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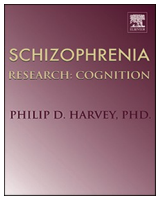

Do loneliness and social exclusion breed paranoia? An experience sampling investigation across the psychosis continuum

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ABSTRACT

Background: The role of loneliness and social exclusion in the development of paranoia is largely unexplored. Negative affect may mediate potential associations between these factors. We investigated the temporal relationships of daily-life loneliness, felt social exclusion, negative affect, and paranoia across the psychosis continuum.

Method: Seventy-five participants, including 29 individuals with a diagnosis of non-affective psychosis, 20 first-degree relatives, and 26 controls used an Experience Sampling Method (ESM) app to capture the fluctuations in loneliness, feelings of social exclusion, paranoia, and negative affect across a 1-week period. Data were analysed with multilevel regression analyses.

Results: In all groups, loneliness and feelings of social exclusion were independent predictors of paranoia over time ($b = 0.05$, $p < .001$ and $b = 0.04$, $p < .05$, respectively). Negative affect predicted paranoia ($b = 0.17$, $p < .001$) and partially mediated the associations between loneliness, social exclusion, and paranoia. It also predicted loneliness ($b = 0.15$, $p < .0001$), but not social exclusion ($b = 0.04$, $p = .21$) over time. Paranoia predicted social exclusion over time, with more pronounced effects in controls ($b = 0.43$) than patients ($b = 0.19$; relatives: $b = 0.17$); but not loneliness ($b = 0.08$, $p = .16$).

Conclusion: Paranoia and negative affect worsen in all groups following feelings of loneliness and social exclusion. This highlights the importance of a sense of belonging and being included for mental well-being. Loneliness, feeling socially excluded, and negative affect were independent predictors of paranoid thinking, suggesting they represent useful targets in its treatment.

1. Introduction

While loneliness is often a transient experience, when severe and protracted its effects can be detrimental to health (Wickens et al., 2021). Loneliness has been declared a major public concern (HMGov, 2018) and has been identified as a risk factor for mental health, suicidal ideation, diabetes, poor immune functioning, cardiovascular diseases, and mortality (for a review, see Hawkley and Cacioppo (2010)). Loneliness is a subjective feeling - it happens when we perceive a mismatch between the quantity and quality of social relationships that we have and those we want (Perlman and Peplau, 1981). Social isolation, which is often quantified as the number of friends or social contacts, and loneliness often co-occur. However, those who are socially isolated do not always feel lonely and feelings of loneliness can be experienced with objectively intact social networks, as supported by moderate correlation between loneliness and objective social isolation (Matthews et al., 2016).

Previous research shows that individuals with psychosis are often alone (Fett et al., 2022) and particularly vulnerable to chronic social isolation (Velthorst et al., 2017), with few contacts outside of mental health services (Norman et al., 2005). Furthermore, they have been found to experience severe levels of loneliness. Eighty percent of

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individuals with psychosis report to feel lonely, which is approximately 2.3 times higher than levels reported by the general population (Badcock et al., 2015; Stain et al., 2012).

The struggle to form and maintain relationships has been considered a consequence of the symptoms of psychosis in individuals with psychotic illness, i.e. individuals with psychosis may be particularly prone to social exclusion due to a lack of social motivation underpinned by paranoid thinking (referring to the inflated belief that others have malevolent intentions), cognitive deficits (Killaspy et al., 2014), and (self-) stigma (Colizzi et al., 2020). Furthermore, problems with social cognition and social skills may contribute to social exclusion and other problems with social functioning (Fett et al., 2011; Halverson et al., 2019; Turner et al., 2018). Loneliness has been suggested to enhance vigilance for social threat and therefore, it is possible that loneliness intensifies psychotic symptoms, specifically paranoid delusions (Bangee et al., 2014; Cacioppo et al., 2006). Others showed that social exclusion and isolation can lead to the occurrence of psychotic experiences, and paranoid delusions in particular (Graeupner and Coman, 2017; Selten and Cantor-Graae, 2005). This is supported by experimental research in non-clinical samples, suggesting that social exclusion drives paranoia (Freeman et al., 2002; Kesting et al., 2013). Recent research indicates that this association may be mediated by feelings of loneliness (Steenkamp et al., 2022). Importantly, while high levels of loneliness and social exclusion in individuals with psychosis are consistently reported and relevant for interventions, their association and unique contribution to paranoid delusions has rarely been studied.

A final important factor that should be considered in the loneliness-social exclusion- paranoia pathway is negative affect. A study by Gollwitzer et al. (2018) has shown that reducing negative affect attenuated the effect of loneliness on paranoia by around 60 %. This finding is supported by previous work suggesting that loneliness exacerbates positive psychotic symptoms via a pathway of increased negative affect (Jaya et al., 2017; Sündermann et al., 2014) and is in line with theoretical models of an affective pathway to paranoia (Fowler et al., 2012; Freeman and Garety, 2014; Jaya et al., 2017; Kesting and Lincoln, 2013; Kramer et al., 2014).

A key limitation of previous studies exploring the association between loneliness, feelings of social exclusion, and paranoia, is that they used cross-sectional retrospective interviews or questionnaires, regarding the phenotypes as static phenomena (van Os et al., 2009). Several studies highlight short-term fluctuations in the intensity and preoccupation in paranoia across moments of the day (Myin-Germeys et al., 2001). To truly understand the nature of the associations between social isolation, loneliness and paranoia, such short-term daily fluctuations should therefore be considered. Real-life indices of social functioning and social emotions can be explored through the Experience Sampling Method (ESM; (Collip et al., 2011; Schneider et al., 2017; Steenkamp et al., 2022), which is a structured self-report diary technique; that has been successfully used to study psychotic disorders (e.g. (Hermans et al., 2021; Myin-Germeys et al., 2018; So et al., 2021)). In the present study we adopted ESM to capture the fluctuations in momentary loneliness, feelings of social exclusion, negative affect, and paranoid thoughts in psychosis. To explore whether these are disorder-specific, or can be detected across the psychosis spectrum, we also included a group of healthy first-degree relatives of individuals with a diagnosis of non-affective psychosis who did not meet criteria for a psychiatric disorder, alongside healthy controls.

We hypothesized that: (i) patients would feel lonelier and more socially excluded and that they would experience greater paranoia than controls, and that relatives would occupy an intermediate position; and explored whether (ii) loneliness and social exclusion would temporally precede increased paranoia and whether any associations would differ between groups, (iii) loneliness and social exclusion would be independent predictors of paranoia, (iv) the relationship between feeling lonely, socially excluded, and paranoid would be mediated by negative affect, in line with a hypothesized affective pathway to paranoia. Finally, we conducted exploratory analysis to examine whether paranoia and negative affect would precede loneliness and feelings of social exclusion and whether any associations would differ between groups.

2. Method

2.1. Sample

Our initial sample included 82 participants. Data of one participant could not be included due to technical problems with the app. To be included in the analyses, participants had to respond validly to at least one-third of the beeps (Delespaul, 1995). Six participants (4 patients, 1 relative and 1 control) were therefore removed from the dataset due to an insufficient number of completed observations. The final analysis data set therefore included 75 participants in three groups: 1) 29 patients with a current primary diagnosis of non-affective psychosis; 2) 20 first-degree relatives of individuals with a diagnosis of non-affective psychosis; 3) 26 controls without a personal or family history of psychosis. Patients met primary diagnoses of schizophrenia (n = 23), schizoaffective disorder (n = 4), or psychosis not otherwise specified (n = 2).

The inclusion criteria were age between 18 and 65 years and the sufficient command of English to complete the informed consent and the study tasks. Exclusion criteria for all participants were a history of neurological conditions and alcohol or drug dependence within six months of the study screening. Recruitment of patients took place via the SLAM NHS Foundation Trust, the 'Consent for Consent c4c' initiative, the OXLEAS-, NELFT- and SEPT NHS Foundation Trusts in cooperation with the Mental Health Research Network. Relatives were recruited via the mental health charities Rethink and Mind. We aimed to recruit patients and relatives from the same families. However, in this sample all first-degree relatives took part as single member from their family (i.e., were not related to the participating patients). Controls were recruited through online advertisements on the websites Gumtree, Call for participants, Craigslist, and the KCL recruitment circular emails. The study was approved by the London-Harrow Research Ethics Committee [14/LO/0710].

2.2. Measures

Participants completed a *demographic questionnaire*, including information on living status, ethnicity, education, age, and sex, as well as relevant clinical variables. The *Positive and Negative Syndrome Scale (PANSS);* (Kay and Opler, 1987) was conducted in patients to assess positive, negative, and general symptoms; items were rated on a seven-point rating scale, representing increasing levels of psychopathology on each scale. The 42 item Community Assessment of Psychic Experiences (CAPE) was used to assess positive and negative schizotypy on a four-point Likert scale (1–4, 'never', 'sometimes', 'often' and 'nearly always') in all participant groups (Stefanis et al., 2002).

The Experience Sampling Method (ESM). Participants received an iPod and completed an app-based ESM questionnaire up to ten times a day when an alarm sounded (henceforth 'beep'). Participants who owned an iPhone were able to run the app on their own device. Beeps occurred at pseudo-random moments between 8.00 am and 10.30 pm, for seven successive days, with at least 15 min and at most 1.5 h between two consecutive beeps. The ESM questionnaire included questions about activities, feelings, and thoughts. The ESM questionnaire contained either 30 or 34 items depending on the answer to the item 'I am on my own', branching into different questions when individuals were alone vs. with others, respectively. ESM items were rated on a seven-point Likert scale (ranging from 'not at all' to 'very'). When individuals were alone, *Loneliness* was assessed with the item 'I feel lonely', as previously used in studies on loneliness (e.g., Steenkamp et al., 2022) and currently recommended by the Office of National Statistics (Snape and Martin, 2018). *Social exclusion* was assessed with the item: 'I feel

excluded'. *Paranoia* was computed for every participant based on an average of the items: 'I feel suspicious'; 'I feel safe (reverse scored)'; 'I feel others dislike me'; 'I feel others intend to harm me', as previously used by others (Collip et al., 2011; Fett et al., 2022; Thewissen et al., 2008). The average paranoia score correlated positively with PANSS suspiciousness, item P6; 'paranoia/persecution' ($r = 0.45$, $p < .01$). *Negative affect* was calculated based on an average of the items: 'I feel irritated'; 'I feel low'; 'I feel tense'; based on factor analysis (respective loadings were: 0.75, 0.80 and 0.79).

2.3. Procedure

This study was part of a larger project on decision making and social context processing in non-affective psychosis (e.g., see (Hanssen et al., 2020b; Hanssen et al., 2021). Participants gave informed consent before the first testing session. The study comprised two testing sessions which took place at King's College London: 1) participants received an iPod and were given the instruction to fill the questionnaires for the next seven days; 2) after completion of the ESM week, participants returned for the second assessment session and the PANSS. Participants returned the iPod and received a £40 compensation for their participation in the study.

2.4. Statistical analyses

The data were analysed with Stata version 16. Analysis of variance was used to examine group differences in age. Group differences in categorical variables were investigated with Pearson's χ^2 tests. Mixed multilevel regression analyses were used to examine group differences in paranoia, loneliness, feelings of social exclusion, and negative affect in N = 2070 datapoints. To analyse temporal associations, we computed lagged variables of paranoia, loneliness, feelings of social exclusion, and negative affect at t_{0-1} if the previous beep occurred within 180 min, as previously used by others who showed temporal associations between paranoia, sadness, anxiety, negative social appraisal and negative affect over this time frame (Kramer et al., 2014; Monsonet et al., 2022). Mixed multilevel regression analyses (MIXED) were conducted to account for the hierarchical structure of the data (i.e., multiple assessments within participants). Significant interactions and factorial main effects were tested with the CONTRAST command (Wald test, χ^2). Non-significant interactions were removed from the statistical model before main effects were interpreted.

i. To test the *temporal relationship between loneliness and paranoia* a mixed multilevel regression was run including the predictors group, lagged loneliness (i.e., loneliness at the previous timepoint t_{0-1} within 180 min) and the interaction between group and lagged loneliness on current paranoia (at timepoint t_0). Loneliness at the current time point (t_0) and lagged paranoia at the previous time point (t_{0-1}) were controlled for in the model.
ii. To test the *temporal relationship between feelings of social exclusion and paranoia* a mixed multilevel regression was run including the predictors group, lagged feelings of social exclusion (t_{0-1} within 180 min), and the interaction between group and lagged feelings of social exclusion on current paranoia (t_0). Feelings of social exclusion at the current time point (t_0) and lagged paranoia at the previous time point (t_{0-1}) were controlled for in the model.
iii. We ran a mixed multilevel regression that included both, lagged loneliness, and lagged feelings of social exclusion (both at t_{0-1}) to investigate their unique predictive contribution to current paranoia (t_0). Current loneliness and feelings of social exclusion (t_0) and lagged paranoia were controlled for in the model (t_{0-1}).
iv. To test whether negative affect acts as a mediator between loneliness, social exclusion and paranoia, we first investigated the associations between current negative affect (t_0) and lagged loneliness and lagged feelings of social exclusion (t_{0-1}), and current paranoia (t_0), as conditions for mediation (Baron and Kenny, 1986). The full mediation model was then run as conditions for mediation were met. The full mediation model was controlled for lagged negative affect and lagged paranoia and current loneliness and current feelings of social exclusion.
v. Last, four mixed multilevel regression models were run to explore whether lagged paranoia and lagged negative affect (t_{0-1}) temporally precede current loneliness and feelings of social exclusion (t_0), respectively. The analyses were controlled for current paranoia and current negative affect, as well as lagged loneliness and lagged feelings of social exclusion, where appropriate.

Analyses i-v were statistically controlled for ethnicity (White = 0/non-White = 1), living status (not alone = 0, alone = 1) and sex at birth (0 = female, 1 = male) and level of education (range 0 = none completed to 4 = university degree or higher).

3. Results

3.1. Sample characteristics

Sample characteristics are displayed in Table 1. The groups differed significantly in sex composition (χ^2 (2) = 12.4, $p < .01$), education ($\chi^2(2) = 23.7$, $p < .01$), living status (χ^2 (2) = 16.6, $p < .01$), and ethnicity ($\chi^2(2) = 25.4$, $p < .01$), but did not differ in age ($F(2, 72) = 0.51$, $p = .60$). The groups differed significantly in CAPE positive ($\chi^2(2) = 9.50$, $p < .0001$) and negative schizotypy scores ($\chi^2(2) = 3.32$, $p = .04$). Patients had significantly higher scores on both dimensions of the CAPE than relatives and controls, which did not differ significantly.

ESM analyses showed that the groups differed significantly in the percentage of time spent alone ($X^2(2) = 11.02$, $p < .01$), with patients being alone more frequently than controls ($p < .05$) and relatives ($p < .001$), and no difference between controls and relatives ($p = .14$). The groups differed marginally significantly in loneliness ($X^2(2) = 5.71$, $p = .057$), with higher levels observed in patients compared to controls ($p = .02$), and no significant differences between patients and relatives ($p = .15$), and relatives and controls ($p = .50$). There were no significant group differences in feelings of social exclusion ($X^2(2) = 2.85$, $p = .25$) or negative affect ($X^2(2) = 0.56$, $p = .75$). The groups differed marginally significantly in their levels of paranoia ($X^2(2) = 5.52$, $p = .06$). Patients experienced marginally significantly greater paranoia than relatives ($p = .08$) and significantly greater paranoia than controls ($p = .03$), but controls and relatives did not differ from each other significantly ($p = .80$). Correlations between demographic variables, averaged ESM measures for loneliness, social exclusion, paranoia, and negative affect and the two CAPE subscales across groups are reported in Table 2. Correlations per group are reported in Table 3.

3.2. The temporal relationship between loneliness, social exclusion, and paranoia

3.2.1. Lagged loneliness and current paranoia

The interaction between group and lagged loneliness on current paranoia was not significant ($X^2(2) = 0.32$, $p = .85$) and was removed from the model. Across, groups, there was a significant effect of lagged loneliness on paranoia (b = 0.06, $p < .001$, 95%CI [0.03 to 0.08]); with greater feelings of loneliness temporally preceding increased paranoid thinking over time.

3.2.2. Lagged feelings of social exclusion and current paranoia

The interaction between group and lagged feelings of social exclusion on current paranoia was not significant ($X^2(2) = 1.79$, $p = .40$) and removed from the model. Across groups, there was a significant effect of lagged feelings of social exclusion (b = 0.07, $p < .0001$, 95%CI [0.04 to 0.10]), with greater feelings of social exclusion temporally preceding

Table 1
Sample characteristics and descriptive statistics for ESM items.

	Patients	Relatives	Controls	Group differences	*P*-value for group effect
	(n = 29)	(n = 20)	(n = 26)		
	%	**%**	**%**		
Sex (male)	79.31	30.00	65.38	P, C > R	<.01
Ethnicity				P ≠ R ≠ C	<.01
Black	61.54	25.00	7.69		
White	25.00	45.00	61.54		
Asian	7.14	20.00	26.92		
Other	7.14	5.00	3.85		
Education				P ≠ R ≠ C	<.01
None/Primary	17.30	5.00	–		
Secondary	31.03	–	26.92		
College	34.48	30.00	23.08		
University	17.24	55.00	50.00		
Other	–	10	–		
Living status				P ≠ R, C	<.01
Alone	68.97	20.00	30.77		
Family/partner	31.03	60.00	46.15		
Other	–	20.00	23.08		
	M (SD)	**M (SD)**	**M (SD)**		
Age	39.10 (9.9)	37.27 (14.64)	36.14 (8.13)		.60
ESM completed beeps	47.68 (12.79)	41.70 (11.96)	51.15 (12.53)	R < C	.04
ESM % alone	69.52 % (30.3)	43.86 % (23.7)	57.21 % (24.3)	P > R, C	<.01
ESM paranoia	2.36 (1.27)	1.85 (1.01)	1.71 (0.95)	P > R, C	.06
ESM loneliness	2.70 (1.59)	2.37 (1.54)	2.01 (1.29)	P > C	.06
ESM social exclusion	2.45 (1.51)	1.99 (1.29)	1.86 (1.31)		.25
ESM negative affect	2.31 (1.30)	2.66 (1.49)	2.17 (1.15)		.75
CAPE positive	1.91 (0.59)	1.44 (0.27)	1.40 (0.30)	P > R, C	<.0001
CAPE negative	2.11 (0.58)	1.78 (0.49)	1.74 (0.36)	P > R, C	.04
PANSS P6 (suspiciousness)	2.80 (1.18)				
PANSS positive average	1.85 (0.61)				
PANSS negative average	2.17 (0.83)				
PANSS general average	1.71 (0.35)				

Note. Reported group differences are significant at p < .05, ≠ significant differences between groups.

Table 2
Correlations between study variables of interest.

Variable	ESM meanlonely	ESM meanexcluded	ESM meanparanoia	ESM meanNA	CAPE pos	CAPE neg	Education	Ethnicity
ESM mean excluded	**0.71**							
ESM mean paranoia	**0.65**	**0.84**						
ESM mean NA	**0.61**	**0.61**	**0.68**					
CAPE pos	**0.45**	**0.39**	**0.57**	**0.47**				
CAPE neg	**0.35**	**0.33**	**0.49**	**0.43**	**0.74**			
Education	−0.20	**−0.28**	**−0.35**	−0.13	**−0.25**	**−0.26**		
Ethnicity	0.19	0.14	0.08	−0.08	0.06	−0.03	0.12	
Living status	**0.32**	**0.26**	**0.30**	0.07	0.12	−0.01	**−0.44**	0.15

Note. Correlations significant at p < .05 are in bold. CAPE = Community Assessment of Psychic Experiences, ESM = Experience Sampling Method, NA = Negative affect, Living status: 0 = living with others, 1 = living alone, Ethnicity: 0 = White, 1 = non-White. ESM entries for the respective item were averaged per person across all beeps before correlations with other study variables of interest were computed.

increased paranoid thinking over time.

3.2.3. Lagged loneliness, feelings of social exclusion, and current paranoia

When lagged loneliness and lagged feelings of social exclusion were simultaneously added to the model as predictors, both lagged loneliness (b = 0.05, $p = .001$, 95%CI [0.02 to 0.08]) and lagged feelings of social exclusion (b = 0.04, $p = .016$, 95%CI [0.01 to 0.08]) significantly predicted current paranoia, suggesting that they are independent predictors of paranoid thinking.

3.3. Is the relationship between loneliness, feelings of social exclusion and paranoia mediated by negative affect?

The assumptions for mediation were met. Current negative affect was significantly associated with lagged loneliness, lagged feelings of social exclusion and current paranoia (all $p < .02$), and was therefore added to the previous model (3.2.3). The effects of lagged loneliness (b = 0.04, $p = .009$, 95%CI [0.009 to 0.06]) and lagged feelings social exclusion (b =0.04, $p = .02$, 95%CI [0.01 to 0.07]) on current paranoia were slightly reduced when negative affect was added to the model but remained significant. We found a significant association between current negative affect and paranoia (b = 0.17, $p < .001$, 95%CI [0.13 to 0.22]), suggesting partial mediation.

3.4. Do paranoia and negative affect temporally precede loneliness and feelings of social exclusion?

3.4.1. Lagged paranoia and current loneliness

The interaction of lagged paranoia and group on current loneliness was not significant ($X^2(2) = 4.93$, $p = .09$) and removed from the model. The effect of lagged paranoia on current loneliness was not significant (b = 0.08, $p = .16$, 95%CI [−0.03 to 0.19]), showing that paranoia does

Table 3
Correlations between study variables of interest by participant group.

	ESM mean lonely	ESM mean excluded	ESM mean paranoia	ESM mean NA	CAPE pos	CAPE neg	Education	Ethnicity
Patients								
ESM mean excluded	**0.54**							
ESM mean paranoia	**0.58**	**0.82**						
ESM mean NA	**0.57**	**0.55**	**0.77**					
CAPE pos	**0.39**	**0.33**	**0.58**	**0.61**				
CAPE neg	**0.36**	**0.35**	**0.57**	**0.58**	**0.81**			
Education	−0.29	**−0.39**	**−0.51**	**−0.43**	−0.23	−0.17		
Ethnicity	−0.05	−0.08	−0.31	**−0.38**	−0.29	−0.23	**0.55**	
Living status	0.14	0.03	0.10	−0.04	−0.19	−0.26	−0.21	−0.03
Relatives								
ESM mean excluded	**0.74**							
ESM mean paranoia	**0.60**	**0.76**						
ESM mean NA	**0.76**	**0.76**	**0.71**					
CAPE pos	0.31	0.39	**0.53**	**0.47**				
CAPE neg	0.15	0.41	**0.64**	**0.54**	**0.67**			
Education	0.04	−0.16	0.08	0.09	0.32	−0.01		
Ethnicity	0.02	−0.13	−0.11	−0.07	0.28	−0.04	−0.05	
Living status	0.00	0.01	−0.07	0.00	−0.27	−0.05	**−0.53**	−0.05
Controls								
ESM mean excluded	**0.88**							
ESM mean paranoia	**0.77**	**0.92**						
ESM mean NA	**0.63**	**0.63**	**0.67**					
CAPE pos	**0.52**	**0.44**	**0.41**	**0.59**				
CAPE neg	0.36	0.12	0.00	0.17	**0.54**			
Education	0.05	−0.01	0.02	0.07	0.17	−0.13		
Ethnicity	0.34	**0.43**	**0.49**	0.21	0.04	−0.08	0.16	
Living status	**0.56**	**0.60**	**0.58**	**0.39**	0.22	−0.06	−0.38	0.16

Note. Correlations significant at $p < .05$ are in bold. CAPE = Community Assessment of Psychic Experiences, ESM = Experience Sampling Method, NA = Negative affect, Living status: 0 = living with others, 1 = living alone, Ethnicity: 0 = White, 1 = non-White.

not predict loneliness over time.

3.4.2. *Lagged paranoia and current feelings of social exclusion*

The analysis showed a significant interaction between lagged paranoia and group on current feelings of social exclusion ($X^2(2) = 9.11$, $p = .01$) (see Fig. 1). At low levels of lagged paranoia, all groups showed low current feelings of social exclusion. Higher levels of lagged paranoia preceded higher feelings of social exclusion, and this effect was significantly more pronounced in controls (b = 0.43) than in patients (b = 0.19; relatives: b = 0.17), as indicated by a significant difference between slopes (b = −0.28, $p = .003$).

3.4.3. *Lagged negative affect and current loneliness*

There interaction of lagged negative affect and group on current

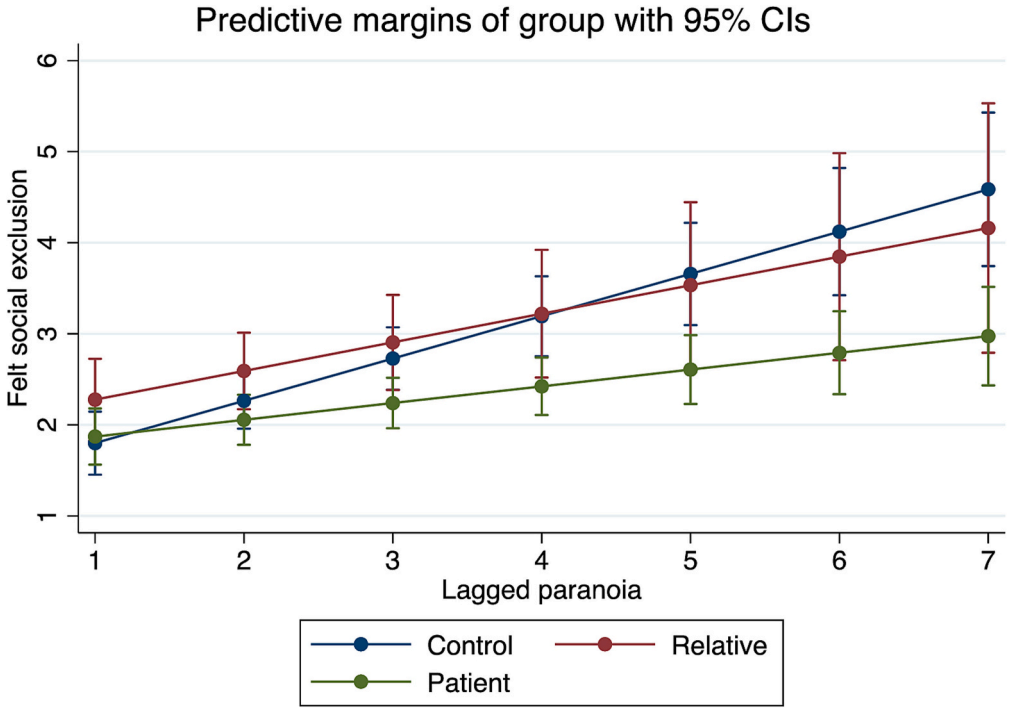

Fig. 1. Interaction between lagged paranoia and group on social exclusion.

loneliness was not significant ($X^2(2) = 2.57$, $p = .27$) and removed from the model. The effect of lagged negative affect on current loneliness was significant (b = 0.15, $p < .0001$, 95%CI [0.07 to 0.24]), showing that it predicts loneliness over time.

3.4.4. Lagged negative affect and current feelings of social exclusion

The interaction of lagged negative affect and group on current feelings of social exclusion was not significant ($X^2(2) = 3.61$, $p = .16$) and removed from the model. The effect of lagged negative affect on current feelings of social exclusion was not significant (b = 0.04, $p = .21$, 95%CI [−0.03 to 0.10]).

4. Discussion

To our knowledge, this study is the first to explore the temporal relationship of loneliness, feelings of social exclusion and paranoia across the psychosis continuum, while considering the mediating role of negative affect. Our most notable finding was that loneliness predicted a subsequent increase of paranoid thinking (where paranoia did not precede an increase in loneliness), while the association between feelings of social exclusion and paranoid thinking was bidirectional. Our findings furthermore support independent effects of loneliness and social exclusion on increasing paranoia, as previously reported in non-clinical populations (Gollwitzer et al., 2018; Lamster et al., 2017). The current findings lend partial support to the idea that loneliness and feelings of social exclusion lead to an increase in paranoia through negative affect (Hawkley and Cacioppo, 2010; Jaya et al., 2017; Sündermann et al., 2014).

4.1. Loneliness

We hypothesized that patients would feel lonelier than relatives and controls and that relatives would occupy an intermediate position between patients and controls in terms of loneliness. Our hypothesis was partially supported. Indeed, higher levels of loneliness were observed in patients compared to controls, but there were no significant differences between patients and relatives or relatives and controls. Our results showed that feelings of loneliness temporally precede paranoid thinking and that they are an independent predictor of paranoia when feelings of social exclusion are accounted for. Our findings do not support the position that loneliness arises because of paranoia but instead suggest that it contributes to its development. As expected, paranoia was more severe in individuals with a psychotic disorder, however our findings suggest that paranoid thinking is affected by loneliness in a similar fashion among controls, relatives, and patients. Paranoid thinking is often reported in non-clinical populations, albeit in a milder form and not necessarily warranting clinical treatment. For example, it has been suggested that clinical and non-clinical psychotic experiences share similar cognitive and psychosocial factors in their psychopathology (van Os and Reininghaus, 2016). The findings are in line with evolutionary model of loneliness, which suggests that loneliness leads to increased attention and surveillance of the social world, presumably to increase safety when in a socially more vulnerable position (Cacioppo et al., 2015, 2016).

4.2. Feelings of social exclusion

In contrast to our hypotheses, we did not find group differences in feelings of social exclusion. We found that social exclusion and loneliness were independent predictors of current paranoid thinking, that had similar effect size associations. However, unlike loneliness, previous feelings of paranoia also predicted current feelings of social exclusion, indicating a bidirectional relationship. The findings may imply that paranoia contributes to the feeling of being actively and wilfully excluded by others (e.g., *"Others don't like me and therefore exclude me from social interaction"*) in contrast to feelings of loneliness, which may reflect a lack of belonging or perceived relationship quality rather than perceived malicious behaviour of others.

4.3. Negative affect

The direct relationship between lagged loneliness and feelings of social exclusion and current negative affect and paranoia in our study is consistent with ideas of the affective pathway to paranoia (Fowler et al., 2012; Freeman and Garety, 2014; Jaya et al., 2017; Kesting and Lincoln, 2013), as well as previous work in a large non-clinical sample using ESM which reported that negative affect preceded paranoia temporally (Kramer et al., 2014). However, the effects of lagged loneliness and social exclusion on paranoia were only slightly reduced by negative affect, suggestive of a weak partial mediation effect. Interestingly, negative affect only predicted loneliness, but not feelings of social exclusion over time. Feeling low, tense and/or irritated could lead individuals to believe others do not understand or like them, or that they do not belong.

4.4. Correlations between psychotic experiences, loneliness, social exclusion, and demographic characteristics

The correlations in Table 2 provide simple effect size estimates for the cross-sectional associations between psychotic experiences, feelings of loneliness, social exclusion, negative affect, and demographic characteristics across groups. Consistent large effect size correlations between positive schizotypy and average levels of paranoia and negative affect in daily life, assessed through ESM, were found in all three participant groups. Average daily-life ESM measures of loneliness, social exclusion, paranoia, and negative affect were strongly correlated in all three groups. While overall significant, other correlations showed inconsistent patters across groups (see Table 3). Living alone, for example, was overall associated with higher paranoia, feelings of social exclusion and loneliness. However, analyses by group showed that this was mostly the case for controls, but less so for relatives and patients. Similarly, while there were no significant overall correlations between psychotic experiences, feelings of loneliness, social exclusion, negative affect, and ethnicity across groups. Analyses by group showed that non-White ethnicity predicted feelings of social exclusion and loneliness specifically in controls. Across groups, a lower level of completed education was related to higher feelings or social exclusion, paranoia and higher schizotypy. Analyses by participant group suggested that these effects were mostly driven by strong associations in the patient group. The analyses suggest some differential mechanisms may underlie feelings of loneliness, social exclusion, negative affect and schizotypy in the different groups.

4.5. Implications for treatment

Individuals with psychosis often feel lonely and/or socially excluded and typically expect this to continue in the future, but often do not receive help for these experiences (Badcock et al., 2020). Frequent concerns of patients in treatment are around social connectedness, including 'find a friend', 'someone to talk to', and 'isolation'(Freeman et al., 2019). If these can be addressed, this may lead to greater treatment engagement and clinical benefit. Our findings suggest that reduction of loneliness and felt social exclusion may also lead to reductions in paranoid thinking.

Loneliness interventions for individuals with psychosis are still very much in their infancy (Badcock et al., 2020; Lim et al., 2020). Within loneliness therapy studies, behavioural activation is of fundamental importance to help people overcome some of their unhelpful beliefs about social contact and engagement (Käll et al., 2020) and our findings suggest that targeting social exclusion and negative affect will be important in this context. App-based interventions that promote social engagement may be helpful in reducing loneliness (Hanssen et al.,

2020a).

4.6. Methodological considerations and suggestions for future studies

To our knowledge, this ESM study was the first to investigate feelings of loneliness independent of feelings of social exclusion. While these are often referred to interchangeably in research, we have shown that paranoid thinking may be a distinct precursor, but a shared consequence. However, the results need to be considered in the light of some limitations. First, we only assessed loneliness and feelings of social exclusion when people were alone; therefore, a knowledge gap remains about the unique contribution of perceived vs. objective social exclusion. Second, our participants were clinically stable and the current results may not be generalisable to an acutely unwell group with non-affective psychosis. Third, the relative group in the current study was relatively small and included fewer males than the other groups, thus limiting conclusions that can be drawn. Future studies should aim to recruit larger and more representative first-degree relative samples. Finally, previous research by Eglit et al. (2018) found that aspects of an individual's social environment were significantly correlated with loneliness, including social class and family income. These characteristics were not measured in our study, and perhaps the psychological and physical aspects of the participant's community could be assessed in future studies to investigate how they impact on the associations between loneliness, social isolation, and paranoia.

4.7. Conclusion

Our study contributes to a better understanding of the social mechanisms that drive and that may result from paranoid thinking. The key finding showed that loneliness and social exclusion are related, yet distinct phenomena that predict paranoia in all groups of people, with potentially clinically meaningful negative effects on levels of paranoid thinking, that are partially mediated by negative affect. In conclusion, this suggests worsening mental health in all groups following loneliness and social exclusion and highlights the importance of fostering a sense of belonging and integration for mental well-being. More studies are needed to understand the underlying mechanisms of loneliness and social exclusion (e.g., actual vs. perceived social isolation, stigma, self-stigma) and how the concepts relate to one another.

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Ethical standards

The authors assert that all procedures contributing to this work 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.

CRediT authorship contribution statement

VB: Conceptualization, writing – original draft; EV: Methodology, writing - review and editing; JA: Data curation and analysis; IMG: Methodology, writing - review and editing; SSS: Writing - review and editing, resources; AKJF: Conceptualization; investigation, methodology, data curation; formal analysis; funding acquisition; writing – review and editing.

Declaration of competing interest

None.

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