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Social perception in parents with schizophrenia or bipolar disorder and their adolescent offspring – The Danish High Risk and Resilience Study☆

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ABSTRACT

Schizophrenia and bipolar disorder are associated with social cognitive impairments, but knowledge on social cognition in offspring of parents with these disorders is sparse. Moreover, investigations of the potential transgenerational transmission of social cognition in at-risk families are lacking. Therefore, we aimed to investigate social perception in parents with schizophrenia or bipolar disorder and their adolescent offspring and population-based controls (PBC).

This study is part of The Danish High Risk and Resilience Study, a prospective familial high-risk study of families with parental schizophrenia (n = 202) or bipolar disorder (n = 120) and PBC (n = 200). Social perception was assessed with The Awareness of Social Inferences Task, Part 2A, including a total score and the subscales sincere, simple sarcasm, and paradoxical sarcasm.

Parents with schizophrenia showed poorer performance on the total scale ($p < 0.007$, $d = 0.33$) and the paradoxical sarcasm subscale ($p < 0.003$, $d = 0.35$) compared with PBC parents. We found no difference between parents with bipolar disorder and PBC parents or between the adolescent offspring. We found no significant interaction effect of familial high-risk status on any association ($p \leq 0.093$), but the parents' and their adolescent offspring's social perception was positively and significantly associated on the total scale ($p < 0.001$), the sincere subscale ($p = 0.005$), and the simple sarcasm subscale ($p = 0.010$), but not the paradoxical sarcasm subscale ($p = 0.052$).

Our findings of transgenerational transmission of social perception in families with parental schizophrenia or bipolar disorder and PBC call for further longitudinal research to determine how social cognitive deficits are transmitted from parents to their offspring.

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1. Introduction

Social cognitive impairments are well-established across different illness states in schizophrenia (Healey et al., 2016; Lee et al., 2015; Savla et al., 2013) and bipolar disorder (Bora et al., 2016; Gillissie et al., 2022; Samamé, 2013) and have proven to be significantly related to symptom severity and functional outcome in both disorders (de Sousa et al., 2019; Vlad et al., 2018; Halverson et al., 2019; Ventura et al., 2013). The most commonly studied domains of social cognition in schizophrenia and bipolar disorder include emotion recognition, theory of mind, social perception, and attributional bias (Gillissie et al., 2022; Green and Leitman, 2008; Pinkham et al., 2013), of which a predominant focus has been on emotion recognition and theory of mind. Social perception, sometimes also referred to as social judgment or social decision-making, has been defined as the interpretation of social cues, including the perception of the nature of relationships between people (Pinkham et al., 2013; Green et al., 2008). Social perception has been examined using different social cognitive tasks with different levels of ecological validity (Vaskinn et al., 2009). One such task is the Awareness of Social Inference Task (TASIT) (McDonald et al., 2003), suggested to be an adequate clinical test of social perception (McDonald et al., 2006). This task has previously been used to assess social perception in schizophrenia, providing evidence for impairments (Sparks et al., 2010; Bliksted et al., 2014; Mathews and Barch, 2010; Chung et al., 2011; Rowland et al., 2013; Lee et al., 2013). To the best of our knowledge, only two previous studies have used TASIT to assess social perception in the context of bipolar disorder. Both studies established that individuals with bipolar disorder exhibit comparable social perception relative to controls, and that individuals with schizophrenia display impairments in social perception both compared with controls and individuals with bipolar disorder (Rowland et al., 2013; Lee et al., 2013). However, further studies investigating social perception in the two disorders are warranted.

Existing research points towards social cognitive deficits as an endophenotypic marker of both schizophrenia and bipolar disorder as meta-analyses consistently report impairments in adult first-degree relatives (Martin et al., 2020; Bora and Özerdem, 2017; Lavoie et al., 2013; Bora and Pantelis, 2013). Offspring of parents with schizophrenia or bipolar disorder have a strongly elevated risk of developing the same or another mental disorder as their parents (Rasic et al., 2013; Uher et al., 2023). Nevertheless, social cognitive abilities in child and adolescent offspring have not been given much attention and, to the best of our knowledge, no previous study has examined social perception in these populations. Social cognition undergoes rapid development during infancy, childhood, and adolescence, and is significantly influenced by the closest relationships, particularly with the main caregivers (Lewis and Carpendale, 2014; Blakemore, 2012). In previous studies of the same cohort investigated in the current study, we found moderate to high heritability estimates for social responsiveness (Veddum et al., 2023b) and positive and significant associations between parents' and their 11-year-old offspring's social responsiveness (Veddum et al., 2023a). This was the case both for families with parental schizophrenia or bipolar disorder and population-based controls (PBC). Considering that parents with schizophrenia or bipolar disorder are likely to exhibit social cognitive impairments, and that social cognitive impairments have been suggested as an important vulnerability marker (Davis et al., 2016; Vaskinn and Horan, 2020), investigation of the potential transgenerational transmission of other social domains, such as social perception, between parents and their offspring may help identifying particularly vulnerable children and families. Taken together, this emphasizes the need for additional studies examining the transgenerational transmission of social abilities in familial high-risk samples.

The aim of this study was to investigate social perception in parents with schizophrenia or bipolar disorder compared with PBC parents and further, to examine social perception in their adolescent offspring by comparing the three groups. Additionally, we aimed to investigate the association between the parents' and their adolescent offspring's social perception.

2. Methods

This study is part of The Danish High Risk and Resilience Study – VIA, a prospective and longitudinal cohort study of families with one or two parents diagnosed with schizophrenia (i.e., familial high-risk of schizophrenia, FHR-SZ), bipolar disorder (i.e., familial high-risk of bipolar disorder, FHR-BP), or neither of these disorders (i.e., PBC).

2.1. Participants

The cohort originally comprised 522 families (FHR-SZ, $n = 202$; FHR-BP, $n = 120$; PBC, $n = 200$) assessed for the first time when the children were seven years old (Thorup et al., 2015). The first follow-up was conducted when the children were 11 years old (FHR-SZ, $n = 179$; FHR-BP, $n = 105$; PBC, $n = 181$) (Thorup et al., 2018), and the second follow-up was conducted when they were 15 years old (FHR-SZ, $n = 158$; FHR-BP, $n = 100$; PBC, $n = 169$) (Thorup et al., 2022). The overall retention rate from baseline to the second follow-up assessment was 81,8 %. At inclusion, the PBC offspring were matched to offspring at FHR-SZ based on sex, age, and municipality. The offspring at FHR-BP were not matched, but comparable to the two other groups in terms of sex and age. Additionally, the PBC parents were matched to parents with schizophrenia based on sex. In the current study, we applied data from baseline and the second follow-up.

2.2. Procedures

The families were identified through Danish Registers (Mors et al., 2011; Pedersen et al., 2006). Prior to participation in each assessment wave, the participants received thorough oral and written information about the study, and before enrolment, oral consent was obtained from the offspring, and written consent was obtained from the legal guardians and the participating parents. Baseline data collection took place from January 1st, 2013, to January 31st, 2016, and data collection for the second follow-up, when the offspring were 15 years old, took place from June 1st, 2021, to May 31st, 2024. Data from the first follow-up assessment, when the offspring were 11 years old, is not used in this paper. Formal approval was obtained from The National Committee on Health and Research Ethics (ref. H-20067908) and The Danish Data Protection Agency (ref. RHP2012–06 and P-2019-273).

2.3. Measurements

At baseline, parents with schizophrenia or bipolar disorder and the matched PBC parents completed the Danish version of the short form of TASIT (Part 2A) (McDonald et al., 2003; Bliksted et al., 2014), and the offspring completed TASIT at age 15. TASIT consists of 15 brief videos (lasting 16–53 seconds) featuring two characters engaging in everyday conversations. These interactions incorporate components targeting the ability to interpret conversational remarks meant literally (i.e., sincere remarks) or non-literally (i.e., sarcasm). More specifically, TASIT consists of three different types of videos (sincere, simple sarcasm, and paradoxical sarcasm), five of each type. In the sincere videos, there is congruence between what is literally being said and the paralinguistic and facial cues. In the simple sarcastic videos, one of the characters is being sarcastic, and there is incongruence between the spoken word and the paralinguistic and facial cues. In the paradoxical sarcastic videos, the conversation between the characters only makes sense if one is able to detect the sarcasm being used as a literal interpretation of the interaction is meaningless. After each video, the participants were asked four simple yes/no questions about the feelings, thoughts, and intentions of the characters and the implied meaning of their remarks (i.e., whether they were sincere or sarcastic). Each video type has a maximum subscore

of 20, equaling a maximum total score of 60, where higher scores indicate better performance.

The parents' personal and social functioning was assessed using The Personal and Social Performance Scale (Morosini et al., 2000), and the offspring's current level of functioning was measured with the Children's Global Assessment Scale (Shaffer et al., 1983) as part of the Kiddie Schedule for Affective Disorders and Schizophrenia, Present and Lifetime Version (Kaufman et al., 1997). Both scales range from zero to 100, where higher scores reflect better functioning.

2.4. Statistical analyses

The study groups were compared based on demographic characteristics using one-way analysis of variance (ANOVA) or Pearson's chi-squared test of independence, followed by pair-wise comparisons in the event of a significant main effect of group. "Don't know" answers on TASIT were assigned with a score of 0, indicating an incorrect answer. Linear regression analyses were applied to test between-group differences on the TASIT total score and the three subscales with the TASIT outcome as the dependent variable and FHR status as the independent variable. The association between the parents' and their adolescent offspring's TASIT scores was first ascertained using linear regression analyses with the offspring's TASIT outcome as the dependent variable and the parent's TASIT outcome as the independent variable. Using multiple linear regression analyses we examined the interaction effect of FHR status on all associations. In the event of a non-significant interaction, the interaction term was removed, and the models were subsequently adjusted for FHR status. Cluster robust variance estimation was used to account for clustering at family level in all regression analyses. Effect sizes were calculated using Cohen's d (small, 0.2; medium, 0.5; and large, 0.7). Alpha level was set to 0.05 for all analyses, and the false discovery rate in the multiple comparisons was calculated according to the Benjamini-Hochberg procedure with the q-value set to 0.05 (Benjamini and Hochberg, 1995). All analyses were conducted using Stata IC software, version 18.0 (StataCorp, 2023).

3. Results

3.1. Demographic characteristics

Our study included TASIT data from 439 biological parents (FHR-SZ, $n = 155$ parents; FHR-BP, $n = 101$; PBC, $n = 187$) and 384 adolescent offspring (FHR-SZ, $n = 143$; FHR-BP, $n = 91$; PBC, $n = 151$). The three groups of parents were comparable regarding sex, but parents with schizophrenia were significantly younger compared with parents with bipolar disorder and PBC parents. Both parents with schizophrenia and parents with bipolar disorder had significantly lower levels of personal and social functioning compared with PBC parents. Similarly, adolescents at FHR-SZ or FHR-BP had significantly lower level of functioning than PBC offspring, but the three groups were comparable regarding sex and age (Table 1).

3.2. Parents' and adolescent offspring's social perception

Parents with schizophrenia had significantly lower scores on the TASIT total score and the paradoxical sarcasm subscale compared with PBC parents, with small effect sizes. The other two subscales did not differ significantly between groups. We did not find any significant difference between adolescent offspring at FHR-SZ or FHR-BP and PBC on the TASIT total score nor on the three subscales (Table 2).

3.3. Association between parents and adolescent offspring's social perception

We identified no significant interaction effect of FHR status on any association between parents and their adolescent offspring's TASIT scores (total score, $p = 0.801$; sincere subscale, $p = 0.708$; simple sarcasm subscale, $p = 0.093$; paradoxical sarcasm subscale, $p = 0.896$). In the model adjusted for FHR status, we found a positive and significant association between parents and their adolescent offspring on the total scale, the sincere subscale, and the simple sarcasm subscale, but not on the paradoxical sarcasm subscale (Table 3).

4. Discussion

In this population-based cohort study of families with parental schizophrenia or bipolar disorder and PBC families, parents with schizophrenia demonstrated impairments in social perception, specifically in their ability to comprehend paradoxical sarcasm. Additionally, we established that offspring at FHR-SZ or FHR-BP and PBC display comparable social perception at age 15. However, parents' and their adolescent offspring's social perception is positively and significantly associated, irrespective of familial risk.

Our finding that parents with schizophrenia exhibit impairments in social perception is in line with the results from previous studies using the same task to assess social perception in individuals with schizophrenia (Sparks et al., 2010; Bliksted et al., 2014; Mathews and Barch, 2010; Chung et al., 2011; Rowland et al., 2013; Lee et al., 2013). In our study, these impairments can be explained by difficulties in understanding paradoxical sarcasm, suggesting that parents with schizophrenia experience difficulties in interpreting and engaging in social interactions when paradoxical sarcasm is being used. Notably, other

Table 1
Demographic and clinical characteristics of the parents and their adolescent offspring in families with parental schizophrenia or bipolar disorder and population-based controls.

	FHR-SZ	FHR-BP	PBC	*p*-value	FHR-SZ vs PBC	FHR-BP vs PBC	FHR-SZ vs FHR-BP
					p-value		
Parents, N	156	101	189				
Female, N (%)	100 (64.10)	62 (61.39)	110 (58.20)	0.533[d]	–	–	–
Age at inclusion, mean (SD)	38.02 (6.10)	40.21 (6.05)	40.66 (4.74)	**<0.001**[c]	**<0.001**	0.794	**0.006**
Personal and social functioning[a], mean (SD)	66.25 (15.71)	69.08 (14.06)	84.42 (9.27)	**<0.001**[c]	**<0.001**	**<0.001**	0.460
Adolescents, N	142	91	151				
Female, N (%)	73 (51.41)	41 (45.05)	73 (48.34)	0.635[d]	–	–	–
Age, mean (SD)	15.93 (0.33)	15.95 (0.38)	15.86 (0.38)	0.119[c]	–	–	–
Level of functioning[b], mean (SD)	65.37 (16.67)	70.05 (16.27)	76.53 (13.68)	**<0.001**[d]	**<0.001**	**0.005**	0.064

Abbreviations: Parents with schizophrenia and their adolescent offspring at familial high-risk of schizophrenia (FHR-SZ), Parents with bipolar disorder and their adolescent offspring at familial high-risk of bipolar disorder (FHR-BP), Population-based controls (PBC), *p*-value = significance level $p < 0.05$.

[a] Assessed with the Personal and Social Performance Scale and based on data from 443 parents (FHR-SZ, $n = 155$; FHR-BP, $n = 101$; PBC, $n = 187$).

[b] Assessed with the Children's Global Assessment Scale and based on data from 384 children (FHR-SZ, $n = 142$; FHR-BP, $n = 91$; PBC, $n = 151$).

[c] One-way analysis of variance (ANOVA).

[d] Pearson's chi-squared test of independence.

Table 2
Between group differences of parents' and their adolescent offspring's TASIT scores in families with parental schizophrenia or bipolar disorder and population-based controls.

	FHR-SZ	FHR-BP	PBC	*p*- value	Pairwise comparisons		
					FHR-SZ vs PBC	FHR-BP vs PBC	FHR-SZ vs FHR-BP
		Mean (95 % CI)				*p*-value (*d*)	
Parents							
Total score	51.04 (50.37;51.71)	52.16 (51.33;52.99)	52.44 (51.83;53.04)	**0.008**	**0.002** (0.33)	0.591 (0.07)	0.039 (0.25)
Sincere	16.10 (15.65;16.56)	16.60 (16.04;17.17)	16.63 (16.21;17.04)	0.199	–	–	–
Simple sarcasm	16.61 (16.22;17.00)	16.89 (16.41;17.37)	16.85 (16.50;17.20)	0.570	–	–	–
Paradoxical sarcasm	18.33 (18.05;18.60)	18.66 (18.32;19.01)	18.96 (18.71;19.21)	**0.004**	**0.001** (0.35)	0.175 (0.19)	0.135 (0.18)
Adolescents							
Total score	51.30 (50.53;52.08)	52.27 (51.45;53.10)	51.85 (51.16;52.53)	0.237	–	–	–
Sincere	16.49 (16.00;16.98)	16.20 (15.57;16.82)	15.98 (15.52;16.44)	0.324	–	–	–
Simple sarcasm	17.18 (16.71;17.66)	17.95 (17.52;18.37)	17.75 (17.37;18.14)	0.053	–	–	–
Paradoxical sarcasm	17.63 (17.24;18.01)	18.13 (17.74;18.53)	18.11 (17.83;18.40)	0.097	–	–	–

Abbreviations: Parents with schizophrenia and their adolescent offspring at familial high-risk of schizophrenia (FHR-SZ), Parents with bipolar disorder and their adolescent offspring at familial high-risk of bipolar disorder (FHR-BP); Population-based controls (PBC); The Awareness of Social Interference Task (TASIT); Confidence Interval (CI); *d* = Cohens *d*; *p*-value = significance level $p < 0.025$ after correction according to the Benjamini-Hochberg procedure.

Table 3
Associations between parents and their adolescent offspring's TASIT scores in families with parental schizophrenia or bipolar disorder and population-based controls.

	Model adjusted for familial risk			
	β	95 % CI	*p*-value	R^2
Total score	0.215	0.11–0.32	**<0.001**	0.06
Sincere	0.173	0.05–0.29	**0.005**	0.03
Simple sarcasm	0.133	0.03–0.23	**0.010**	0.04
Paradoxical sarcasm	0.117	0.00–0.24	0.052	0.04

Abbreviations: The Awareness of Social Interference Task (TASIT); Confidence Interval (CI); *p*-value = significance level $p < 0.05$.

studies have also reported difficulties with understanding simple sarcasm, and the mean for the parents with schizophrenia in our study is generally higher compared to previous studies of patient groups, indicating less impairment (Sparks et al., 2010; Bliksted et al., 2014; Chung et al., 2011; Rowland et al., 2013). This may relate to the fact that our sample only included individuals with schizophrenia being parents, thereby representing a higher-functioning sample compared with childless individuals with schizophrenia (MacCabe et al., 2009; Mowbray et al., 2005; Hansen et al., 2024). Additionally, the parents included in our study were recruited though the Danish registers instead of through psychiatric facilities, which allowed for participation of parents who were not currently in contact with mental health care, ensuring that participation was not necessarily related to parental severity of illness. Our finding that parents with bipolar disorder exhibit comparable social perception relative to PBC parents is in line with results from previous studies that have applied Part 2 from TASIT (Rowland et al., 2013; Lee et al., 2013).

To the best of our knowledge, the current study is the first to assess social perception in adolescent offspring of parents with schizophrenia or bipolar disorder compared with PBC. Contrary to our expectations, we did not observe any difference in social perception between adolescent offspring at FHR-SZ or FHR-BP and PBC. However, TASIT may not be a sensitive tool to assess subtle deficits, which is what we would expect the adolescent offspring at FHR-SZ or FHR-BP in our cohort to display. For example, the design of TASIT allows the participant to think before answering, but does not involve assessment of latency. In a previous study of emotion recognition accuracy and latency in individuals at ultra-high risk of psychosis, latency prior to a correct response was identified as a more sensitive measure than total number of correct responses (i.e., accuracy) (Glenthøj et al., 2016). Importantly though, evidence from a recent meta-analysis revealed that youth or young adults (aged 35 or younger) with a first-degree relative with schizophrenia display impairments in other social cognitive domains such as theory of mind and emotion recognition (Tucci et al., 2023). This corresponds to meta-analytic evidence of impaired social cognition in adult first-degree relatives of individuals with schizophrenia or bipolar disorder (Bora and Özerdem, 2017; Lavoie et al., 2013). However, adolescence is a critical period in social cognitive development (Blakemore, 2008; Paus et al., 2008), emphasizing the importance of longitudinal studies of social cognition in offspring at FHR-SZ or FHR-BP.

Interestingly, we showed a positive and significant association between parents with schizophrenia, bipolar disorder, or neither and their adolescent offspring's social perception. This finding is in line with previous studies of the same cohort, where we found high heritability estimates along with a positive and significant association between parents' and their 11-year-old offspring's social responsiveness (Veddum et al., 2023b; Veddum et al., 2023a). Although the association in the current study was small, our findings imply a transgenerational transmission of social responsiveness and social perception between parents and their adolescent offspring in families with parental schizophrenia or bipolar disorder as well as in PBC families, presumably occurring due to a combination of genetic and environmental factors (Bohacek and Mansuy, 2015; Plomin and Daniels, 2011). Implicitly, this suggests that if parents display impairments in social perception, we expect their adolescent offspring to do as well. However, it is important to note that we did not observe a significant association between parents' and their adolescent offspring's scores on the paradoxical sarcasm subscale. As already discussed previously, the observed group difference between

parents with schizophrenia and PBC parents can be explained by difficulties with understanding paradoxical sarcasm, which may partly explain why we did not observe a significant association on this exact subscale.

The findings from this study should be interpreted in the light of some strengths and limitations. First of all, our study is part of the largest familial high-risk study to date, including information on the same social cognitive task from both parents and their same-aged offspring. Additionally, our population-based cohort is highly unique as the participants were retrieved from the Danish registers (Mors et al., 2011; Pedersen et al., 2006), most likely enhancing the representativity and generalizability of our results. Nevertheless, as TASIT was only administered to the offspring once (at age 15), we were not able to include longitudinal investigations. Additionally, the parents completed TASIT at the baseline assessment when their offspring were seven years old, whereas the offspring completed TASIT at age 15 due to that TASIT cannot be administered to children. However, although TASIT is a validated tool for assessment of social perception in adult clinical populations (McDonald et al., 2006), it may not be a suitable tool for assessment of subtle impairments in adolescent samples. Nonetheless, the current study is the first familial high-risk study to link social cognitive data from parents and their same-aged offspring.

In conclusion, the findings from the current study indicate that parents with schizophrenia display impairments in social perception, while parents with bipolar disorder and adolescent offspring at FHR-SZ or FHR-BP do not. Importantly, the parents' and their adolescent offspring's social perception is positively and significantly associated, irrespective of familial risk, indicating a transgenerational transmission. Future studies would benefit from assessing social perception using age-validated assessment tools sensitive to subtle impairments. Moreover, our findings call for longitudinal research in familial high-risk populations in order to determine how social cognition is transmitted from parents to their offspring.

Glossary

TASIT	The Awareness of Social Inference Task
FHR-SZ	Familial high-risk of schizophrenia
FHR-BP	Familial high-risk of bipolar disorder
PBC	Population-based controls

CRediT authorship contribution statement

Lotte Veddum: Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Anette Faurskov Bundgaard:** Writing – review & editing, Investigation. **Andreas Færgemand Laursen:** Writing – review & editing, Investigation. **Sanciya Mano Perfalk:** Writing – review & editing. **Maja Gregersen:** Writing – review & editing, Investigation. **Mette Falkenberg Krantz:** Writing – review & editing. **Birgitte Klee Burton:** Writing – review & editing, Investigation. **Camilla Jerlang Christiani:** Writing – review & editing, Investigation. **Ditte Ellersgaard:** Writing – review & editing, Investigation. **Sinnika Birkehøj Rohd:** Writing – review & editing, Investigation. **Marta Schiavon:** Writing – review & editing, Investigation. **Doris Helena Bjarnadóttir Streymá:** Writing – review & editing, Investigation. **Jens Richardt Møllegaard Jepsen:** Writing – review & editing. **Kerstin Plessen:** Writing – review & editing. **Nicoline Hemager:** Writing – review & editing, Project administration, Investigation, Funding acquisition. **Anne Amalie Elgaard Thorup:** Writing – review & editing, Project administration, Funding acquisition. **Merete Nordentoft:** Writing – review & editing, Project administration, Funding acquisition. **Ole Mors:** Writing – review & editing, Project administration, Funding acquisition. **Aja Neergaard Greve:** Writing – original draft, Visualization, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

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Declaration of competing interest

All contributing authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scog.2025.100370.

Data statement

The participants in this study did not give consent for their data to be shared publicly, so due to the sensitive nature of the research and the General Data Protection Regulation policy, data sharing is not available.

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