Social cognitive bias increases loneliness both directly and by decreasing social connection in patients with schizophrenia.

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Abstract: While considerable emphasis has been put on investigating the mechanisms that drive reduced social connection in patients with schizophrenia (SCZ), recent studies have increasingly focused on the issue of loneliness in SCZ. Both social cognitive bias and self-reported empathy predict loneliness in non-clinical populations, the current study, therefore, aims to examine the relationship between loneliness, reduced social connection and social cognitive biases, and self-reported empathy in SCZ. Ninety-three adult SCZ and sixty-six matched healthy individuals completed a battery of questionnaires measuring loneliness and social connection (Revised-UCLA Loneliness scale, Lubben Social Network Scale, Social Disconnectedness Scale), cognitive biases (Ambiguous Intentions Hostility Questionnaire (AIHQ); Davos Assessment of Cognitive Biases Scale (DACOBS), Cognitive Biases Questionnaire for psychosis, CBQp) and self-reported empathy (Interpersonal Reactivity Index, IRI). Significant predictors of loneliness in SCZ were entered into two latent variables (“Social Threat Bias”, “Social Connection”), and structural equation modeling was used to explore the direct and indirect relationships between Social Threat Bias and loneliness in SCZ. Patients reported higher levels of loneliness, cognitive biases, and personal distress compared to controls. Furthermore, SCZ reported less social connection and perspective-taking compared to controls. AIHQ Blame Score, CBQp Threatening Events, DACOBS, and IRI Personal Distress were significantly associated with loneliness in SCZ. SEM modeling revealed that Social Threat Bias was linked to increased loneliness in SCZ both directly and indirectly via a decreased social connection. The results of the current study suggest that social threat bias should be considered while planning the interventions aimed to reduce loneliness in schizophrenia.

Keywords: loneliness, social isolation, schizophrenia, social cognitive bias, hostile attribution bias, empathy

Introduction:

Loneliness is currently recognized as one of the major challenges in modern society. Contrary to objective social isolation which is defined as a small number of social relationships and reduced participation in social activities, loneliness (or perceived social isolation) may be defined as a subjective mismatch between the quantity or quality of one's social relationships and his/her preferences for social involvement (Cacioppo & Cacioppo, 2018). Although there has been a strong emphasis on investigating the mechanisms that drive reduced social connection in patients with schizophrenia (SCZ) (Green et al., 2018), recent studies have increasingly focused on the issue of loneliness in this clinical group (Badcock et al., 2019; Lim, Gleeson, Alvarez-Jimenez, & Penn, 2018). Importantly, previous studies have found loneliness to be more prevalent among SCZ (Michalska da Rocha, Rhodes, Vasilopoulou, & Hutton, 2018). Importantly, Roe, Mashiach-Eizenberg, & Lysaker, (2011) found that loneliness is negatively correlated with quality of life and self-reported measures of recovery in SCZ. Badcock et al., (2019) also showed an association between loneliness and metabolic syndrome in people with psychotic disorders, which is particularly important given the increased mortality due to cardiovascular disorders in SCZ.

Given the importance of loneliness for the well-being and clinical outcomes of patients, an increased effort has been put into examining predictors of loneliness in schizophrenia. In a systematic review of the literature on loneliness in psychosis, Lim et al., (2018) listed a number of psychological (depression, psychosis, and anxiety) and social (poor social support, poor quality of life, internalized stigma, and perceived discrimination) factors potentially influencing the feeling of loneliness in patients. Importantly, while impaired social cognition was proposed as an important factor underlying worse social outcomes in SCZ (Green et al., 2018), previous studies investigating social cognitive correlates of loneliness in this clinical group reported no significant findings. Trémeau, Antonius, Malaspina, Goff, & Javitt (2016) observed no association between loneliness and performance-based measures of social cognition, and Ludwig et al., (2020) found that loneliness was related to neither social cognitive abilities nor functional outcomes in this clinical group. At the same time, it has been suggested that loneliness may be linked to more specific processes associated with social cognition which are not well captured by the standard performance-based assessment of social cognition, e.g. cognitive biases that enhance the salience of negative social events (Spithoven, Bijttebier, & Goossens, 2017).

Both theoretical conceptualizations and empirical studies emphasize the role of cognitive biases as one of the factors which may play a crucial role in sustaining symptoms in SCZ (Garety, Bebbington, Fowler, Freeman, & Kuipers, 2007). Social cognitive biases, including hostile attribution bias, which is marked by a tendency to interpret ambiguous social situations as negative, have been shown to be more

prevalent in SCZ compared to non-clinical control groups. Furthermore, a relationship between social cognitive biases and hostility, suspiciousness of others, and emotional discomfort in patients has been documented (Buck, Pinkham, Harvey, & Penn, 2016).

Of note, we recently demonstrated that only reduced social connection is associated with worse social cognitive abilities, whereas hostile attribution bias predicts both reduced social connection and loneliness in a large sample of individuals without mental health diagnoses (Okruszek et al., 2021). As such, social cognitive bias may be a plausible predictor of loneliness in patients. It has been previously shown that hostility bias, as measured by the AIHQ score, is associated with social engagement in SCZ, as reflected by Birchwood's Social Functioning Scale (Kanie et al., 2014). Furthermore, Lahera et al., (2015) observed that hostile attribution bias may contribute to poor social functioning both in SCZ and persons with bipolar disorder. Thus, it is possible that hostility bias increases patients' levels of loneliness by negatively impacting their social functioning.

Similarly, previous studies have shown that self-reported empathy may be a significant predictor of loneliness in non-clinical populations. Beadle, Brown, Keady, Tranel, & Paradiso (2012) observed that self-reported empathy explained almost 9% of loneliness variance in a sample of 110 community-dwelling participants. Abnormal interpersonal reactivity, with reduced tendencies for empathetic concern and perspective-taking, but increased personal distress is a consistent finding in schizophrenia research, as documented by the meta-analysis of 32 studies (Bonfils, Lysaker, Minor, & Salyers, 2017). However, there is conflicting evidence as to whether specific mechanisms associated with loneliness in the general population may be generalized to SCZ (Eglit, Palmer, Martin, Tu, & Jeste, 2018; Trémeau et al., 2016). For these reasons, the aim of the current study is to test the hypothesis that social cognitive biases and abnormal interpersonal reactivity predict loneliness in SCZ. A secondary aim of this study is to test the hypothesis that social cognitive bias increases loneliness in patients both directly and indirectly by decreasing social connection.

Methods:

Participants:

Patients with schizophrenia (n=93) were recruited into the study from the patients treated at the Institute of Psychiatry and Neurology in Warsaw. Adult patients (over 18-years-old) diagnosed with schizophrenia according to the ICD-10 criteria were recruited for the study. Only clinically stable patients, those who had not undergone any treatment change or displayed any significant changes in symptom severity during the 4 weeks preceding the examination, were included in the study. Patients

with intellectual disability or a history of comorbid neurological or psychiatric disorders, or substance abuse were excluded from the project.

Participants for the control group (n=66) were recruited from healthy volunteers who responded to online advertisements. Healthy individuals were screened for exclusion criteria (declared history of neurological or psychiatric disorders, or substance abuse) and matched with patients with regard to sex, age, and parental education (Table 1). Each participant provided signed informed consent before participating in the study. The protocol for this study was approved by the Ethics Committee at the Institute of Psychology, Polish Academy of Sciences. Participants were compensated for their time and effort associated with participating in the study (100 PLN (~25 USD) for completing the assessment).

	SCZ (n=93)	HC (n=66)	
Age	33.09 (7.82)	30.77 (7.66)	t(157)=1.85 p=.066 d=.30 [.02, .62]
Sex	34F/59M	30F/36M	Chi-sq(1)=1.27 p=.260
Years of education	14.06 (2.58)	15.84 (1.95)	t(156)=4.59 p<.001 d=
Maternal education	13.66 (2.66)	14.16 (2.79)	t(152)=1.12 p=.263 d=
Paternal education	13.42 (2.84)	13.98 (3.07)	(153)=1.16 p=.248 d=
PANSS Positive	13.15 (5.33)	-	-
PANSS Negative	16.41 (6.01)	-	-
PANSS General	29.29 (7.41)	-	-
CGI	4.36 (1.05)	-	-
SOFAS	66.00 (11.15)	-	-
CPZ equivalent	580 (674)	-	-

Table 1. Participant Demographic and clinical characteristics.

Assessment of loneliness and social connection:

The Polish version of the Revised UCLA Loneliness scale (Kwiatkowska, Rogoza, & Kwiatkowska, 2017) was used to measure loneliness in the current study. R-UCLA is a 20-item Likert-style questionnaire. Participants are asked to rate how often statements describe them from 1 (never) to 4 (always). The Polish version of the task has been shown to have an excellent internal consistency (alpha=.92).

The 6-item version of the Lubben Social Network Scale (L-SNS) consists of 3 questions about the number of people with/from whom the participant (1) is in regular contact, (2) might confide, and (3) might seek help. The first part of the questionnaire asks about members of the participant's family, whereas the second part of the questionnaire asks about friendships. Furthermore, a cut-off point of 12 points on the 6-item L-SNS scale has been suggested to indicate social isolation, thus we examined the percentage of individuals endorsing fewer than 12 points for relationships with family or friends (Lubben et al., 2006).

The Social Disconnectedness Scale (SD) includes eight items that assess the overall characteristics of one's social network (i.e., size, range, or frequency of interactions with others) and social participation (socializing with friends, attending organized meetings, volunteering).

Patients (but not controls) were also assessed with the Social and Occupational Functioning Scale (SOFAS) (Morosini, Magliano, Brambilla, Ugolini, & Pioli, 2000) by an MD-level psychiatrist (MJ).

Social cognitive bias measurement:

Social cognitive bias was measured by the Ambiguous Intentions Hostility Questionnaire (AIHQ) Blame Score subscale (Combs, Penn, Wicher, & Waldheter, 2007), Davos Assessment of Cognitive Biases Scale (DACOBS-18 (Gawęda et al., 2018)), and the Cognitive Biases Questionnaire for psychosis (CBQp (Peters et al., 2014)).

In the AIHQ, the participant is presented with 5 short vignettes which illustrate ambiguous social situations. Then, they are asked to describe the cause of each character's behavior that was directed toward the participant. Additionally, there are three Likert-style items measuring intentionality hostility, and blame attributed. The Blame Score is calculated by taking an average of these three subscales (Combs et al., 2007).

The DACOBS-18 is an abbreviated (18-item) version of the full 42-item Polish version of the DACOBS questionnaire. It has demonstrated good internal consistency (Cronbach's alpha for the total scale = 0.84) (Gawęda et al., 2018). Due to the strong intercorrelations between its subscales (from .46 to .79), the total DACOBS-18 score was used in the current study.

The CBQp is a 30-item questionnaire measuring 5 cognitive distortions (jumping to conclusions, intentionalizing, catastrophizing, emotional reasoning, and dichotomous thinking). The CBQp consists of two groups of vignettes: 15 referring to Anomalous Perceptions and 15 referring to Threatening Events. Research suggests that persons with psychotic disorders or depression receive higher scores than control participants (Peters et al., 2014).

Self-reported empathy

Empathy was measured with the Polish version of the Interpersonal Reactivity Index (IRI), a 28-item self-report measure that was developed to examine empathic tendencies (Kaźmierczak, Plopa, & Retowski, 2007). While the original version of the questionnaire has four domains: empathic concern, perspective-taking, personal distress, and fantasy, the Polish version of the test does not include the final factor (fantasy) due to concerns about ecological validity. The three remaining subscales of the Polish version of the IRI have shown satisfactory reliability (alphas from .74 to .78) (Kaźmierczak et al., 2007).

Statistical analysis:

A series of between-group t-tests was performed to compare demographic characteristics and variables associated with social functioning, social cognitive bias, and self-reported empathy between patients and controls.

Next, the associations between loneliness and (i) social cognitive bias (DACOBS, AIHQ Blame Score and CBQp subscales), (ii) self-reported empathy (IRI subscales), and (iii) social connection (L-SNS and SD scores) were examined separately for SCZ and HC using Pearson's r correlation coefficient. Variables significantly associated with loneliness in SCZ were entered into a structural equation model (SEM), to test direct and indirect effects.

Results:

Social connection and loneliness: Patients reported greater loneliness and reduced social connection as measured by L-SNS, than controls (Table 2). Furthermore, social isolation, as indicated by <12 score on L-SNS was also more prevalent in SCZ (34.4%) compared to HC (15.2%; $\chi^2(1)=7.37$ $p=0.01$). When specific subscales of L-SNS were considered, SCZ reported reduced social connection with friends, but not with family.

Social cognitive biases and self-reported empathy: SCZ reported more personal distress and less perspective-taking compared to controls. Furthermore, SCZ reported more threatening events and anomalous perception than HC. Robust between-group effects were also found for self-reported cognitive biases and problems in DACOBS.

	SCZ (n=93) M(SD)	HC (n=66) M(SD)	t(157)	p	Cohen's d [95% confidence interval]
Empathy					
IRI Empathic Concern	38.73 (6.99)	40.40 (6.92)	1.48	.140	.24 [.08, .56]
IRI Personal Distress	24.60 (6.01)	32.52 (6.09)	3.18	.002	.51 [.19, .83]
IRI Perspective Taking	31.45 (5.99)	33.97 (5.67)	2.66	.009	.43 [.11, .75]
Social Cognitive Bias					
AIHQ Blame Score	2.71 (0.80)	2.50 (0.68)	1.75	.082	.28 [.04, .60]
DACOBS	59.42 (16.46)	44.76 (15.43)	5.68	<.001	.91 [.27, .94]
CBQp Threatening Events	24.82 (4.02)	22.92 (3.20)	3.19	.002	.51 [.19, .83]
CBQp Anomalous Perception	21.43 (3.93)	19.53 (3.14)	3.26	.001	.60 [.20, .84]
Loneliness					
R-UCLA Loneliness Scale	43.25 (10.97)	35.44 (10.28)	4.53	<.001	.73 [.40, 1.05]
Social Connection					
L-SNS Friends	6.13 (3.41)	8.76 (3.78)	4.58	<.001	.74 [.41, 1.06]
L-SNS Family	7.60 (3.04)	8.00 (3.20)	0.80	.428	.12 [.19, .44]
L-SNS Total	13.73 (5.50)	16.76 (5.89)	3.32	.001	.53 [.21, .85]
SD Social Network Characteristics	8.95 (3.13)	8.63 (3.34)	0.51	.542	.10 [.22, .41]
SD Social Participation	11.58 (3.97)	12.68 (3.81)	1.75	.082	.28 [.04, .60]

Table 2. Descriptive statistics for empathy, social cognitive bias, loneliness and social connection.

Full SEM model:

The pattern of correlations with loneliness for each group is shown in Table 3.

	SCZ (n=93)	HC (n=66)
Empathy		
IRI Empathic Concern	-.021	-.370**
IRI Personal Distress	.631***	.303*
IRI Perspective Taking	-.005	-.273*
Social Cognitive Bias		
AIHQ Blame Score	.335**	.112
DACOBS	.557***	.663***
CBQ Threatening Events	.432***	.472***
CBQ Anomalous Perception	.164	.621***
Social Connection		
L-SNS Friends	-.485***	-.552***
L-SNS Family	-.459***	-.356**
L-SNS Total	-.554***	-.548***
SD Social Network Characteristics	-.227*	-.333**
SD Social Participation	-.092	-.313*
SOFAS	-.242*	-

Table 3. Zero-order correlations between loneliness and the other primary study variables.

To examine the direct and indirect (via social connection) effects of social threat bias on loneliness in SCZ, a structural equation model (SEM) with two latent variables was constructed. The first latent variable was comprised of four variables from social cognitive bias and empathy questionnaires. All of the four variables (IRI Personal Distress, CBQp Threatening Events, DACOBS overall score, and AIHQ Blame Score) were associated with abnormal social threat and social distress perception, thus the latent variable was termed ‘Social Threat Bias’. The second latent variable (‘Social Connection’) included two L-SNS (Friends, Family) and the SD ‘social network characteristics’ subscale. R-UCLA total score was entered as the main outcome score.

The model which is shown in Figure 1, had satisfactory fit ($\chi^2(18)=23.95$ $p=.157$, RMSEA=.060, CFI=.972). As indicated by their respective moderate to high factor loadings (betas from .496 to .781, all $ps<.001$), all variables were reliable indicators of their latent variables. The model accounted for 69.1% of variance in loneliness.

Both ‘Social Threat Bias’ ($\beta=.603$ $p<.001$) and ‘Social Connection’ ($\beta=-.383$ $p=.001$) were significant predictors of loneliness. ‘Social Threat Bias’ also reduced ‘Social Connection’ ($\beta = -.393$ $p=.021$), and bootstrapping analysis revealed its significant indirect effect on loneliness ($\beta=.150$; $p=.018$).

Figure 1. SEM model tested in the study.

Discussion:

The current study aimed to investigate the association between social cognitive bias and self-reported empathy and loneliness among SCZ. To explore the potential impact of reduced social connection, which is a well-established experience among this population (Green et al., 2018), we tested a model in which social threat bias is linked with loneliness both directly and indirectly via decreasing social connection in patients.

First, we found increased loneliness in SCZ compared to healthy individuals. This result is consistent with previous literature supporting the association between loneliness and psychosis (Michalska da Rocha et al., 2018). Furthermore, we observed that while overall social network characteristics and social participation do not differentiate patients from healthy controls, increased prevalence of social isolation, as measured by the L-SNS cut-off score, among the clinical group was over twice that of the control group. Although both groups reported similar amounts of contact with family members, patients reported significantly less contact with and support from friends. Interestingly, our findings suggest a stronger negative association between loneliness and contact with friends than with family for individuals without a psychiatric diagnosis. At the same time, in patients,

a similar strength of association with loneliness was observed for the two types of contacts examined in L-SNS. Whereas social participation was significantly negatively related to loneliness reported by control participants, no such association was found in SCZ. While both functional and structural social support has been included among factors associated with loneliness in the general population (Czaja, Moxley, & Rogers, 2021) and in SCZ (Lim et al., 2018), findings from the current study suggest that mechanisms associated with social network dynamics and social support may be differentially linked with the loneliness experienced by clinical and non-clinical populations.

Second, in line with our previous findings in a non-clinical sample (Okruszek et al., 2021), we found a robust association between hostile attribution bias, as measured with vignette-based (AIHQ) and self-report (DACOBS) instruments, and loneliness in SCZ. Notably, a strong positive correlation was also found between loneliness and Threatening Events but not the Anomalous Perceptions subscale of the CBQp questionnaire, which measures a range of specific cognitive biases related to potentially threatening (mostly social) situations (Peters et al., 2014). The results of the current study align with previous research demonstrating an association between hostility bias and decreased social engagement and functioning endorsed by SCZ (Kanie et al., 2014; Lahera et al., 2015). Interestingly, another study has found that paranoid SCZ do not differ in social cognitive ability from non-paranoid SCZ (Pinkham, Harvey, & Penn, 2016). However, persons with greater paranoia endorsed more hostile and blaming attributions and showed larger impairments in real-world interpersonal relationships compared to non-paranoid individuals.

Importantly, while all aspects of self-reported empathy were correlated with loneliness in healthy individuals; only the tendency to experience anxiety and unease during negative social situations ('self-oriented' distress) was significantly associated with loneliness in SCZ. It should be noted that the role of personal distress as a component of empathy has been previously debated: evidence suggests this construct captures self-oriented negative emotions and interpersonal discomfort rather than empathetic response (Bonfils et al., 2017). In addition, it has been theorized that increased personal distress may prevent SCZ from responding empathically to others and increase social withdrawal in this group (Corbera, Wexler, Ikezawa, & Bell, 2013). Thus, the personal distress could be seen as an aspect of social cognitive bias rather than empathy, and empathy. This notion finds support in the SEM model presented in the current study, which found four variables from social cognitive bias and empathy questionnaires to be reliable indicators of a single construct, namely social threat bias, i.e. an overall tendency to perceive social situations as threatening, challenging, and distressing.

In line with our prediction, this social threat bias was related to increased loneliness in SCZ both directly and indirectly via decreased social connection reported by patients. Taken together, findings from the SEM model extend existing knowledge in two important ways. First, in addition to associations between social cognition and social functioning in schizophrenia, the results of the current study suggest social cognitive biases might also impact loneliness experienced by persons with the disorder. Second, our findings suggest that research examining loneliness in schizophrenia would benefit from considering the various ways in which people may negatively appraise social situations, such as endorsing a more hostile attributional style, experiencing increased personal distress in contact with others, and engaging in distorted cognitions when interpreting social information. Interestingly, the strength of associations between social threat bias, loneliness, and social connection among patients was similar to the strength of relationships we reported in the recent study examining loneliness among a cohort of healthy individuals (Okruzsek et al., 2021), thus suggesting that overall mechanisms may be similar regardless of diagnostic grouping. Yet, the increased incidence of various forms of negative social appraisals in SCZ may underlie increased loneliness in this clinical group.

Importantly, the findings of the current study are congruent with cognitive mechanisms postulated by the Evolutionary Theory of Loneliness, as proposed by Cacioppo and Cacioppo (2018). In a recent review examining the cognitive mechanisms associated with the feeling of loneliness (Spithoven et al., 2017), social skill deficits in lonely individuals could potentially stem from negative cognitive biases. Specifically, Spithoven and colleagues (2017) suggested that negative cognitive biases "could lead to misinterpretation of the social interactions (e.g., attribution of hostile intent), which in turn results in a mismanagement of the interaction" (p. 104). Taken together, the association between social cognitive bias and both reduced social connection and loneliness in SCZ may perpetuate social withdrawal in this clinical group.

Importantly, the results of the current study stress the importance of addressing social cognitive bias when developing and implementing interventions aimed to improve social functioning in SCZ. A recent meta-analysis examining the effectiveness of psychological interventions targeting loneliness revealed a significant small-to-moderate effect in reducing loneliness across various clinical populations (Hickin et al., 2021). Additionally, small to moderate beneficial effects were found for reducing cognitive bias in SCZ in another meta-analysis of 15 distinct types of interventions (Sauvé, Lavigne, Pochiet, Brodeur, & Lepage, 2020). When considered with the results of the current study, the aforementioned meta-analytic results highlight the possibility of reducing loneliness in SCZ by using interventions aimed at reducing social cognitive bias. Given the wealth of techniques that have been shown to effectively decrease hostile attribution bias even via remote measures (e.g. Osgood, Kase, Zaroukian, & Quartana, 2020), such interventions are accessible even under physical distancing

restrictions and can be applied and tested in a cost-effective manner, especially given the rise of the telehealth methods due to the COVID-19 pandemic.

Several limitations of the current study design should be noted. First, the cross-sectional nature of the current investigation precludes the possibility of establishing a causal relationship between social cognitive mechanisms and loneliness in patients. Future investigations could aim to capture the association between social cognitive bias and loneliness in patients in specific clinical groups and over time. For example, researchers may choose to explore longitudinal associations between these constructs earlier in the course of illness (i.e., among persons at ultra-high risk for psychosis or experiencing an early episode of psychosis). Furthermore, while the questionnaire methods utilized in the current study are validated and well-established measures of social cognitive bias, the necessity of supplementing such methods with performance-based and/or informant-based measures would provide valuable collateral information and improve our understanding of the observable impact of loneliness on social functioning (Buck et al., 2016). Finally, while the sample of patients was large enough to allow SEM and reliably test the model proposed in the current study, the sample power was not sufficient to introduce other potentially important groups of predictors, such as clinical symptoms or neurocognitive abilities that were also collected during the current study. Notwithstanding these limitations, the current results demonstrate that social cognitive bias is likely an important contributor to loneliness in SCZ, both directly and indirectly via concomitant decreases in social connection.

Acknowledgments: The study was supported by Grant 2016/23/D/HS6/02947 (PI: Łukasz Okruszek) from the National Science Centre, Poland.

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