealed that paranoia changes did not explain significant variance in SFS total scores ( $p = .087$ ). However, when prosocial activities were entered as the outcome, a significant contribution of paranoia variability above and beyond current paranoia and anxiety severity as well as assessment numbers was revealed. Specifically, the combination of STAI and P6 accounted for a significant proportion of variance in the prosocial activities subscale of SFS (adjusted  $R^2 = 0.15$ ,  $p = .013$ ; Table 5). Higher levels of current paranoia as reflected by P6 were also associated with fewer prosocial activities ( $b$

**Table 2**  
Demographic and clinical characteristics in each paranoia change group.

	No change (n = 22)	One change (n = 19)	Two changes (n = 14)	F/ $\chi^2$	Partial $\eta^2$
Age	36.00 (9.97)	38.21 (12.15)	36.79 (11.74)	0.35	0.014
Gender				5.11	–
Male	8	7	10		
Female	14	12	4		
Race				3.58	–
Caucasian	9	11	6		
African American	11	8	7		
American Indian/ Alaskan Native	1	0	0		
Asian	1	0	1		
Ethnicity				2.11	–
Hispanic	6	2	2		
Non-hispanic	16	17	12		
Primary diagnoses				16.53	–
SCZ	2	3	3		
SCZ-A	13	5	8		
MDD without psychosis	4	3	2		
BP without psychosis	0	4	1		
BP with psychosis	1	4	0		
ASD	1	0	0		
ADHD	1	0	0		
Monthly assessments	11.32 (1.21)	9.89 (3.18)	9.43 (2.59)	3.16 <sup>b</sup>	0.108
P6 of PANSS	3.68 (1.73)	2.26 (1.73)	3.29 (1.54)	4.51 <sup>a</sup>	0.153
PS	59.09 (18.85)	46.53 (17.41)	54.93 (14.95)	2.76	0.100
STAI (state)	44.50 (13.60)	42.63 (15.58)	43.92 (15.86)	0.08	0.003
SFS (total)	122.95 (30.41)	136.58 (23.36)	136.57 (19.52)	1.86	0.067
SFS (social_engage)	10.77 (3.60)	12.37 (3.77)	9.79 (2.12)	2.53	0.089
SFS (inter_com)	6.18 (2.26)	6.84 (1.98)	6.07 (1.98)	0.71	0.027
SFS (recreation)	19.09 (6.41)	22.42 (5.99)	21.43 (4.86)	1.71	0.062
SFS (prosocial)	18.23 (12.32)	22.58 (10.42)	26.71 (10.89)	2.45	0.086
SFS (independence-p)	28.14 (8.03)	29.79 (5.70)	31.50 (4.64)	1.15	0.042
SFS (independence-c)	34.05 (4.62)	36.74 (2.49)	36.14 (2.74)	3.21 <sup>a</sup>	0.110
SFS (employment)	6.50 (3.39)	5.84 (4.13)	4.93 (4.01)	0.73	0.027

Values in the cell represent mean (standard deviation) or frequency or statistical values.

Abbreviations: SCZ, schizophrenia; SCZ-A, schizoaffective disorder; MDD, Major Depressive Disorder; BP, Bipolar Disorder; ASD, Autism Spectrum Disorder; ADHD; Attention Deficit Hyperactivity Disorder; PANSS, Positive and Negative Symptom Scale; PS, Paranoia Scale; STAI (state), the state subscale of the State and Trait Anxiety Inventory; SFS (total), the total score of the Birchwood Social Functioning Scale; SFS (social\_engage), the social engagement/withdrawal subscore of the Birchwood Social Functioning Scale; SFS (inter\_com), the interpersonal communication subscore of the Birchwood Social Functioning Scale; SFS (recreation), the recreation subscore of the Birchwood Social Functioning Scale; SFS (prosocial), the prosocial activities subscore of the Birchwood Social Functioning Scale; SFS (independence-p), the independence-performance subscore of the Birchwood Social Functioning Scale; SFS (independence-c), the independence-competence subscore of the Birchwood Social Functioning Scale; SFS (employment), the employment subscore of the Birchwood Social Functioning Scale.

<sup>a</sup>  $p < .05$ .

<sup>b</sup>  $p < .06$ .

$= -2.11$ ,  $SE = 0.91$ ,  $p = .024$ ). More importantly, adding paranoia variability to the model explained an additional 11% of variance in the prosocial activities subscale of SFS ( $\Delta R^2 = 0.11$ ,  $p = .013$ ), and the overall model remained significant (adjusted  $R^2 = 0.25$ ,  $p = .001$ ; Table 5). Again, individuals with higher levels of current paranoia tended to be less engaged in prosocial activities ( $b = -1.93$ ,  $SE = 0.85$ ,  $p = .029$ ). Further, those with more shifts between paranoia categories (i.e., higher paranoia variability) demonstrated more participation in prosocial activities ( $b = 5.23$ ,  $SE = 1.89$ ,  $p = .008$ ). Models with other subscores of SFS as the outcomes were nonsignificant.

Paranoia changes also explained significant variance in the averaged SFS total score. STAI and P6 as well as assessment numbers accounted for a significant proportion of variance in the averaged SFS total score (adjusted  $R^2 = 0.19$ ,  $p = .004$ ; Table 5), and current paranoia was negatively linked to overall social functioning ( $b = -5.06$ ,  $SE = 1.96$ ,  $p = .014$ ). Paranoia variability explained an additional 7% of variance in the averaged SFS total score ( $\Delta R^2 = 0.07$ ,  $p = .030$ ) and the model remained significant (adjusted  $R^2 = 0.25$ ,  $p = .001$ ; Table 5). Individuals with higher levels of current paranoia demonstrated poorer overall social functioning ( $b = -4.74$ ,  $SE = 1.91$ ,  $p = .017$ ), and more importantly, those with higher paranoia variability showed better overall social functioning ( $b = 9.45$ ,  $SE = 4.22$ ,  $p = .030$ ).

Finally, none of the regression models using direction of change as the independent variable and SFS as the outcomes were significant.

#### 4. Discussion

The current study investigated the natural fluctuation of paranoia as well as its relationship with social functioning in patients with clinical diagnoses. By following patients for up to 12 months and capturing their paranoia each month, we found that 60.00% of the patients showed at least one change between distinct, clinically-classified states of paranoia presence vs. absence, with 25.50% of the patients demonstrating two changes over the course of one year. The three paranoia change groups did not differ significantly in demographics, symptom severity, or social functioning, except that individuals with no paranoia change showed higher current paranoia and lower scores in the independence-competence subscale of SFS compared with individuals with one change. Correlation analyses showed that current clinically-rated and self-reported paranoia and self-reported state anxiety were positively correlated with each other, and they were all negatively correlated with social functioning. Hierarchical regression analyses revealed that paranoia changes explained significant variance in social functioning above and beyond the effects of current paranoia and anxiety severity and that greater variability was associated with better social functioning. However, the direction of the changes did not show a significant association with social functioning. These findings indicate that fluctuation in paranoia appears to be prevalent across even relatively short periods of time, and that both paranoia severity and variability impact social functioning, but in opposite directions. Specifically, lower levels of paranoia severity but higher levels of paranoia variability are associated with better interpersonal functioning.

Consistent with previous work suggesting the vacillating nature of paranoia (Buck et al., 2019; Oorschot et al., 2012; Podubinski et al., 2012; So et al., 2018), we also observed that a high proportion of patients with clinical diagnoses demonstrated shifts between paranoid and non-paranoid states. Using clinician-rated paranoia, the present study extends previous work that relies on patients' self-reports (Buck et al., 2019; Oorschot et al., 2012; So et al., 2018) by demonstrating that these observed fluctuations are not likely due to patients' impaired insight or inability to report their mental states consistently and accurately. Furthermore, these findings fit with the attribution-self-representation model and stress-vulnerability model of persecutory delusions, both of which agreed that paranoid beliefs are affected by environmental stressors, attributions, as well as current knowledge about the self (Bentall et al., 2001; Bentall and Kaney, 2005; Zubin and Spring, 1977).

**Table 3**  
Zero-order correlations among the main variables.

	1	2	3	4	5	6	7	8	9
1. Age	–								
2. Gender	–0.124 <sup>a</sup>	–							
3. Race	–0.047 <sup>a</sup>	0.177 <sup>b</sup>	–						
4. Ethnicity	–0.106 <sup>a</sup>	0.043 <sup>b</sup>	–0.261 <sup>b</sup>	–					
5. Diagnoses	0.005 <sup>a</sup>	–0.266 <sup>b,*</sup>	–0.206 <sup>b</sup>	–0.148 <sup>b</sup>	–				
6. P6	–0.083	–0.173 <sup>a</sup>	0.043 <sup>a</sup>	0.083 <sup>a</sup>	–0.470 <sup>b,***</sup>	–			
7. PS	–0.135	–0.183 <sup>a</sup>	0.142 <sup>a</sup>	0.143 <sup>a</sup>	–0.316 <sup>a,**</sup>	0.696 <sup>***</sup>	–		
8. STAI (state)	–0.061	0.021 <sup>a</sup>	0.044 <sup>a</sup>	0.034 <sup>a</sup>	–0.114 <sup>a</sup>	0.333 <sup>*</sup>	0.600 <sup>***</sup>	–	
9. SFS (total)	–0.003	0.128 <sup>a</sup>	0.161 <sup>a</sup>	0.027 <sup>a</sup>	0.138 <sup>a</sup>	–0.415 <sup>**</sup>	–0.412 <sup>**</sup>	–0.383 <sup>**</sup>	–

Abbreviations: P6, the suspiciousness/persecution section of the Positive and Negative Symptom Scale; PS, Paranoia Scale; STAI (state), the state subscale of the State and Trait Anxiety Inventory; SFS (total), the total score of the Birchwood Social Functioning Scale.

<sup>a</sup> Point biserial correlation.

<sup>b</sup> Spearman's rank correlation. Pearson's correlation was performed if not specified.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

**Table 4**  
Zero-order correlations among P6, PS, paranoia changes, and SFS subscales.

	1	2	3	4	5	6	7	8	9	10
1. P6	–									
2. PS	0.696 <sup>***</sup>	–								
3. Paranoia Changes	–0.134 <sup>a</sup>	–0.130 <sup>a</sup>	–							
4. SFS (social_engage)	–0.271 <sup>*</sup>	–0.331 <sup>*</sup>	–0.076 <sup>a</sup>	–						
5. SFS (inter_com)	–0.301 <sup>*</sup>	–0.334 <sup>*</sup>	0.001 <sup>a</sup>	0.503 <sup>***</sup>	–					
6. SFS (recreation)	–0.298 <sup>*</sup>	–0.259	0.180	0.283 <sup>*</sup>	0.343 <sup>*</sup>	–				
7. SFS (prosocial)	–0.351 <sup>**</sup>	–0.300 <sup>*</sup>	0.294 <sup>a,*</sup>	0.410 <sup>**</sup>	0.430 <sup>**</sup>	0.454 <sup>***</sup>	–			
8. SFS (independence-p)	–0.201	–0.337 <sup>*</sup>	0.206 <sup>a</sup>	0.303 <sup>*</sup>	0.197	0.437 <sup>**</sup>	0.348 <sup>**</sup>	–		
9. SFS (independence-c)	–0.426 <sup>***</sup>	–0.412 <sup>**</sup>	0.256 <sup>a</sup>	0.480 <sup>**</sup>	0.344 <sup>*</sup>	0.382 <sup>**</sup>	0.451 <sup>**</sup>	0.645 <sup>***</sup>	–	
10. SFS (employment)	–0.131	–0.062	–0.164	0.341 <sup>*</sup>	0.334 <sup>*</sup>	0.162	0.289 <sup>*</sup>	0.214	0.239	–

Abbreviations: P6, the suspiciousness/persecution section of the Positive and Negative Symptom Scale; PS, Paranoia Scale; SFS (social\_engage), the social engagement/withdrawal subscore of the Birchwood Social Functioning Scale; SFS (inter\_com), the interpersonal communication subscore of the Birchwood Social Functioning Scale; SFS (recreation), the recreation subscore of the Birchwood Social Functioning Scale; SFS (prosocial), the prosocial activities subscore of the Birchwood Social Functioning Scale; SFS (independence-p), the independence-performance subscore of the Birchwood Social Functioning Scale; SFS (independence-c), the independence-competence subscore of the Birchwood Social Functioning Scale; SFS (employment), the employment subscore of the Birchwood Social Functioning Scale.

<sup>a</sup> Point biserial correlation. Pearson's correlation was performed if not specified.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

Supporting this theory, a previous study reported that negative emotions (i.e., anxiety) and lower levels of self-esteem predicted the onset of paranoia (Thewissen et al., 2011). Consequently, the fluctuation in paranoia may result from unstable living environments that further introduce life stressors, altered inferential processes, and/or labile self-schema. In other words, the current findings imply that paranoia is a rather amenable phenomenon that could be impacted by a variety of factors. Given that there was no constraint on, or monthly assessment of, the treatments that patients were receiving, the observed fluctuations in paranoia might also stem from treatment. Future studies simultaneously tracking treatment changes along with paranoia variability would be valuable in determining if and what kinds of treatments play a role in the fluctuation of paranoia.

More importantly, to our best knowledge, the present study is the first to associate intra-individual variability in paranoia with social functioning by reporting that higher paranoia variability is related to better social functioning and that such contribution remained valid even after controlling for current paranoia and anxiety levels. This intriguing finding is compatible with a recent study reporting the positive correlation between within-individual variability in paranoia and the perception of feeling social (Buck et al., 2019). The present findings may also inform the distinction between trait and state paranoia. The overall distrustful attitude captured by PS may reflect a relatively stable

tendency to mistrust, whereas P6 of PANSS may represent recent persecutory thoughts (i.e., in the past week) that may be relevant to social context and recent social interactions. This distinction is in line with previous work reporting that trait paranoia as measured by PS was not associated with time spent in familiar vs. unfamiliar company, but a higher level of state/momentary paranoia was related to more perceived social threat in less familiar company in individuals with low and medium trait paranoia (Collip et al., 2011). Additionally, these findings may help to explain why changes in P6 of PANSS showed a positive correlation with prosocial activities rather than social engagement or interpersonal communication subscales of SFS (Table 4): participating in common activities (e.g., sports, class, etc.) may not require a high level of interpersonal trust because individuals should be familiar with these activities, which can also be completed with relatively limited interaction with people; however, more in-depth social contact and communication (e.g., initiating a conversation) may require relatively stable beliefs that people in general are trustworthy. Therefore, fluctuation in state paranoia (e.g., occasionally thinking that people might not intend harm) may be less related to more demanding social interaction.

The current findings may reflect a bidirectional association between paranoia variability and social functioning. On one hand, periods of lower paranoia may encourage more attempts to engage in social activities (Combs et al., 2013; Pinkham et al., 2016). On the other hand, it

**Table 5**

Variance in SFS (prosocial) and averaged SFS (total) explained by paranoia variability controlling for current paranoia and anxiety as well as number of monthly assessments.

Variables	SFS (prosocial)							
	<i>b</i> (95%CI)	<i>SE</i>	$\beta$	<i>t</i>	<i>R</i> <sup>2</sup>	Adjusted <i>R</i> <sup>2</sup>	$\Delta R^2$	$\Delta F$
Step 1								
Intercept	35.80 (19.89, 51.71)	7.92	–	4.52***				
STAI (state)	–0.18 (–0.40, 0.04)	0.11	–0.22	–1.63	0.20	0.15	0.20	3.98*
P6	–2.11 (–3.93, –0.28)	0.91	–0.32	–2.32*				
Monthly Assessments	0.07 (–1.11, 1.26)	0.59	0.02	0.13				
Step 2								
Intercept	25.68 (9.03, 42.32)	8.28	–	3.10**				
STAI (state)	–0.18 (–0.38, –0.03)	0.10	–0.22	–1.73	0.31	0.25	0.11	7.68**
P6	–1.93 (–3.64, –0.21)	0.85	–0.29	–2.26*				
Monthly Assessments	0.58 (–0.59, 1.75)	0.58	0.13	0.99				
Paranoia Changes	5.23 (1.44, 9.03)	1.89	0.35	2.77**				
Averaged SFS (total)								
Step 1								
Intercept	172.80 (138.10, 207.50)	17.27	–	10.00***				
STAI	–0.44 (–0.92, 0.04)	0.24	–0.25	–1.86	0.23	0.19	0.23	4.96**
P6	–5.06 (–9.04, –1.09)	1.96	–0.34	–2.57*				
Monthly Assessments	–0.52 (–3.10, 2.07)	1.29	–0.05	–0.40				
Step 2								
Intercept	154.50 (117.30, 191.70)	18.50	–	8.35***				
STAI	–0.44 (–0.90, 0.02)	0.23	–0.25	–1.94	0.31	0.25	0.07	5.02*
P6	–4.74 (–8.57, –0.90)	1.91	–0.32	–2.48*				
Monthly Assessments	0.40 (–2.22, 3.02)	1.30	0.04	0.31				
Paranoia Changes	9.45 (0.97, 17.93)	4.22	0.28	2.24*				

Abbreviations: STAI (state), the state subscale of the State and Trait Anxiety Inventory; P6, the suspiciousness/persecution section of the Positive and Negative Symptom Scale; SFS (prosocial), the prosocial activities subscale of the Birchwood Social Functioning Scale; SFS (total), the total score of the Birchwood Social Functioning Scale.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

is also possible that individuals with better social functioning are more likely to have positive social experiences, which could provide counterevidence to paranoid thoughts and prevent the stability of being consistently paranoid. An alternative explanation is that individuals with higher fluctuation in paranoia may have less social cognitive bias and more adaptive inferential strategies. In line with this notion, mounting literature has demonstrated pronounced social cognitive bias in patients with significant paranoia and individuals with elevated subclinical paranoia, including attributional bias (Combs et al., 2013; Craig et al., 2004; Pinkham et al., 2016), emotion recognition deficits (Combs et al., 2013; Klein et al., 2018), and impaired theory of mind ability (Craig et al., 2004; Klein et al., 2018; Montag et al., 2011). A recent study also reported attenuated belief updating ability (i.e., the ability to update one's knowledge about the environment according to meaningful social clues) in individuals with subclinical paranoia (Nour et al., 2018). Thus, it is possible that greater paranoia, as well as more stable paranoia, may be related to social cognitive impairments which may then contribute to poorer social functioning. Indeed, a recent study using ecological momentary assessments found that patients with schizophrenia used more ineffective emotion regulation strategies in daily life (Visser et al., 2018). However, the role of social cognition in the relationship between intra-individual variation in paranoia and social functioning remains enigmatic, thus future research investigating whether social cognition may serve as a mediator will be informative.

Several limitations of the current study should be addressed. First, the sample size of the current study is relatively small, which may be underpowered to detect between-group differences in SFS subscales. Second, paranoia is a continuum spanning across pathological to healthy populations (Combs et al., 2006); however, the current results are limited to a clinical sample and cannot inform whether similar findings would be observed in healthy populations. Future studies recruiting a community sample are recommended to further assess the generalizability of the present findings. Third, the measurement of social

functioning is based on self-report, which might have introduced bias due to decreased introspective accuracy (i.e., the ability to evaluate one's own functioning and performance) in psychosis (Harvey and Pinkham, 2015; Silberstein and Harvey, 2019). Therefore, future research applying objective measures (e.g., informant- or clinician-rated) of social functioning would be preferred to minimize such bias. Forth, we focused on categorical shifts in paranoia presence vs. absence; however, more subtle changes in objectively assessed paranoia severity may also be of interest. P6 of PANSS also fails to capture and differentiate elements of paranoia (e.g., ideas of reference, sensitivity, etc.), which may associate differently with social functioning. Moreover, the causal relationship between paranoia fluctuations and better social functioning is an interesting arena to explore in the future. While paranoia changes were entered as the independent variable and social functioning was treated as the dependent variable in the current regression model, we did not have strong assumptions about causal effects and thus future experimental studies and longitudinal studies that assess social functioning at multiple timepoints are highly recommended. Finally, while the present study did not observe a significant association between the direction of the changes (i.e., changing from paranoid to non-paranoid states vs. changing from non-paranoid to paranoid states) and social functioning, these null findings might result from restricted variance/range given that the maximum number of changes is 2 for each participant in the present sample. Again, future research using intensive longitudinal designs (e.g., ecological momentary assessment) with more observations of paranoia levels and current functioning could better address this issue.

## 5. Conclusions

The present work is the first investigating the intra-individual variability in paranoia and its relationship with social functioning. We found that paranoia variability is prevalent across the course of one year, and

that paranoia variability affects social functioning above and beyond current paranoia and anxiety severity, with higher levels of paranoia variability being associated with better interpersonal functioning. These findings may help to understand the natural dynamics of paranoia and provide a foundation for future research investigating the psychosocial and biological determinants of such fluctuation, which could further improve the social functioning of individuals with elevated paranoia.

### Ethical approval

All procedures relevant to the present study comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects/patients were approved by the Institutional Review Board of the University of Texas at Dallas. All participants provided written informed consent.

### Funding sources

This work was supported by the National Institute of Mental Health (R21 MH112930, PI Pinkham).

### CRediT authorship contribution statement

**Linlin Fan:** Conceptualization, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. **Emily Bass:** Conceptualization, Investigation, Data curation, Project administration. **Hans Klein:** Investigation, Project administration. **Cassi Springfield:** Data curation, Project administration. **Amy Pinkham:** Conceptualization, Funding acquisition, Supervision, Writing - review & editing.

### Declaration of competing interest

The authors declare no conflict of interest.

### Acknowledgements

We thank all the participants in the current study.

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