Journal of Psychiatric Research 114 (2019) 120–125

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

Social exclusion in schizophrenia: Psychological and cognitive consequences

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ARTICLE INFO

Keywords:
Schizophrenia
Cyberball
Social exclusion
Cognition

ABSTRACT

Social exclusion is associated with reduced self-esteem and cognitive impairments in healthy samples. Individuals with schizophrenia experience social exclusion at a higher rate than the general population, but the specific psychological and cognitive consequences for this group are unknown. We manipulated social exclusion in 35 participants with schizophrenia and 34 demographically-matched healthy controls using Cyberball, a virtual ball-tossing game in which participants believed that they were either being included or excluded by peers. All participants completed both versions of the task (inclusion, exclusion) on separate visits, as well as measures of psychological need security, working memory, and social cognition. Following social exclusion, individuals with schizophrenia showed decreased psychological need security and working memory. Contrary to expectations, they showed an improved ability to detect lies on the social cognitive task. Controls showed a decrease in psychological security after exclusion that was larger than that seen in the schizophrenia group. The results suggest that social support and interventions targeting social integration may benefit community functioning by reducing cognitive impairments and psychological stress.

1. Introduction

Cognitive impairment significantly interferes with daily functioning for individuals with schizophrenia (Green et al., 2000; Baumeister et al., 2002). It is well established that cognition is essential for successful independent living in schizophrenia, however, the predictors of cognitive performance in this population are not well understood. Importantly, social neuroscience highlights social exclusion as an important predictor of cognitive performance in healthy controls and some clinical populations (Themanson et al., 2013; Williams et al., 2000). Although it is known that social exclusion is a common experience in the lives of individuals with schizophrenia, the specific psychological and cognitive consequences of social exclusion in schizophrenia have not been examined.

People with schizophrenia experience social exclusion at much higher rates than the general population. Most of the psychosocial risk factors associated with developing schizophrenia are characterized at least in part by social exclusion, including ethnic or sexual minority status, migrating from a developing country, having high perceived discrimination, being raised in urban areas, having low IQ, a hearing impairment, or a history of victimization in childhood (Gevondon et al., 2014; Veling et al., 2007, 2008; Wickham et al., 2014; Selten et al., 2017). Animal models of social defeat, which measure the negative experience of being excluded from a group, show increased dopamine release in the nucleus accumbens and prefrontal cortex, and increased firing of dopaminergic neurons in the ventral tegmental area. The resultant dopamine dysregulation is consistent with both the stress-vulnerability and neurodevelopmental models of psychosis (Selten et al., 2017); thus, social exclusion is considered a viable mechanism that contributes to the pathogenesis of psychosis. In addition to its role in etiology, social exclusion is a common consequence of schizophrenia (Angermeyer and Dietrich, 2006; Green et al., 2017; Myin-Germeys et al., 2001; Oliveira et al., 2015). Even when positive symptoms remit, the degree of social disability in schizophrenia remains high (Hegarty et al., 1994; WHO, 2008), and most adults living with schizophrenia have fewer friends, lower marriage rates, and more estrangement from family members than the general population (Cohen et al., 2008).

Recent findings show social exclusion can lead to affective and cognitive impairments. In healthy populations, social exclusion negatively impacts performance on measures of learning, decision making, cognitive control, and social perception (Baumeister et al., 2002; Campbell et al., 2006; Otten and Jonas, 2013; Themanson et al., 2013; Williams et al., 2000). Various psychiatric disorders are associated with hyper-responsivity to social exclusion: in depression and anxiety, social

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https://doi.org/10.1016/j.jpsychires.2019.04.010
Received 16 August 2018; Received in revised form 9 April 2019; Accepted 11 April 2019
0022-3956/ Published by Elsevier Ltd.

exclusion leads to slowed processing speed, deficits in social self-regulation, and impaired cognitive control, memory, attention, and motivation (Baumeister et al., 2002; Themanson et al., 20113). Individuals with psychotic illnesses are more likely to be excluded than those with other mental disorders, however there is less research examining the effects (Killaspy et al., 2014), and no studies have examined the cognitive consequences of social exclusion in schizophrenia.

The most extensively validated paradigm to assess the effects of social exclusion is the Cyberball task, a computer-based ball-tossing game in which the participant is excluded by two virtual peers (Williams et al., 2000; Williams and Jarvis, 2006). The virtual ostracism in the task is sufficient to lower self-reported levels of belonging, control, self-esteem, and meaningful existence, and to increase negative affect (Williams and Jarvis, 2006; Zadro et al., 2004). Previous behavioral Cyberball studies in schizophrenia have focused largely on emotion and symptom responses. In one, the schizophrenia group, compared to controls, reported less intense positive emotions related to social inclusion (Engel et al., 2016), and another found that participants with schizophrenia had similar emotional reactions as controls immediately following exclusion, but the patients' negative emotions lasted longer (Perry et al., 2011). A third study found that participants with schizophrenia had stronger increases in paranoia following exclusion (Sundag et al., 2018). No study has examined the consequences in schizophrenia for social or nonsocial cognitive abilities following the experience of social exclusion.

The current study examined the psychological and cognitive effects of social exclusion in adults with schizophrenia and healthy controls. Based on previous findings in clinical samples, we had two primary hypotheses. First, we expected social exclusion to impact those with schizophrenia more negatively than healthy controls on the measure of psychological security (i.e., belonging, control, self-esteem, and meaningful existence). Second, we expected social exclusion to impact those with schizophrenia more negatively than healthy controls on two measures of cognition (i.e., working memory and social cognition). Thus, for both of our primary hypotheses, we expected an interaction between group and condition such that participants in both groups would show decreases on the measures of interest following the exclusion condition, but the detrimental effects would be more significant for individuals with schizophrenia. As an exploratory question we also wanted to examine the relation between clinical symptoms and response to social exclusion on the primary dependent variables.

2. Methods

2.1. Participants

The sample included 35 individuals with schizophrenia and 34 healthy controls who were matched demographically (age, parental education, sex, race, ethnicity) at the group level. Selection criteria for participants with schizophrenia included: (1) Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) diagnosis of schizophrenia, determined with the Structured Clinical Interview for DSM-5 Disorders-Research Version (SCID-5-RV) (First et al., 2015) (2) age 18–60 years, (3) no clinically significant neurological disease, (4) no history of serious head injury, (5) no evidence of substance dependence in the past 6 months and no evidence of substance abuse in past month, (6) no history of mental retardation or developmental disability, and (7) clinically stable (i.e., no inpatient hospitalizations for 3 months prior to enrollment, no changes in antipsychotic medication type in the 4 weeks prior to enrollment). Clinical symptom assessments were conducted by interviewers trained in accordance with established procedures that included a library of videotaped interviews developed by the Treatment Unit of the Department of Veterans Affairs (VA) VISN 22 Mental Illness Research, Education, and Clinical Center (MIRECC). Symptom raters were trained to a minimum ICC of 0.80.

Selection criteria for the healthy control sample included (1) no psychiatric history involving schizophrenia spectrum disorder (including avoidant, paranoid, schizotypal, or schizoid personality disorders), or other psychotic or recurrent axis I mood disorder, according to the SCID-I and SCID-II, (2) no family history of a psychotic disorder among first-degree relatives based on participant report, (3) no history of substance or alcohol dependence and no current substance use, (4) age 18–60 years, (5) no clinically significant neurological disease, and (6) no history of serious head injury. For all study participants, written informed consent was obtained prior to participation after providing a complete description of the study in accordance with approval from the Institutional Review Board at the VA Greater Los Angeles Healthcare System.

2.2. Procedures

The study included two separate visits to the laboratory. Diagnoses were confirmed and clinical symptom ratings were ascertained during the first visit. Cyberball inclusion and exclusion conditions were administered in a counterbalanced order to all participants, two weeks apart. Immediately after each version of the task, participants were administered the measures of working memory and social cognition. Following the cognitive testing, all participants were administered the psychological need security self-report measure. Following the second visit, all participants were debriefed and the examiner explained the deception component of the study, answered any questions, and provided participants with a copy of the debriefing form as well as a list of local mental health providers.

3. Measures

3.1. Cyberball Task

The examiner explained to participants that they would be playing a virtual ball-tossing game with two other participants. However, in reality, the participants played a computer program with predetermined events. Each task began with a display that imitated the computer game initiating contact with the other participants. The names of the participant and confederates were displayed on the screen under cartoon figures representing the players (Fig. 1). The participants were told that the other players were in a testing room at the nearby university. Before starting the task, the examiner used an example screen to demonstrate what the task would look like, and how to pass the ball. After these instructions, a display with three characters in three corners of an imaginary equilateral triangle appeared. Participants clicked the mouse above the player to whom they wanted to pass the ball. When the ball was passed, it moved across the screen and was caught by the intended player.

During the exclusion condition, there were a total of 30 throws; the

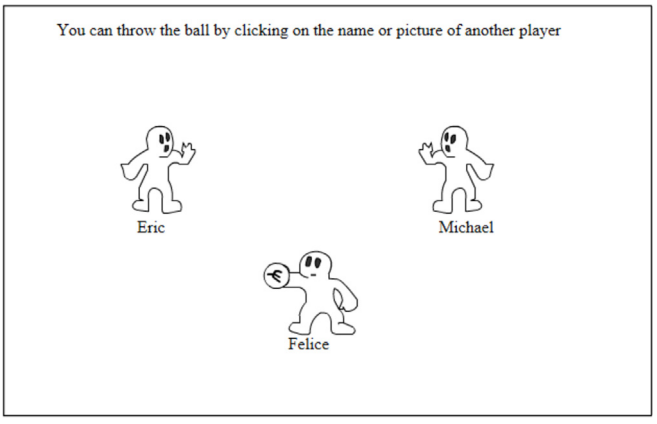

Fig. 1. Cyberball task.

participant received two of the first five throws and then received no further throws and watched the other two players throw the ball back and forth. During the inclusion condition, the participant received the ball 33% of the time for the sequence of 30 throws. During each trial of the inclusion and exclusion conditions, the cyber stooges waited 200 to 1500 ms (determined randomly) before passing the ball to mimic the time it would take a human player to pass the ball.

3.2. Psychological need security

The Need-Threat Scale (NTS; van Beest and Williams, 2006) was administered to assess psychological need security and social stress. The NTS is 20-item measure that includes four subscales: belongingness ("I felt rejected"), self-esteem ("I felt liked"), control ("I felt powerful"), and meaningful existence ("I felt invisible"), and a total score, which is commonly used to assess affective experiences during the Cyberball task. Participants rate each item on a scale from 1 (Fully Disagree) to 7 (Fully Agree). Ten of the items are reverse scored and higher total scores indicate more need security.

3.3. Working memory

The WAIS-III Letter–Number Sequencing (LNS; Wechsler, 1997) requires the participant to listen to strings of spoken letters and numbers and repeat back the numbers in ascending order, followed by the letters in alphabetical order. For example, if the examiner says "7-F-3-K-8-B", the correct response is "3-7-8-B—F—K". There are 24 alphanumeric strings and total scores are the number correct, ranging from 0 to 24.

3.4. Social cognition

The Awareness of Social Inference Test – Part 3 (TASIT; McDonald et al., 2003) is a measure of social inference abilities in which participants watch 16 videotaped vignettes that depict people interacting and use the contextual information (visual and verbal), and voice and face cues to determine if an untrue statement presented in the vignette is either sarcasm or a lie. There are two subscale scores: lie detection and sarcasm detection.

3.5. Symptoms

Clinical symptoms were evaluated at baseline to characterize the sample. We used the expanded UCLA version of the Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993), and the Clinical Assessment Interview for Negative Symptoms (CAINS; Horan et al., 2011). The BPRS includes 24 items and provides subscales for positive symptoms, depression, and agitation. The CAINS is a 13-item instrument that yields two subscales: Motivation and Pleasure (MAP) and Expression.

3.6. Statistical analysis

Distributions and skewness/kurtosis indicated the variables were normally distributed. To examine our two primary hypotheses (i.e., interaction between group and condition on psychological need security, working memory, and social cognition), we used repeated measures analyses of variance (rmANOVA) with condition (inclusion vs exclusion) as a within subject factor and group as a between subject factor. We conducted sensitivity analyses by including order as a covariate in the rmANOVAs and found no difference in observed effects. To examine correlations with symptoms, we derived a difference score (inclusion – exclusion) for the NTS, LNS, and TASIT and examining correlations with the BPRS and CAINS subscales.

Table 1
Demographics of the sample.

	Schizophrenia n = 35	Control n = 34	Group comparison
Sex (% male)	69%	64%	X^2 = 0.19, ns
Age	49.7 (10.5)	48.5 (7.8)	t = 0.56, ns
Race			
Black	31%	30%	
White	57%	58%	X^2 = 2.68, ns
Other	12%	24%	
Ethnicity (% Hispanic/ Latino)	23%	12%	X^2 = 1.34, ns
Education	12.5 (1.9)	14.2 (1.5)	t = - 4.0, p < .001
Parental Education	12.7 (2.5)	13.9 (2.8)	t = −1.63, ns

4. Results

4.1. Participants

Table 1 provides the demographic characteristics for the sample. The schizophrenia and control groups did not differ in age, parental education, sex, race, or ethnicity. As expected, participants with schizophrenia had significantly lower personal education than controls.

4.2. Psychological need security

The Need Threat Scale, an indicator of psychological stress that validates the Cyberball exclusion manipulation, revealed a main effect of condition ($F(1, 65) = 126.5$, $p < .001$, $d = 1.4$) such that both groups reported more psychological stress following the exclusion condition, compared to inclusion. There was a significant interaction ($F(1,65) = 7.1$, $p = .01$, $d = 0.65$) (Fig. 2) between group and condition such that controls showed a significantly greater decrease in sense of security than the schizophrenia group.

4.3. Working memory

There was a significant main effect of condition on LNS performance ($F(1,64) = 11.2$, $p < .001$, $d = 0.42$). For participants in both groups, scores immediately following social exclusion were significantly worse than following social inclusion. Additionally, there was a main effect of group such that individuals with schizophrenia performed worse than controls ($F(1,64) = 27.8$, $p < .001$, $d = 1.3$). There was no significant

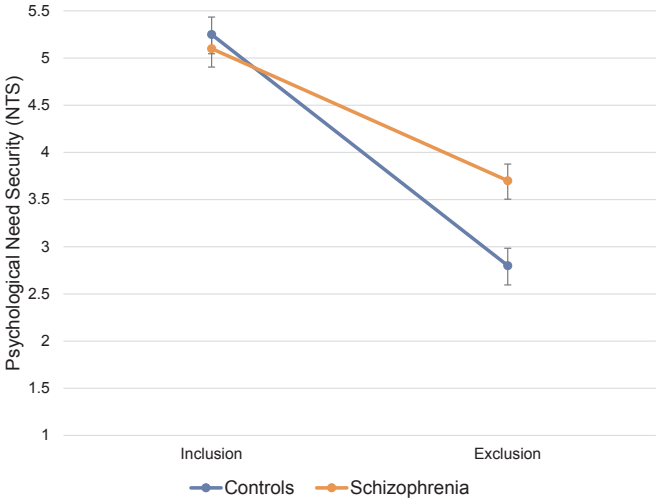

Fig. 2. Group and condition effects for psychological need security.
Note: NTS, Need Threat Scale; Error bars denote standard error.

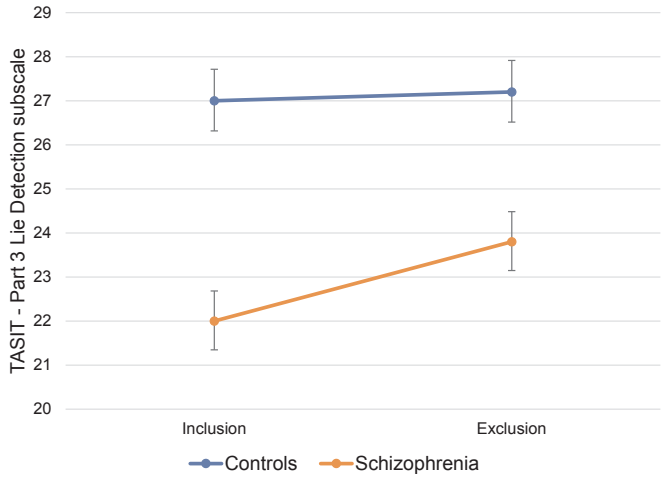

Fig. 3. Group and condition effects for social cognitive lie detection task.
Note: TASIT, The Awareness of Social Inference Test; Error bars denote standard error.

interaction.

4.4. Social cognition

There was a significant main effect of condition ($F(1,54) = 4.6$, $p < .05$, $d = 0.29$) on the lie detection subscale of TASIT – Part 3 such that both groups improved following social exclusion, compared to inclusion. There was a main effect of group ($F(1,65) = 20.5$, $p < .001$, $d = 1.1$), such that controls had higher scores than the schizophrenia group at both time points. Examination of the data suggests that the condition effect is largely driven by the schizophrenia group, however, the interaction only achieved trend-level significance ($F(1,63) = 2.7$, $p = .1$, $d = 0.41$) (Fig. 3). There were no effects on the sarcasm subscale of the TASIT – Part 3.

4.5. Symptoms

We examined correlations between clinical symptoms (i.e. BPRS positive, depression, and agitation; and CAINS MAP and Expression) and the social exclusion difference scores for the psychological and cognitive variables (i.e. NTS, LNS, TASIT). There were no significant correlations between baseline symptoms and the dependent variable difference scores (all r-values between .01 and .30).

5. Discussion

The current study examined the psychological and cognitive consequences of social exclusion for adults with schizophrenia. Consistent with previous studies, our results confirm that the Cyberball task is a valid experimental manipulation of social exclusion. Our findings suggest there are psychological and cognitive consequences of social exclusion for healthy controls and participants with schizophrenia. We predicted these consequences would be more pronounced for individuals with schizophrenia, however, our hypotheses were not supported. On the measure of psychological need security, both groups showed a decrease following exclusion but controls experienced more threat to their sense of security than did patients. Both groups showed decreases in working memory ability following social exclusion, but on the measure of social cognition, the opposite was true – participants in both groups improved in their ability to detect subtle sarcasm immediately following social exclusion. The overall pattern suggests that individuals with schizophrenia, as a group, may self-report less psychological pain than controls owing to exclusion, but experience similar effects in terms of cognitive performance.

Our finding of decreased psychological security following social exclusion is consistent with previous studies of social exclusion in healthy samples (Seidel et al., 2013; Themanson et al., 2013). Although both groups reported they felt a threat to psychological need security (i.e., belongingness, self-esteem, control, and meaningful existence) during social exclusion, the controls reported more threats to these needs. This pattern may indicate that social exclusion is less familiar, and therefore more salient and painful, for controls.

The fact that working memory impairments following social exclusion were approximately the same severity in both groups suggests that, even if exclusion was subjectively more painful for controls, its cognitive impact is comparable across groups. This finding was contrary to our hypothesis that the group with schizophrenia would be more negatively impacted by the exclusion experience. Our finding that exclusion interferes with cognition supports the notion of working memory malleability, based on social environmental experiences. Recent studies have looked at stress and memory abilities in schizophrenia. For instance, in one study, group differences in working memory capacity and episodic memory between individuals with schizophrenia and controls became nonsignificant after controlling for physiological indicators of stress (i.e., cortisol, heart rate, and skin conductance) (Krkovic et al., 2017). Similarly, among persons with schizophrenia, those with heightened emotional reactions to stress tend to have more cognitive impairments (Myin-Germeys et al., 2002). These types of findings may have implications for intervention, and future studies could investigate whether positive social experiences prior to cognitive testing can optimize performance.

The improvement in lie detection observed in both groups was not hypothesized, as we expected the experience of exclusion to impair social cognitive abilities. However, this seemingly counterintuitive finding is consistent with social psychology research that shows threats to social security heighten alertness and vigilance to possible threats (e.g., Kiat et al., 2018; Romero-Canyas et al., 2010). This phenomenon has been shown previously in healthy samples who experienced social exclusion (Kelly et al., 2017; Masten et al., 2012; Sleegers et al., 2017; Themanson et al., 2015) but this is the first study to show the effect in schizophrenia. It is unclear whether this improvement in lie detection would lead to an increase in positive symptoms such as paranoia, or would adaptively augment impaired social cognition abilities such as theory of mind. Again, there may be implications for intervention – perceiving subtle social cues is considered a higher-level social cognitive ability and our data offer initial support for the notion that individuals with schizophrenia can improve on this skill when faced with social threat.

The previously published studies that showed social exclusion in schizophrenia may incur longer lasting negative emotions and an increase in paranoia (Perry et al., 2011; Sundag et al., 2018) may provide context for our finding that social exclusion altered performance on non-social and social cognition tests. Further, in the Sundag et al. (2018) study, maladaptive self-schemas accounted for the increase in paranoia following social exclusion. Taken together, these findings have implications for intervention – intervening at the emotional and psychological level may improve cognitive performance in times of social stress. While we did not directly assess paranoia before and after inclusion and exclusion, it may be related to heightened vigilance we detected and future studies could examine the symptom and cognitive variables concurrently.

Differentiating between chronic and acute social exclusion is relevant to the interpretation of the current findings. Our results showing an apparent mismatch between the effect of exclusion on psychological security (less severe in patients than in controls) and on cognition (equivalent in both groups) may be explained by Williams' Temporal Need Threat Model of Ostracism (Williams, 2009). In this model, repeated or prolonged ostracism leads, first, to reflexive painful responses that are followed by a sense of threat to psychological security, and ultimately result in cognitive appraisals and schemas adapted to the

threatened self-esteem and security. Thus, chronic experiences of social exclusion, which are characteristic of many people with schizophrenia, may persistently threaten fundamental psychological needs and alter psychological and cognitive responses. Because we found that patients endorsed less psychological stress, they may be more accustomed to exclusion and may have adopted relevant cognitive schemas that predict/explain social exclusion. Despite this psychological response, the social stress still appears to interfere with working memory and, given the link between cognition and functioning, chronic rejection and exclusion may contribute to difficulties in functioning.

This study had several limitations. First, we did not measure symptoms following the inclusion and exclusion conditions, and our exploratory examination of correlations with baseline symptoms did not reveal any patterns. Much of the work examining the impact of social exclusion on clinical and high-risk samples has focused on symptoms, and positive symptoms such as paranoia may be worsened following social exclusion (Kesting et al., 2013; Kim et al., 2014; Sundag et al., 2018; Westermann et al., 2012). Second, we failed to assess history of exposure to social exclusion. We are interpreting our findings based on published research showing social exclusion is more prevalent, chronic, and severe in the lives of people with schizophrenia, but we are unable to confirm that previous experiences with exclusion affected the psychological response to the acute exclusion Cyberball paradigm in the current study. Third, we only used single measures of social and nonsocial cognition. More thorough batteries may detect stronger effects; however, they take longer to administer and thus, performance would not be as proximal to the experience of exclusion as it was in our brief assessments. Finally, we did not correct for multiple comparisons. Overall, our findings support the validity of the Cyberball task in schizophrenia samples and show that people with schizophrenia experience significant psychological and cognitive consequences from social exclusion.

Contributors

Author LFR designed the study and wrote the first draft of the manuscript. Author EAR installed the task and helped with statistical analyses and interpretation. Author MFG consulted on study design and edited the manuscript. All authors contributed to and have approved the final manuscript.

Conflicts of interest

The authors declare they have no conflicts of interest.

Role of the funding source

This project was funded by a grant from the Brain and Behavior Research Foundation to LFR. The funding source had no direct role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

Acknowledgement

We gratefully acknowledge all of the individuals who participated in the present study.

References

Angermeyer, M.C., Dietrich, S., 2006. Public beliefs about and attitudes towards people with mental illness: a review of population studies. Acta Psychiatr. Scand. 113 (3), 163–179.
Baumeister, R.F., Twenge, J.M., Nuss, C.K., 2002. Effects of social exclusion on cognitive processes: anticipated aloneness reduces intelligent thought. J. Personal. Soc. Psychol. 83 (4), 817–827.
Campbell, W.K., Krusemark, E.A., Dyckman, K.A., Brunell, A.B., McDowell, J.E., Twenge, J.M., Clementz, B.A., 2006. A magnetoencephalography investigation of neural correlates for social exclusion and self-control. Soc. Neurosci. 1 (2), 124–134.
Cohen, A., Patel, V., Thara, R., Gureje, O., 2008. Questioning an axiom: better prognosis for schizophrenia in the developing world? Schizophr. Bull. 34 (2), 229–244.
Engel, M., Fritzsche, A., Lincoln, T.M., 2016. Anticipation and experience of emotions in patients with schizophrenia and negative symptoms. An experimental study in a social context. Schizophr. Res. 170 (1), 191–197.
First, M.B., Williams, J.B.W., Karg, R.S., Spitzer, R.L., 2015. Structured Clinical Interview for DSM-5 Disorders-Research Version (SCID-5-RV). American Psychiatric Association Arlington, VA.
Gevondon, M.J., Selten, J.P., Myin-Germys, I., de Graaf, R., ten Have, M., van Dorsselaer, S., et al., 2014. Sexual minority status and psychotic symptoms: findings from The Netherlands mental health survey and incidence studies (NEMESIS). Psychol. Med. 44 (2), 421–433.
Green, M.F., Kern, R.S., Robertson, M.J., Sergi, M.J., Kee, K.S., 2000. Relevance of neurocognitive deficits for functional outcome in schizophrenia. In: Sharma, T., Harvey, P.D. (Eds.), Cognition in Schizophrenia. Oxford University Press, New York, pp. 178–192.
Green, M.F., Horan, W.P., Lee, J., McCleery, A., Reddy, L.F., Wynn, J.K., 2017. Social disconnection in schizophrenia and the general community. Schizophr. Bull. 44 (2), 242–249.
Hegarty, J.D., Baldessarini, R.J., Tohen, M., Waternaux, C., Oepen, G., 1994. One hundred years of schizophrenia: a meta-analysis of the outcome literature. Am. J. Psychiatry 151 (10), 1409–1416.
Horan, W.P., Kring, A.M., Gur, R.E., Reise, S.P., Blanchard, J.J., 2011. Development and psychometric validation of the clinical assessment interview for negative symptoms (CAINS). Schizophr. Res. 132 (2–3), 140–145.
Kelly, D.L., Demyanovich, H.K., Eaton, W.W., Cascella, N., Jackson, J., Fasano, A., Carpenter, W.T., 2017. Anti Gliadin Antibodies (AGA IgG) Related to Peripheral Inflammation in Schizophrenia. Brain, Behavior, and Immunity.
Kesting, M.L., Bredenpohl, M., Klenke, J., Westermann, S., Lincoln, T.M., 2013. The impact of social stress on self-esteem and paranoia: an experimental study. J. Behav. Ther. Exp. Psychiatry 44, 122–128.
Kiat, J.E., Cheadle, J.E., Goosby, B.J., 2018. The impact of social exclusion on anticipatory attentional processing. Int. J. Psychophysiol. 123, 48–57.
Killaspy, H., White, S., Lalvani, N., Berg, R., Thachil, A., Kallumpuram, S., Mezey, G., 2014. The impact of psychosis on social inclusion and associated factors. Int. J. Soc. Psych. 60 (2), 148–154.
Kim, B.N.R., Lee, H.S., Yi, J.S., Lee, H.P., 2014. The relationship between social exclusion and paranoid ideation: analysis of moderating and mediating effects of depression and self-esteem. J. Korea Neuropsychiatr. Assoc. 53 (6), 394.
Krkovic, K., Moritz, S., Lincoln, T.M., 2017. Neurocognitive deficits or stress overload: why do individuals with schizophrenia show poor performance in neurocognitive tests? Schizophr. Res. 183, 151–156.
Masten, C.L., Telzer, E.H., Fuligni, A.J., Lieberman, M.D., Eisenberger, N.I., 2012. Time spent with friends in adolescence relates to less neural sensitivity to later peer rejection. Soc. Cognit. Affect Neurosci. 7 (1), 106–114.
McDonald, S., Flanagan, S., Rollins, J., Kinch, J., 2003. TASIT: a new clinical tool for assessing social perception after traumatic brain injury. J. Head Trauma Rehabil. 18 (3), 219–238.
Myin-Germeys, I., Krabbendam, L., Jolles, J., Delespaul, P.A., van Os, J., 2002. Are cognitive impairments associated with sensitivity to stress in schizophrenia? An experience sampling study. Am. J. Psychiatry 159 (3), 443–449.
Myin-Germeys, I., van Os, J., Schwartz, J.E., Stone, A.A., Delespaul, P.A., 2001. Emotional reactivity to daily life stress in psychosis. Arch. Gen. Psychiatr. 58 (12), 1137–1144.
Oliveira, S.E., Esteves, F., Carvalho, H., 2015. Clinical profiles of stigma experiences, self-esteem and social relationships among people with schizophrenia, depressive, and bipolar disorders. Psychiatr. Res. 229 (1–2), 167–173.
Otten, M., Jonas, K.J., 2013. Out of the group, out of control? The brain response to social exclusion with changes in cognitive control. Soc. Cognit. Affect Neurosci. 8 (7), 789–794.
Perry, Y., Henry, J.D., Sethi, N., Grisham, J.R., 2011. The pain persists: how social exclusion affects individuals with schizophrenia. Br. J. Clin. Psychol. 50 (4), 339–349.
Romero-Canyas, R., Downey, G., Berenson, K., Ayduk, O., Kang, N.J., 2010. Rejection sensitivity and the rejection-hostility link in romantic relationships. J. Personal. 78 (1), 119–148.
Seidel, E.M., Silani, G., Metzler, H., Thaler, H., Lamm, C., Gur, R.C., Kryspin-Exner, I., Habel, U., Derntl, B., 2013. The impact of social exclusion vs. inclusion on subjective and hormonal reactions in females and males. Psychoneuroendocrinology 38 (12), 2925–2932.
Selten, J.-P., Booij, J., Buwalda, B., Meyer-Lindenberg, A., 2017. Biological mechanisms whereby social exclusion may contribute to the etiology of psychosis: a narrative review. Schizophr. Bull. 43 (2), 287–292.
Sleegers, W.W.A., Proulx, T., van Beest, I., 2017. The social pain of Cyberball: decreased pupillary reactivity to exclusion cues. J. Exp. Soc. Psychol. 69, 187–200.
Sundag, J., Ascone, L., Lincoln, T.M., 2018. The predictive value of early maladaptive schemas in paranoid responses to social stress. Clin. Psychol. Psychother. 25 (1), 65–75.
Themanson, J.R., Ball, A.B., Khatcherian, S.M., Rosen, P.J., 2013. The effects of social exclusion on the ERN and the cognitive control of action monitoring. Psychophysiology 51 (3), 215–225.
Themanson, J.R., Schreiber, J.A., Larsen, A.D., Dunn, K.R., Ball, A.B., Khatcherian, S.M., 2015. The ongoing cognitive processing of exclusionary social events: evidence from event-related potentials. Soc. Neurosci. 10 (1), 55–69.
van Beest, I., Williams, K.D., 2006. When inclusion costs and ostracism pays, ostracism still hurts. J. Personal. Soc. Psychol. 91 (5), 918–928.

Veling, W., Selten, J.-P., Susser, E., Laan, W., Mackenbach, J.P., Hoek, H.W., 2007. Discrimination and the incidence of psychotic disorders among ethnic minorities in The Netherlands. Int. J. Epidemiol. 36 (4), 761–768.
Veling, Wim, Susser, E., van Os, J., Mackenbach, J.P., Selten, J.-P., Hoek, H.W., 2008. Ethnic density of neighborhoods and incidence of psychotic disorders among immigrants. Am. J. Psychiatry 165 (1), 66–73.
Ventura, J., Lukoff, D., Nuechterlein, K.H., Liberman, R.P., Green, M., Shaner, A., 1993. Appendix 1: brief Psychiatric Rating Scale (BPRS) Expanded version (4.0) scales, anchor points and administration manual. Int. J. Method Psychiatr. 3, 227–244.
Wechsler, D., 1997. Wechsler Adult Intelligence Scale, third ed. Psychological Corporation, San Antonio, TX.
Westermann, S., Kesting, M.-L., Lincoln, T.M., 2012. Being deluded after being excluded? - how emotion regulation deficits in paranoia-prone individuals impact on state paranoia during experimentally induced social stress. Behav. Ther. 43, 329–340.
WHO, 2008. The Global Burden of Disease: 2004 Update.
Wickham, S., Taylor, P., Shevlin, M., Bentall, R.P., 2014. The impact of social deprivation on paranoia, hallucinations, mania and depression: the role of discrimination social support, stress and trust. PLoS One 9 (8), e105140.
Williams, K.D., 2009. Chapter 6 Ostracism: A Temporal Need-Threat Model, Advances in Experimental Social Psychology. Academic Press, pp. 275–314.
Williams, K.D., Cheung, C.K., Choi, W., 2000. Cyberostracism: effects of being ignored over the inernet. J. Personal. Soc. Psychol. 79 (5), 748–762.
Williams, K.D., Jarvis, B., 2006. Cyberball: a program for use in research on interpersonal ostracism and acceptance. Behav. Res. Methods 38 (1), 174–180.
Zadro, L., Williams, K.D., Richardson, R., 2004. How low can you go? Ostracism by a computer is sufficient to lower self-reported levels of belonging, control, self-esteem, and meaningful existence. J. Exp. Soc. Psychol. 40 (4), 560–567.