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ORIGINAL ARTICLE

Affect recognition and the quality of mother-infant interaction: understanding parenting difficulties in mothers with schizophrenia

Sarah J. Healy[1] · **Jona Lewin**[1] · **Stephen Butler**[2] · **Kyla Vaillancourt**[3] · **Fiona Seth-Smith**[1]

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Abstract This study investigated the quality of mother-infant interaction and maternal ability to recognise adult affect in three study groups consisting of mothers with a diagnosis of schizophrenia, mothers with depression and healthy controls. Sixty-four mothers were recruited from a Mother and Baby Unit and local children's centres. A 5-min mother-infant interaction was coded on a number of caregiving variables. Affect recognition and discrimination abilities were tested via a series of computerised tasks. Group differences were found both in measures of affect recognition and in the mother-infant interaction. Mothers with schizophrenia showed consistent impairments across most of the parenting measures and all measures of affect recognition and discrimination. Mothers with depression fell between the mothers with schizophrenia and healthy controls on most measures. However, depressed women's parenting was not significantly poorer than controls on any of the measures, and only showed trends for differences with mothers with schizophrenia on a few measures. Regression analyses found impairments in affect recognition and a diagnosis of schizophrenia to predict the occurrence of odd or unusual speech in the mother-infant interaction. Results add to the growing body of knowledge on the mother-infant interaction in mothers with schizophrenia and mothers with depression compared to healthy controls, suggesting a need for parenting interventions aimed at mothers with these conditions. While affect recognition impairments were not found to fully explain differences in parenting among women with schizophrenia, further research is needed to understand the psychopathology of parenting disturbances within this clinical group.

Keywords Schizophrenia · Mother-infant interaction · Affect recognition · Postnatal depression · Parenting

✉ Sarah J. Healy
sarah.healy1@nhs.net

[1] Coombe Wood Perinatal Service; Central and North West London NHS Foundation Trust; Park Royal Centre for Mental Health, Central Way, London NW10 7FL, UK

[2] Research Division of Clinical, Educational and Health Psychology, University College London, Gower Street, London WC1E 6BT, UK

[3] Institute of Psychiatry, Psychology and Neuroscience, King's College London, 16 De Crespigny Park, London SE5 8AF, UK

Introduction

There is substantial evidence that the mother-infant interaction, the quality of which relies to a large extent on the mother's ability to recognise the infant's cues, is impaired to variable degrees in mothers with mental illness. Research involving mothers diagnosed with depression and schizophrenia has found significant differences in the quality of mother-infant interaction when compared to mothers with no psychiatric diagnosis (Cohn et al. 1990; Murray et al. 2009; Riordan et al. 1999). Consequently, children of mothers with mental health problems have been found to be at risk of poor functioning in a range of domains and of later psychopathology (Goodman and Gotlib 1999; Hay et al. 2001, 2003; Stein et al. 2009; Wan et al. 2008a).

In recent years, the assessment of affect recognition has gained increasing importance in mental health research. Possible impairment in affect recognition has been studied with particular interest in patients with schizophrenia, mood disorder and autism (Getz et al. 2003; Gur et al. 1992; Kohler et al. 2003). Research has shown deficits in recognising, assessing and experiencing emotions to be associated with of a neuropsychological deficit profile of schizophrenia

(Schneider et al. 1995). Limited research has examined the association of affect recognition and parenting, focusing on abusive parenting (Balge and Milner 2000; Kropp and Haynes 1987). To our knowledge, the extent to which impairments in affect recognition impact on the mother-infant interaction has not yet been examined, either generally or in relation to specific clinical groups. This study compared the relationship between the quality of the mother-infant interaction and adult affect recognition skills in mothers with schizophrenia, mothers with depression and healthy controls.

Parenting, mental health and affect recognition

The postpartum period is a particularly sensitive period in regard to an infant's development, and it is now well established that the quality of care provided during this time is of much importance for later child outcomes (Goodman and Gotlib 1999; Stein et al. 2009; Wan et al. 2008a). Growing evidence suggests that early mother-infant interactions may be compromised in mothers suffering from depression or psychosis in the postpartum period, particularly in regard to maternal sensitivity (see Murray et al. 2003 for a review). The pathway by which mental health difficulties impact on these caregiving impairments is not fully understood. The current study aims to address this by exploring the possible role of affect recognition.

Accurate recognition and interpretation of facial emotion are critical to normal social and cognitive development (Philpot and Feldman 1990), adaptive social functioning and psychological health and well-being across the lifespan (Goleman 1995). Affect recognition can be seen as a first step in the social communication process (Pinkham et al. 2003) and contributes significantly to the interpretation of interpersonal information (Ihnen et al. 1998). It logically follows that affect recognition skills would play a key role in one's ability to parent a young infant.

At present, there is limited research in this area, with contradictory findings making it difficult to draw conclusions. Kropp and Haynes (1987) found abusive, compared to non-abusive, mothers made more errors in identifying infant's emotions in facial photographs. However, two further studies failed to replicate this finding, with abusive and non-abusive mothers showing no difference in their ability to identify emotions in children (Camras et al. 1988; During and McMahon 1991) or adults (During and McMahon 1991). Balge and Milner (2000) looked at the abilities of mothers deemed at high risk of child physical abuse compared to low-risk mothers, examining their ability to accurately recognise emotions in adults and children. They found that high-risk mothers did not make significantly more emotion recognition errors, with only a post hoc finding of more overall emotion recognition errors in high-risk mothers observed. None of these studies, however, measured parenting directly; so, the extent to which affect recognition abilities are associated with early mother-infant interaction is unknown.

Schizophrenia, parenting and affect recognition

Based on prevalence of 0.3 %, over 37,000 women of childbearing age in the UK have schizophrenia, with around a thousand of these women giving birth every year (Howard et al. 2002). Children of mothers with schizophrenia have been shown to be a particularly high-risk group in regard to developmental and clinical outcomes (Niemi et al. 2003; Wahlberg et al. 2004), but there is limited research about the mechanisms associated with these associations, such as possible impairments in maternal sensitivity impacting on the quality of mother-infant interaction.

When compared with mothers diagnosed with affective disorders, there is small but growing body of evidence over a range of study designs which have demonstrated mothers with schizophrenia to be less sensitive, less responsive, more intrusive and less stimulating when interacting with their infants (Goodman 1987; Riordan et al. 1999; Steadman et al. 2007; Wan et al. 2007). Bosanac and colleagues (2003) in their review of parenting in mothers with a diagnosis of schizophrenia identify specific impairments including the following: reduced eye contact, lack of stimulation, difficulty or inability to pick up cues and discordance between mother and infant, all of which been demonstrated to have lasting cognitive, emotional, behavioural and social consequences for infant development. However, there are also a few studies that have failed to find differences in mothers with schizophrenia when compared to those with affective disorders (Sameroff et al. 1982; Seifer et al. 1992; Pawlby et al. 2010). The research in this area to date is limited by small sample sizes, utilisation of parenting coding schemes designed for measuring impairment in mothers with depression and a very limited use of non-clinical control groups.

There are a number of reasons why mothers with schizophrenia may have difficulties when interacting with their infants, including the following: attributional errors (Brune et al. 2007), reasoning biases (Garety et al. 2005), difficulties with empathy (Montag et al. 2007) or specific positive symptoms (Chandra et al. 2006). While research has not looked specifically at the role of affect recognition in understanding parenting among women with schizophrenia, impairments of social functioning are among the hallmark characteristics of schizophrenia. These impairments, although present in other mental disorders, are most pronounced in persons with schizophrenia (Mueser and Bellack 1998), and the deficits in recognising, assessing and experiencing emotions are part of a neuropsychological deficit profile of schizophrenia (Schneider et al. 1995) and are likely to impact on caregiving abilities.

Deficits in the recognition of facial expressions of emotion in patients with schizophrenia have been shown in several

studies across different cultures (Mandal et al. 1998; Morrison et al. 1988). Two longitudinal studies have shown that these deficits remain stable over the course of the illness and that they are relatively unaffected by severity of acute symptoms (Addington and Addington 1998; Wöllwer et al. 1996). A more recent study, however, showed that affect recognition deficits in schizophrenia are trait features of the disorder and increase with illness duration (Kuchrska-Pietura et al. 2005). The impact of these deficits on parenting has not yet been examined.

Depression, parenting and affect recognition

Postpartum depression (PPD) is the most common disorder after childbirth, with most publications estimating that it effects 10–15 % of women (Beck 2001; O'Hara and Swain 1996; Stuart et al. 1998).

A growing body of evidence from naturalistic longitudinal studies attests to an adverse impact of PPD on the quality of the early mother-infant relationship, and on the course of child socio-emotional development (Goodman et al. 2011; Murray et al. 2003). The long-term negative outcomes, including behavioural, emotional and health problems, are often associated, at least partially, with disturbance within mother-infant interactions (Beardslee et al. 1998; Murray et al. 2003). In a meta-analysis of studies on maternal depression and parenting (Lovejoy et al. 2000), it was found that mothers who were depressed in the infant's first 3 months of life were found to be more irritable and hostile, less engaged, less likely to exhibit warmth and emotion and to have lower rates of play with their 3-month-old infants. Infants of mothers who are depressed in the postnatal period have been consistently found to have higher rates of insecure attachment than infants of well mothers (Martins and Gaffan 2000). Impairments in the interactions of depressed mothers and their infants appear to be universal across cultures and socioeconomic status groups (Danaci et al. 2002; Eapen et al. 2005; Murray et al. 1996; Righetti-Veltema et al. 2002).

While research to date has not looked specifically at the impact of impaired affect recognition on parenting, several studies have shown distorted interpretations of facial affects in patients with mood disorders. One study of patients with mania showed a specific, mood-congruent, negative bias in sad facial affect recognition (Lennox et al. 2004). A further study of patients with bipolar disorder showed impaired recognition of happy and sad facial expressions (Gur et al. 1992). This finding was confirmed in a third study, which showed that patients with bipolar disorder were able to recognize faces but had difficulty processing facial affective cues (Getz et al. 2003). In patients with major depressive disorder, studies have demonstrated either generalised or specific impairments in the identification of emotional facial expressions, or a bias towards the identification of expressions as sad (Gur et al. 1992).

Aim and objectives

This study aimed to investigate whether impaired affect recognition abilities impact on the quality of mother-infant interaction in a sample of mothers with schizophrenia, when compared to mothers with depression and mothers with no mental health diagnosis.

This study hypothesized that:

1. There will be group differences in both measures of affect recognition and mother-infant interaction. Mothers with schizophrenia will score significantly worse than controls on all measures of parenting and affect recognition. Mothers with postpartum depression will perform poorer than controls but better than those with schizophrenia.
2. Affect recognition abilities will predict the quality of the mother-infant interaction. That is, mothers who perform better on tasks of affect recognition will also be more attuned to their infant's emotional needs. Affect recognition skills will account for the quality of mother-infant interaction across all clinical groups.

Method

Participants

The sample consisted of 64 mothers and their infants, divided into two clinical groups and a control group. Power analyses found that in order for the study to have sufficient power (90 %) to detect a medium size correlation of 0.4 or greater between the two outcomes, with a 5 % significance, 61 subjects in total were required.

All participants were women with healthy, full-term babies aged between 2 and 16 months. The clinical groups consisted of 18 mothers (28 % of the sample) with a diagnosis of schizophrenia and 24 mothers (38 %) with a diagnosis of depression and both were recruited from a mother and baby unit (MBU) in London, England. The MBU is composed of ten inpatient beds and a community perinatal service. Mothers were recruited from both inpatient admissions and the community service, in order to increase both the number of participants as well as the range in illness severity. In the depressed group, 20 mothers were recruited via the community service and 4 when inpatients. In the schizophrenia group, 3 were recruited via the community service and 15 when inpatients. Only those mothers considered well enough to give informed consent were approached to take part in the research. A control group of 22 mothers (34 % of the sample) and their infants were

recruited from children's centres in the same locality that the MBU served.

Inclusion criteria

For both clinical groups, inclusion criteria were broad. Women with organic brain disease or history of alcohol or substance abuse were excluded. Whereas many studies exclude mothers whose first language is not English, this was not an exclusion criterion for the current research. As a result, three participants spoke another language (two speaking Tamil, one speaking Greek) to their infant throughout the interaction, which was later translated. A further eight required some translation, where a mother spoke a few sentences in her native language, though most of the interaction was in English. One participant was speaking a language that could not be determined and thus was excluded from the analyses.

Schizophrenia group In order to be included in the research, mothers with schizophrenia had to have a clinical diagnosis of schizophrenia for which they had received treatment prior to the pregnancy. The mother-infant interaction was filmed when the mothers had recovered to the extent that discharge from the inpatient service was being planned. Mothers were not included in the study when they were floridly psychotic.

Depression group The participant's depression had to have lasted for at least 4 weeks, and was confirmed by a score of 12 or more on the *Edinburgh Postnatal Depression Scale* (EPDS; Cox et al. 1996). Of the mothers recruited, 13 had a previous history of depression, whereas for 11, the depressive episode following the birth of their baby was their first. Filming of the mother-infant interaction was done as close to discharge as possible. Mothers who experienced psychotic symptoms as part of their depression were excluded.

Assessments

Mental health assessments

All participants completed the *Edinburgh Postnatal Depression Scale* (EPDS) (Cox et al. 1996), a ten-item questionnaire used to identify women with postnatal depression. For mothers with schizophrenia, their psychiatrist completed the informant version of the *Positive and Negative Syndrome Scale* (PANSS) (Kay 1991).

Demographics

All participants completed a brief demographic form to record basic information including the following: age, level of education, ethnicity, relationship status and duration of illness.

Tests of affect recognition

In order to assess possible impaired affect recognition, participants completed the Emotions Battery of the University of Pennsylvania Computerised Neuropsychological Test (PennCNP; Kohler et al. 2003). This is a computer-based test which includes the following tasks: Penn Emotion Recognition Task (ER40), Penn Emotion Discrimination Task (EmoDIff40) and Penn Emotion Acuity Test (PEAT40). The full battery of tests takes approximately 15 min to complete. Across emotional categories, stimuli are balanced for posers' gender and emotions.

The Penn Emotion Recognition Task (ER40) is a measure of emotion recognition. Participants are shown a series of 40 adult faces, one at a time, and asked to determine what emotion the face is showing for each trial. There are five answer choices: happy, sad, anger, fear and no emotion. Participants respond to each trial by clicking with the mouse on the word describing the emotion each face expresses. There are 4 female faces for each emotion (4×5=20) and 4 male faces for each emotion (4×5=20). The faces are coloured pictures derived from the University of Pennsylvania Emotion Recognition Task (Kohler et al. 2004), balanced for equality and intensity of emotion, age, gender and ethnicity.

The EmoDiff40 is a measure of emotion discrimination. Participants are shown 40 pairs of faces, one pair at a time. Each pair of faces consists of two pictures of the same person with or without a subtle, computer-generated difference in emotion expression, which may or may not represent a difference in the intensity of the emotion between the two faces. For each pair, the participant must decide which face expresses the given emotion more intensely or whether they are equally emotional. There are a total of 40 pairs: 18 where one of the faces is happier, 18 where one of the faces is more sad and 4 where the faces are equally happy or equally sad. Facial stimuli are black and white photographs of Caucasian actors and actresses analysed and reviewed as described in by Erwin et al. (1992).

The PEAT40 is a measurement of emotion recognition and discrimination. The task presents images of 40 faces, one at a time, composed of 5 happy, 5 sad and 10 neutral, male and female faces, respectively. Participants are asked to rate the emotional valence of the expression on each face on a seven-point scale: very sad, moderately sad, somewhat sad, neutral, somewhat happy, moderately happy and very happy. Facial stimuli were the same as in the EmoDiff40 test described above.

Assessment of the mother-infant interaction

Parenting was assessed via a mother-infant interaction, where mother and infant were videotaped interacting in a 5-min face-to-face play session. The technique of recording is one

previously described by Murray (1988). The infant is placed in a chair positioned in front of the mother to allow face-to-face interaction. A mirror is positioned beside the infant, at an angle, so that a camera placed beside the mother records a simultaneous image of the baby, the mother's face in profile and the mother's reaction to her infant. The mother was asked to play with her baby as she normally would for 5 min and was asked to not use toys during the interaction. Tapes were subsequently rated according to the Global Rating Scales of Mother-Infant Interaction (GRS) (Murray 1988). The GRS were designed to discriminate between mothers with depression and controls, with infants between 2 and 4 months. As the current sample included older infants, an adapted version was used (Martins 2003).

Maternal behaviour was rated on 7 dimensions (warm/positive vs cold/hostile; accepting vs rejecting; responsive vs unresponsive; non-demanding vs demanding; sensitive vs insensitive; non-intrusive vs intrusive; and non-remote vs remote), and infant behaviour was also rated (attentive vs avoidant; lively vs inert; happy vs distressed). The GRS have been used by other studies that have included mothers with depression and schizophrenia and thus allow for comparisons with previous findings.

While the GRS have been used to examine the mother-infant interaction in mothers with schizophrenia, previous studies highlighted limitations in using the GRS with this clinical population (Riordan et al. 1999; Wan et al. 2007). As the GRS was originally developed for use with less severely ill women with non-psychotic depressive illness, it may not be sufficiently sensitive, or may fail to capture interactive deficits specific to schizophrenia. In line with these concerns, an initial viewing of the interactions in the current study highlighted a number of maternal behaviours that were odd and at times potentially frightening for the infant, behaviours that were not sufficiently captured by the GRS. Thus, the present study developed a further coding scheme to be used in addition to the GRS, to examine the content of the speech used by the mothers when interacting with their infants (hereby referred to as the utterance scheme). Coding maternal speech involved transcribing interactions verbatim and then dividing the speech up into utterances, which were delimited by pauses and intonational cues. Fragments of sentences and phrases were counted as an utterance if they had a complete intonational pattern (following the procedure outlined by Murray and Trevarthen (1986).

The utterance coding scheme was developed from Murray and Trevarthen's work (1986) which examined 'babytalk' in mothers without mental health difficulties. This coding scheme operationalises maternal speech in terms of 'infant-centred', 'mother-centred' or 'other-centred' speech, depending on the focus of the mother's communication with her infant. The present study extended this coding scheme considering literature on caregiving behaviours associated with maltreatment and disorganised attachment. In particular, the work of Main and Hesse (1990) as well as Lyons-Ruth and colleagues (Lyons-Ruth et al. 1999) was incorporated into the coding scheme, as they have described mother-infant interactions where there are disturbances in the mother's ability to interact with her infant, namely through maternal behaviours which are frightening or reflect a marked failure to regulate infant arousal. A specific aim of developing this scheme was to capture the more unusual aspects of interaction observed in mothers with schizophrenia, aspects which have been noted to be missing when using other standardised measures of caregiving with this clinical group (Pawlby et al. 2010; Wan et al. 2008b). The coding scheme resulted in four categories, each including a number of codes. Only the category of unusual/bizarre statements was included in the analyses for this study. This included statements with odd or unusual content; statements that were clearly inappropriate based on the developmental stage of the child (e.g. 'And remember, I keep telling you, your chest area, your chest area is the most important part of your body') and making frightening or unusual noises (e.g. growling).

Two researchers, both blind to clinical status and study hypotheses, coded all 57 tapes, one coded for the Global Ratings Scales and one coded for the utterance scheme. Both researchers were trained to reliably use the Global Ratings Scales by the scheme's author.

Inter-rater reliability

A 15 % sample of the mother-infant interactions rated by the one of the two researchers was independently coded by a second trained rater. Interactions for reliability were selected to be equally distributed across groups (three tapes from each group were coded). For the maternal dimensions, identical ratings were obtained on 40 % of cross-rated items, and 90 % were scored within one point of each other. For the infant dimensions, identical ratings were obtained on 67 % of cross-rated items and 96 % were scored within one point of each other. Intraclass correlations were as follows: sensitivity 0.91, warmth 0.78, acceptance 0.93, responsiveness 0.73, demanding 0.84, intrusiveness 0.88, remoteness 0.69, infant attentiveness 0.87, infant lively 0.85, infant happy 0.69, unusual statements 0.72.

Procedure

Participants were tested either at the mother and baby unit or in the participant's home. Mothers were tested as close to discharge as possible for inpatients in the two clinical groups. For three of the participants, it was not possible to complete the filming due to the infant's state during a home visit assessment, and rescheduling was not possible. One participant did not want to complete the mother-infant interaction but

completed all the other tasks. Finally, one participant was not sufficiently audible and was wearing the hijab, which further affected the sound quality. All five of these participants were in the depression group (all of them did complete the affect recognition task). One mother in the schizophrenia group spoke to her infant in a language that could not be identified for roughly half the interaction, and thus, it was not possible to translate her interaction. Additionally, one mother in the schizophrenia group chose not to complete the computer task. Thus 58 mother-infant interactions were analysed and 63 participants completed the affect recognition assessments.

Results

Plan of analyses

Prior to testing the study hypotheses, group differences on a number of demographic variables were examined. Following this, group differences on the parenting variables and then the affect recognition tests were analysed. Finally, to test the hypothesis that emotion recognition difficulties might lead to less sensitive parenting, regression analyses were conducted. Nonparametric tests were used for variables where the data was not normally distributed. The Bonferroni correction was applied for all post hoc tests.

Demographics

There was no difference between groups on maternal age, F (2, 61)=1.48, p=.235, or age of the infant, F (2.56)=.743, p=.480. There was no association between groups and infant gender, χ^2 (2)=1.45, p=.484. There was a significant association between group and marital status, χ^2 (2)=6.67, p=.036, with 95 % of controls in relationships, compared to 67 % of depressed, and 67 % of those with schizophrenia. Means are summarised in Table 1.

Group and ethnicity were significantly associated, χ^2 (2)= 24.59, p<.001. While 29 % of the depressed participants and 23 % of controls were from Black, Asian or mixed ethnic backgrounds, 94 % of the schizophrenia group were from these ethnic backgrounds.

There was also a significant association between group and primiparity; with this being their first pregnancy for 72 % of the schizophrenia group and 86 % of the controls, but only for 46 % of the depressed mothers, χ^2 (2)=8.84, p=.012.

Clinical group status was associated with education, χ^2 (2)=11.63, p=.003; with 100 % of controls having achieved A-levels or higher, compared with 74 % of depressed mothers and 56 % of mothers with schizophrenia.

As would have been expected, EPDS scores significantly differed by group, F (2, 61)=34.62, p<.001. The mean score for mothers in the depressed group was significantly higher than both controls, and the schizophrenia group (both significantly different at p<.001) (cf. Table 1). The mean for both the control and schizophrenia group was not higher than the clinical cut-off of above 12 for the EPDS.

Results of emotion recognition task

To test for differences in affect recognition, the three emotion recognition tests of the PENN Emotion Battery were analysed for group differences, with Bonferroni corrected post hoc tests carried out where differences emerged. The PENN Emotion Acuity task was not normally distributed; thus, nonparametric tests were used for this measure.

In the Penn Emotion Recognition Task (ER40), participants are asked to determine what emotion a face is showing, with five possible choices: happy, sad, anger, fear and no emotion. With 40 faces shown, the maximum total score is 40; so, higher scores indicate better performance. On this task, there was a significant difference between groups, F (2.60)= 3.68, p=0.03. Post hoc tests using the Bonferroni correction showed the schizophrenia group, M=31.41, SD=3.67, to perform significantly worse on this task than controls, M=34.14,

Table 1 Demographic group differences

	Schizophrenia (n=18)	Depression (n=24)	Controls (n=22)
Mother's age in years, mean (SD)	31.60 (7.2)	34.24 (6.93)	34.81 (4.12)
Age of infant in weeks, mean (SD)	31.81 (18.57)	28.51 (14.59)	34.06 (11.27)
Infant gender, n male (%)	12 (67)	12 (50)	11 (50)
Married/cohabiting, n (%)	12 (67)	16 (67)	21 (96)
Primiparity, n (%)	13 (72)	11 (46)	19 (86)
Caucasian, n (%)	1 (6)	17 (71)	17 (77)
Education, A-levels or higher, n (%)	10 (56)	17 (71)	22 (100)
Duration of illness in years, mean (SD)	10.12 (6.77)	5.79 (8.79)	N/A
EPDS, mean (SD)	7.67 (4.2)	14.8 (4.88)	7.82 (4.30)

SD=2.30, *p*=0.06. The depressed group, *M*=32.25, *SD*=3.69, did not significantly differ from controls or the schizophrenia group.

In the Penn Emotion Discrimination Task, mothers were asked to discriminate between two faces, to see which was more happy or more sad. They were shown 40 pairs of faces, and the total correct responses (range 0–40) were analysed by group. There was a significant effect of group, *F* (2.60)=5.23, *p*=0.008. Post hoc tests using the Bonferroni correction found participants with schizophrenia, *M*=20.88, *SD*=6.54, to perform significantly worse on this task than controls, *M*=27.18, *SD*=5.21, *p*=0.007. The depressed group, *M*=23.50, *SD*=6.61, did not significantly differ from the other two groups.

The final Penn test Emotion Acuity involved both emotion recognition and discrimination, with participants asked to rate the emotional valence of the expression on each face on a 7-point scale. The total of correct responses within one point on the scale was analysed for differences between groups (range 0–40). A significant difference between groups was found with a Kruskal-Wallis test, χ^2 (2, *N*=63)=17.366, *p*<.001. In post hoc tests with the Bonferroni correction applied, the schizophrenia group performed worse on this task, with a Mann-Whitney test finding the schizophrenia group, *Mdn*=37, to have a significantly lower score than the depressed group, *Mdn*=40, *p*=.001, and controls, *Mdn*=40, *p*<.001. The depressed group did not significantly differ from controls. While the schizophrenia group was more impaired in their performance on this task, the standard deviation was larger for this group than for either of the other groups, indicating a larger variability in performance.

To summarise, across all measures of emotion recognition and discrimination, mothers with schizophrenia were significantly more impaired than controls and showed a significantly poorer performance than mothers with depression on the task involving both recognition and discrimination skills.

Results of parenting measures

Global ratings scales

None of the mother-infant interaction items, on a scale of 1–5 (with a higher score indicating more optimal parenting), were normally distributed, and thus, nonparametric tests were used throughout (means and SD reported in Table 2). Kruskall-Wallis test showed maternal sensitivity to differ by group, χ^2 (2, *N*=58) =12.82, *p*=.002, with mothers with schizophrenia, *Mdn*=*2.00*, scoring as significantly less sensitive than controls, *Mdn*=*4.00*, *p*=.001. Group differences were also found on maternal warmth, χ^2 (2, *N*=58)=9.135, *p*=.01, with mothers with schizophrenia, *Mdn*=*3.00*, displaying less warmth than controls, *Mdn*=*4.00*, *p*=.014. Scores on responsiveness differed by group, χ^2 (2, *N*=58)=8.253, *p*=.016, with mothers with schizophrenia, *Mdn*=3.00 less responsive than controls, *Mdn*=*4.00,* *p*=.016. There were no group differences on other scales, see Table 2 for a summary of results.

Table 2 Group differences on global rating scales

	Schizophrenia M (*SD*)	Depression M (*SD*)	Controls M (*SD*)
Maternal dimensions			
Sensitivity	2.41 (0.71) *	3.05 (0.85)	3.41 (0.73)
Warmth	3.06 (0.66) *	3.58 (0.69)	3.73 (0.77)
Acceptance	2.88 (1.11)	3.32 (1.06)	3.64 (0.85)
Responsiveness	3.41 (1.00) *	4.11 (0.99)	4.32 (0.78)
Non-demanding	3.06 (1.30)	3.74 (1.24)	3.73 (1.16)
Non-intrusive	2.71 (1.40)	3.53 (1.02)	3.55 (1.01)
Non-remote	3.65 (1.00)	3.89 (1.15)	4.36 (0.85)
Infant dimensions			
Attentive	2.82 (0.88) [a]	3.63 (0.83)	3.09 (0.92)
Lively	3.76 (0.90)	3.95 (0.71)	4.36 (0.66)
Happy	3.53 (0.51)	3.58 (0.84)	3.59 (0.73)
Unusual statements			
% of total statements	0.0174* [a]	0.0056	0.0027

*Significant difference from controls, *p*≤*.05*; ~trend for difference from controls; [a] trend for difference from depression group

On the infant scales, there were group differences in attentiveness, χ^2 (2, *N*=58)=*6.837*, *p*=.033, with the infants of depressed mothers, *Mdn*=4.00, showing a trend towards being more attentive than mothers with schizophrenia, *Mdn*=3.00, *p*=.032 (Bonferroni adjustment requires significance of 0.017). Neither clinical group differed from the infants of control mothers. There was a trend for the infant's level of activity (lively vs inert) to differ by group, χ^2 (2, *N*=58)=5.823, *p*=.054. There were no group differences in the infant's level of happiness.

Utterance scheme

To capture the more unusual aspects thought to occur in interactions of mothers with schizophrenia, transcripts were analysed for the number of unusual and/or inappropriate statements or sounds. The percentage of total utterances was then analysed by group. For mothers with depression, only 0.06 % (SD=0.003) of statements were inappropriate, and for control mothers, this was even lower at 0.03 % (SD=0.005) of statements. Mothers with schizophrenia, however, had a mean of 2 % (SD=0.023) of inappropriate statements. The Kruskal-Wallis test showed a significant effect of group on the number of unusual statements, χ^2 (2, *N*=52)=7.87, *p*=.011. Mothers with a diagnosis of schizophrenia had a higher proportion of unusual statements, *Mdn*=0.008 than control mothers, *Mdn*<0.001, *p*=.004, and a trend towards a higher number than mothers with depression, *Mdn*=0.003, *p*=.066. It should be

noted that the unusual/bizarre statements rarely occurred in control mothers, accounting for the very low median.

Summary of parenting findings

Across both the Global Ratings Scales and the utterance coding, mothers with schizophrenia performed consistently poorer than controls, and for some dimensions poorer than mothers with depression. There was some evidence that infants of mothers with schizophrenia were less attentive than infants of depressed mothers. The parenting of depressed mothers did not differ from controls on any of the measures.

Emotion recognition and parenting

To test the hypothesis that difficulties in emotion recognition might lead to difficulties in mother-infant interaction, regression analyses using the results from the emotion recognition tasks to predict variables of maternal sensitivity, responsiveness and bizarre/unusual statements were carried out. *t* tests were run to see if the demographic variables that differed by group were associated with the parenting variables used in the regression (non-parametric analyses were used in examining the number of bizarre/unusual statements).

Education was not associated with responsiveness, t (54)=−1.686, p=.098, sensitivity, t (54)=−0.483, p=.631 or the number of unusual statements, U=212.5, p=.171. Primiparity was not associated with responsiveness, t (55)=0.577, p=.566, sensitivity, t (55)=0.104, p=.917 or the number of unusual statements, U=333, p=.744. Similar results were found with relationship status, which was not associated with responsiveness, t (54)=−0.986, p=.329, sensitivity, t (54)=1.723, p=.091 or the number of unusual statements, U=213, p=.280. Thus, education, primiparity and relationship status were not included in regression analyses. While there were group differences in regard to ethnicity, Bakermans-Kranenburg and colleagues have suggested the relationship between ethnicity and maternal sensitivity to be mediated by socioeconomic status, with poverty hampering maternal sensitivity (Bakermans-Kranenburg et al. 2004). A limitation of this study is that we did not measure socioeconomic status. For this reason, we chose not to include ethnicity in the regression analyses, as we would not be able to show whether any differences were explained by socioeconomic status.

Global ratings scales

A hierarchical linear regression was run to test whether the emotion recognition tests were a predictor of sensitivity and responsiveness, beyond the influence of diagnosis. As such, the three emotion recognition variables were first entered into the model, followed by diagnosis.

For maternal sensitivity, the first model which included the three emotion recognition variables was not significant, F (3, 53)=1.351, p=.268. Adding diagnoses significantly improved the model, F (5, 51)=2.920, p=.022, which accounted for 22 % of the variance in maternal sensitivity (Adj R^2=0.146). When examining the coefficients, a diagnosis of schizophrenia was a significant predictor in lower scores on the sensitivity measure, t=−3.147, p=.003, whereas a diagnosis of depression was not (see Table 3 for a summary of regression analyses).

In examining maternal responsiveness, the first model which included the emotion recognition and discrimination variables was not significant, F (3, 53)=1.215, p=.313. Adding diagnostic category did not significantly improve the model, F (5, 51)=1.750, p=.140.

Unusual statements

When looking at the number of bizarre/unusual statements, regression analysis found that the emotion recognition variables were a significant predictor in the model accounting for 21 % of the variance, F (3, 53)=4.542, p=.007. Examining the coefficients, the combined emotion recognition and discrimination task were a significant predictor, and there was a trend for emotion discrimination as a predictor (see Table 4). The addition of the diagnostic categories did significantly improve the model, explaining an additional 7 % of the variance (see Table 4 for results), and the combined model was significant, F (5, 51)=3.885, p=.005. Examining the coefficients, a diagnosis of schizophrenia was a significant predictor of unusual statements.

Table 3 Summary of hierarchical regression analysis for variables predicting maternal sensitivity

Variable	*B*	*SE B*	B
Step 1			
Emotion acuity	0.054	0.048	0.156
Emotion recognition	0.028	0.039	0.113
Emotion discrimination	0.011	0.020	0.089
Step 2			
Emotion acuity	−0.005	0.049	−0.014
Emotion recognition	0.027	0.037	0.110
Emotion discrimination	−0.007	0.019	−0.058
Control vs depression	−0.331	0.259	−0.184
Control vs schizophrenia	−0.964	0.306	−0.511*

*p<.05; note: R^2 =0.071 for step 1; ΔR^2 =0.152 for step 2, p=.011)

Discussion

This study presents findings on differences in the mother-infant interaction and the links to affect recognition in mothers with schizophrenia as compared to mothers with depression and healthy controls. As hypothesised, group differences were found in measures of affect recognition and in the mother-infant interaction. Mothers with schizophrenia showed consistent impairments across most of the parenting measures and all of the measures of emotion recognition and discrimination. Evidence was found that while impairments in emotion recognition partially predicted the occurrence of unusual statements in the mother-infant interaction, a diagnosis of schizophrenia increased the likelihood of such utterances. In regard to maternal sensitivity, it was the diagnosis of schizophrenia that was most implicated in poor performance.

The findings that women with schizophrenia showed impairments in emotion recognition and discrimination are in line with previous research (Mueser and Bellack 1998; Schneider et al. 1995). In the present study, women with schizophrenia performed more poorly than controls in their ability to identify and discriminate adult affect and were particularly impaired in more complex affect recognition tasks (i.e., that involved an assessment of both recognition and discrimination) than women with depression and controls. Although there was a relationship between these abilities and one aspect of the mother-infant interaction (unusual utterances), it did not explain much of the variance in maternal sensitivity and responsiveness. Future research may want to examine whether emotion discrimination skills in regard to infant, rather than adult, faces may be a more powerful predictor of maternal responsiveness and sensitivity. The findings on parenting replicates previous research showing mothers with schizophrenia to be less sensitive, less responsive and less warm than control mothers (Riordan et al. 1999; Steadman et al. 2007; Wan et al. 2007). Consistent with our hypotheses, mothers with depression fell between the mothers with schizophrenia and healthy controls on most measures, replicating findings of previous research (Goodman and Brumley 1990). Of note is that depressed women's parenting was not significantly poorer than controls on any of the measures. This is contrary to what one would expect based on previous research showing the parenting of mothers with depression to be impaired compared to mothers with no mental health difficulties (Lovejoy et al. 2000) and is at odds with previous research using the Global Ratings Scales (Riordan et al. 1999; Wan et al. 2007). This may be a result of the fact that the majority of women in the depression group were involved with a perinatal community team and thus not severe enough to warrant hospital admission, in contrast to samples of other studies using only inpatient admissions of depression.

These unusual and potentially frightening behaviours displayed by some mothers with schizophrenia may be related to the mother experiencing positive symptoms or due to significant social cognitive deficits. Indeed, findings from the present study suggest that deficits in social cognition, particularly difficulty in identifying and discriminating affect states, are associated with the presence of these more unusual maternal behaviours. This study has demonstrated that not only are women with schizophrenia more impaired in affect recognition than healthy controls, but these impairments in affect recognition are associated with the incidence of odd or unusual statements within the mother-infant interaction. It may be that difficulties in recognising and discriminating emotions in general contribute to specific difficulties in being able to respond appropriately to an infant. It is important to note, however, that not all of the mothers with a diagnosis of schizophrenia showed evidence of these statements and it would be interesting to understand, as to the longer-term impact, differences in those who did show evidence versus those who did not. Additionally, it was our observation that most mothers with schizophrenia showed some evidence, even if rare, of child centred statements. Video-feedback interventions could be used to build on these positive moments to improve parenting in mothers with schizophrenia. Research from Kenny and colleagues (2013) suggests that mothers with schizophrenia can be as sensitive as mothers with no mental health problems when they receive support such as that provided from a specialist mother baby unit, highlighting the merit of supporting women with schizophrenia in their parenting role. There is a need for better controlled studies to ensure that such interventions are evidence based and effective for this high-risk group and their infants.

The current research also aimed to address concerns of previous studies that have identified limitations of some routinely used measures of mother-infant interaction for not being sufficiently sensitive to account for qualitative differences observed in mothers with severe mental illness (Pawlby et al.

Table 4 Summary of hierarchical regression analysis for variables predicting unusual statements

Variable	*B*	*SE B*	β
Step 1			
Emotion acuity	−0.002	0.001	−0.390*
Emotion recognition	0.001	0.001	0.244
Emotion discrimination	−0.001	<0.001	−0.287**
Step 2			
Emotion acuity	−0.002	0.001	−0.268*
Emotion recognition	0.001	0.001	0.241
Emotion discrimination	<0.001	<0.001	−0.188
Control vs depression	0.003	0.004	0.098
Control vs schizophrenia	0.012	0.005	0.347*

*$p<.05$, **trend for significance. Note: $R^2 = 0.205$ for step 1; $\Delta R^2 = 0.071$ for step 2 ($p=.091$)

2010; Riordan et al. 1999; Wan et al. 2007). The present study created a new measure to classify the nature of individual utterances that mothers communicate to their infants. The addition of this coding scheme, which took into consideration the nature and content of maternal speech, highlighted a unique feature in the mother-infant interactions of mothers with schizophrenia. In particular, it identified that mothers with schizophrenia were more likely to speak in unusual and bizarre ways to their infants. In line with this finding, Wan et al. (2007) have reported a higher instance of 'abnormal' behaviour in the mother-infant interactions of women with schizophrenia. This suggests that there are meaningful differences that can be quantified in the interactions of mothers with schizophrenia, but further research is needed to replicate these findings and identify if these differences are clinically significant (i.e. if they are related to less optimal child outcomes) and how they relate to mother's current symptomatology.

There are a number of strengths of the current study. First, the sample of mothers with schizophrenia is larger than many others looking at mother-infant interaction in women with schizophrenia (McNeil et al. 1983; Riordan et al. 1999; Steadman et al. 2007; Wan et al. 2008a; Wan et al. 2007). This may be due in part to a long recruitment period (nearly 3 years) and the inclusion of mothers who spoke to their infants in a language other than English. The inclusion of non-English speaking women may also account for the high percentage of women from ethnic minority groups in the schizophrenia group. Previous studies have excluded mothers who did not speak English to their infant (Riordan et al. 1999; Wan et al. 2007). Second, this study included mothers from both community and inpatient settings. Previous research in this area has relied heavily on inpatient MBU admissions, which overlooks mothers who have a diagnosis of schizophrenia but are functioning in the community. However, it should be noted that the present study did exclude those with bipolar disorder and psychotic depression. The extent to which affect recognition deficits and unusual/ bizarre maternal behaviour are present in these clinical presentations warrants further investigation. Future research including a wider range of clinical presentations would help to elucidate the extent to which certain maternal behaviours are associated with specific diagnostic groups, symptom profiles and other factors (e.g. social cognition). Finally, this study included a healthy control group, which allowed for differences in the group of mothers with schizophrenia to be identified. This may explain why some studies have failed to find differences between interactions of mothers with schizophrenia as compared to mothers with other psychiatric diagnoses (Mullick et al. 2001).

In spite of these strengths, a number of methodological limitations should be highlighted. First, although greater than other studies, the number of mothers with schizophrenia remains relatively small, a difficulty faced by other research with this clinical group (e.g. Riordan et al. 1999; Steadman et al. 2007). Larger samples of mothers with schizophrenia would allow for the examination of more detailed hypotheses regarding symptomology, functioning and duration of treated and/or untreated illness. Nevertheless, care was taken in the present study to ensure that there was adequate power to be reasonably confident that differences between groups could be determined.

Another consideration is whether diagnostic categories are best placed to predict the quality of mother-infant interaction. Previous research has shown that illness severity and chronicity were a stronger predictor than psychiatric diagnosis alone in regard to the impact on parenting (Sameroff et al. 1982; Sneddon et al. 1981; Snellen et al. 1999). Sameroff et al. (1987) found severity of illness in mothers, independent of diagnosis to be associated with lower spontaneity in their infants. However, other studies have found a schizophrenia diagnosis, rather than illness severity to determine parenting capacity (Wan et al. 2007). Other research has found schizophrenia duration and severity to predict attitudes that are related to maternal sensitivity (Rogosch et al. 1992). While a measure of severity was obtained in the present study, the sample was not large enough to examine the extent to which severity could explain less optimal parenting. However, visual inspection of the data suggests that the interactions were more disturbed in mothers with higher PANSS' scores. Future research using a larger sample could endeavour to address this question in addition to examining if the presence of positive and negative symptoms differentially impact on caregiving behaviour.

Finally, it is possible that the measure of adult emotion recognition was not sufficiently sensitive and therefore did not explain the variance in the measures of maternal sensitivity and responsiveness. Future research may want to examine whether emotion discrimination skills in regard to infant faces may be a more powerful predictor of maternal responsiveness and sensitivity. This has been examined in a recent study where mothers with borderline personality disorder were significantly poorer at infant emotion recognition overall, and particularly neutral expressions which were misattributed most often as sad (Elliot et al. 2014). It would be interesting to see where these findings also held for mothers with schizophrenia.

Based on the findings of the current study, it is our view that research on parenting among mothers with schizophrenia needs to take account of the odd or unusual aspects of interaction evidenced in this study. Research arising from Lyons-Ruth and colleagues (Lyons-Ruth et al. 1999) which has examined anomalous mother-infant communication, potentially akin to what has been identified in the present study, have demonstrated consistent associations between these maternal behaviours and disorganized mother-infant attachment relationships (Madigan et al. 2006), highlighting the potential importance of identifying these behaviours in mothers with

severe mental illness. It is known that severe mental illness in a parent conveys the greatest risk for a child developing a serious mental illness themselves (Cannon et al. 2002); yet, the process for this intergenerational transmission, especially socially mediated (or 'nurture') factors associated with this transmission, is not well understood. Findings from the present study highlight that there are unique differences in the way in which mothers with schizophrenia interact with their infants and these may be related to social cognitive deficits. It is hoped that the present study will encourage future research to consider these parenting behaviours in order to better understand their sequalae in this group as well as to guide early intervention efforts to support the developing relationship between mothers with schizophrenia and their infants.

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