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Loneliness and Psychotic-Like Experiences in Middle-Aged and Older Adults: The Mediating Role of Selective Attention to Threat and External Attribution Biases

Pawel Lucjan^{a*}, Timothy Bird^b, Caroline Murray^a, Angus Lorimer^a

^a *Department of Clinical Psychology, Older Adult Mental Health Service, NHS Grampian, Aberdeen, UK;* ^b *School of Health and Social Sciences, University of Edinburgh, Edinburgh, UK*

* *Corresponding author. Email: pawel.lucjan@yahoo.co.uk*

Objectives: Loneliness has been associated with psychotic-like experiences (PLEs) in the general population, but the mechanisms underlying this association are poorly understood. Theoretical models, corroborated by empirical findings, signify the key role of biased cognition in both loneliness and psychosis. This study tested whether two cognitive biases – Selective Attention to Threat (ATB) and External Attribution Bias (EAB) – account for the association between loneliness and PLEs.

Method: A convenience sample ($n = 357$) of middle-aged and older adults (aged 40+) was recruited online from the UK population. The parallel mediation model with two the aforementioned cognitive biases as mediators was tested.

Results: A mediation effect between loneliness and PLEs via ATB ($ab_1 = .441$, 95% CI = [.264, .646]) and EAB ($ab_2 = .354$, 95% CI [.124, .627]) was established. This model remained significant after controlling for the current symptoms of anxiety and depression.

Conclusion: Greater loneliness was associated with a higher rate of PLEs in the sample of middle-aged and older adults. This association was fully explained by ATB and EAB, independent of the current symptoms of anxiety and depression.

Keywords: loneliness; psychotic-like experiences; cognitive biases; mediation.

Introduction

Loneliness or perceived social isolation (Cacioppo & Hawkley, 2009) is an unpleasant experience of a discrepancy between one's desired and actual network of social relationships (de Jong Gierveld et al., 2018). Loneliness is considered a social and public health threat (Hawkley & Cacioppo, 2010) and has been associated with multiple adverse physical and mental health outcomes (Leigh-Hunt et al., 2017). Given that the risk of loneliness increases with advanced age (Dykstra et al., 2005), and that the world's population is growing older, loneliness is a pertinent issue for older adults.

According to the cognitive model, the experience of loneliness activates implicit hypervigilance for social threat and increases proneness to attentional, confirmatory and memorial biases, which make lonely people more likely to recall more negative social events, see the world as more threatening, and form more negative social impressions of others (Cacioppo & Hawkley, 2009). Loneliness is also associated with negative and hostile intent attributions, an expectation of rejection, negative self- and other-evaluation, and increased avoidance in social situations (Spithoven et al., 2017). With such biased cognition, lonely individuals may elicit behaviours in others that validate their negative expectations. Paradoxically, they may push away people they want to reconnect with and, consequently, perceive themselves as passive victims of their social world (Cacioppo & Hawkley, 2009). Loneliness has become a frequent target of campaigns and health and social interventions (Cacioppo et al., 2015) with the most successful treatments being psychological interventions targeting maladaptive social cognition (Masi et al., 2011).

Among various adverse consequences in older age, loneliness has been associated with increased risk of adverse physical and mental health outcomes (Donovan & Blazer, 2020), including, dementia (Solmi et al., 2020), premature mortality (Schutter et al., 2022). Loneliness is also associated with psychosis at clinical (Michalska da Rocha et al., 2018) and

subclinical levels (Chau et al., 2019). In their meta-analysis, Chau et al. (2019) found that loneliness was moderately associated with positive and negative PLEs, the strongest relationship was with paranoia. Experimental findings have indicated that loneliness can cause paranoia (Lamster et al., 2017) and auditory hallucinations (Michalska da Rocha, 2016). Lim et al. (2019) demonstrated that loneliness can be a viable target of psychosis interventions. Given low compliance (Madhusoodanan & Coleman, 2019) and often poor response to psychopharmacological treatment (Giblin et al., 2004) in late-onset schizophrenia, this group might particularly benefit from interventions addressing psychosocial factors, such as loneliness (e.g., Kanetomo & Kawasaki, 2024).

Cognitive models of psychosis (e.g., Garety et al., 2001) highlighting the importance of social cognition in developing and maintaining positive psychotic symptoms have gained some empirical support. For instance, external attributions appear to be important trait markers of schizophrenia, predating the onset of psychosis (Lee et al., 2015), and hostile misinterpretations of others' intentions have been linked to persecutory delusions, anxiety and depressive symptoms in schizophrenia (Buck et al., 2020). The roles of attentional and attributional biases toward threat appraisal have also been proposed as important mechanisms in understanding how psychosis develops (Underwood et al., 2016). In their integrated model of psychosis, Howes and Murray (2014) theorise that social adversities, such as social isolation, bias individuals towards developing cognitive schemas of perceiving the world as threatening and attributing negative events to external causes, such as other people. Attention and interpretation biases have been found to be particularly important in maintaining delusions because they involve the selective processing of delusion-congruent information (Savulich et al., 2012). Moritz & Lauden (2007) showed experimentally that patients with schizophrenia are more alert to paranoia-relevant information than other stimuli, which then facilitates the processing of congruent information. Interestingly, a similar evolutionary

mechanism has been postulated to link increased attention to threat with both paranoia (Green & Phillips, 2004) and loneliness (Cacioppo et al., 2006).

The hypothesis of the psychosis continuum (Van Os et al., 2009) postulates that symptoms traditionally associated with psychotic disorders (e.g. hallucinations; delusions) can be observed in milder forms in healthy individuals. These subclinical manifestations are frequently referred to as psychotic-like experiences (PLEs). They are more common than psychotic disorders (Linscott & Van Os, 2013) and has been reported across the lifespan; they are estimated to be present in 33.4% of 40-49 years old, 31.2% of 50-59 years old, 24.2% of 60-69 years old, and 19.7% of 70 years or older (Rep et al., 2023). In older age, PLEs are common but are often misdiagnosed and underreported due to self and public stigma (Badcock et al., 2017). Kelleher and Cannon (2011) demonstrated that psychotic phenomena observed in individuals with schizophrenia-spectrum disorders and healthy individuals have similar main characteristics and risk factors. That includes the same types of cognitive biases displayed by individuals at various levels along the psychosis continuum (Livet et al., 2020). The psychosis continuum framework has stimulated much research in psychosis (Morgan et al., 2020) and advanced understanding of risk and protective factors for psychotic disorders that otherwise would not be possible by studying patients alone (DeRosse & Karlsgodt, 2015). PLEs are a risk factor for psychosis, with one in three individuals with psychotic disorders having a history of PLEs (Dominguez et al., 2011), and 7.4% of people with PLEs will develop a psychotic disorder (Linscott & Van Os, 2013). Additionally, most individuals who experience PLEs meet diagnostic criteria for common mental health disorders and associated behaviours, including anxiety disorders, depression, substance abuse, or increased rate of suicidal ideations and attempts (for review, Healy & Cannon, 2020). These associations between presence of PLEs and psychiatric comorbidities remain very significant in middle-aged and older people (Rep et al., 2023). Thus, PLEs might be

better conceptualised as a transdiagnostic marker for general psychopathology (Healy & Cannon, 2020) and could provide insight into psychosis and other mental health difficulties in later life. Although, that would require further study to establish.

Findings in psychosis have stimulated research on cognitive biases in non-clinical samples with PLEs (Livet et al., 2020). For instance, external attribution bias (ETB) or the tendency to attribute adverse events to external factors and selective attention to threat bias (ATB) has been positively moderately associated with PLEs in healthy and ultra-high-risk samples (Gawęda et al., 2015; Livet et al., 2020). Both biases have been linked to psychosis proneness (Livet et al., 2020).

Although loneliness and psychosis have been associated with similar information processing biases in a social context, their possible role as mediators between loneliness and psychosis still awaits investigation. Thus, the current study aimed to test whether the association between loneliness and PLEs in middle and older age, found in previous studies (Chau et al., 2019), may be explained by changes in cognitive processing elicited by loneliness. More specifically, it is proposed that loneliness will increase PLEs indirectly through heightened sensitivity to threat and the attributional style of ascribing the cause of negative events to external causes, especially other people. This hypothesis was based on two lines of evidence. Firstly, it was derived from the empirical literature demonstrating the relationship between loneliness and the psychosis continuum (Chau et al., 2019; Michalska da Rocha et al., 2018). Secondly, it drew from the cognitive models of loneliness (Cacioppo & Hawkey, 2009) and psychosis (e.g., Garety et al., 2001), and growing empirical evidence of the role of social cognition in both loneliness (Spithoven et al., 2017) and psychosis (Allot & Lin, 2020; Livet et al., 2020).

Furthermore, to acknowledge the interplay between cognition and emotion, the main model was adjusted for current symptoms of anxiety and depression. Loneliness can lead to

anxiety and depression (Erzen and Çikrikci, 2018; Park et al., 2020) and has been linked with psychosis through increased anxiety (Sündermann et al., 2014) and depression (Jaya et al., 2017). Given the prominent role of cognition in models of psychosis and loneliness, it was expected that the indirect impact of loneliness through cognitive biases would remain significant after controlling for anxiety and depression.

Materials and Methods

Procedure

This cross-sectional study used data from an online survey hosted on the JISC Online Surveys platform between May 2021 and January 2022. The participants were recruited from the general population through online advertising on Facebook, Twitter, a research recruitment platform (www.peopleinresearch.org), UKRI Loneliness & Social Isolation in Mental Health Network, and through mass emails sent to students and staff members at the University of Edinburgh. No incentives were used. Participants were eligible to participate in the study if they were (1) at least 40 years old and (2) were fluent English speakers. People who reported a history of neurological disorders or neurodegenerative disorders were excluded, as this is a common confounder in explaining the aetiology of psychotic experiences in older age (e.g., Reinhardt & Cohen, 2015). Similarly, people with a history of psychotic disorders or bipolar disorder were also excluded, as we aimed to investigate loneliness as a risk factor rather than a consequence of psychotic symptoms. These diagnoses were screened with self-report information (34 participants were excluded based on these criteria). The School of Health in Social Science Research Ethics Committee at the University of Edinburgh reviewed and approved the study materials.

A Monte Carlo Power Analysis for Indirect Effects using shiny package for R Software (Schoemann et al., 2017) based on 10000 replications and 20000 Monte Carlo

draws per replication suggested a minimum sample size of 275 participants to detect anticipated effect sizes based on a parallel model with two mediators, given $\beta = 0.8$ and $\alpha = 0.05$. Post-hoc power analyses suggested that with the sample of 357, the main model was fully powered to detect mediation effect through ATB (Power = 1.00) and EAB (Power = 0.91). However, the current sample was not sufficient to detect a significant difference between two effects using a pairwise comparison (Power = 0.13). Therefore, analysis of the indirect effect difference was not performed.

Participants

The current study used a sample of 357 UK residents from a total pool of 642 participants recruited worldwide for the original study published as a doctoral thesis. This study focuses on participants from one country to increase homogeneity of the sample. Table 1 presents sample characteristics.

[Table 1]

Measures

Demographic data

Demographic information regarding age, gender, race, marital status, country of residence, highest educational attainment, and physical and mental health were collected.

Loneliness

Loneliness was measured with the De Jong Gierveld Loneliness Scale (de Jong Gierveld & Van Tilburg, 2006). The scale consists of six statements, such as "I experience a general sense of emptiness" and "There are enough people I feel close to". Possible answers are "Yes!", "yes", "more or less", "no", and "No!". Scores for positively formulated items are reversed. Answers are dichotomised so that "Yes!", "yes" and "more or less" indicate

loneliness (i.e., '1'), whereas "no" and "No!" indicate the absence of loneliness (i.e., '0'). Scores are totalled (range 0 – 6), with high scores indicating a higher level of loneliness. Internal consistency in our sample was acceptable (Cronbach's $\alpha = .78$).

Psychotic-like experiences

The Community Assessment of Psychic Experiences (CAPE) is a 42-item self-report measure of lifetime psychotic experiences in the general population. It consists of three subscales relating to positive and negative symptomatology of psychosis and depressive symptoms (Stefanis et al., 2002). In the current study, only a positive subscale was used. Each item uses two four-point Likert scales to assess symptom frequency and distress associated with the experience of a given symptom (Stefanis et al., 2002). Following the majority of previous studies with the CAPE scale (Mark & Touloupoulou, 2016), only the frequency of symptoms was assessed.

CAPE-*pos* consists of 20 items covering a broad range of positive psychotic-like experiences (PLEs) covering such domains as bizarre experiences, perceptual anomalies, or persecutory ideation (Mark & Touloupoulou, 2016). Example items include “Do you ever feel as if things in magazines or on TV were written especially for you?” or “Do you ever feel as if you are being persecuted in some way?”. The possible answers range from 0 = “never” to 3 “always”. Answers are summed (range 0 – 60) such that the higher score indicates a higher frequency of PLEs. In the current study, CAPE-*pos* had good internal consistency ($\alpha = .88$).

Cognitive biases

Davos Assessment of Cognitive Biases Scale (DACOBS) (van der Gaag et al., 2013) is a self-report questionnaire measuring cognitive biases playing an important role in developing and maintaining psychosis. The current study included two of seven subscales: Selective Attention to Threat Bias (ATB) and External Attribution bias (EAB). Both subscales consist

of six statements, including "Things went wrong in my life because of other people" (EAB) and "To protect myself, I remain on guard" (ATB). Participants rated how much they agreed with the statement in the past two weeks on a seven-point Likert scale from 1 = "strongly agree" to 7 = "strongly disagree". Scores across all items are summed (range is 6 – 42 for each subscale), such that high scores represent higher levels of cognitive biases. Both scales achieved satisfactory internal consistency in our sample (Cronbach's α s = .77 and .78 for ATB and EAB, respectively).

Current depression and anxiety symptoms

Depression and anxiety symptoms were assessed with two subscales from Depression Anxiety Stress Scales (DASS) (Lovibond & Lovibond, 1995). Both subscales consist of seven statements, including "I was aware of dryness of my mouth" (Anxiety) and "I felt that I had nothing to look forward to" (Depression). The responses are recorded regarding the past week and range from 0 = "Did not apply to me at all" to 3 = "Applied to me very much or most of the time". The analysis included the overall scores (range 0 – 21 for each scale). Both subscales achieved excellent internal reliability (Cronbach's α s = .95 and .88 for DASS-D and DASS-A, respectively).

Data analysis

All analyses were performed using R Statistical Software (v 4.1.2; R Core Team, 2023). There were no missing values. Correlation analysis was conducted to examine relationships between loneliness, psychotic-like experiences, both cognitive biases, anxiety, and depressive symptoms. Next, PROCESS v4.3 for R (Hayes, 2022) was used to test the parallel mediation models. The models were interpreted using Hayes's conditional process analysis rather than a more historical casual steps approach. One of the key differences between the two approaches is that the presence of total effect is not required of mediation in

the conditional process analysis approach (Hayes, 2022). The percentile bootstrap method was used with 10000 samples. HC3 heteroscedasticity-consistent standard error estimator was implemented for any computations that use the standard error of a regression coefficient. Results were regarded as statistically significant if the p -value was less than or equal to .05 or bootstrap confidence intervals did not contain zero.

Results

Initial analysis

Table 2 presents Pearson correlations among key variables. All correlations were significant ($p < .001$) and positive. Psychotic-like experiences (PLEs) were weakly correlated with loneliness ($r = .20$) and moderately with all other variables ($r_s = .41$ to $.53$). Associations between loneliness and other variables ranged from weak to moderate ($r_s = .33$ to $.54$).

[Table 2]

Next, the OLS regression models were computed that were used for mediation analyses. Values of variation inflation factor (VIF) (1.56–2.60) and tolerance (.38–.64) indicated no multicollinearity in the regression models.

Parallel mediation models

In our parallel mediation model (Figure 1), the a_1 path represents the path from loneliness to ATB, the b_1 path the impact of ATB on the frequency of PLEs; the a_2 path depicts the path from loneliness to EAB, the b_2 path the impact of EAB on the frequency of PLEs; the c path represented the total effect of loneliness on PLEs, and the c' path portrays the direct impact of loneliness on PLEs that is not explained by mediators. Unstandardised coefficients were reported for each path.

Our first hypothesis predicted ATB and EAB to mediate the relationship between loneliness and PLEs in middle-aged and older adults. Consistent with this hypothesis, evidence was found for a significant indirect relationship between loneliness and PLEs through biased information processing (Figure 1). Specifically, loneliness influenced PLEs indirectly through its effect on ATB ($ab_1 = .441$, $CI_{95\%} = [.264, .646]$). People feeling lonelier were more vigilant to threat ($a_1 = 1.465$, $p < .001$), which in turn was associated with a higher frequency of PLEs ($b_1 = .301$, $p < .001$). Simultaneously, loneliness influenced PLEs indirectly through its effect on EAB ($ab_2 = .354$, $CI_{95\%} [.124, .627]$). People feeling lonelier reported a greater tendency to blame others for negative events ($a_2 = 1.721$, $p < .001$), which was associated with a higher frequency of PLEs ($b_2 = .206$, $p < .01$). The direct effect was non-significant ($c' = -.073$, $p = .649$, $CI_{95\%} [-.386, .241]$).

[Figure 1]

Our second hypothesis predicted that the mediating role of ATB and EAB on the relationship between loneliness and PLEs would remain statistically significant after controlling for the possible confounding role of current symptoms of anxiety and depression. Overall, both indirect effects attenuated but remained significant, and the substantial interference of the model remained unchanged, providing support for Hypothesis 2 (Figure 2). Specifically, loneliness positively influenced PLEs through ATB ($ab_1 = .148$, $CI_{95\%} = [.050, .275]$). After controlling for current symptoms of anxiety and depression, the strength of associations between loneliness and ATB ($a_1 = .810$, $p < .001$) and ATB and PLEs ($b_1 = .182$, $p < .001$) decreased but remained significant. Concurrently, loneliness influenced PLEs indirectly through its effect on external attribution bias (EAB) ($ab_2 = .191$, $CI_{95\%} = [.057, .360]$). The strength of associations between loneliness and EAB ($a_2 = 1.135$, $p < .001$) and

EAB and PLEs ($b_1 = .168, p = .006$) again attenuated but remained significant. The direct effect was again non-significant ($c' = .020, p = .901, CI_{95\%} [-.288, .327]$).

[Figure 2]

Discussion

We hypothesised that Selective Attention to Threat (ATB) and External Attribution Bias (EAB) would mediate the relationship between loneliness and positive psychotic-like experiences (PLEs). This hypothesis was confirmed. It appears that lonely people tend to perceive social situations as more threatening. At the same time, they are more likely to interpret the intentions of others as malevolent. When viewing the social world as threatening and unfriendly, lonely individuals are less likely to participate in social activities, maintain close connections and are more prone to behaviours and reactions that push others away and perpetuate their loneliness (Cacioppo & Hawkley, 2009). Furthermore, loneliness is known to promote alternative ways of bringing a sense of social connectedness, such as through relationships with television characters, digital connections, anthropomorphism of pets, technical gadgets, or celestial bodies (Cacioppo & Hawkley, 2009). It could be that, similarly, loneliness facilitates PLEs. Sensitivity to social threats and misappraisal of intentions of others as hostile may take the form of delusion-like ideations, whereas substituting social connections with proxy ones also elicits unusual hallucination-like perceptual experiences.

The above findings support a line of research that explains the adverse effect of loneliness by highlighting the key role of information processing and cognition (Cacioppo & Hawkley, 2009). A recent systematic review supported this, pointing to several cognitive biases, including heightened attention to threat and negative and hostile intent attributions, as more prevalent in lonely individuals than non-lonely controls (Spithoven et al., 2017).

Furthermore, our findings are also in line with studies that highlight the presence of similar cognitive biases in people reporting PLEs (for review, Livet et al., 2020).

In our second hypothesis, we expected that the significant mediating roles of ATB and EAB would persist even after controlling for current symptoms of depression and anxiety. This hypothesis was confirmed. Depression and anxiety are prevalent in psychosis (Majadas et al., 2012) and have been suggested as mediators between PLEs and loneliness (Leathem et al., 2022). Thus, it was crucial to establish the significance of cognitive mediators by demonstrating that loneliness remained significantly associated with cognitive biases in the current study, even when accounting for current anxiety and depression symptoms. Similarly, associations between cognitive biases and PLEs remained significant when current anxiety and depression symptoms were included in the regression model. This allowed us to demonstrate that the mediating role of cognitive biases between loneliness and PLEs was not better explained by symptoms of anxiety and depression. While the direct effect of loneliness on PLEs was nonsignificant when depression and anxiety were considered, the indirect effect through ATB and EAB was established, meeting the conditions for mediation (Hayes, 2022). Our interpretation aligns with previous research, suggesting that loneliness affects information processing by heightening hypervigilance for social threat and promoting a tendency to perceive others' intentions as more negative and hostile. Such altered cognition, in turn, increases susceptibility to experiencing PLEs.

The results of this study have several implications. First, although the role of ATB and EAB have been documented in individuals experiencing loneliness (Spithoven et al., 2017) and PLEs (Livet et al., 2020), this is the first study to demonstrate that these cognitive processes can explain why people who feel lonely are more likely to report PLEs, showing the importance of accounting for cognitive mechanisms in exploring this relationship. Second, most studies to date have been conducted on younger populations, but this study

demonstrated that similar cognitive biases play a key role in middle-aged and older adults who experience loneliness and PLEs. Thus, the clinical characteristics of PLEs may be shared across younger and older cohorts, which would be in line with the clinical studies demonstrating that late-onset and early-onset schizophrenia share most of the core demographic and clinical characteristics and represent forms of the same illness (Maglione et al., 2014).

Third, given the general dearth of studies on non-affective non-organic psychosis in later life (Suen et al., 2019), this study demonstrated that employing the psychosis continuum framework is a feasible alternative to studying clinical populations that could contribute to our understanding of psychosis in late-life similarly as it has stimulated the study of early-onset psychosis. Fourth, our findings further support studies that indicate that biased social cognition can be a viable target of psychological interventions focused on reducing loneliness in people with psychosis (Masi et al., 2011). Furthermore, we demonstrated that biased cognition is an important factor even when controlling for symptoms of anxiety and depression. This is an important finding, given that previous studies highlighted the important role of common mental health symptoms in explaining the relationship between loneliness and PLEs (Leathem et al., 2022).

Limitations

Several limitations of this study should be noted. First, the cross-sectional design did not allow for causal inferences. Moreover, the reverse causation with PLEs leading to increased loneliness could also be possible (Lim et al., 2018).

Second, recruitment occurred during the Covid-19 pandemic, which may have led to higher reported levels of loneliness compared to pre-pandemic levels due to the pandemic and measures introduced to mitigate it. However, systematic reviews of loneliness prevalence during the pandemic indicate that the overall increase in loneliness was small, with recovery

observed after an initial spike at the pandemic's onset (e.g., Ernst et al., 2022). Consequently, since our recruitment occurred in the later stages of the pandemic, it likely had a minimal impact on the reported levels of loneliness in our sample. In terms of other clinical variables, the pandemic has been associated with increased psychological distress and poorer mental health outcomes (e.g., Zaninotto et al., 2022). Therefore, the timing of recruitment may have contributed to higher reported levels of anxiety, depression, or psychotic-like experiences.

Third, loneliness was operationalised as a single index measured with the 6-item version of the De Jong Gierveld Loneliness Scale (de Jong Gierveld & Van Tilburg, 2006). Therefore, no distinction was made between the type of loneliness (i.e., social vs emotional) or the temporal aspect of loneliness (i.e., chronicity vs transience). However, these aspects of loneliness might be important to consider as previous studies identified important differences between these subtypes of loneliness (e.g., Dahlberg & McKee, 2014) as well as the more detrimental effect of the more chronic experience of loneliness (e.g., Zhong et al., 2016).

Fourth, broad inclusion criteria, use of a convenience sample, and the recruitment method likely led to selection bias, and the sample is not wholly representative of the demographics in British society (e.g., no individuals over 80 years were recruited; disproportionate number of females over males). Additionally, the prevalence of mental health difficulties was notably elevated in our sample. For instance, 49% of participants reported experiencing depression, significantly surpassing estimated rates in the UK. Therefore, our findings may not generalise to the wider population, and observed effects may be attenuated in less clinically skewed cohorts. Furthermore, the majority of our sample consisted of women (83.8%). While some studies have found no significant gender effects on psychosis proneness in middle age (Therman et al., 2014), postmenopausal women are at a higher risk of developing psychosis, and the effect of female hormones, particularly oestrogens, acting as neuromodulators, may explain these gender differences (Nombora et al.,

2024). Therefore, our findings may not be generalised to men. Similarly, our sample was predominantly composed of individuals identifying as White (92.2%), so caution is needed when applying our findings to the general population or other samples with different racial compositions.

Fifth, we based our findings on empirical and theoretical data linking loneliness with PLEs, though alternative interpretations of our data are possible. For instance, our regression models might also indicate that anxiety (but not depression) indirectly affects PLEs through both cognitive biases. Theoretical overlap exists between anxiety and loneliness in how they bias cognition, requiring further research to explore their interaction and the significance of loneliness for older adults with psychosis and comorbid anxiety.

Future directions

It is unclear whether PLEs in middle and older age are associated with clinical psychotic symptoms or might be better conceptualised as a transdiagnostic marker for more general psychopathology (Healy & Cannon, 2020). Regardless, their study can advance our understanding of mental health in this population. Future research could explore the correlates and risk factors of PLEs in middle-aged and older adults. It would also be beneficial if future studies would attempt to unravel the association between cognitive biases and the aspects of PLEs, such as hallucination-like or delusion-like experiences.

Furthermore, in our study, we only controlled for the effects of anxiety and depressive symptoms rather than testing their role in explaining the relationship between loneliness and PLEs. Future studies may wish to test alternative models that can have clinical applications for older individuals with psychosis. For example, in our study, anxiety (but not depression) was mediated by ATB, while both were mediated by EAB, though these effects were weaker than those of loneliness. Models that consider anxiety and depression as sources of cognitive biases that increase susceptibility to psychotic experiences are theoretically sound. Given that

patients with psychosis often identify loneliness, social anxiety, and depression as important treatment goals (Moritz et al., 2017), future studies may seek to establish the relative importance of these factors as treatment targets.

Conclusion

This study found evidence that loneliness is associated with an increased rate of psychotic-like experiences. Two cognitive mechanisms were tested and found to mediate this association significantly. Thus, loneliness was associated with increased attention to threat and the tendency towards externalisation bias, which in turn were associated with greater frequency and range of psychotic-like experiences. These indirect effects proved robust after adjusting for the current symptoms of anxiety and depression. However, the cross-sectional design did not allow for any conclusion about the direction of these associations. Because of the convenience sample, bias in time and method of recruitment, the results of this study require further confirmation using a more rigorously designed study.

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Conflict of interest

None.

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Table 1. Sample characteristics

Gender	
Male	54 (15.1%)
Female	299 (83.8%)
Other	3 (.8%)
Not reported	1 (.3%)
Age (M, SD)	
40-49 years	92 (25.77%)
50-59 years	99 (27.73%)
60-69 years	147 (41.18%)
70-79 years	17 (4.76%)
80-89 years	2 (0.56%)
Race	
White	329 (92.2%)
Asian	15 (4.2%)
Black/African	4 (1.1%)
Mixed	7 (2.0%)
Not reported	2 (.6%)
Marital status	
Single (never married)	70 (19.6%)
In relationship (including married)	163 (45.7%)
Separated or divorced	88 (24.6%)
Widowed	32 (9.0%)
Not reported	4 (1.1%)
Education attainment	
Left school before age 16	15 (4.2%)
Left school at 16	33 (9.2%)
Left school at age 17-18	17 (4.8%)
Completed college course	103 (28.9%)
Completed university degree	187 (52.4%)
Not reported	2 (.6%)
Country of residence	
Scotland	130 (36.4%)
England	203 (56.9%)
Northern Ireland	11 (3.1%)
Wales	13 (3.6%)
Psychiatric diagnosis	
Anxiety Disorders, including OCD	114 (31.9%)
Depression	175 (49.0%)
PTSD	44 (12.3%)
Personality disorders	7 (2.0%)
None	153 (42.9%)
Not reported	1 (.3%)
Physical health	
Poor	37 (10.4%)
Fair	140 (39.2%)
Good	180 (50.4%)
Sensory impairments	

Hearing	13 (3.6%)
Visual	14 (3.9%)
Variables M (SD)	
Psychotic-like experiences (CAPE- <i>pos</i>)	7.11 (6.72)
Loneliness (DJGLS)	4.25 (1.86)
Attention to threat bias (ATB)	24.16 (7.74)
External attribution bias (EAB)	21.14 (6.99)
Anxiety symptoms (DASS-Anx)	8.27 (6.65)
Depressive symptoms (DASS-Dep)	4.54 (4.84)

Table 2. Correlations among PLEs, loneliness, cognitive biases, depressive and anxiety symptoms.

	1	2	3	4	5	6
1. Psychotic-like experiences	–	.200	.477	.427	.410	.529
2. Loneliness		–	.351	.457	.541	.329
3. Attention to threat bias			–	.641	.431	.473
4. External attribution bias				–	.467	.396
5. Depressive symptoms					–	.708
6. Anxiety symptoms						–

Note: All correlations are significant at the $p < .001$ level (2-tailed).

Figure 1. Mediation of the relationship between loneliness and psychotic-like experiences through selective attention to threat bias and external attribution bias ($n = 357$).

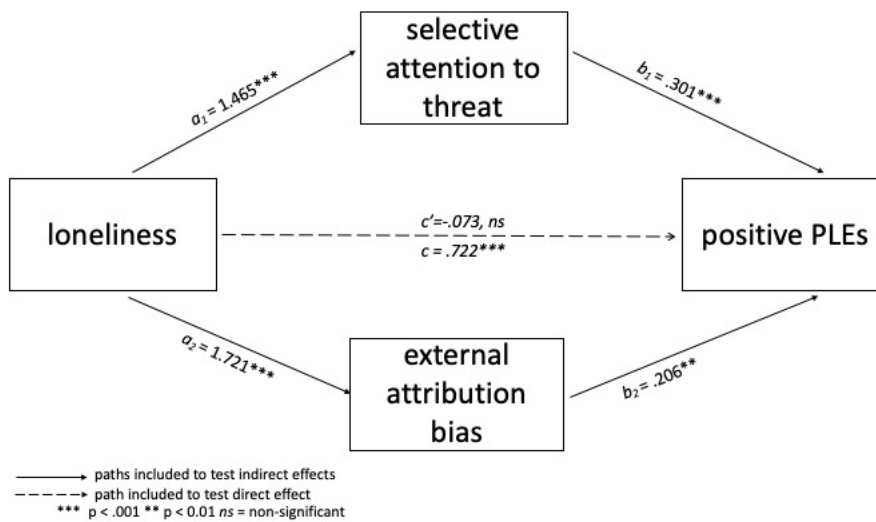


Figure 2. Relationship between loneliness and psychotic-like experiences via attention to threat bias and external attribution bias adjusted for the current depressive and anxiety symptoms ($n = 357$).

