The transmission of risk to children from mothers with schizophrenia: A developmental psychopathology model

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Abstract

Research in children of mothers with schizophrenia (HRsz children) has focused on identifying the early antecedents of adult illness to understand its intergenerational (primarily genetic) transmission. From a developmental psychopathology perspective, the vulnerability of HRsz children may result from multiple environmental factors interacting with ongoing developmental processes. The objectives were: (1) to understand the extent to which having a mother with schizophrenia impacts on developmental and clinical trajectories; (2) to review whether research supports a proposed model for the non-genetic transmission of risk in HRsz offspring; (3) to discuss the implications of the model for early intervention. HRsz children show vulnerability in a range of areas throughout childhood, but the findings are not unanimous in any single domain, and poor developmental functioning in any given domain does not necessarily predict morbidity. Broad support for a developmental psychopathology model is provided by studies suggesting a generalised vulnerability and studies on the impact of psychosocial factors. However, little empirical research has elucidated specific proximal social environmental influences through development. Gaps in the literature are identified where studies in depressed mothers and other groups are potentially informative, and which suggest that conventional psychological therapies may not be sufficient to enhance offspring outcomes. Future research could inform our understanding of developmental psychopathology and the development of preventative interventions.

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Keywords: Maternal schizophrenia; High risk; Developmental outcome; Gene–environment interaction

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1. Introduction

1.1. The vulnerability of children of mothers with schizophrenia

Schizophrenia is a severe and chronic psychotic disorder that is understood to have a highly heritable component (Sullivan, Kender, & Neale, 2003). Research into the development of children born to mothers with schizophrenia has to date been dominated by a high-risk (HR) perspective, which assumes a specific shared genetic risk. However, the illness in mothers appears to confer a generalised rather than illness-specific psychiatric risk in their children: children of mothers with schizophrenia (henceforth referred to as HRsz children) are at risk for psychiatric disorders of all kinds. In a study of HRsz offspring (N = 204), a fifth of the sample developed a psychotic disorder (including schizophrenia) and another fifth developed schizotypal personality disorder, but a quarter developed some other psychiatric disorder (Parnas et al., 1993). A study of offspring who were adopted away from their mothers with schizophrenia (N = 164) found that 7% developed schizophrenia (compared with 2% of control adoptees), but 53% developed a different psychiatric diagnosis (Tienari et al., 2000). This generalised risk of HRsz offspring argues against a simple shared genetic risk model, and could be viewed as resulting from ongoing developmental processes interacting with multiple environmental stressors.

Gene–environmental interaction models are widely used to understand the aetiology of schizophrenia. A meta-analysis of twelve studies found consistent evidence for common or shared environmental influences on liability to the disorder (Sullivan et al., 2003). In this paper, we explore a developmental psychopathology approach, a central tenet of which involves “elucidating the interplay among the biological, psychological, and social-contextual aspects of normal and abnormal development across the life span” (Cicchetti, 2006). This approach considers the influence of parental mental disorder as a particular perturbation in the context of normative developmental processes. Maternal mental disorder can be viewed as an enduring childhood adversity factor in itself which, like other enduring stressors, carries
non-specific but cumulative psychosocial risk (Friedman & Chase-Lansdale, 2002). Indeed, poor mental health, including schizophrenia, is associated to varying degrees with a range of proximal and distal environmental stressors, which have a bidirectional impact with maternal and child wellbeing. Such processes may interact with genetic influences to determine clinical outcomes in adulthood. This interaction may be more potent than the contribution of genetic or environmental factors alone (Tienari et al., 2004).

As one model for this enquiry, we take examples from the literature on consequences for children of maternal depression. This literature is extensive and has been fruitful for increasing our understanding of specific mechanisms and moderators of developmental and psychological risk from mentally ill parents to children (c.f. Goodman & Gotlib, 1999; Lovejoy, Graczyk, O’Hare, & Neuman, 2000). We will discuss the extent to which a similar approach might illuminate the consequences of maternal schizophrenia.

1.2. Objectives of the review

The overarching aim of this review is to examine whether current evidence supports a developmental psychopathology model to explain the impact of maternal schizophrenia on offspring. Our first objective is to establish the extent to which having a mother with schizophrenia (and its associated environmental factors) impacts on developmental and mental health trajectories. Secondly, we review the evidence for non-genetic mechanisms and moderating factors of developmental risk in HRsz children, and their consistency with a developmental psychopathology model. As the empirical literature on genetic risk is vast and well established, evidence for genetic mechanisms is not presented in any detail. In developing the model, and particularly in areas with limited or questionable evidence, we refer to studies in children of mothers with depression and other mental disorder to evaluate the applicability of their findings in the context of schizophrenia. Finally, we discuss, from the evidence, implications for treatment and for future research that is needed for a more complete understanding of the ongoing role of psychosocial factors in the generational transmission of schizophrenia.

The papers reviewed here were identified by computerised PsycINFO and Medline searches using the keywords, ‘schizophrenia’ or ‘psychosis’, and either ‘high-risk’, ‘children’, ‘offspring’, ‘mothers’, ‘parents’ or ‘development’. Specific key terms were combined with ‘schizophrenia’ according to the specific area investigated (e.g. ‘neuromotor’). Many HR studies, particularly in recent years, include participants whose affected relative is not the mother (c.f. Owens & Johnstone, 2006); for our purposes these studies were excluded unless otherwise specified. Studies reporting results for mixed psychosis samples only were also excluded, unless otherwise specified. In areas with few or no studies in HRsz offspring, general searches were made using the keywords ‘schizophrenia’ or ‘psychosis’ and terms related to the specific area (e.g. ‘parenting stress’; ‘reasoning biases’, ‘intervention’). For these studies, we included only those in which female participants were represented in the sample. We made similar searches for studies of mothers with other disorders, using the keywords ‘maternal depression’, ‘mental disorder’ or ‘psychiatric illness’.

2. The development of children of mothers with schizophrenia

From an HR perspective, the developmental functioning or ‘abnormalities’ in HRsz children has been hypothesised to represent early risk indicators or genetic markers of schizophrenia. HR studies have thus focused on the value of these abnormalities in predicting later psychosis (for a fuller review from the HR perspective, see Niemi, Suvisaari, Tuulio-Henriksson, & Lönnqvist, 2003). Here, we give an overview of the evidence from an alternative perspective; that is, a description of the generic risk to child development (in approximate chronological order) in each area.

2.1. Neurodevelopmental and motor deviations

Studies have reported various infant neurodevelopmental problems (Blennow & McNeil, 1991; Fish & Kendler, 2005; Fish, Marcus, Hans, Auerbach, & Perdue, 1992) but Sameroff, Barocas, and Seifer (1984) found slight impairments limited to infancy, and Goodman (1987) found no infant neurodevelopmental deviations. McNeil, Harty, Blennow, and Cantor-Graae (1993) reported that 30% of six-year-old HRsz children showed neuromotoric deviations, which was more prevalent than in controls, but which differed little from children of mothers with other psychosis. Later, in their small sample (N=23), ‘overflow’ neuromotor problems (e.g. tremors) were strongly linked with a
concurrent psychiatric diagnosis (McNeil, Cantor-Graae, & Blennow, 2003). Niemi, Suvisaari, Haukka, and Lönnqvist (2005) reported from school health record data that neurological soft signs were observed in 9% of HRsz children and adolescents (N=88) compared to 3% in controls (N=97). However, 5 of the 21 children of mothers with affective disorder were also impaired (24%).

HRsz offspring risk is likely to lie in particular areas of neurodevelopment. For example, neuromotor problems appear to be closely related to impairments in sustained attention but not other neurodevelopmental deviations (Chen et al., 2001). Also, Kéri, Must, Kelemen, Benedek, and Janka (2006) found that HRsz eight- to eleven-year-old children showed impaired visual perception in terms of motion but not form. Sex differences have been reported in three studies of children where either parent had schizophrenia, in which boys were much more vulnerable to neuromotor impairments (Mirsky, Silberman, Latz, & Nagler, 1985; Rieder & Nicholas, 1979; Schiffman, Walker et al., 2004).

2.2. Cognitive and attentional deficits

Goodman (1987) reported that HRsz infants and young children (N=71) showed a lower average IQ (85) than children of depressed mothers (99) and of well mothers (97), but the sample was predominantly of black, low-income single parent families. General cognitive deficits, reported in infancy, may disappear later in childhood (Goodman, 1987; Sameroff, Seifer, Zax, & Barocas, 1987). In Niemi et al. (2005), children of mothers with psychosis (N=145) were slightly but not significantly more likely to show delayed mental development in infancy or school age (8%) than controls (3%), but separate figures were not provided for HRsz children specifically who made up two thirds of the sample. Children of mothers with schizophrenia-spectrum disorders were more likely to have a severe academic problem (15%) than controls (8%), but 20% of children of mothers with affective disorder also had a severe academic problem (Niemi et al., 2005).

Impairments are more consistently found in specific cognitive domains, such as verbal ability, executive functioning and processing speed, but, to our knowledge, all such studies have involved various first degree relatives of schizophrenia patients, and have tended to be of young adults (Byrne, Hodges, Grant, Owens, & Johnstone, 1999; Klemm, Schmidt, Knappe, & Blanz, 2006; Seidman, Guiliano et al., 2006; Wolf, Comblat, Roberts, Maminski Shapiro, & Erlenmeyer-Kimling, 2002). The most relevant study involved seven- to twelve-year-old children of parents (mothers or fathers) with schizophrenia (N=79), who showed more verbal memory deficits than children of other psychiatric groups (Erlenmeyer-Kimling et al., 2000). Most (83%) children who later developed schizophrenia showed such deficits, compared with 28% who did not develop schizophrenia. Schiffman, Lam, Jiwatram, Ekstrom, Sorensen, and Mednick (2004) reported that young HRsz adolescents who showed perspective-taking deficits were more likely to later develop a mental disorder, but not necessarily schizophrenia.

Some studies found that HRsz children show no significant attentional deficits (Driscoll, 1984; Niemi et al., 2005) or that performance is poorer only with increased executive function demand (Nuechterlein, 1984). However, studies that also include offspring of fathers and other first degree relatives with schizophrenia (which tend to be more recent, using more specific tests) have consistently reported attention problems (Erlenmeyer-Kimling, 2000; Erlenmeyer-Kimling & Comblatt, 1992; Marcus et al., 1987; Wang et al., 2007). Among those who later developed schizophrenia-spectrum disorder, 58% showed childhood attentional deficits, compared with 18% who did not develop schizophrenia (Erlenmeyer-Kimling et al., 2000).

2.3. Social and emotional difficulties

Compared with young infants of mothers with affective disorder, HRsz infants have been reported to show poor behavioural interaction (Riordan, Appleby, & Faragher, 1999; Wan, Penketh, Salmon, & Abel, in press; Wan, Salmon et al., 2007) and insecure attachments (D’Angelo, 1986; Näslund, Persson-Blennow, McNeil, Kaij, & Malmquist-Larsson, 1984) with their mother. However, infant interactive impairments may not be consistently poor (McNeil, Näslund, Persson-Blennow, & Kaij, 1985; Näslund, Persson-Blennow, McNeil, & Kaij, 1985; Persson-Blennow, Näslund, McNeil, & Kaij 1986; Persson-Blennow, Näslund, McNeil, Kaij, & Malmquist-Larsson, 1984) and may be related to maternal disorder severity rather than schizophrenia per se (Sameroff et al., 1987). In infancy and early childhood, Goodman (1987) observed that both HRsz children and children of depressed mothers had poorer social competence than well controls. However, HRsz children, but not the depression group, tended to show...
less affection, hostility, communicative competence and negative expression, and more activity. Another longitudinal study found that social–emotional and cognitive competence in four-year-old children of mothers with schizophrenia or depression was predicted by the number of environmental risk factors present (e.g. chronic maternal illness, negative parental values and attitudes, poor maternal interaction, minority group status, stressful life events); (Sameroff et al. (1987), Sameroff, Seifer, Baldwin, & Baldwin (1993). Having a mother with schizophrenia had the least impact.

At school age and adolescence, social adjustment and peer relation problems have been reported in clinical interviews (Dworkin et al., 1993), and teacher (Olin, John, & Mednick, 1995) and peer reports (Garnezy & Devine, 1984). Niemi et al. (2005) found that more young HRsz children had emotional problems (17%) than controls (3%) or children of mothers with affective disorder (5%), a difference which disappeared in the school years. The frequency of reported school-age conduct problems was similar between HRsz children (8%) and children of mothers with affective disorder (10%), but social inhibition was found only in HRsz children (7%). Early behavioural problems in HRsz children may anticipate more serious later psychopathology (Parnas, Schulsinger, Schulsinger, & Mednick, 1982). However, not all studies show that HRsz children have more social or behavioural difficulties than children of other clinical groups or well mothers (Sameroff et al., 1984; Wrede, 1984). A study of children of either a mother or father with schizophrenia found that their social and communicative competence was lower than in children of depressed and well parents only after substance abuse was controlled for (Amminger et al., 1999).

2.4. Clinical symptoms

The interest of HR studies in clinical problems primarily lies in their value as predictors of later psychopathology, and they are often referred to as ‘prodromal’ or ‘prepsychotic’ symptoms, or ‘genetic markers’. For example, HRsz offspring who develop schizophrenia are more likely to have had higher psychoticism scores earlier in adulthood (Parnas, Cannon, Schulsinger, & Mednick, 1999) and to have been susceptible to future emotional or psychotic symptoms at school age (Olin et al., 1995). However, no one symptom or cluster of symptoms predict with certainty which individual will make the transition to schizophrenia or psychosis in the general population (Isohanni, Murray, Jokelainen, Croudace, & Jones, 2004) or among HRsz offspring (Davidson & Weiser, 2004; Holzer, Halfon, & Laget, 2005; Sarfati & Hardy-Baylé, 2002).

The few studies that have reported on symptoms in full HRsz cohorts suggest that, although HRsz children are more likely to show symptoms, most children do not develop clinical-level problems. Goodman (1987) found that schizophrenia and depression groups were equally likely to have their young children receive a childhood DSM-III diagnosis, although the group was typically very young. Only one child (whose mother had depression) in the whole sample (N=99) showed a diagnosis lasting over one time point (three measurements were taken, each a year apart). In an older sample, McNeil and Kaij (1987) found that six-year-old HRsz children (N=22) were more likely to score highly on a mental disturbance scale (73%) than children of other psychiatric groups (23–50%) and matched controls (28%). An early study of HRsz children found that 24% were rated to be poorly or relatively poorly adjusted, compared with 1% of controls (Mednick & Schulsinger, 1968). A recent study of 21 thirteen- to twenty-eight-year-olds with a parent or sibling with schizophrenia found only a trend towards higher psychoticism than controls, and no difference in depression, anxiety or positive symptoms (Seidman, Thermenos et al., 2006).

Adoptive studies of HRsz offspring can partial out the possible environmental effects associated with being raised by a mother with schizophrenia. The findings are not clear-cut, but the weight of evidence suggests that some HRsz offspring are protected from clinical problems when raised by adoptive parents (although new risk factors may be introduced). Siira, Wahlberg, Miettunen, Läksy, and Tienari (2005) found that HRsz adoptees (mean age: 24 years) showed lower hostility than control adoptees and no other differences in the Minnesota Multiphasic Personality Inventory scales. When mentally disordered adoptees were excluded (26/86 of HRsz adoptees and 20/96 of control adoptees), the HRsz group additionally showed poorer emotional responsiveness and more restricted affect, and the control adoptees had more phobias (Siira et al., 2006). At an average age of 25 years, 45% of HRsz adoptees had a psychiatric diagnosis, but the rate for other adoptees was also high (31%), with no difference in thought disorder symptoms between groups (Metsänen et al., 2005). Another study found that slightly more reared-apart participants (18/25) developed psychiatric illness than those reared by the biological mother (13/25; Higgins et al., 1997), which is more difficult to explain. Certain HRsz children may be more likely to be adopted (e.g. those with more affected relatives), or adoptees may be exposed to a different set of environmental risk factors.
3. Establishing vulnerability in HRsz children

3.1. Methodological issues

A number of methodological constraints needs to be considered when evaluating studies, particularly as maternal schizophrenia is relatively rare. Studies vary in their recruitment strategy and sampling frame. Due to the difficulties in identifying and recruiting this group, many samples are small and are unlikely to be representative of women with schizophrenia who become parents (e.g. some studies relied on inpatients). Other studies involved large cohorts recruited perinatally using prospective, longitudinal designs spanning decades, leading to high attrition rates. Those children who drop out may be from families of poorer functioning and of highest vulnerability. Moreover, children who are adopted away may be more genetically vulnerable and may have been exposed to an adverse early environment. This possibility brings into question the representativeness of samples in HR studies (where only children who remain with the biological mother are followed up) and HR adoptive studies (where, by definition, only separated children are studied).

Variations in the broadness of a schizophrenia diagnosis (or schizophrenia and related disorders) may explain some disparities between studies, as diagnostic criteria change over time and some longitudinal HR studies involve samples diagnosed decades ago. Many studies rely on health and other record data that was not collected especially for the study; therefore, developmental difficulties in offspring may have escaped diagnosis. Comparison groups that act as controls vary in their mental health status and psychiatric history, and attempts to match for social adversity may not be accurate. Studies vary widely in the developmental period at which children were assessed. To maximise sample size, many HR studies involve samples of a very wide age range. Finally, a wide array of measures has been employed to assess a given developmental outcome between studies and between developmental time points, which almost certainly account for some inconsistencies.

3.2. Explaining the developmental functioning of HRsz children

Evidence to date suggests that having a mother with schizophrenia confers a generalised vulnerability to developmental and clinical difficulties, particularly in attention, motor and social competence. Many HRsz children show significant differences in these areas from children of well mothers, although similar differences are found in children of mothers from other psychiatric groups in many domains. It is worth emphasising that, despite the raised risk, most HRsz children are not affected to a clinical level, and that problems are not necessarily stable over time. The findings raise the question of the role of the environment and of resilience factors. Although most HR studies involve children whose affected parent is the mother, they do not generally consider the demands on her as the (expected) caregiver or the possible effects on the child of being cared for by the affected parent. The wider social context in which children are raised is generally not considered. HRsz offspring are highly likely to be exposed to a range of adverse environmental factors and in stronger doses than other offspring. Particular social and environmental factors are likely to be more potent or relevant at certain developmental stages or periods in life, which may alter the mental health trajectories for these children. For example, neuromotor skills may be influenced very early in development by factors such as an insult in utero, highly insensitive early maternal interaction, neglect and maltreatment in early childhood (Bergman, Wollson, & Walker, 1997).

Studies have shown that HRsz children with developmental problems (particularly when measured near adulthood), compared with those who do not, are more vulnerable to mental disorder. However, such problems are not reliable indicators of future schizophrenia or other psychosis. Gene–environment correlations, where HRsz offspring are raised by their biological mother, may explain overestimations in heritability of the disorder (McGuffin & Rutter, 2002). Functional impairments and delays in childhood may therefore be considered as ‘poor outcomes’ in their own right, arising from the interaction of genetic and environmental factors. This perspective is broadly consistent with the vast empirical literature on children of depressed mothers, which has indicated similarly mixed developmental outcomes (e.g. Burt et al., 2005; Cogill, Caplan, Alexandra, Robson, & Kumar, 1986; Field et al., 1988; Murray, 1992; Sinclair & Murray, 1998). Maternal depression studies have viewed such developmental and clinical problems as resulting largely from the social context provided by the mother (particularly during the postnatal period) rather than the expression of genetic vulnerability. These problems may then raise future clinical risk.

Adoptive studies suggest that, although genetic risk plays a role, its impact on outcomes is not straightforward. Various types of correlation with (probably multiple) chronic stressors may account for sample differences as well as
individual variation in developmental outcomes. The developmental psychopathology perspective distinguishes different kinds of gene–environment correlation: (1) the nature of the psychosocial environments that mothers with schizophrenia tend to provide (passive gene–environment correlation); (2) the kind of environments that these children tend to seek or create (active gene–environment correlation); (3) the kind of responses the tendencies of these children evoke in others (evocative gene–environment correlation) (Plomin, DeFries, McClearn, & McGuffin, 2000; Rutter & Silberg, 2002).

4. A developmental psychopathology model

As we are not aware of any previous attempt to integrate the evidence in this area, we set out a developmental psychopathology model to explain the transmission of risk to HRsz offspring (Fig. 1). The model is based largely on Goodman and Gotlib’s (1999) integrative, developmental model for the transmission of psychopathology to children, which was supported to various degrees by maternal depression research. The vulnerabilities of HRsz offspring to poor outcomes, as found in many studies discussed earlier, are represented in Fig. 1 as ‘vulnerabilities/developmental outcomes’ and ‘clinical outcomes’. Using the model as a framework, we will examine the evidence for mechanisms, excluding genetic factors, which may be responsible for the poor outcomes in HRsz offspring. The model includes bidirectional effects and so recognises that poor functioning in children may further exacerbate (exposure to) environmental stress, poorer quality of relationships and care, and maternal cognitive, behavioural and affect impairments.

We will also review the evidence for moderators that affect the nature of the association between maternal schizophrenia and negative developmental and clinical outcomes. The model shows that, for example, the effect of exposure to abnormal parenting on child development can be moderated by child characteristics (e.g. high cognitive ability) and/or disorder characteristics (e.g. severe symptoms), which in turn helps protect against or elevates the risk that developmental difficulties (e.g. cognitive deficits and emotional problems) will develop into clinical symptoms and diagnoses. As the links (arrows) refer to probabilities, a mother with adaptive parenting, stable family relations, and low environmental stress, moderated by less chronic disorder and more partner support, will have low offspring risk. Although the mechanisms and moderators are interrelated, the evidence for each factor will be discussed individually.

5. Mechanisms of risk

To consider the psychosocial mechanisms, we posed the question: If genetic factors cannot completely explain the generational transmission of developmental risk, what is it about having a mother with schizophrenia that makes the
child vulnerable to poor outcomes? We present evidence that the following factors are more common among HRsz offspring and may increase developmental and clinical vulnerability: Poorer quality of family relationships and of care, maladaptive maternal cognitions, affect and behaviour, and a stressful in utero and postnatal environment.

5.1. Quality of family relationships and maternal care

Mothers with schizophrenia are more likely to have no partner or other supportive networks (Abel, Webb, Salmon, Wan, & Appleby, 2005; Miller & Finnerty, 1996), suggesting that many HRsz children are highly dependent on maternal care. Given this likelihood, and the infant’s probable genetic risk, the quality of that care seems to be crucial. Half of mothers with schizophrenia were discharged from an MBU in England (N = 239) under social services supervision (Abel et al., 2005). Although the sample is not representative, it suggests that a significant proportion of mothers with schizophrenia find caring for their child difficult. Shortly prior to MBU discharge, half of the mothers with schizophrenia were rated to have a problem providing their infant with practical or emotional care or to be at risk of harming their infant, compared to a fifth of mothers with affective disorder (Salmon, Abel, Cordingley, Friedman, & Appleby, 2003).

Earlier studies suggest that quality of care is crucial for future offspring mental health when it is not provided by the biological mother (Tienari, 1991; Walker, Cudeck, Mednick, & Schulsinger, 1981). More recently, in their adoptive study, Wynne, Tienari, Nieminen, Sorri, Lahti, Moring, et al. (2006) found that the quality of the adoptive family environment was particularly important in the context of genetic risk. Among HR adoptees (N = 166), where the family environment was rated as normal, only 6% developed schizophrenia, whereas 35% of offspring in families with severe family dysfunction developed schizophrenia and 40% developed a broad schizophrenia-spectrum disorder. In offspring with no family history of schizophrenia who were adopted into severely dysfunctional families, 4% developed a schizophrenia-spectrum disorder. Among HR adoptees who had an adoptive parent with any psychiatric diagnosis, a trend was found towards higher offspring risk, but quality of family relationships seemed to be more important than the mental health of adoptive parents.

The quality of the parent–child relationship may also be important. A Danish study reported that young people (mean age: 15 years) with mothers with schizophrenia had a poorer relationship with them than matched controls, as assessed by parent and offspring interviews (Burman et al., 1987; Schiffman et al., 2002). Also, poor family relationships in the high-risk group predicted morbidity whereas having positive relationships with both parents was protective. Individuals who had poor relations with both parents were around four times more likely to develop schizophrenia than those with good relations (Schiffman et al., 2002). A poor relationship with the mother (with schizophrenia) was not more pernicious to offspring than a poor relationship with the father. However, the quality of relationships may in part reflect the offspring’s (and parents’) functioning and wellbeing, and so possibly their genetically higher-risk status.

5.2. Maternal cognition

The extent to which children are affected by specific cognitive impairments and biases associated with schizophrenia has not been studied. From what we know about normative developmental influences, we propose that: (i) cognitive deficits affect the mother’s capacity to provide the appropriate support for her child’s cognitive development; and (ii) cognitive and reasoning biases are transmitted from mother to child via social learning. We will discuss the evidence for each assertion.

Compared with mothers with other psychiatric diagnoses, mothers with schizophrenia tend to involve their infants less in their talk (Wan et al., in press), which suggests poor mentalisation from the mother of the infant’s state of mind, while attending to play. Mothers with schizophrenia also tend to provide less play stimulation than mothers with affective disorder (Goodman, 1987). People with schizophrenia may show difficulty in making mental state attributions, which is strongly associated with social competence (Brüne, Abdel-Hamid, Lehmkämper, & Sonntag, 2007). We found no studies indicating how these impairments might impact on children. A small qualitative study describes how mothers with schizophrenia (N = 5) tended to have a very poor understanding of their child’s bedtime anxiety (e.g. by providing superficial explanations), and attributed their own ineffectiveness in using bedtime strategies to medication-induced fatigue (Graham & King, 2005). In normative samples, how mothers talk and interact with their young children have been shown to predict children’s own theory of mind and language development (Symons & Clark, 2000; Symons, Fossum, & Collins, 2006).
Reasoning biases, such as the tendency to ‘jump to conclusions’, show absolutist, dichotomous reasoning and have inflexible beliefs about one’s own symptoms, are related to schizophrenia, particularly to delusions (Fine, Gardner, Craige, & Gold, 2007; Garety et al., 2005). Their impact on children has not been studied directly, but children may learn some disruptions in communication from their parents. A study found that HRsz adoptees showed an increased likelihood of developing thought disorder only when their adoptive parents showed disorganised communicative speech (Wahlberg et al., 2004). Also, individuals with schizophrenia may tend to be poorer at processing facial (Edwards, Jackson, & Pattison, 2002; Johnston, Devir, & Karayanidis, 2006; Van ’t Wout et al., 2007) and vocal emotion information (Hooker & Park, 2002; McGilloway, Cooper, & Douglas-Cowie, 2003) compared with controls, although impairments are not always in one direction, and may not be significant in women or the early stages of psychosis (Kucharska-Pietura, David, Masiak, & Phillips, 2005). Such impairments have been related to poorer social functioning (Myin-Germeys, Delespaule, & deVres, 2000), but whether they impact on parenting sensitivity is unknown. One study reported that mothers with schizophrenia (N=11) tend to use negative intonation with positive comments to their infants more than mothers with other psychosis (N=40) (Näslund et al., 1985; Persson-Blennow et al., 1986).

Mothers with schizophrenia may have particular beliefs about parenting, perhaps in common with mothers with other mental disorder. For example, among a sample of mothers with severe mental illness (41% of which had schizophrenia or schizoaffective disorder), insensitive maternal behaviour was associated with having expectations of young children supporting the parent (Leventhal, Jacobsen, Miller, & Quintana, 2004). Maladaptive attitudes and beliefs concerning parenting have been shown to contribute towards poor developmental outcomes in children of mothers with schizophrenia and other mental illness (Sameroff et al., 1987, 1993). Maladaptive parenting attitudes may reflect the attachment representations of mothers with mental disorder. Two studies suggest that adults with schizophrenia are more likely to have an insecure-avoidant pattern of relating than adults with other mental disorder, who in turn also show elevated insecurity compared with well adults (Dozier, 1990; Dozer, Stevenson, Lee, & Velligan, 1991).

Studies of mothers with depression strengthen the argument that some maternal cognitive deficits and biases impact on children’s cognitive development. Child cognitive deficits are accounted for by the lack of appropriate support and encouragement of representational thought provided by depressed mothers (Murray et al., 2006) and in normative groups (Goldsmith & Rogoff, 1997). Children of depressed mothers also seem to learn their mother’s cognitive style, which in turn increases their risk for depression (Hammen & Brennan, 2003; Hammen, Burge, & Adrian, 1991). However, facial emotion processing deficits in depressed mothers are limited to recognising adult faces, perhaps because infant expressions are more obvious (Carton, Kessler, & Pape, 1999; Rubinow & Post, 1992).

5.3. Maternal behaviours and affect

When affected by schizophrenia, mothers tend to be more withdrawn and self-absorbed, and less behaviourally sensitive and responsive to their infants (Riordan et al., 1999; Wan, Salmon et al., 2007) and children (Goodman, 1987; Goodman & Brumley, 1990). However, longitudinal assessment suggests that their mother–child interactions are not consistently poor. When feeding and play interactions were compared with mothers with other psychiatric disorder on six occasions prior to one year postpartum, mothers with schizophrenia showed tenser and lower social contact at four time points and lower physical contact and attention at two time points (McNeil et al., 1985; Näslund et al., 1984, 1985; Persson-Blennow et al., 1986). No other consistent impairments were observed. The only study, to our knowledge, that used purely home observations found a deficit only in maternal involvement at four months, which disappeared at twelve months (Sameroff, Seifer, & Zax, 1982; Sameroff et al., 1984, 1987). Heterogeneity in symptomatology is likely to explain some of the lack of consistent findings. A small study of mothers with schizophrenia (N=15) suggests that more sensitive maternal and dyadic interaction is related to reduced positive symptoms (Snellen, Mark, & Trauer, 1999). Some mothers may exhibit positive symptoms (e.g. delusions) that involve their children (Chandra, Bhargavaraman, Raghunandan, & Shaligram, 2006), but which are unlikely to be captured in a brief episode of mother–child interaction.

Few studies link maternal interactive deficits directly with infant functioning or later impairments in HRsz children. MBU samples of young HRsz infants were observed to be more avoidant of their mother, less active and less interested in their environment than infants of mothers with affective disorder (Riordan et al., 1999; Wan, Salmon et al., 2007). Two small studies suggest that HRsz infants are more likely than infants of depressed and well
mothers to show an insecure attachment pattern toward their mothers (D’Angelo, 1986; Näslund et al., 1984). Whether interactive deficits generalise to other people is unknown. Sameroff et al. (1987) reported that HRsz infants showed no behavioural differences from infants of depressed mothers at four or twelve months. At thirty months, poorer socio-emotional adjustment behaviour was found only in the depression scale, whereas infants of depressed mothers showed less adaptive behaviours in a range of areas. Generally, severity of the disorder was more important than specific diagnosis.

In contrast to schizophrenia research, there has been extensive research interest in how maternal behaviours are affected by depression, and which behaviours might impact on child development. A number of behaviour and affect variables has been highlighted, which have not been studied in maternal schizophrenia. Difficulties in affection, reciprocity, punitiveness, hostility, retaliation, and scaffolding (emotional, motivational and learning support) have been studied, mainly in the postnatal period, and have been shown to affect a range of developmental domains in children of depressed mothers (e.g. Cohn, Campbell, Matias, & Hopkins, 1990; Field, Healy, Goldstein, & Guthertz, 1990; Hoffman, Crnic, & Baker, 2006; Robbins Broth, Goodman, Hall, & Raynor, 2004). Such studies have employed microanalytic measures pioneered in developmental psychology. By coding responses following particular prescribed behaviours, it has emerged that depressed mothers do not simply lack responsiveness towards their infants, but tend to be more contingent when responding negatively and less contingent when responding positively, compared with controls (Murray, Hipwell, Hooper, Stein, & Cooper, 1996; Stanley, Murray, & Stein, 2004). Given the comorbidity of depression in mothers with schizophrenia (Bottlender, Staub, & Moller, 2000; Rocca et al., 2005), it may also be possible that affective impairment in schizophrenia may add to risk to children from the disorder.

Mild stress conditions may be needed to elicit interactive impairments and regulatory strategies in infants, such as those found in infants of depressed mothers (Dunn & Kendrick, 1981; Tronick & Giannino, 1986). The ‘still-face’ paradigm assesses infant response when, mid-interaction, the mother is asked to keep a blank face for a period after which she resumes interaction (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Rather than showing distress or avoidance, as is typical in infants of depressed mothers (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986), infants of mothers with borderline personality disorder increased their looking away and dazed looks (Crandell, Patrick, & Hobson, 2003), akin to the infant ‘freezing’ observed in disorganised infant attachment (Main & Solomon, 1990). Mothers may also need to be ‘stressed’ to observe their responses to challenging child behaviour, and be observed in their home environment for longer periods, although ethical issues also need to be considered.

5.4. Social adversity and maternal stress

Little research attention has been paid to the social adversities commonly experienced by mothers with schizophrenia and their effects on offspring development. The literature on social factors associated with schizophrenia provides some general insight, since evidence suggests that environmental factors acting on the individual and community level have some impact on the development of schizophrenia (e.g. Kirkbride et al., 2006). High incidence rates are associated with ethnic minority status; for example, among African-Caribbean and Black African men and women in the UK (Fearon et al., 2006; Selten, Cantor-Graae, & Kahn, 2007), as well as urbanicity (Krabbendam & van Os, 2005) and second generation migrant status (Cantor-Graae & Pedersen, 2007). What these factors are likely to have in common is the experience of marginalisation and chronic ‘social defeat’.

Although, in extreme cases, children are removed to care, a substantial proportion of those raised by their biological mothers are exposed to similar social adversity. Sameroff et al. (1982, 1987) reported that the negative effects of social exclusion (poverty or minority status) on the developmental outcomes of HRsz children were greater than that of maternal mental illness, and that their combined risk produced the worst outcomes. Social adversity may impact on offspring outcomes by affecting adversely parenting behaviour. Goodman and Brumley (1990) found, in their black, low-income sample, that mothers with schizophrenia had lower affectionate involvement and responsiveness than depressed or control mothers and that these behavioural deficits, rather than maternal diagnosis, accounted for later cognitive and social competence in their children. Other studies suggested that higher socio-economic status and having supportive marital and other relationships protect against parenting problems in mothers with schizophrenia (Abel et al., 2005) but not against poor maternal sensitivity when interacting with their infant (Wan, Salmon et al., 2007).
Mothers affected by schizophrenia tend to have high stress levels, as the disorder often leads to diminished quality of life, social adversity, and stress in the family (Chernomas, Clarke, & Chisholm, 2000; Duncan & Reder, 2000). Trauma is common, with a PTSD rate of at 28% or more (Kilcommons & Morrison, 2005; Mueser et al., 2004). Women with schizophrenia are more likely than well women to be victims of sexual and physical abuse (Coverdale & Turbott, 2000) and partner violence (Miller & Finnerty, 1996). For example, at least half report having experienced adult sexual abuse (Kilcommons & Morrison, 2005; Resnick, Bond, & Mueser, 2005) and many have experienced childhood emotional abuse and physical neglect (Morgan & Fisher, 2007; Schäfer et al., 2006). From an attachment perspective, preoccupied parental attachment states of mind may result from childhood trauma, which are likely to affect parenting and offspring mental health (e.g. Yoo, Kim, Shin, Cho, & Hong, 2006).

Studies of mothers with depression highlight the need to consider how associated risk factors, such as social adversity (e.g. Kurstjens & Wolke, 2001; Murray et al., 1996), partner conflict (e.g. Cox, Puckering, Pound, & Mills, 1987; Cummings, Keller, & Davies, 2005; Hipwell, Murria, Docournau, & Stein, 2005) and maternal alcohol abuse (e.g. Peiponen, Laukkanen, Korhonen, Hintikka, & Lehtonen, 2006), moderate child outcomes. A recent study of over five thousand twin pairs found that maternal depression at three years was highly related to mother-reported degree of chaos in the home and feelings towards her child (Pike, Iervolino, Eley, Price, & Plomin, 2006). Moreover, maternal schizophrenia studies have not examined individual stress. Perceived stress reported by mothers has predicted a range of poor outcomes in children of depressed mothers (Billings & Moos, 1983; Hammen et al., 1987). Although symptoms may influence subjective stress, maternal report appears to predict vulnerability in the child.

5.5. Prenatal stress

Maternal exposure to a major stressor periconceptually or during pregnancy may increase the risk of schizophrenia in the general population (c.f. Boog, 2004). Infant development may also be affected by prenatal exposure to factors associated with maternal schizophrenia. Mothers with schizophrenia are more likely to have children with congenital malformations and intra-uterine growth retardation (Bennedsen, Mortensen, Olesen, & Henriksen, 1999, 2001). Stillbirth, neonatal death, low birth weight and prematurity may also be more common in mothers with schizophrenia, although probably no more likely than in other hospitalised mentally ill women (Bennedsen et al., 1999, 2001; Webb et al., 2006). Heavy smoking is common among people with schizophrenia (De Leon & Diaz, 2005; Henriksson, Larmark, & McNeil, 2005), and may contribute towards obstetric complications.

Maternal cortisol, crossing the placenta, has been implicated as a mechanism for abnormal neurodevelopment in HRsz offspring. However, early pregnancy maternal hypothalamo–pituitary–adrenal (HPA) axis parameters are not a good predictor of the likelihood of preterm birth; maternal free corticotrophin levels in late pregnancy were significantly higher in women delivering preterm (Erickson et al., 2001). Maternal anxiety has been associated with impaired uterine bloodflow (e.g. Glover, 1997) and neonatal physiology (e.g. Diego et al., 2004). However, high levels of maternal steroid hormone binding globulin may render the cortisol biologically unavailable; in addition, the HPA axis is generally blunted in women during pregnancy because of high hormone levels (Douglas, Meddle, Toschi, Bosch, & Neumann, 2005).

6. Moderating factors

The model proposes that effects on development are further moderated by various characteristics in the mother–child dyad. The question we address is: What characteristics, associated with schizophrenia, vary the degree of risk to the child? The moderating factors we will consider are the severity, chronicity and timing of the illness, whether the mother has a partner and the amount of support he provides, and child characteristics. For each factor, we examine the evidence for their relevance in families in which the mother is affected by schizophrenia and for a moderating link with poor developmental outcomes in HRsz offspring.

6.1. Illness characteristics: chronicity and severity

If social environmental exposure to maternal schizophrenia directly impacts on offspring development, then we might expect to observe a dose–response relationship. Despite considerable heterogeneity in the disorder, little is
known about whether risk in the child increases with symptom exposure. Chronic or severe schizophrenia may be associated with more social behavioural abnormalities (Brüne, 2005) and poorer parenting attitudes (Rogosch, Mowbray, & Bogat, 1992). However, Wan, Salmon et al. (2007) reported in a small sample that the poorer behavioural sensitivity observed in mothers with schizophrenia (N=13) and lack of activity in their infants, compared with mothers with affective disorder (N=25), were not accounted for by illness duration or amount of medication. Another study found that mothers with more severe or chronic disorder, irrespective of affective or schizophrenic diagnosis, tended to be less involved and to show more negative affect at four and twelve months, and their infants tended to be less spontaneous and responsive in their interactions at twelve months (Sameroff et al., 1987). In early childhood, ‘mental illness severity, chronicity and anxiety’ (as one factor) uniquely predicted social–emotional adjustment, after social status, maternal values and attitudes, and family stress were controlled for. The same factor did not explain the variance in child IQ. Overall, the number of risk factors, rather than any single factor, was associated with reduced four-year social–emotional competence in children of mothers with schizophrenia and depression. Sameroff et al. (1987) observed that the social impact of maternal schizophrenia on a child generally decreases with age. Thus, the amount of maladaptive maternal behaviour to which the child is exposed, rather than mental illness per se, appears to determine the future outcomes of children born to mothers with schizophrenia (Wynne et al., 2006). Low self-esteem and the presence of depressive symptoms are associated with positive symptoms and how individuals perceive their disorder (Smith et al., 2006; Watson et al., 2006), which may also directly impact on the child’s development of self-concept and self-esteem.

Precise measurement of illness chronicity and severity in maternal depression research has led to a greater understanding of the link between maternal disorder and child development. In support of the ‘dosage’ hypothesis, Hammen and Brennan (2003) reported that exposure to one or two months of maternal major depression or over twelve months of mild depression in the first ten years of life is linked with elevated risk of depression in adolescence. Genetic factors were not considered. Campbell, Brownell, Hungerford, Speiker, Mohan, and Blessing (2004) showed that intermittent maternal depression across the first three years was associated with an insecure-ambivalent or disorganised child attachment and that chronic depression was associated only with disorganised attachment. Several studies have also reported that chronic maternal depression is particularly pernicious for childhood attachment (Campbell, Cohn, & Meyers, 1995; Teti, Gelfand, Messinger, & Isabella, 1995) and adolescent mental health and adjustment (Beardslee, Schultz, & Selman, 1987; Halligan, Murray, Martins, & Cooper, 2007). However, in the context of schizophrenia, symptoms and cognitive ability vary with the course (Hori et al., 1999) and chronicity of the disorder (Brüne, 2005; Mullick, Miller, & Jacobsen, 2001). Stronger effects may be related not to exposure duration, but to symptoms that only appear with more chronic disorder. Another consideration, particularly when studying mothers with schizophrenia, is the tendency for children to be cared for by other family members or temporary foster carers when illness is severe. Alternative care may protect against risk (Walker et al., 1981; Wynne et al., 2006).

6.2. Illness characteristics: onset and timing

Women are more vulnerable to psychotic disorder and relapse in the postpartum period than at any other time (Kendell, Chalmers, & Platz, 1987), but whether exposure to maternal schizophrenia in infancy, versus later periods, is more harmful has received no research attention. Schizophrenia is a chronic disorder with a high relapse rate. When symptoms exacerbate, they tend to occur for both positive and negative symptoms (Ventura et al., 2004). Exposure to florid symptoms may be particularly pernicious during ‘sensitive’ periods for the child, such as in infancy. In HR adoptive studies, many infants spend their formative months and years exposed to maternal schizophrenic symptoms, but we located only one study that controlled for age of placement (Siira et al., 2006).

Depression studies have attempted to address timing aspects, but have tended to confine measurement to early childhood (Sohr-Preston & Scaramella, 2006). Current illness seems to have the most negative impact on parenting (Lovejoy et al., 2000; McLearn, Minkovitz, Strobin, Marks, & Hou, 2006), but illness confined to the postnatal period may have enduring effects on children that persist following remission (e.g. Alpern & Lyons-Ruth, 1993; Sharp et al., 1995). Long-term effects may be due to the persistence of maternal hostile communication or the continued lack of shared affect (Stein et al., 1991; Weissmann & Paykel, 1974). Cornish, McMahon, Ungerer, Barnett, Kowalenko, and Tennant (2006) found that, at fifteen months postpartum, only mothers with chronic depression of over twelve months in duration reported higher parenting stress related to characteristics of their infants. Other studies reported that boys
showed increased risk of internalising behaviours when exposed to maternal depression in infancy but not in toddlerhood (Essex, Klein, Miech, & Smider, 2001; Essex, Klein, Cho, & Kraemer, 2003), whereas girls were at increased risk of externalising symptoms when exposed in toddlerhood (Essex et al., 2001). Halligan et al. (2007) recently found that adolescents, whose mothers had been postnatally depressed, were more vulnerable to affective disorder only if their mother had later depressive episodes, as did two thirds of the sample in their preliminary findings.

### 6.3. Child characteristics

HR studies tend to refer to concepts such as the quality of the family rearing environment, when considering protective factors. The characteristics within the child are generally not considered to be protective. Certain child characteristics (such as cognitive skill, temperament or gender) may contribute to the vulnerability of some HRsz children to later difficulties and psychopathology, and may explain the resilience of other children. Some sex differences have been found, mainly in the motor impairment of HRsz boys (McNeil et al., 2003; Schiffman, Walker et al., 2004), which is viewed to reflect the generally higher risk of boys to developmental deviations. Although HRsz children may tend to show cognitive delay in early childhood (e.g. Sameroff et al., 1987) and perspective-taking deficits in adolescence (Schiffman, Lam et al., 2004). Strengths in these developmental domains have been associated with general resilience (Friedman & Chase-Lansdale, 2002). HRsz children may therefore tend to lack these resilience characteristics and their social environment is likely to show poor ‘goodness of fit’.

Maternal depression studies suggest some child characteristics that may be protective. Infants with easier temperaments (e.g. Cutrona & Troutman, 1986) or better social cognitive skill (e.g. Downey & Walker, 1989) may be less vulnerable to the kind of parenting provided by mothers with depression. One study of young children of depressed mothers found no psychiatric disorder among those children who were of above average intelligence, socially engaging and had a “special positive place in their families” (Radke-Yarrow & Sherman, 1990). A recent study, however, suggests that some resilience factors may not be sufficient when depression is chronic or severe. Bohon, Garber, and Horowitz (2007) found that higher cognitive ability was associated with a lower likelihood of dropping out of school in adolescents of non-depressed mothers, but not in those of depressed mothers. A number of studies has shown gender differences in vulnerability to later problems, although not consistently in one direction (Davies & Windle, 1997; Fergusson, Horwood, & Lynskey, 1995; Hipwell et al., 2005; Sharp et al., 1995). Generally, boys seem to be at risk due to parenting and family environmental correlates (Burt et al., 2005; Cohn et al., 1990; Hart, Field, del Valle, & Pelaez-Nogueras, 1998; Murray, Kempton, Woolgar, & Hooper, 1993), whereas girls’ vulnerability comes from modelling and mother–daughter conflict (Cummings et al., 2005; Hops, 1996; Sheeber, Davis, & Hops, 2002). It would be interesting to determine in HRsz offspring whether any of these child characteristics explain variations in diagnosis on the broad schizophrenia spectrum.

### 6.4. Partner support as a protective factor

Although women with schizophrenia are more likely than well women to have no partner or to have a partner with psychiatric disorder (Miller & Finnerty, 1996), partner support has been given almost no attention in schizophrenia research. In an MBU sample, mothers with schizophrenia were more than twice as likely to have a partner treated by mental health services (22%) than mothers with affective disorder (10%), and partner support moderated clinician-rated parenting problems at discharge (Abel et al., 2005). Eighty percent of mothers with schizophrenia with a mentally ill partner were discharged to social services intervention and three quarters were rated as having a significant parenting problem. Conversely, partner wellness may be protective of offspring outcomes. A small study of the partners of a psychiatric sample (N = 14; schizophrenia: n = 2) demonstrated warm and positive father–infant interactions that appear to be ‘compensatory’ (Albertsson-Karlsgren, Graff, & Nettelbladt, 2001).

A recent study suggests that the interaction of father involvement in infancy with a heightened biobehavioural sensitivity to social contexts predicts mental health symptoms in middle childhood, an association which may be strengthened by the presence of maternal depression (Boyce et al., 2006). Studies of depressed mothers also strongly suggest that the presence, mental health and role of the father are significant moderators of child outcomes (e.g. Goodman, Brogan, Lynch, & Fielding, 1993; Mezulis, Hyde, & Park, 2004; Thomas & Forehand, 1991). Fathers may show ‘compensatory’ positive interactions with their infants (Hossain et al., 1994) and children (Hops et al., 1987), while parental separation is another likely moderator of poor outcomes in offspring (Cheng, Dunn, O’Connor, &
Golding, 2006). Other family members may buffer any negative effects of maternal depression, such as grandparents (Silverstein & Ruiz, 2006).

7. Prevention and Intervention

7.1. Predictions from the developmental psychopathology model

HR research has more recently turned to the early identification and treatment of prodromal symptoms in HR relatives and other adults assessed to be at risk of psychosis (c.f. Addington et al., 2007). Medication (Miller, Byrne, Hodges, Lawrie, & Johnstone, 2002; Tsuang, Stone, Tarbox, & Faraone, 2002) and cognitive therapy (Morrison et al., 2007) may delay progression to psychosis. However, the findings are preliminary and ethical questions have been posed over the management of symptoms in individuals who have no formal diagnosis (Perkins, 2004). The developmental psychopathology model offers alternative intervention approaches by lowering the impact of social and environmental factors. In keeping with the cumulative risk model, an appealing and logical general approach is to attempt to reduce the total number of key additive risks impacting on the child’s development. A number of candidate risks can be identified. Firstly, treating the mother’s symptoms may potentially reduce the effect of maladaptive maternal cognitions, behaviours and affect, and possibly the moderating effect of illness severity on offspring. A second intervention method is to remove environmental stress for the family, which might also reduce maladaptive maternal caregiving and illness severity, and improve partner support and future child resilience. A third strategy is to modify maladaptive cognitions, behaviours and affect in the mother, which could maximise child resilience, reduce environmental stress and decrease illness severity. As yet, no formal attempts have been made to improve the functioning of HRsz children using these strategies, but we discuss their potential.

7.2. Maternal treatment for symptoms

While pharmacology is the front-line treatment for schizophrenia, adjunctive treatments include cognitive behaviour therapy (CBT), cognitive remediation, family interventions, and social skills training. Of these, CBT (in conjunction with pharmacological treatment) has most evidence for improving symptoms and reducing relapse (c.f. Butler, Chapman, Forman, & Beck, 2006; Pilling, Bebbington, Kuipers, Garety, Geddes, Orbach et al., 2002; Rathod & Turkington, 2005). In theory, CBT would reduce symptoms and diminish reasoning biases, leaving the mother better placed to support her child’s development, but current evidence has somewhat mixed implications. Improvements in self-esteem (Gumley et al., 2006) and functioning (Kemp, Hayward, Applewhaite, Everitt, & David, 1996) have been reported, which may reduce offspring risk. Group CBT focusing on stigma and self-esteem has been effective in reducing symptoms and improving self-esteem (in the short term), but not in improving coping or empowerment (Knight, Wykes, & Hayward, 2006). Brief nurse-led CBT was shown to improve insight and negative symptoms, but did not improve psychotic symptoms, depression or occupational recovery (Turkington et al., 2006).

Cognitive remediation is a more recent approach that aims to improve neurocognitive abilities, such as attention and executive functioning. Although a meta-analysis of five studies found that early findings were not promising (c.f. Pilling, Bebbington, Kuipers, Garety, Geddes, Martindale et al., 2002), more recent studies suggest that cognitive remediation can improve emotion processing (Van der Gaag, Kern, van den Bosch, & Liberman, 2002) and social functioning (Penadés et al., 2006; Wykes et al., 2003). Social skills training has yielded mixed results (c.f. Pilling, Bebbington, Kuipers, Garety, Geddes, Martindale et al., 2002; Roder et al., 2002). In summary, CBT shows most promise in terms of reducing symptoms and improving functioning in areas that may be important in parenting and child development, but we know little about how such interventions actually impact on children.

Several studies in the maternal depression literature may be informative. In depressed mothers with infants, psychodynamic therapy and CBT related to mother–infant interaction style have led to improved maternal mood (Cooper, Murray, Wilson, & Romaniuk, 2003), but do not seem to enhance their behavioural sensitivity towards their infants or improve their infants’ long-term outcomes (Murray, Cooper, Wilson, & Romaniuk, 2003). Mothers became more involved and positive towards their infants following psychotherapy (Clark, Wenzel, & Tluczek, 2003) and a social/vocational programme (Field et al., 2000), but symptoms did not decrease. In contrast, Forman, O’Hara, Stuart, Gorman, Larsen, and Coy (2007) reported that interpersonal psychotherapy reduced maternal depressive symptoms and parenting stress in postnatally depressed mothers, but no changes were reported in (mother-rated) child attachment,
behaviour or temperament. In a study of depressed mothers with young children with behavioural problems, Verduyn, Barrowclough, Roberts, Tarrier, and Harrington (2003) found that group CBT did not significantly improve depression or child problems compared to controls, but some within-group improvements were found, particularly in child problems. Sanders and McFarland (2000) found reductions in maternal depression and child conduct problems following a behavioural family intervention and cognitive behavioural family intervention, although reductions were more likely to persist at six-month follow-up for the latter. The findings may suggest that conventional therapies can slightly reduce vulnerability in depressed mothers, but an approach more focused on the family or child is likely to be more effective, particularly in the context of more chronic disorder such as schizophrenia.

7.3. Social support

The vulnerability of HRsz children may, in theory, be reduced by minimising stress in the family environment by creating a more supportive environment, by providing social support, or by reducing the social stressors present (e.g. financial and social deprivation). The main approach taken in schizophrenia research is to actually involve the families of the affected individual, providing them with psycho-education, problem-solving work and/or support. Family interventions have generally been shown to be efficacious (Lenior, Dingemans, Linszen, de Haan, & Schene, 2001; Pilling, Bebbington, Kuipers, Garety, Geddes, Orbach et al., 2002), possibly through an emotional rather than cognitive process (Kuipers, 2006). Such interventions have been reported to reduce the relapse rate by 20% and to reduce the amount of burden felt by the family (c.f. Pilling, Bebbington, Kuipers, Garety, Geddes, Orbach et al., 2002; Pitschel-Walz, Leucht, Bäuml, Kissling, & Engel, 2001), which may create a more stable and less stressful home environment for children. Single family therapy seems to be more effective in reducing family burden than family support (Berglund, Vahlne, & Edman, 2003), and in improving social adjustment than a relatives group (Montero et al., 2001). Whether such interventions reduce levels of ‘emotional expression’ (criticism and overinvolvement) by family members is unclear (Montero et al., 2001; Pilling, Bebbington, Kuipers, Garety, Geddes, Orbach et al., 2002). Most family interventions involve the parents of individuals with schizophrenia, rather than their partners and children.

Befriending and similar social support, such as individual counselling, may also be beneficial, but are usually used in research as the non-active control in CBT trials. Some studies suggest that befriending can decrease symptoms (Milne, Wharton, James, & Turkington, 2006; Samarasekera et al., 2007), but little is known about whether this reduces maternal stress in this group. Although social support groups, such as mother and baby groups, exist, we located no studies of individuals with schizophrenia. Some countries offer specialist MBU facilities where mothers receive inpatient support, but the benefits for offspring are difficult to evaluate (Wan, Warburton et al., 2007).

In depressed mothers, support groups (Fleming, Klein, & Corter, 1992) non-directive counselling (Cooper et al., 2003), and a nurse home-visit intervention (Gelfand, Teti, Seiner, & Jameson, 1996) have been shown to improve maternal sensitivity, particularly in the context of high social adversity. Lyons-Ruth, Connell, Grunebaum, and Botein (1990) focused on providing maternal support and modelling positive mother–child interaction during home visits to mothers from low socio-economic families (a third of whom had a history of psychiatric hospitalisation) and found that their infants were twice as likely to be securely attached and had higher cognitive ability than the untreated group. Taken with the schizophrenia findings, family support, and possibly individual social support, may be beneficial for preventing the transmission of risk from some mothers where parenting stress is high.

7.4. Parenting interventions

Since the evidence suggests that treating the mother’s symptoms may not be sufficient to improve HRsz outcomes, intervention may need to focus on altering maladaptive maternal cognitions, behaviours and affect with respect to parenting and the mother–child relationship. Interventions which seek to enhance mother–infant attachment security may offer potential benefit since the formation of secure attachment is a process fundamental to competent emotional, social and cognitive functioning (Friedman & Chase-Lansdale, 2002). Although some mothers with schizophrenia may be involved in parent training (e.g. behavioural video-based work in an MBU), we know of no empirical data on its effectiveness.

A study that evaluated toddler–parent psychotherapy in mothers with major depression found that two thirds of insecure toddlers became securely attached compared with less than one third of depressed controls (Cicchetti, Toth, &
Rogosch, 1999). Behavioural sensitivity training using video-based feedback has been effective in groups known to have mother–infant relational difficulties, including mothers with depression (c.f. Green et al., in press). Recent studies have shown that such interventions can improve mother–infant interaction in mothers with eating disorders (Stein et al., 2006) and mothers of highly reactive infants (Velderman, Bakermans-Kranenburg, Juffer, & van Ijzendoorn, 2006), but longer-term changes are unclear. Special considerations need to be taken into account when developing this kind of intervention for mothers with schizophrenia who may need a more personalised programme.

8. Discussion

8.1. Empirical support for the model

This article has provided a review of studies of mothers with schizophrenia and their children, where developmental or social environmental factors have been considered. While the consensus of evidence reviewed earlier supports the high heritability of schizophrenia, the risk to the next generation to a range of poor outcomes is generalised. Not all children experience difficulties and those that arise may be transient. The empirical literature to date provides broad support for our proposed model and highlights areas in need of further research and potential methods for intervention. Proximal and distal aspects of the child’s social environment are likely to be operating on the child; for example, inadequate, possibly harmful parenting (in the form of maladaptive maternal cognitions, interaction and affect), a disturbed or unstable family environment, exposure to maternal stress induced by personal trauma etc., and the experiences of chronic social adversity and social exclusion. Further study is required to elucidate specific causal relationships between proposed psychosocial and environmental mechanisms and the outcomes of HRsz offspring. Insecure and preoccupied ‘internal working models’ of attachment are a possible mechanism through which risk is transmitted via the social environment.

Most evidence for a social environmental causal pathway derives from studies that suggest that the social behaviour of HRsz children is related to the caregiving behaviours of their mothers. Even here, some inconsistencies were found longitudinally and between studies, which may be accounted for by differences in measurement, comparison group, and timing of exposure. Whether these interactive deficits with their mother generalise to other people and lead to longer-term social and emotional deficits is unclear. Few schizophrenia studies have attempted to explain poor cognitive and social cognitive outcomes in HRsz offspring via social exposure. Studies of HRsz, depressed and non-clinical groups suggest that maternal cognitive impairments affect parenting and child development. Disorganised communication, which probably reflects disorganised thought, has been identified as particularly pernicious in raising clinical risk. Impaired attitudes towards parenting may also contribute towards poor offspring outcomes. Some evidence relates socio-economic deprivation among mothers with schizophrenia to poor developmental outcomes, as an independent effect and through adversely affecting parenting behaviour. No studies identify specific environmental stressors that account for offspring risk in this group, although partner conflict and traumatic experiences merit further study. We also found no direct evidence that prenatal environmental stress is a significant mechanism independent of genetic factors.

Schizophrenia is typically severe and chronic, and usually has a course that extends over the postpartum period in mothers. Evidence suggests that mothers with schizophrenia tend to have insufficient or no partner support and that their children have fewer resources to draw on to develop resilience. If the proposed illness, partner and child characteristics moderate outcomes, in most cases they will significantly raise offspring risk in HRsz children. Some evidence indicates that the severity and chronicity of illness moderate HRsz offspring risk, particularly for social–emotional outcomes. Illness onset and timing, child characteristics and partner support may be important modifying factors, due to the severity and chronicity of schizophrenia. Developmental psychopathology emphasises the early months and years as a crucial developmental period, when the developing brain and neuroregulatory system are plastic, for consolidating interactive skills and cognitive processes (Rutter & Silberg, 2002; Stern, 1985).

A relative lack of developmental focus has meant that HRsz studies have been inadequate in addressing when, how and what aspects of particular environmental and social factors impact on child development. Maternal depression research is a valuable source for evidence and methods to study areas that have traditionally been ignored in schizophrenia research. For example, there is virtually no evidence in schizophrenia for some proposed mechanisms (e.g. prenatal exposure, social modelling, social cognitive deficits) and moderators (e.g. timing of exposure, the role of child characteristics), where maternal depression studies are potentially informative. Although further research is
required to understand the extent to which findings can apply to HRsz offspring, current evidence suggests that the
same factors broadly influence child development but they may do so to varying degrees, and specific factors may be
more relevant than others. For example, maternal depression studies have shown that maladaptive behaviours and
negative affect impact on development, whereas positive symptoms and blunted affect may be pernicious in the context
of schizophrenia exposure. The impact of symptoms on child development may be moderated by its interference on
maternal sensitivity rather than through the modelling of maternal behaviours. Poor partner support (partly due to
partner mental illness) could also be a stronger moderator in schizophrenia and timing of illness onset may be less
relevant.

8.2. Methodological limitations

A number of methodological issues arise from studying a group of this nature. Firstly, there is a question of whether
the samples in the studies reviewed are representative of all HRsz children. Many studies included parents with
particularly chronic and severe disorder (e.g. MBU samples), and some involved parents from highly disadvantaged
backgrounds (e.g. Goodman, 1987). Genetic and environmental risk may therefore be even higher in these samples
than is typical for parents with schizophrenia. Adoptive studies also may involve children whose biological parents had
more chronic and severe disorder, so that these children may have inherited more genetic risk than is representative of
HRsz children generally. Control group characteristics differ between studies, as described in most cases in this review.
If comparison samples (e.g. mothers with affective disorder) also showed higher (genetic or social) vulnerability than is
typical for that group, then HRsz offspring ‘deficits’ may seem to be reduced. For example, Amminger et al. (1999)
reported a lack of effect of maternal schizophrenia on social competence unless substance abuse was controlled.

Most HR studies which included offspring whose other first degree relatives have been affected are excluded from
this review, as our interest was specifically in the effects that having a mother with schizophrenia might have on the
child. While this means that we have a more homogenous sample (particularly in terms of the child’s early environment
being impacted by the affected mother), there are a number of shortcomings. Firstly, many other HR studies found
similar poor developmental outcomes in children who have any affected first degree relative, which may provide a
stronger genetic argument. Secondly, as more recent HR projects moved away from only including children of mothers
with schizophrenia (Owens & Johnstone, 2006), many recent studies were excluded. These studies may have used
more up-to-date measures and diagnostic procedures.

8.3. Future research

The review highlights a number of research avenues that may help us understand further the importance of these
mechanisms. We suggest that microanalytic studies of mother–infant interaction and detailed mother–child
observations will be important methodologies in this process. Such studies should consider: the role of social learning
and modelling; the prevalence and impact of particular stressors (e.g. childhood trauma; partner conflict); mothers’
perceived stress and its impact on HRsz children; and the effects of prenatal stress and symptom exposure. Cognitive
and social impairments specific to schizophrenia (or psychosis) may underlie interactive deficits and may be
particularly harmful to children. The adult ‘internal working model’ of attachment of mothers with schizophrenia is a
possible specific mechanism through which socio-emotional difficulties are transmitted. Future research must
incorporate measures that investigate: mother–infant interaction longitudinally and under mild stress situations; the
effects of ‘theory of mind’ and emotion processing deficits, the effects of reasoning biases on mother–child interaction;
and the impact of positive and negative symptom exposure.

Further research is needed to identify a dose–response relationship between schizophrenia exposure and poor
offspring outcomes that also consider the timing of exposure, and to identify whether particular children experience less
or more exposure (e.g. those of mothers with more severe illness). We also suggest that research needs to examine
protective child characteristics and possible child improvements with maternal remission. How children understand this
most perplexing illness may modify a child’s behaviours and could be informative in identifying resilience factors.
Large prospective studies are needed to investigate these factors to shed more light on the non-genetic contribution to the
generational transmission of the disorder.

We identified no early preventative intervention work in HRsz children. The developmental psychopathology model
serves as a framework for three approaches, which we have discussed, that might prevent the psychosocial transmission
of risk. However, we must first delineate the mechanisms and moderators of poor offspring functioning. By moving away from the traditional HR approach, contextualising maternal schizophrenia as a specific perturbation in the normative developmental process, and adopting new observational approaches, it is our view that research will be better placed to inform the development of effective interventions.

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