The Biological and Behavioural Effects of Maternal Trauma and Posttraumatic Stress Disorder on Child Development

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by

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Abstract

Environmental factors such as stress and hormones acting during embryogenesis, as well as early life experiences such as parental care have been clearly demonstrated in animal models to shape the individual’s phenotypic gene expression, brain development, and behavioural repertoires (Meaney, 2005). However, human studies have not assessed both prenatal mental health and the quality of postnatal parental care with the same sample of mothers. The current study sought to fill this gap by investigating the impact of women’s experiences of trauma and posttraumatic stress disorder (PTSD) before pregnancy on the mother’s ante- and postnatal mental health problems, parenting, and children developmental outcomes. The study reported here is the second phase of a longitudinal study that commenced in 2002. In phase one community based middle class women in their third trimester of pregnancy were recruited and followed during the early postnatal period (Linke, 2002; Lowe 2003). The current study assessed forty four mother-infant dyads at three time points during the second postnatal year. The dyads were divided into one of three groups (control, trauma control and PTSD) depending on the mother’s trauma experience and whether she met the lifetime diagnosis for PTSD. The assessments included the measure of the mother and infant’s basal cortisol, the mother’s lifetime and ongoing mental health problems, the quality of the mother-infant relationship, and the development of the infant’s general cognitive abilities, emerging language skills and emotional and behavioural self regulation.

The current study found infant morning cortisol levels measured at 13 months of age were significantly predicted by maternal trauma experience and the subsequent PTSD symptoms of hyperarousal supporting the research of Yehuda and colleagues (2005) and implicating
an epigenetic transmission of environmental experience from the mother to her offspring possibly via *in utero* programming of the HPA axis. Overall, maternal trauma was found to impact on both child language and self regulation development. Unexpectedly, the trauma control or resilient mothers were found to be least engaged with their infants, and their infants had the lowest language development. However, poorer language development was not mediated through dyadic emotional availability or maternal sensitivity. Maternal PTSD was found to be related to poorer child emotional and behavioural outcomes which were mediated through maternal mental health problems. Overall, the findings of the current study suggest that maternal trauma experience is associated with a biologically based mechanism occurring in both the mother and the infant which is protective for both the mother and the child’s emotional health, but comes at a cost of slower infant language development. Furthermore, this mechanism appears to have broken down in the presence of maternal PTSD for both the mother and the infant with subsequent associations with greater maternal mental health problems, more problematic infant emotional and behavioural problems, and disorganised attachment. These findings have clinical implications, particularly for early intervention programs. The results need to be interpreted with caution due to the small sample size. However, the findings have broad implications in relation to resilience to trauma and the development of psychopathology and warrant repetition.
Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for photocopying and loan.

Jacqueline Anne Beall

I believe that this thesis is properly presented, conforms to the specification for the degree of sufficient standard to be, prima facie, worthy of examination.

Professor Alexander Cowell McFarlane

Principal Supervisor
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1. **Introduction**

This multifaceted and prospective study investigates the impact of women’s experiences of trauma and posttraumatic stress disorder (PTSD) on their parenting and ultimately their children’s developmental outcomes. The study reported here is the second phase of an Adelaide based longitudinal study that commenced in 2002 under the guidance of Dr Clara Bookless. In the first phase pregnant women, with and without traumatic experiences, were recruited from the community and the mother-infant dyads were followed for three months post birth (Linke, 2002; Lowe, 2003). The current study tracked the same mother-infant dyads over their second postnatal year. The mother’s lifetime and ongoing mental health status, mother’s and infant’s biological stress systems, the quality of the mother-infant interactions and infant attachment, as well as the development of the children’s language and self regulation were assessed using a variety of quantitative research methods. These methods included semi structured clinical interviews, biological assays, videotaped observations of mother-infant interactions, clinical developmental assessments, and self and maternal-report questionnaires.

1.1. **Significance of the Study**

Mental health in Australia is now viewed as a major public health issue (Department of Health and Ageing, 2003). The susceptibility to mental health disorders, like disease, is thought to be the result of the complex interplay between genetic endowment and environmental influences (McEwen & Wingfield, 2003). Environmental factors such as stress and hormones acting during embryogenesis, as well as early life experiences such as parental care have been clearly demonstrated in animal models to shape the individual’s phenotypic gene expression, brain development, and behavioural repertoires (Crews & McLachlan,
Internationally child and adolescent mental health problems have been found to be on the rise (Bird, 1996). Currently, approximately one in six Australian children and adolescents have significant mental health problems (Sawyer et al., 2001; Sawyer et al., 2000; Zubrick, Silburn, Burton, & Blair, 2000). Many mental health problems in children and adolescents present as either internalising (withdrawing) or externalising (acting out) behaviours, both of which can be viewed as deficits in self regulation. Early deficits in these areas have shown remarkable continuity from toddlerhood through childhood, adolescence (Hofstra, van der Ende, & Verhulst, 2000; Keenan, Shaw, Delliquadri, Giovannelli, & Walsh, 1998), and adulthood (Angold & Costello, 1995; Harrington et al., 1994; Offord & Bennett, 1994).

Human studies of both pre- and postnatal maternal anxiety and depression have been found to impact on later child outcomes (Matthey, Barnett, Howie, & Kavanagh, 2003; Murray & Cooper, 2003; O'Connor et al., 2005; van den Bergh, Mulder, M., & Glover, 2005), with the quality of infant attachment being identified as a major predictor of long-term psychopathology (Carlson & Sroufe, 1995). Trauma experience and PTSD have enduring mental health sequelae (McFarlane, 2000) that could account for much of the anxiety and depression seen in mothers of young infants. However, little empirical research has been conducted specifically on the impact of maternal PTSD on parenting and child development (Appleyard & Osofsky, 2003). Research has shown that traumatic events are associated with altered biological, behavioural and socio-emotional responses that may permanently impact on the individual (McFarlane, 2003). In addition, several recent studies have suggested that intergenerational transmission of these problems may be passed on to offspring via some epigenetic event such as in utero programming of the HPA system (Seckl & Meaney, 2006; Yehuda et al., 2005), or by early maternal behaviour (Lyons-Ruth & Block, 1996; Yehuda,
Halligan, & Grossman, 2001). Both these mechanisms have been found to occur in relation to maternal stress in animal models (Meaney, 2001).

Early intervention programs such as home visiting programs have been established in Australia and overseas which are either universal screening programs (e.g. Child and Youth Health, 2004), or programs targeted to high risk poverty groups (e.g. Olds, 2006), with the aim of improving mother-infant interactions to reduce the development of later psychopathology in the offspring. However, both these approaches are unlikely to capture the mothers of the consistently identified 15% of low risk, middle-class toddlers and young children who display disorganised behaviours that are linked with less optimal mental health outcomes (van Ijzendoorn, Goldberg, Kroonenberg, & Frenkel, 1992). Firstly, these mother-infant dyads would not be considered high risk, and secondly, research has found that maternal behaviours thought to be associated with disorganised infant behaviour is not easily detected in middle class families during short term observations (Lyons-Ruth, Melnick, Bronfman, Sherry, & Llanas, 2004). Furthermore, many of the current methods used in research to detect mother-infant problems require extensive training, are time consuming, and too expensive to use as screening tools. Using a combined biological and psychological approach this longitudinal study aims to identify possible maternal risk factors and early markers of biological and environmental dysfunction associated with trauma experience and PTSD in middle class families which may inform intervention programs about this hard to identify group. An additional benefit of studying middle-class families is the reduction of the confounding effects of low socio-economic status that negatively impacts on family functioning and child outcomes (Greenberg, 1999).

1.2. Aims of the Study

The broad aims of the current study are to investigate:
1. the relationship between prior maternal trauma experience, PTSD and ongoing PTSD symptoms and the pattern of basal cortisol production in both the mother and the infant.

2. whether prenatal or postnatal environmental experiences best predict basal cortisol levels.

3. whether prior maternal trauma history, PTSD or ongoing symptom level negatively impact on the mother-infant interaction, and ultimately her attachment with her child. In addition, the association between maternal behaviour, infant attachment status and basal cortisol levels will be investigated.

4. whether prior maternal trauma history, PTSD, ongoing symptom level, or infant basal cortisol negatively impacts on the child’s subsequent development of cognitive processes and self regulation.

5. whether prenatal or postnatal environmental experiences best predict child cognitive and behavioural outcomes.

1.3. Overview of Thesis

The thesis is organised into eight chapters. Chapter 2 firstly reviews the literature on the prevalence, diagnosis and course of PTSD, identifying PTSD as playing a significant role in the ongoing mental health of women. The physiological impact of stress and PTSD on the HPA axis in both animal models and humans is reviewed, before discussing current views on the epigenetic transmission of PTSD to the next generation. The second half of the literature review focuses on the impact of maternal behaviour on child attachment and developmental outcomes, as well as how maternal mental health and PTSD in particular are thought to negatively impact on healthy child development.
Chapter 3 outlines the study design, and gives descriptions of all the methods used in the study. Chapter 4 starts by describing the sample in terms of size and demographic variables before dividing the sample using trauma experience and lifetime diagnosis of PTSD. Further, this chapter compares control and trauma groups on a variety of demographic, maternal mental health variables, potential confounding variables, early infant development measures, and those who withdrew and remained in the study. Chapter 5 investigates the relationship between maternal trauma and mother and infant cortisol levels to gain a better understanding of the effects of prior maternal PTSD on her own and her offspring’s basal level cortisol. Furthermore, predictors of child cortisol levels were investigated to determine whether epigenetic factors or early maternal behaviour were more influential. Chapter 6 investigates the impact of maternal trauma experience and PTSD on maternal-infant interactive behaviours and whether trauma mothers are more overprotective or hypervigilant in their behaviours. Chapter 7 investigates the impact of maternal trauma on child language and self regulation development, as well as determining what prenatal and postnatal variables were the best predictors of less optimal outcomes.

The eighth and final chapter critically discusses the limitations of the study before drawing together several key themes that arise throughout the study. The concluding section will address implications for intervention programs and future research.
2. Literature Review

International studies have identified high and increasing rates of child and adolescent mental health problems (Bird, 1996). Several recent Australian epidemiological studies have identified that between 14% (Sawyer et al., 2001) and 18% (Zubrick et al., 2000; Zubrick, Silburn, & Garton, 1995) of Australian children and adolescents have a clinically significant mental health problem. This means that approximately one in every six Australian children and adolescents have a significant internalising or externalising mental health problem. Furthermore, research has demonstrated that many child and adolescent mental health problems progress into adulthood (Angold & Costello, 1995; Harrington, 2001b; Harrington et al., 1994; Offord & Bennett, 1994). These studies have highlighted the extent of this important public health issue and emphasise the need for research into possible preventive and early intervention strategies. The aetiology of mental health problems, like physical problems, is thought to be the result of genetic endowment and environmental impact (Harrington, 2001a). Furthermore, the large individual differences found in how we respond to stress are thought to be an important variable in the development of both physical and mental health problems (Goodyer, Park, Netherton, & Herbert, 2001; Hellhammer, Schlotz, Stone, Pirke, & Hellhammer, 2004). Both biological and environmental factors have been implicated in how we respond to stress and traumatic experiences. Recent animal and human research indicates that maternal stress and trauma experience, both pre and postnatally, may be transmitted from a mother to her offspring via epigenetic changes occurring in utero and in the early postnatal period, setting the infants ability to cope with stress perhaps for life (Meaney, 2001; Meaney & Szyf, 2005; O'Connor et al., 2005; Seckl & Meaney, 2006; van den Bergh et al., 2005; Yehuda, 2006).
Altered levels of stress reactivity have been associated with emotional and behavioural problems in children and adolescents (Lopez, Vazquez, & Olson, 2004; O'Connor et al., 2005). Deficits in internalising and externalising behavioural problems are viewed as deficits in self regulatory processes (Calkins & Fox, 2002). Although socio-emotional adaptation occurs across the life span (Carlson, Sroufe, & Egeland, 2004), the first three years of a child’s life are central for optimal development of self regulation with the quality of the infant-carer relationship being of utmost importance (NICHD, 2004). During this time infants are required to develop stage related tasks related to self regulation such as, establishing physiological regulation (Gunnar & Donzella, 2002), synchronizing interactions with their carers (Tronick & Gianino, 1986), forming attachment to carers (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1988), learning to manage impulses, establishing autonomy, and learning social norms and standards around social interaction (Cicchetti & Toth, 1995; Sroufe, Cooper & deHart, 1996). The relative contributions of pre and postnatal environmental influences are unknown. The current study aims to advance the knowledge in this area by investigating the effects of prior maternal trauma on child biological and developmental outcomes starting from the third trimester of pregnancy through the first two years of life.

Severe trauma has been found to have an adverse impact on individuals with the majority of people developing an acute stress reaction. Broadly, severe trauma is recognised as short or long term exposure to a stressor which is extreme enough that it is likely to cause pervasive distress in most people (World Health Organisation, 1993), and can include natural disasters, life threatening accidents, experience of war or terrorism, and interpersonal violence occurring to oneself or others (American Psychiatric Association, 1994). For most people the initial acute posttraumatic stress resolves within several months, but for some it develops into the long lasting pathological sequelae termed posttraumatic stress disorder (PTSD; Davidson,
Stein, Shalev, & Yehuda, 2004; McFarlane, 1996). Moreover, trauma occurring in childhood and adolescence is of particular importance as it is thought to have a modulating effect on neurobiological development and therefore impact on behavioural, emotional, cognitive, and physiological development (Cicchetti & Rogosch, 2001a, 2001b; De Bellis, Baum et al., 1999; De Bellis, Keshavan et al., 1999; Lipschitz, Rasmusson, & Southwick, 1998; Sanchez, Ladd, & Plotsky, 2001), with measurable effects being found in adult survivors (Felitti et al., 1998; Fergusson, Horwood, & Lynskey, 1996; Johnson, Cohen, Brown, Smailes, & Bernstein, 1999; MacMillan et al., 2001). The current study is concerned with severe trauma that has occurred to women at any time in their life before conceiving a child. In particular, how maternal traumatic experience may impact on her own and her infants biological stress system, as well as affect her parenting, and whether these factors impact on the subsequent developmental outcomes of her infant. This study, and the majority of studies involving carer-infant relationships and child outcomes, focuses on the mother-child interaction. This is not to deny the importance of the role of fathers in the development of their children but reflects the reality that mothers are still the primary carers of infants in Australia and other western countries. The interplay between all family members is a very important area of research but is outside the scope of the current study and this review. This chapter will initially review the PTSD literature, with a particular focus on how PTSD may impact on the physiology of both the mother and infant, as well as the mother-infant interactions and subsequent child developmental outcomes, before presenting the aims of the current study.

2.1. Trauma

Trauma and PTSD research is a broad field and will be briefly reviewed in relation to the psychopathology and biological changes found following trauma. The focus of this review is on the impact of trauma on women, but will include more general findings. The area of PTSD treatment is beyond the scope of this study and is not included.
2.1.1. Psychopathology Following Trauma

This section reviews the literature on prevalence rates for trauma and PTSD, as well as the diagnosis of PTSD, the longitudinal course of PTSD, and models of PTSD development.

2.1.1.1. Trauma prevalence rates

Before reviewing the trauma literature several methodological differences between studies need to be highlighted. Large community based epidemiological studies use either the Diagnostic Interview Schedule (DIS; Robins, Helzer, Cottler, & Golding, 1989) or the Composite International Diagnostic Interview (CIDI; World Health Organisation, 1997). Early studies with the DIS have yielded lower trauma prevalence rates as the original DIS used only one question to elicit information about trauma experience whereas the CIDI and the modified DIS use lists of events which yield higher recall (Breslau, 2002). In addition, the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 1994) has altered the definition of trauma in the current DSM-IV. What constitutes a traumatic event has changed from an overwhelming experience outside the normal range in the DSM-III and DSM-III-R to a list of qualifying stressors and the subjective experience of feeling intense fear, helplessness or horror in the DSM-IV. In addition, studies vary on use of comparison groups with some studies comparing people with PTSD to those without PTSD (regardless of trauma exposure), while others compare to a trauma control group (trauma experience without PTSD), and some to both a trauma control group and a control group (no trauma experience).

High numbers of people in the community have experienced a severe trauma across their lifetime. The highest level of trauma prevalence rate that has been reported in a community sample is 89.1% (Breslau & Kessler, 2001). This study was conducted in America using the DSM-IV, the same sample would have yielded a trauma exposure of rate 68.1% using the
DSM-III-R trauma criterion (Breslau & Kessler, 2001). An early study using the DSM-III-R, the American National Co-morbidity Survey (NCS; Kessler, Sonnega, Bromet, Nelson, & Hughes, 1995) found approximately 60% of men and 50% of women had been exposed to at least one significant traumatic event over their lifetime. Whereas an Australian study using the DSM-IV, The Australia National Survey of Mental Health and Wellbeing (NSMHWB; (Creamer, Burgess, & McFarlane, 2001), found rates of approximately 65% for men and 50% for women, with higher rates being reported for those aged between 25-54 years of age. Interestingly, a South Australian epidemiological study of mental health, also using the DSM-IV criteria found 58.3% of women between 21-40 years of age had experienced at least one trauma over their lifetime (Taylor, Dal Grande, & Parsons, 1997). A further study in the United States, using the DSM-III-R trauma criteria and a modified DIS, found 68.9% of women had experienced a trauma across their lifetime (Resnick, Kilpatrick, Dansky, Saunders, & Best, 1993). Using similar instruments, Breslau and colleagues found 39.1% of American women between 21-30 years of age (Breslau, Davis, Andreski, & Peterson, 1991), and 35-45% of mothers with young infants, (Breslau, Davis, Peterson, & Schultz, 1997) had experienced a trauma. These lower rates of lifetime exposure to trauma presumably reflect the younger population and the use of the earlier DSM-III-R. Overall, recent studies using the DSM-IV in the United States indicate that up to 90% of the population has experienced at least one significant trauma across their lifetime, with the only large scale Australian community study showing considerably lower rates with 65% of men and 50% of women.

Gender differences have been consistently found in both the number of traumas and the type of traumas experienced. For example, in the Australian NSMHWB, Creamer, Burgess and McFarlane (2001) not only found the rate of trauma exposure was higher for men, but of those who had experienced trauma more men (62%) than women (48%) experienced more than one trauma in their lifetime. Gender differences have also been found for the types of
traumas experienced with women experiencing less life-threatening accidents, natural disasters, physical attack, attack with a weapon, or combat related trauma than men, but significantly higher experience of rape and sexual molestation (Creamer et al., 2001; Kessler et al., 1995).

2.1.1.2. Psychological impact of traumatic events

Fortunately, not all people who experience a trauma go on to develop lasting psychopathology. Indeed, a relatively new area of research suggests that traumatic experiences can lead to positive effects via what is now termed posttraumatic growth, with positive changes thought to occur in perception of self, relationships with others, and philosophy of life (for review see Tedeschi, Parks & Calhoun, 1998). However, there is also a well established body of research which has demonstrated serious adverse outcomes following trauma (for recent reviews see Breslau, 2002; McFarlane, 2003; Yehuda, 2002). Most people who experience a significant trauma display symptoms of an acute stress response which for the majority of people resolves quickly. There are a range of possible psychological and psychiatric problems that can develop following a serious traumatic event, of which PTSD with and without co-morbid depressive or anxiety disorders are the most commonly addressed in the literature. Increases in depression, anxiety disorders, and substance abuse (Kessler et al., 1995), as well as somatic symptoms, and physical illnesses such as chronic pain, asthma, and hypertension, have been reported in people who have experienced traumatic events (Boscarino, 1996; Zatzick et al., 1997). In contrast, Breslau (2002) in reviewing recent studies that address this issue reported that trauma victims who do not develop PTSD are not at a higher risk of developing depression and substance abuse disorders compared to unexposed people. Childhood trauma, particularly maltreatment, has consistently been linked to the later development of depression, anxiety, borderline personality disorder, dissociative disorders, eating disorders and substance abuse, as well as
PTSD (for review see Streeck-Fischer & van der Kolk, 2000), although physical abuse during childhood and adolescence shows less association with reported PTSD symptoms (Lyons-Ruth & Block, 1996), and a greater association with external behavioural difficulties (Deblinger, McLeer, Atkins, Ralphe, & Foa, 1989; Pelcovitz & Kaplan, 1996). Women who do not meet the full criteria for PTSD following domestic violence have been found to suffer subclinical symptoms that impair their day to day functioning (Merlin & Mohr, 2000).

2.1.1.3. Prevalence of PTSD

The primary focus of this section is on the development of PTSD following trauma. Studies of PTSD prevalence rates use a range of prevalence indicators such as current, 6- or 12-month, or lifetime prevalence (number of people who would have obtained a diagnosis of PTSD at some point in their life) and cover a wide range of populations such as military and emergency service personnel, and victims of natural disasters, accidents, interpersonal violence, and terrorism (see McFarlane, 1996). Creamer, Burgess and McFarlane (2001) give a comprehensive overview of current and 12 month prevalence rates in community samples. However, this review will focus on lifetime prevalence rates in community samples, and specifically female samples where possible.

Lifetime prevalence rates for community samples range from 1.0% to 13.8% with the lower rates being found in several early studies from the American Epidemiological Catchment Area (ECA) Program which used the earlier measures of the DSM-III and the unmodified DIS (Davidson, Hughes, Blazer, & George, 1991; Helzer, Robins, & McEvoy, 1987). The NCS, with over 8,000 respondents, using the later DSM-III-R found overall rates of 7.8%, with women reporting rates of 10.4% compared to 5% for men (Kessler et al., 1995). Resnick and colleagues (1993) in a national survey of 4,008 American women found lifetime PTSD rates of 12% for the total sample and 18% for those who had experienced a trauma. In a
Michigan community sample of 1007 young adults (aged 21-30 years), Breslau and colleagues (1991) found lifetime prevalence rates for women of 11% of the total sample and 31% for those exposed to trauma, compared to men who had rates of 6% for the total sample and 14% of those exposed to trauma. A more recent study by Breslau and colleagues (1997) of 801 mothers of young children found overall lifetime prevalence rates of 13.8%, with 16.8% for women who lived in the city as opposed to 11% for women who lived in suburban areas, with the city women being slightly more likely to develop PTSD post trauma, with 37% of city women exposed to trauma developing PTSD compared to 32% of suburban women. In a review of Australian studies on victims of domestic violence, PTSD estimates ranged from 33% to 84% (Merlin & Mohr, 2000). Merlin and Mohr suggests this broad range of findings was due to the use of different populations (shelters, community or mixed), timing after last exposure and lack of uniformity in instruments to measure PTSD. Overall, lifetime prevalence rates in the United States using either the DSM-III-R or DSM-IV have found between 10.4% and 13.8% of females have experienced PTSD at some time in their life. Although, not directly comparable to the above studies, the Australian NSMHWB, using over 10,000 respondents, found the much lower rates 12-month PTSD prevalence of rates in the total sample of 1.3% compared to the NCS study (Kessler et al., 1999) of 3.9%. This difference in PTSD rates is likely to be due to the lower levels of trauma experienced in Australian populations as well as differences in types of trauma exposure.

Gender differences are obvious from these prevalence studies with consistently higher lifetime PTSD prevalence rates for women, who are nearly twice as likely to develop PTSD post trauma compared to men. Women are more likely to develop PTSD following rape, sexual molestation, and physical attack than other traumas (Breslau et al., 1991; Creamer et al., 2001; Resnick et al., 1993). However, various American studies have still found gender differences even if rape is controlled for suggesting women are more vulnerable to the
psychological sequelae of assault than men (reviewed by Breslau, 2002). In contrast, Yehuda
(2002) suggests that women are not more vulnerable, as higher rates of PTSD have been
found in men following rape, and that differences are due to the different levels of threat and
injury involved in different types of traumas, with women experiencing considerably greater
levels of sexual and physical assault than men. This view is supported by the Australian
NSMHWB study that found gender differences disappeared when trauma type was controlled
for indicating that females were not more susceptible to PTSD and that higher rates of PTSD
for women are likely to be due to a higher level of interpersonal violence such as rape
(Creamer et al., 2001). A recent nested case-control study of 30,000 Gulf war veterans
exposed to either sexual assault or combat trauma found that both men and women were
equally at risk for developing PTSD (Kang, Dalager, Mahana, & Ishii, 2005). Nemeroff and
associates (Nemeroff et al., 2006) suggest that perhaps under situations of extreme trauma
gender differences are negligible.

Another consistent finding across clinical and community samples, as well as trauma types, is
the co-morbidity of depressive and anxiety disorders and substance abuse disorders with
PTSD (Breslau, 2002; McFarlane, 1996). For example, Breslau and colleagues’ study of
mothers with young children found 73% of women with PTSD had lifetime co-morbidity
with any Axis-1 disorder compared to 38.3% of those without PTSD. More specifically, 43%
of mothers with PTSD had co-morbid major depression and 55% any other anxiety disorder,
compared to 13.3% and 26.1% respectively for those without PTSD. This is consistent with
the Australian NSMHWB which found co-morbidity with at least one other Axis-1 disorder
over the previous 12 months in 85.2% of males and 79.7% of females who had a diagnosis of
PTSD (Creamer et al., 2001).
2.1.1.4. Diagnosis and characteristics of PTSD

Posttraumatic stress disorder is characterised by a pattern of symptoms that may emerge following a variety of traumatic events such as natural disasters, accidents, war, terrorism, interpersonal violence and shock at the sudden death to a loved one. The emergence of similar types of symptoms from these very different types of traumatic events suggests a common underlying process of symptom formation (McFarlane, 2002). The diagnosis of PTSD occurs with the characteristic emergence of a cluster of three symptom groups, namely, intrusive memories, avoidance and emotional numbing, and hyperarousal, for a period of at least one month.

The re-experiencing of the trauma via intrusive memories is viewed as a primary symptom in the diagnosis of PTSD (van der Kolk & van der Hart, 1991). Repeated involuntary memories may occur spontaneously or be triggered by a range of real or symbolic stimuli (McFarlane, 2002). These memories may be visual or sensory and may or may not be accompanied by extreme psychological distress and physiological responses. Some people may demonstrate a greater degree of dissociation and experience traumatic dreams or flashbacks.

Symptoms of avoidance and emotional numbing can dominate the clinical presentation of PTSD in some people (McFarlane, 2002). The person may actively avoid places, activities and other circumstances that are related to their traumatic experience. In addition, they may experience a general numbing of their emotional responsiveness and avoid thoughts, feelings or conversations associated with their trauma. Furthermore, they may block out memories about the trauma, demonstrate a diminished interest in normal activities, have a reduced range of affect, and feel detached from others.
Posttraumatic stress disorder also results in a pattern of increased physiological arousal. This may include sleep disturbances, problems with memory and concentration, insomnia, irritability, hypervigilance and an exaggerated startle response. This pattern of hyperarousal may become the dominant clinical picture particularly in chronic cases of PTSD (McFarlane, 2002).

There are currently two systems for the diagnosis of PTSD, DSM-IV (American Psychiatric Association, 2000) and the ICD-10 (World Health Organisation, 1992). Despite broad agreement on the key symptoms that constitute PTSD diagnosis, DSM-IV and ICD-10 demonstrate significant differences in the importance that is placed on symptom clusters and the need for personal appraisal of impact. The DSM-IV is more stringent and has been demonstrated to identify 2.5 fold fewer cases of PTSD than the ICD-10 criteria (Lehmann, Mattiske, & McFarlane, Manuscript in preparation). The diagnostic criteria for both systems are summarised in Chapter 3.

Lehmann, Mattiske and McFarlane (Manuscript in preparation) analysed the Australian NSMHWB to investigate the differences between outcomes for people who were diagnosed by DSM-IV or ICD-10. In this study the CIDI-2.1 interview schedule, which can be scored for either diagnostic criteria, was used for the diagnosis of PTSD within the past 12 months. They found that people diagnosed with PTSD using the DSM-IV criteria suffered significantly more co-morbid Axis 1 disorders (82.3%) than those diagnosed with ICD-10 criteria (49%). Furthermore, 57% of the DSM-IV group had two or more Axis 1 diagnoses compared with 25.7% for those in the ICD-10 group. Lehmann and colleagues proposed that the results indicated a ‘stepping’ effect with the DSM-IV group having significantly higher levels of co-morbidity and disability than the ICD-10 group, who in turn had significantly higher levels of co-morbidity and disability than those without PTSD.
2.1.1.5. **Longitudinal course of PTSD**

The experience of an extremely stressful event is often followed by an acute stress reaction. The further development of an acute stress disorder has been linked with an increased risk of later development of PTSD (Harvey & Bryant, 1998). However, the level of this acute reaction may be less important in the development of PTSD than the presence of persistent dissociation and early symptoms of hyperarousal and the individual’s ability to modulate their acute response and restore homeostasis (McFarlane, 2003). Once PTSD has developed, its course is variable. The DSM-IV defines three subtypes, acute PTSD which refers to symptoms less than three months duration, chronic PTSD which refers to symptoms that last for more than three months, and delayed onset which refers to symptoms that begin greater than six months after the trauma (American Psychiatric Association, 1994). However, studies have found a broader range of outcomes (McFarlane, 1988b; Solomon, Kostler, Shalev, & Lin, 1989) which have led to suggestions that the number of subtypes needs to be expanded to account for the range of outcomes from natural remission, through intermittent recurrence and reactivation, to residual and long term chronic disability (Blank, 1993). Several longitudinal studies have found significant levels of chronic PTSD years later. For example, a 14-year follow up of the 1972 Buffalo Dam Creek collapse found the current prevalence of PTSD in the follow up sample had dropped from 44% at two years post trauma to 28% 12 years later (Grace, Green, Lindy, & Leonard, 1993). The large community based National Co-morbidity Study found that PTSD was likely to resolve in 60% of people over the first six years post trauma, with resolution occurring earlier for those who had sought treatment (Kessler et al., 1995). Therefore, for 40% of people with PTSD, a chronic condition develops which may be unremitting, or oscillate between active symptoms and remission (Davidson et al., 2004; McFarlane, Yehuda, & Clark, 2002). In a study of Holocaust survivors symptoms consistent with PTSD have been found almost 50 years later (Silow, 1993).
The nature of the symptom presentation is thought to change over the course of the disorder, with intrusive symptoms decreasing, while symptoms of avoidance and emotional and interpersonal disconnection, and hyperarousal increase (McFarlane, 1996). These changes may alter the effectiveness of the current diagnostic criteria to detect various forms of PTSD (Blank, 1993; McFarlane, 2002). Further, the co-morbid presentation of major depression and anxiety disorders, particularly panic disorder and phobias, also show a pattern of recurrence that adds to the long term morbidity (McFarlane, 1996). Yehuda and colleagues (Yehuda et al., 2000) found adult offspring of Holocaust survivors with a lifetime diagnosis of PTSD had a greater level of depressive and anxiety symptoms compared to offspring without a diagnosis of PTSD, demonstrating greater ongoing mental health problems in the PTSD group. Moreover, McFarlane (1996) concluded that both the clinical and biological evidence indicates that a series of biological changes occur in PTSD which are likely to be permanent, remaining even when the symptoms remit, leaving the individual vulnerable to other psychiatric disorders and further adverse life events.

2.1.1.6. Models of PTSD development

Because most people who experience a trauma do not go on to develop PTSD, research has focussed on why some people develop PTSD and others do not. Posttraumatic stress disorder is thought to develop due to an atypical biological response in the period immediately after the traumatic experience which ultimately leads to a cascade of physiological and behavioural maladaptions (Davidson et al., 2004). A study of over 3300 twins exposed to combat identified specific genetic variance for PTSD of 13.6%, a shared genetic variance of 21.3% with other psychiatric disorders, with the remaining variance thought to be due to environmental factors (Chantarujikapong, Scherrer, & Xian, 2001). A meta analysis of trauma exposed adults identified three risk factors for developing PTSD that have been consistently found across studies: a previous history of psychiatric problems, a family history
of psychiatric disorders; and a history of childhood maltreatment (Brewin, Andrews, & Valentine, 2000). However, this study was not inclusive of all suspected risk factors such as prior trauma other than child maltreatment (Breslau, 2002). Other studies such as Resnick and colleagues (1995) found increased risk of PTSD following rape if a prior assault had been experienced, suggesting that prior trauma exposure is a risk factor for development of PTSD after later traumas. Childhood violence also leads to an increased risk of victimisation in adulthood (Bremner, Southwick, Johnson, Yehuda, & Charney, 1993; Nishith, Mechanic, & Resick, 2000; Widom, 1999; Zlotnick et al., 1996) suggesting that an indirect link between child maltreatment and adult PTSD may occur. The genetic influence combined with the additive affects of trauma exposure support a diathesis stress model for the development of PTSD.

A range of psychological models have been proposed to help explain the onset and maintenance of PTSD (for a review see McGarvey & Collins, 2001). However, it is the advances in the biological underpinning of PTSD that has attracted the bulk of research interest in this area. Posttraumatic stress disorder is essentially viewed as a disorder of memory where the traumatic memory is not properly integrated and dominates the patient’s consciousness (van der Kolk & van der Hart, 1991). The continued exposure via re-experiencing symptoms maintains the distress and increases physiological arousal, which in turn alters perceptions about the level of threat and lead to avoidant behaviours in an attempt to reduce anxiety (McFarlane, 1996). Findings of alterations in cortisol production and various brain structures involved in memory and the fear responses have led to the development of biological models such as the neural network model (McFarlane et al., 2002), and cascade model (Davidson et al., 2004), which essentially propose that the traumatic experiences trigger a chain of neurological and biological events which ultimately lead to...
behavioural changes and PTSD. Research into the biological changes found after trauma are reviewed in the next section.

2.1.2. Biological Impact of Trauma

Multiple neurotransmitter systems, including catecholamine, dopamine, serotonin, and GABA systems, as well as multiple neuroendocrine axes, such as the HPA axis, the hypothalimic-pituitary-thyroid axis, the hypothalamic-pituitary-growth hormone axis, and the hypothalamic-pituitary-gonadal axis, may be affected by stress and trauma (Lipschitz et al., 1998). Alterations in the sympathetic nervous system have been demonstrated. For example, higher heart rates immediately following trauma exposure have been found in non-physically injured trauma victims who later went on to develop PTSD (Shalev et al., 1998). In addition, increased levels of circulating norepinephrine have been found in patients with chronic PTSD (Southwick, Yehuda, & Wang, 1998). Yehuda (2002) proposes this increased reactivity of the sympathetic nervous system combined with increased thyroid activity may be responsible for some of the somatic symptoms associated with PTSD (Yehuda, 2002). Furthermore, neuroanatomical studies of PTSD patients have found functional changes in two major brain structures associated with fear and memory, the amygdala (Liberzon et al., 1999; Rauch et al., 2000) and the hippocampus (Schuff et al., 2001; Vasterling, Brailey, Constans, & Sutker, 1998). However, the majority of biological studies have addressed the alterations found in the HPA axis. These changes will be addressed in the following sections, after a brief introduction of the major components of this system and methods used to test its efficacy.

2.1.2.1. The HPA system

The front line of defence in the human stress system is the steroid hormone cortisol, the main glucocorticoid produced by the HPA system. It operates in conjunction with the
catecholamines, epinephrine and norepinephrine (adrenaline and noradrenaline), which are controlled by the sympathetic-adrenomedullary system.

2.1.2.1.1. Normal production of cortisol

Cortisol, with other hormones, plays an important role in homeostasis, normal metabolic processes and the anti-inflammatory response, as well as a major role in the body’s response to stress (Tortora & Grabowski, 1993). Production of cortisol follows a normal diurnal rhythm which is unrelated to stressful challenges (Bailey & Heitkemper, 1991). The highest levels of circulating cortisol are found in the morning with levels rising to a peak in the first 30 minutes after wakening, followed by a rapid decrease over the next hour before a more gradual decline over the remainder of the day (Schmidt-Reinwald et al., 1999), with there being approximately a 10-fold difference between morning and evening levels (Goodyer, Herbert, Tamplin, & Altham, 2000). This pattern of cortisol production is established by the time infants are 3 months old and is linked to the sleep-wake and day-night cycles (Price, Close, & Fielding, 1983). Basal levels are maintained by pulses of cortisol being produced throughout the day, with more frequent pulses occurring in the morning (Deuschle et al., 1997). The level of serum cortisol is tightly controlled by a negative feedback system using corticoid receptors in the pituitary, hypothalamus and hippocampus (Jacobson & Sapolsky, 1991), with high levels of cortisol triggering the shut down of cortisol production. The large individual differences found in basal level production of cortisol and reactivity to stress are thought to be an important variable in the development of both physical and mental health problems (Goodyer et al., 2001; Hellhammer et al., 2004). The large individual variability in basal level cortisol may occur from differences in various components of the HPA axis. Genetic factors play an important role in individual differences with an estimated heritability of 62% for basal level of cortisol (Bartels, van der Berg, Sluyter, Boomsma, & de Geus, 2006).
2003). However, epigenetic and environmental factors also play a significant role in the individual differences found in the regulation of the HPA axis (Wust et al., 2004).

2.1.2.1.2. Normal stress response

The body attempts to maintain a constant physiological environment despite the varying stresses placed upon the system. However, if stress is extreme, long lasting or unusual the normal mechanisms are not sufficient. When this occurs, the stress triggers a stronger response called the stress response and prepares the body for emergency (Seyle, 1973).

When stressors appear they may initiate a stress response through two pathways. The first is the alarm reaction which is short lived and predominately involves the sympathetic nervous system and the production of epinephrine and norepinephrine that increase heart rate, blood pressure, blood flow and glucose to the muscles. The second is a more sustained response via the HPA axis. During stress the hypothalamus secretes a peptide called corticotrophin-releasing factor (CRF) which stimulates the pituitary gland to produce adrenocorticotrophic hormone (ACTH), which enters the blood stream and stimulates the adrenal gland to produce cortisol. This response provides the body with the energy, enzymes, and circulatory changes required to meet a wide range of stressors such as strenuous activity, emotional challenges, and physical trauma (Tortora & Grabowski, 1993). Cortisol levels produced are thought to be proportional to the magnitude of the stressor, with circulating cortisol levels returning to normal within several hours. This reduction in cortisol is controlled by the negative feedback system through the cortisol receptors in the pituitary, hypothalamus and hippocampus. There are two main types of receptors involved in this regulation, the mineralocorticoid receptors (MR) and the glucocorticoid (GR) receptors, with the higher affinity MRs being predominately occupied under basal level conditions and GRs under stress conditions (Reul & De Kloet, 1985; Young, Lopez, Murphy-Weinberg, Watson, & Akil, 1998). Increased cortisol levels are also involved in the negative feedback control of the sympathetic nervous
system. Differences in various components of the stress response as well as basal level production of cortisol have been studied in relation to PTSD.

2.1.2.1.3. Measurement of the stress response

Cortisol is the most frequently measured component of the stress response due to its ease of collection and measurement. Other components such as CRF (Baker et al., 1999; Bremner et al., 1997), ACTH (Dahl et al., 1991), and cortisol metabolites (Lundberg, De Chateau, Winberg, & Frankenhauser, 1981; Tennes, Downey, & Vernadiakis, 1977) have been studied but require the collection of cerebral spinal fluid (CSF), blood, and 24-hour urine, respectively. Cortisol can be measured in both blood and saliva, with saliva collection being preferred, particularly with infants and children, as it is non-invasive and can easily be collected by the participant or parent (Gunnar & Donzella, 2002). Blood samples contain greater amounts of cortisol (95% protein bound and 5% unbound fractions) where as saliva contains only the unbound active component (Goodyer et al., 1996; Kirschbaum & Hellhammer, 1994). Levels of cortisol found in saliva have been found to highly correlate with serum levels and levels of CRF in CSF (Guazzo, Kirkpatrick, Goodyer, Shiers, & Herbert, 1996). Given the diurnal rhythm of cortisol production, the timing of collections are important and need to be taken into consideration when comparing studies (Goodyer et al., 2001).

Some studies have investigated differences in basal level production of cortisol to assess possible long term alterations in the production of cortisol, such as studies of ongoing maternal stress and depression on infant cortisol production (Essex, Klein, Cho, & Kalin, 2002), effects of child care (Dettling, Gunnar, & Donzella, 1999; Dettling, Parker, Lane, Sebanc, & Gunnar, 2000), child abuse (Cicchetti & Rogosch, 2001b; De Bellis, Baum et al., 1999; King, Mandansky, King, Fletcher, & Brewer, 2001), adult survivors of severe trauma
(Yehuda et al., 2001), and environmental stressors such as poverty (Lupien, King, Meaney, & McEwen, 2000, 2001). Other studies have specifically investigated the current stress response levels by collection of saliva before and after behavioural challenge tasks (Gunnar, Brodersen, Kreuger, & Rigatuso, 1996; Gunnar, Larson, Hertsgaard, Harris, & Brodersen, 1992; Ramsay & Lewis, 2003). In addition, dysregulation of the HPA axis has been tested by pharmacological stimulation or inhibition which yields valuable information on the functioning of the HPA system without the need higher cortical processing. Stimulation of the HPA system is done by either injections of CRF or ACTH which allows the assessment of both ACTH and cortisol, or cortisol production alone, in response to known amounts of chemical stimulus (Christine Heim, Jeffery, Bonsall, Miller, & Nemeroff, 2001).

Dexamethasone (DEX) is used to suppress the HPA axis and therefore can be used to measure feedback sensitivity of the HPA axis (Gunnar & Vazquez, 2001). Dexamethasone is administered in the evening when cortisol levels are low and therefore suppresses the early morning peak of cortisol production. Failure to suppress the production of cortisol following DEX indicates an under active negative feedback system, where as prolonged suppression is indicative of an over active negative feedback system. Both basal level cortisol production and cortisol response to stress have been found to be stable in infants by 12 months of age (Goldberg et al., 2003). Even though cortisol fluctuates across the day due to daily stressors basal level cortisol levels have been shown to be stable over time establishing its usefulness as a marker for vulnerabilities (Yehuda et al., 2000).

2.1.2.1.4. Effects of PTSD on the HPA axis

Research into the normal variation of stressors in early life has found associated variation in the HPA axis responsiveness. Animal studies using the ‘neonatal handling’ paradigm, which mimics normal variation in maternal handling of rat pups, have demonstrated increased levels of hippocampal GR levels, sensitivity to negative feedback and lower plasma levels of
cortisol throughout life (Meaney, 2001; Meaney, Aitken, Viau, Sharma, & Sarrieau, 1989). Moreover, normal neonatal handling of rodent pups leads to the specific activation of only one of six possible type of GR mRNA that is specifically used in the hippocampus suggesting an environmental activation of tissue specific proteins (McCormick et al., 2000). In contrast, many studies mimicking negative environmental input have found the opposite effects which has led to the hypothesis that severe or chronic levels of stress may lead to a more reactive HPA system which in turn increases the individual’s risk to later emotional disorders, particularly if the stress occurred during childhood (Cicchetti & Rogosch, 2001a; De Bellis, Baum et al., 1999; De Bellis, Keshavan et al., 1999; Gunnar & Vazquez, 2001; Heim, Owen, Plotsky, & Nemeroff, 1997; Sanchez et al., 2001; Southwick et al., 1998).

Animal studies have found that the direct administration of CRF to the brain yields behavioural and physiological symptoms similar to those seen with stress, depression and anxiety (Matsuzaki, Takamatsu, & Moroji, 1989). Recent reviews of the animal literature (Caldji et al., 2001; Ladd et al., 2000; Sanchez et al., 2001) reported that consistently strong evidence has been found that adverse stress or trauma in the prenatal and postnatal periods result in adult animals exhibiting behaviours such as anxiety, hypervigilance, preference for ethanol, and cognitive deficits. These reviews also reported consistent findings in relation to the increased activity of the HPA system, measured by both ACTH and corticosterone (rodent cortisol) activity when adult rodents exposed to early life stress or deprivation were exposed to stressful situations. Further, inhibition studies found trauma exposed rodents failed to engage the normal negative feedback mechanisms following administration of DEX indicating reduced negative feedback. A review of the non-human primate literature found traumatised animals also consistently displayed anxiety-like behaviours, depression, social and sexual dysfunction and behavioural disorganisation (Suomi, 1997). However, in contrast to the rodent literature, Sanchez (2001) noted the endocrine results have been less clear for
nonhuman primates, with both increases and decreases in basal level cortisol being found, and either no differences in HPA responsivity to stressful stimuli or blunting of the HPA response, despite behavioural problems being evident. Inconsistencies in HPA basal levels and responsiveness to stress have also been found in human studies.

One of the few consistent findings in studies of human cortisol and psychopathology is the raised evening cortisol levels found in over a third of severely depressed adults (Gold, Goodwin, & Chrousos, 1988; Plotsky, Owens, & Nemeroff, 1998) and adolescents (Goodyer et al., 1996). In contrast to animal studies and human studies of depression, human studies of trauma victims have yielded mixed results with some counter to expectations. Many of these earlier studies were retrospective in nature and in relation to child maltreatment. Comparisons between studies are confounded by the presence of co-morbid depression, current versus past trauma experiences, lack of systematic evaluation of PTSD, variations in group comparisons, and the different levels of the HPA axis measured. Despite these difficulties, and within an historical context, a consensus of opinion from both the child and adult literature was reached that elevated CRF levels and hypersecretion of cortisol occurs initially following traumatic experiences which over time gives way to hypocortisolism characterised by low cortisol, flattened daytime patterns, and blunted cortisol responses to induced stress thought to occur due to increased negative feedback (De Bellis, Baum et al., 1999; Gunnar & Vazquez, 2001; Heim, Ehlert, & Hellhammer, 2000; Yehuda, Teicher, Trestman, Levengood, & Siever, 1996). In addition, these authors suggested that this alteration of the HPA axis, combined with genetic vulnerability, predisposed these individuals to increased risk of affective and anxiety disorders including PTSD. Differences between adults and children were thought to reflect maturation or long term adaptation of the HPA axis after trauma experience (De Bellis, Baum et al., 1999; Tarullo & Gunnar, 2006). However, no prospective studies have been published to verify these speculations, although
more recent studies which have been more specific in their measurement of PTSD have shown a somewhat clearer picture of HPA axis activity post trauma.

There is now considerable evidence of HPA axis dysfunction in adults with PTSD (for recent reviews see Davidson et al., 2004; Yehuda, 1997, 2002, 2006). Basal cortisol levels are often found to be lower in people with PTSD, although findings of similar and higher levels have also been reported (Yehuda, 2006). Other findings such as decreased basal levels of 24-hour urinary cortisol (Mawson, Giller, Kosten, Ostroff, & Podd, 1986; Yehuda, Kahana et al., 1995), decreased basal 24-hour plasma cortisol levels (Yehuda et al., 1996), exaggerated suppression of cortisol in response to the inhibitive effect of DEX (Yehuda, Boisoneau, Lowy, & Giller, 1995), reduced ACTH response to administration of CRF (Yehuda, 1997), and increased levels of CRF (Bremner et al., 1997) have led researchers to conclude that many individuals with PTSD have an increased negative feedback system in the HPA axis (Lipschitz et al., 1998; Yehuda, 1997). However, not all findings have followed this pattern (Lemieux & Coe, 1995; Pittman & Orr, 1990). Another alternative explanation is reduced adrenal output (Yehuda, 2006), but neither model fully accounts for the data found.

Of particular interest, a range of prospective studies found that low cortisol levels immediately following rape (Resnick, Yehuda, Pitman, & Foy, 1995), and motor vehicle accidents (MVA; Anisman, Griffiths, Matheson, Ravindran, & Merali, 2001; Delahanty, Raimonde, Spoonster, & Cullado, 2003; McFarlane, Atchison, & Yehuda, 1997) and prior trauma history were predictive of subsequent PTSD development. These studies suggest that prior trauma may reduce the cortisol response to later trauma and in turn increase the risk of developing PTSD (Delahanty & Nugent, 2006; Delahanty et al., 2003; McFarlane et al., 1997; Resnick et al., 1995). This hypothesis has led to the recent proposal that PTSD may be an extension of the normal stress response whereby low levels of cortisol, a result of
enhanced negative feedback, fail to control the acute stress response at the time of the trauma. This results in a cascade of biological and psychological changes (Davidson et al., 2004; Yehuda, 2002). Further, these authors suggest that one of the immediate consequences of reduced cortisol would be the continued activation of the sympathetic nervous system. This would lead to the extended availability of norepinephrine to brain synapses which may facilitate the enhanced memory consolidation of the trauma and increased somatic symptoms (Yehuda, 2002). Support for this hypothesis comes from animal studies (Jeong et al., 2000; Pacak, Palkovits, Kopin, & Goldstein, 1995) as well as human findings such as the association of intrusive thought with lower morning cortisol levels found following the Armenian earthquake (Goenjian et al., 1996). Hypocortisolism has also been found to be associated with a range of health problems involving burnout and somatic complaints (Hellhammer et al., 2004).

If low cortisol is a risk factor for PTSD, what leads to low cortisol levels? As reviewed earlier, researchers have speculated that trauma experiences, particularly in childhood, initially increase the cortisol response. But if it remains high for extended periods of time the system becomes exhausted resulting in the increased negative feedback and flattened cortisol production (Gunnar & Vazquez, 2001; Heim, Ehlert & Hellhammer, 2000; De Bellis, Baum et al., 1999; Yehuda et al., 1996). In support of this hypothesis are two recent prospective studies by Delahanty and colleagues (2003, 2005). One study assessed urinary cortisol following the impact of ‘first-time’ childhood trauma (non-maltreatment, aged 8-18 years) and found higher levels of urinary cortisol and epinephrine (controlling for depression) following a physical trauma severe enough to require hospitalisation. However, the addition of children with prior trauma experience did not alter the outcome. Problematically, only a small percentage of children in this study meet the full diagnostic criteria for PTSD and therefore the study compared cortisol levels to PTSD symptom level (Delahanty, Nugent,
Christopher, & Walsh, 2005). Although numbers were small, gender differences were found with a significant gender by PTSD interaction for boys but not girls, with the girls often presenting opposite cortisol patterns (low). The finding of higher cortisol in children post trauma is in line with an earlier urinary cortisol study of maltreated children with chronic PTSD, although no gender differences were found (De Bellis, Baum et al., 1999). De Bellis and colleagues did find an association between length of maltreatment and cortisol levels. To further complicate the picture, a study of 5 to 7 year old girls who had experienced sexual abuse within the past two months had significantly lower cortisol levels than matched controls (King et al., 2001). These differing results may reflect gender differences in initial reactions to trauma and warrants further investigation. Importantly for the above hypothesis, the results from Delahanty’s child study (Delahanty et al., 2003) were in direct contrast to a similar study conducted by the same research group with adults following MVA in which they found prior trauma and low cortisol predicted PTSD development (Delahanty et al., 2003). Extended longitudinal studies of traumatised children will need to be carried out to determine if this causal pathway is correct. If so, this is unlikely to be the only causal pathway with some studies indicating a possible intergenerational transmission.

2.1.2.1.5. Intergenerational transmission of PTSD

Animal studies suggest that the vulnerability to later psychopathology following early trauma may in part be heritable (Sanchez et al., 2001). Human twin studies have found significant genetic influence in the variability of individual cortisol levels (Bartels et al., 2003) and individual susceptibility to PTSD (Chantarujikapong et al., 2001). These studies have also found variance that is accounted for by environmental influences. Possible environmental influences related to maternal behaviour will be addressed later. This section will review the literature in relation to the potential interaction between trauma and biological factors that may be involved in intergenerational transmission of PTSD.
Solomon, Kolter and Mikulincer (1988) found that the offspring of Holocaust survivors were more likely to develop PTSD after experiencing war combat than offspring of parents who did not experience the Holocaust. Following on from this, a series of studies conducted by Rachel Yehuda on the adult offspring of Holocaust survivors has raised the possibility of intergenerational transmission of low cortisol and vulnerability to PTSD. Holocaust survivors have been found to have higher lifetime prevalence rates of PTSD and as such constitute a high risk group (Yehuda, Schmeidler, Wainberg, Binder-Brynes, & Duvdevani, 1998). Increased lifetime PTSD prevalence rates were also found in the offspring of the Holocaust survivors with the disorder (both parents) but not in offspring of survivors without the disorder suggesting some type of familial link in the development of PTSD (Yehuda, McFarlane, & Shalev, 1998). Further, significant associations were found between low urinary cortisol concentrations in adult offspring, lifetime PTSD and parental PTSD suggesting parental PTSD was a possible risk factor for both low cortisol and development of PTSD (Yehuda et al., 2000). However, further investigation also found an increase in child maltreatment in the offspring, with emotional and sexual abuse predicting PTSD in addition to parental PTSD, indicating prior childhood trauma was an independent risk factor for the disorder (Yehuda et al., 2001). In addition, this study found a strong relationship between low cortisol levels in offspring, emotional abuse during childhood, and PTSD. Interestingly, a relationship between low cortisol and sexual abuse was only found in the presence of PTSD, while sexual abuse experience without the disorder yielded elevated levels of cortisol. Given the link between low cortisol, PTSD and prior trauma exposure, the presence of high levels of child maltreatment in the offspring of Holocaust survivors makes it difficult to determine whether low cortisol and posttraumatic stress in the offspring is related to their own trauma experiences or that of their parents.
To obtain a clearer picture of intergenerational transmission of PTSD in the absence of child maltreatment Yehuda and colleagues (Brand, Engel, Canfield, & Yehuda, 2006; Yehuda et al., 2005) conducted a study of 98 women who were pregnant at the time they were directly exposed to the terrorist attacks on the World Trade Centre. This study measured the morning and evening basal cortisol levels of both mothers and infants when the infants were approximately 9 months old. Significant correlations were found between maternal and infant cortisol levels, but no correlations were found between maternal symptoms of depression and infant cortisol. The mothers were assessed for PTSD using a short questionnaire that covers the three symptom clusters found in PTSD, with clinical cut-off scores being suggestive of PTSD (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). Mothers with PTSD were found to have significantly lower levels of both morning and evening cortisol than those without. Further, Yehuda and colleagues (2005) reported infants of mothers with PTSD also had low cortisol (subset of 38 women). When the effects of the trimester of pregnancy at time of trauma were included in the analysis, low infant cortisol was found to be significant for the third trimester only. Unfortunately, no indication was given of group sizes. A scatter plot of infant morning cortisol and maternal scores on the trauma questionnaire suggest the numbers in the PTSD group would have been very small if the normal cut-off value was used. Even though the sample size is small, these results are in line with the previous Holocaust studies by Yehuda reviewed above but without the confounding problem of child maltreatment. In addition, the association between maternal PTSD, low infant cortisol, and trauma occurring in the third trimester of pregnancy implicates in utero effects as a mechanism for the transgenerational risk of PTSD (Yehuda et al., 2005). Also, mothers with PTSD rated their 9 month old children as showing more distress to novelty compared to mothers without PTSD (Brand et al., 2006). The mothers with PTSD did not generally rate their children negatively indicating this result was unlikely to be due to a generalised negative perception of their children. These results suggest that mothers with a greater susceptibility for developing
PTSD may have infants who are more temperamentally shy or fearful when confronted with novelty.

Prenatal influences of stress and cortisol have been associated with child and adult outcomes in both animal and human studies (for reviews see Seckl, 2001; Seckl & Meaney, 2006; van den Bergh et al., 2005; Weinstock, 2005). Human studies have found severe maternal stress impacts on foetal behaviour and results in lower scores on neurobehavioural measures postnatally (Hepper, 2002). The prenatal period is a time when the environment can exert pressure on a range of genes to alter phenotypic expression and influence developmental outcomes (Crews & McLachlan, 2006). In relation to the HPA axis, Seckl (2001, 2006) proposes that prenatal stress in the mother can alter the in utero environment of the foetus and set the responsiveness of the HPA axis of the offspring, a process termed ‘early-life programming’ or ‘imprinting’. Seckl further proposes that a possible mechanism for this trans-placental programming of the HPA axis is the specific timing and action of the type 2 11β-hydroxysteroid dehydrogenase (11β-HSD-2) enzyme which rapidly converts maternal cortisol to inactive cortisone. Exposure to high levels of cortisol has been found to be detrimental to the developing brain, particularly the hippocampus (Uno et al., 1990). The abundant presence of 11β-HSD-2 in the foetal CNS is thought to protect the developing brain by inactivating the maternal cortisol that crosses the placenta. Both animal and human studies have found that the expression of 11β-HSD-2 is dramatically turned off after mid-gestation, approximately weeks 19-26 gestation in humans (Brown et al., 1996; Stewart, Murry, & Mason, 1994). Seckl (2001) proposes that this mechanism of switching on and off 11β-HSD-2 enzyme production provides a critical period during gestation to set the infants HPA axis to reflect the in utero environment. Moreover, the effect of this programming may persist throughout life.
Most research into the effects of prenatal stress and glucocorticoids has been in relation to increased levels of cortisol. Exposure to high levels of prenatal cortisol in rats results in high basal levels of cortisol in adulthood, due to what are thought to be permanent decreases in the density of both GRs and MRs in the hippocampus (Welberg, Seckl, & Holmes, 2001). A recent study of prenatal stress in pigs also found increased cortisol production in offspring as well as differential patterns of increased CRF mRNA expression depending on what stage of gestation the mother was exposed to stress (Jarvis et al., 2006). Stress in the second trimester led to increased CRF production in the hypothalamus and the amygdala, while stress in the third trimester resulted in increases in the amygdala only. Exposure to high levels of cortisol during pregnancy has been associated with impaired coping during stressful events in adult rats (Welberg et al., 2001), and abnormal maternal behaviour in the offspring of pigs exposed to stress in utero (Jarvis et al., 2006).

Human studies have found infants exposed to multiple doses of glucocorticoids, given during foetal development due to risk of preterm delivery, are at increased risk of behavioural and attentional problems (French, Hagan, Evans, Godfry, & Newnham, 1998). Furthermore, associations have been demonstrated between maternal anxiety in late pregnancy and increased morning cortisol levels in 10 year old offspring (O'Connor et al., 2005). Previous studies of this and other large cohorts have shown increased risk of emotional and behavioural problems following prenatal maternal anxiety; with regulation problems in newborns; reduced attention and general development in infancy; attentional, hyperactivity and behavioural and emotional problems in childhood; and low IQ in adolescents. (O'Connor, Heron, Golding, Michael, & Glover, 2002; van den Bergh & Marcoen, 2004; van den Bergh et al., 2005). These effects have remained significant after controlling for confounding prenatal factors, as well as postnatal depression and anxiety. The negative effect of the specific timing of exposure to anxiety during pregnancy is unclear with studies showing a
variety of outcomes depending on different time of exposure, suggesting different mechanism may be operating at different developmental stages (van den Bergh et al., 2005). Exposure at 32 weeks gestation has been shown to be a strong predictor of emotional and behavioural problems at age 4 and 7 (O'Connor, Heron, Golding et al., 2002). Moreover, in a recent review van den Bergh and associates (2005) have suggested that foetal programming of the HPA axis, limbic system and prefrontal cortex was the likely link between prenatal anxiety and child development outcomes, with high levels of cortisol during neurogenesis being detrimental to neurons in these areas. In addition, the prenatal environment is thought to interact with genetic factors to define the infant’s phenotype. The prefrontal cortex is involved with executive processes such as control of attention and working memory, and is essential for the control and integration of cortical functions. Yehuda and colleagues (2005), propose that if high maternal stress and subsequent high maternal cortisol can up-regulate the HPA axis of offspring then it is possible that low maternal cortisol levels could down regulate the HPA axis of offspring. This down regulation may occur by increasing levels of MRs and GRs in various brain structures such as the hippocampus. Moreover, in a review on flattened diurnal cortisol patterns, Gunnar and Vazquez (Gunnar & Vazquez, 2001) speculated that low morning cortisol may reduce a child’s ability to maintain attention to their environment across the day, and subsequently have a negative impact on learning. Although little is known about low cortisol levels in children, one study that found flattened cortisol patterns on school days were related to more behavioural problems including poorer attention supports this hypothesis (Spangler, 1995).

Several recent studies on depression during pregnancy have reported links with later child outcomes. One study found that mother’s prenatal levels of cortisol and norepinephrine predicted infant levels of cortisol postnatally (Field, Diego, Hernandez-Rief et al., 2004). A study by Hout and colleagues found prenatal but not postnatal maternal depression predicted
infant cortisol level at 6 months and negative affect in children between 6 months and 5 years of age (Huot, Brennan, Stowe, Plotsky, & Walker, 2004). In line with these studies, newborn babies of depressed mothers have been found to have poorer scores on the Brazelton Neonatal Assessment Scale (Field, Diego, Dieter et al., 2004), and higher levels of irritability (Zuckerman, Bauchner, Parker, & Cabral, 1990). These and other studies suggest that problems with maternal depression and negative child outcomes may be part of a sequence of events that start during pregnancy.

Only the study by Yehuda and colleagues (Yehuda et al., 2005) of pregnant mothers exposed to the World Trade Centre attacks has investigated the association between the effects of PTSD, basal level activity of the maternal HPA axis, and the subsequent basal level activity of the infant HPA axis. Although this study was small it did suggest that in utero programming of low basal level activity of the infants HPA axis may have occurred. Apart from small numbers, this study also did not report detailed information in relation to prior history of maternal trauma, nor did they use standard interviews for the diagnosis of PTSD but relied on a short self report questionnaire relating to current levels of symptoms. Their follow-up study using a larger sample also found associations between maternal PTSD and maternal low cortisol and infant distress to novelty (Brand et al., 2006). The current study proposes to advance the information in this area by investigating the relationship between maternal trauma before pregnancy (not during pregnancy), PTSD diagnosis, current symptom level, and the pattern of cortisol production in both the mother and the infant, as well as infant cognitive, emotional and behaviourial development. In addition, postnatal influences in relation to maternal behaviour will also be investigated. The next section will review the literature in relation to the impact of stress and PTSD on parental behaviour in the postnatal period and the possible effect on the developmental outcomes of the infant.
2.2. Impact of Trauma on Parenting Behaviours

Despite recent research implicating the prenatal period as a critical time for the negative impact of maternal stress, depression or anxiety on infant development, these maternal problems are not likely to disappear once the infant is born. Therefore, the subsequent impact of maternal parenting behaviour on the development of the child cannot be ignored. It is a challenge to researchers to understand the relative importance of these prenatal and postnatal effects in order to aid in decision making about the type and most effective early interventions possible. There is surprisingly little human research on the direct effects of trauma and PTSD on parenting. At the same time, with the symptom cluster of intrusive thoughts, psychological numbing and hyperarousal found in PTSD, it is not surprising that the few available studies as well as clinical evidence, suggest that trauma has a negative impact on relationships (McFarlane & Bookless, 2001), as well as on the ability to parent effectively and to be sensitive to the emotional needs of children (Appleyard & Osofsky, 2003). Further, indirect evidence from well documented research into carer-infant attachment, and postnatal maternal depression and anxiety, add significantly to the view that traumatic experiences and PTSD impact negatively on parenting and subsequently on child outcomes. This review will first report on animal studies of stress on maternal behaviour and intergenerational effects. In addressing human research in this area, an overview of attachment theory will be given before assessing the specific research on the effects of PTSD, depression, and anxiety on subsequent parenting and child outcomes. Where available, results from cortisol studies will be included.

2.2.1. Animal Studies

As discussed earlier, a series of studies by Meaney and colleagues (for review see Meaney, 2001) in rats has demonstrated postnatal programming of the HPA axis in specific brain areas such as the hippocampus (Meaney & Szyf, 2005). Taken together with work on prenatal
stress this indicates that there are both pre- and postnatal mechanisms for altering the HPA axis throughout life, with a similar molecular pathway for both implicated (Seckl & Meaney, 2006). In relation to behaviour, Meaney and colleagues (2001) have found that naturally occurring differences in maternal care such as licking and grooming (LG) and arch-backed nursing (ABN) altered not only the HPA axis but also the female pup’s later behaviour as a mother. Levels of LG and ABN in the mother can be increased by short term ‘normal’ mother-pup separations, or decreased by long ‘abnormal’ separations. The pups of low LG and ABN mothers have been found to have poorer stress responses and be more fearful as adults and demonstrate low LG and ABN with their own pups (Francis, Diorio, Lui, & Meaney, 1999). The converse is true for high LG and ABN pups. Cross fostering studies have found that the fearfulness and the later maternal behaviour of the pups represented the rearing mother’s behaviour not the biological mother’s clearly indicating maternal behaviour as the important factor. The pattern of high LG and ABN has also been reversed by stress during pregnancy with maternal behavioural changes continuing for subsequent litters (Champagne & Meaney, 2000). Several recent studies in non-human primates have also found associations between early environmental influences (such as varying foraging demands), maternal-infant interactions, and later stress responses and patterns of behaviour in the offspring (Bardi, Bode, Ramirez, & Brent, 2005) with the timing of environmental stress being important for both maternal and offspring responses (Coplan et al., 2006). In PTSD the effect on the HPA axis appears to be the same direction as the more positive maternal behaviours. As Yehuda (2006) has suggested on face value you would expect PTSD to be associated with poorer maternal behaviours. In humans the biologically driven infant-carer attachment system has been demonstrated to be affected by carer behaviours, with long term consequences.
2.2.2. Attachment: The Importance of the Carer-Infant Relationship

Human infants are born helpless and require continual support and sustenance from a mature human being for their ongoing survival. During this process of nurturing a strong affectionate bond, called the attachment bond, is formed between the infant and primary carers. In the early to mid 1900’s the dominant hypotheses in relation to the development of these bonds were from psychoanalytic and social learning theories (Freud, 1957; Sears, Maccoby, & Levin, 1959). These secondary drive theories were based on the infant associating pleasure with the carer when their hunger drive was satisfied (for an overview of these theories see Ainsworth, 1969). In the 1950’s, John Bowlby (Bowlby, 1951, 1958, 1969/1982, 1973, 1980; Weinfield, Sroufe, & Egeland) started to publish his ethological theory of attachment related specifically to these affective emotional bonds that develop between an infant and their main caregivers. Attachment theory is now viewed as the combined work of John Bowlby and Mary Ainsworth (1991), with Bowlby formulating the basic tenets of the theory and Ainsworth developing innovative methods for its measurement (Bretherton, 1992). Despite initial opposition, attachment theory has become the most influential theory of infant social emotional development and has focussed attention on the need for consistent sensitive parenting (Zeanah, 1996).

2.2.2.1. Attachment behavioural system

The development of the attachment relationship is thought to be dyadic and reciprocal with infant attachment behaviours (such as crying, smiling, vocalising, and approaching), eliciting care-giving behaviours from the attachment figure. These attachment behaviours are innate and ensure the increase in proximity of the attachment figure to the infant, which in turn increases the likelihood of protection and provides survival advantage. Bowlby (1979) postulated that the development of the intense emotions associated with attachment behaviours have resulted from evolutionary pressures (Bowlby, 1979).
Bowlby proposed that attachment behaviours are organised by an ‘attachment behavioural system’ (1969/1982). This system responds to a variety of internal and external cues as well as elicits a variety of behaviours which have similar meaning and serve similar functions. The presence of this stable internal organisation of the attachment system not only allows a child’s behaviours to vary with developmental abilities, but also allows for flexibility to environmental changes (Sroufe & Waters, 1977). The attachment system does not operate in an on-off way but is regulated by the infants desired level of proximity to the carer depending on the circumstances (Cassidy, 1999). Like the physiological systems (such as body temperature, blood pressure, and hormone levels) this behavioural homeostatic system is maintained within set limits, when fear is low the child moves away from their attachment figure to explore the environment, when fear increases they move closer and exploration diminishes or stops. The degree to which the attachment system is activated depends on the level of distress of the child. If distress is high, contact with the attachment figure may be necessary. If distress is moderate an increase in proximity or the attachments figures soothing voice may be enough to regulate the child’s emotions.

2.2.2.1.1. Secure base behaviour

The attachment system is closely linked to other behavioural systems, such as the exploratory and fear systems. Cassidy (Cassidy, 1999) noted that Bowlby focussed primarily on the exploratory and fear systems as they give survival advantage to the infant by allowing the individual to gain valuable information from exploration of their environment as well as protection by early recognition of danger (Bowlby 1969/1982). The presence of an attachment figure alone reduces the child’s susceptibility to fear (Ainsworth, 1963; Sorce & Emde, 1981). The interrelationship of the exploratory and fear systems with the attachment system allows the child to explore their environment when threat is low (low activation of fear and attachment systems) and seek proximity to their attachment figure when fear is high.
(high activation of the fear and attachment systems). The flexibility in this attentional behaviour is often termed the attachment-exploration balance or secure base behaviour (Ainsworth, 1969; Ainsworth, Bell, & Stayton, 1971). Despite this though, the majority of research has focussed on the attachment component with little attention given to the way in which exploration is helped or hindered by attachment security (Grossman, Grossman, & Zimmerman, 1999). Further, several European research groups have recently criticised infant research for focussing predominately on the attachment system without taking into account a variety of other interconnected motivational systems (Brisch, 2005; Grossman & Grossman, 2005; Stern, 2005).

2.2.2.1.2. Internal working model

Beyond infancy, attachment relations become governed by internal or mental representations of the attachment figure, the self, and the environment, based on their joint relationship history (Bretherton & Munholland, 1999). Bowlby termed these mental representations ‘internal working models’ (1969/1982; 1988). The internal working model (IWM) is viewed as a set of conscious and/or unconscious rules for the organisation of information regarding attachment-related experiences, feelings, and ideations that allow the individual to interpret behaviour, anticipate future behaviour and plan accordingly, therefore allowing the individual to operate in a more efficient manner (Main, Kaplan, & Cassidy, 1985).

As the child develops, their internal working models are revised and updated. The child with positive internal working representations of their attachment figure as being available and sensitive to their needs is free to fully attend to other positive experiences, such as learning from exploration of their environment or from interactions with others (Bretherton & Munholland, 1999). As these secure children become older they are able to use these working models to feel secure even when their attachment figures are not present. In addition, with the
development of language skills the child is able to view their attachment figures emotions,
desires and intentions (Wellman, 1990).

Working models are viewed as affectively stable as they become developmentally more
complex (Bretherton & Munholland, 1999). However, current working models are not only
dependent on past relationships but also current relationships and therefore are revised
throughout one’s life (Bretherton, 1990; Sroufe, Egeland, & Kreutzer, 1990). Stability of
attachment over time has been found to vary significantly depending on the nature of the
population being studied. Middle class, low risk samples have demonstrated very high levels
of stability of attachment security over time (Main & Cassidy, 1988; Wartner, Grossman, &
Fremmer-Bombik, 1994; Weinfield et al., 2000) whereas high risk poverty samples have
demonstrated considerably less stability (Weinfield et al., 2000) indicating that long term
continuity should not be expected where families undergo major changes in family
functioning or when they are under chronic stress (Solomon & George, 1999). However,
even within this background of instability in high poverty samples links have been found
between representational measures and both earlier experience as well as later experience
(Bowlby, 1988; Carlson et al., 2004). These studies support the view that working models are
both stable, but also dynamic over time allowing, at least in part, for the prediction of later
relationship patterns based on earlier attachment relationships (Bowlby 1988; Sroufe &
Fleeson, 1986). The development of the ability to share attention with a social partner,
termed joint attention (Mundy & Gomes, 1998), may be central to the development of the
IWM with joint attention allowing infants to transfer experience into a shared context and
meaning (Klaus, Grossman & Grossman, 2005).
2.2.2.2. Patterns of infant attachment

Attachment, as a biological system, should be universal. All children, except in some cases of extreme privation in infancy have been found to form attachments (Rutter et al., 1999). The infant’s first attachment(s) is usually formed by the seventh month of life to their primary carer(s) (Main, 2000). Children form attachments to maltreating parents (Carlson, Cicchetti, Barnett, & Braunwald, 1989; Crittenden, 1992; Morton & Browne, 1998) and depressed mothers (DeMulder & Radke-Yarrow, 1991) as easily as they do to nurturing ones. The difference found between children is not in the number of their attachment behaviours but in the quality of the attachments they form (Ainsworth et al., 1978; Main & Solomon, 1990; Sroufe & Waters, 1977). Cross cultural studies have supported the universality of attachment, with some differences found in distribution patterns of subgroups of secure and insecure attachments (van Ijzendoorn & Sagi, 1999).

Originally three patterns of attachment were identified by Mary Ainsworth based on extensive home observations and the development of the laboratory based Strange Situation Procedure (SSP), one secure and two insecure patterns (Ainsworth et al., 1978; Carlson & Sroufe, 1995; Main, 2000; Solomon & George, 1999). The SSP is an observational measure of the behavioural patterns of the infant following activation of the attachment system by two separations from their attachment figure when the child is 12-18 months of age. A detailed description of the SSP is given in Chapter 3. The secure infant displays a balance between secure base behaviours, that is, contact and proximity seeking with their carer when they are stressed (separation and reunion), followed by a smooth transition back to exploration and play when their carer returns, stress has subsided and threat is low. This is seen as an organised flexible pattern of behaviour which allows for maximum safety and exploration depending on the level of threat and is adaptive in both the short and long term. The secure
pattern (B) of attachment is thought to develop following a history of the carer being available and responsive when the child is over aroused (Ainsworth et al., 1978; Bowlby, 1988).

Two patterns of insecure attachment were identified, namely, avoidant (A) and resistant/ambivalent (C). These patterns minimise and maximise attachment behaviours, respectively. The avoidant infants display low levels of contact and proximity to their carers particularly in times of emotional need when they direct their attention away from their attachment figure. These children have a history of being rebuffed when they express their emotional needs and have developed the strategy of cutting off their feelings by focusing on the environment, enabling them to minimise the associated pain of rejection (Bowlby, 1980; Sroufe, 1983). This strategy is adaptive in the short term as the child can maintain the proximity of their carer without alienating them. In contrast, the ambivalent child has maximised their attachment behaviour by continually seeking contact with their carer to ensure they are always available if needed. This pattern of behaviour develops from a history of the carer being inconsistently available in times of emotional need (Bowlby, 1980; Sroufe, 1983). These children often demonstrate anger toward their carer presumably due to this inconsistency of caring and the effort required by the child. Again this attachment pattern is adaptive in the short term but inflexible and non-adaptable long term. These secure and insecure attachment patterns represent organised patterns of behaviour as they are predictable and understandable.

Not all children were found to fit comfortably into the three patterns of organised behaviour with Mary Main and colleagues finding 13% of a large middle-class sample failing to fit the traditional A-B-C system (for review see Hesse & Main, 2000). These unclassifiable infants behaved in unpredictable ways that did not make sense, such as; immediately following
separation a distressed child greets the wall instead of their carer; the distressed child freezes or collapses instead of approaching their carer; or the child demonstrates a breakdown in organisation by resisting the carer in one reunion and avoiding them the next. The types of behaviours found in these children were extremely varied. These children lacked a unifying behavioural strategy when their attachment system was activated and their attachment style has been termed disorganised/disorientated (D) (Main & Solomon, 1990). Main and Solomon developed a procedure for identifying these disorganised infants by their unusual behaviours observed in the SSP. This disorganisation in attachment behaviours is thought to arise because the attachment figure, who should be the infant’s safe haven, is actually their source of fear (demonstrate frightening behaviour and/or frightened behaviours). In this paradoxical situation, minimising or maximising attachment behaviours does not help and leads to ineffectual coping strategies. These infants may appear to have an organised attachment strategy in times of low stress, however the organisation breaks down in situations of high emotional stress. Infants are classified as A, B, or C before being coded for the presence or absence of D behaviours, and are often reported as D-secure (B) or D-insecure (A or C). Sroufe and Carlson (2004) believe the disorganised behaviours have the purpose of modulating the infant’s emotional arousal.

The proportion of securely attached children versus those with insecure attachments varies dramatically depending on the sample being studied. Ainsworth and colleagues original study using a middle class non-clinical sample found 66% of infants are classified as secure, 22% avoidant, and 12% ambivalent (Ainsworth et al., 1978). These rates have been found to be consistent across a number of American studies. With the inclusion of the D classification approximately 15% of infants in normal populations are also found to be disorganised (van Ijzendoorn et al., 1992). The number of insecure and disorganised infants rises substantially for high risk and clinical populations. For example, studies of attachment in maltreated
samples have found between 60 and 100% of infants classified as insecure, with disorganisation being the predominant classification (for review see Morton & Browne, 1998). Cultural differences have also been found which are thought to represent cultural differences in child rearing practices. For instance, children raised in kibbutz style communities with communal sleeping arrangements have greater levels of ambivalent attachments and very few avoidant attachments (van Ijzendoorn & Sagi, 1999). An Australian sample of 134 twelve month old infants, using the initial A-B-C only scoring, found 70% secure, 16% avoidant, and 14% ambivalent (Barnett, Blignault, Holmes, Payne, & Parker, 1987). Two more recent Australian studies of 12-month old infants have found approximately 60% secure, 8-10% avoidant, 19-24% ambivalent, and 9-10% disorganised (Gibson, Ungerer, McMahon, Leslie, & Saunders, 2000; Harrison & Ungerer, 2002). These more recent Australian studies have reported higher levels of ambivalent attachments than the 8% found in American studies using the 4-way coding system (van Ijzendoorn et al., 1992).

Methods for measuring attachment security for preschool (Crittenden, 1995) and early school age (Main & Cassidy, 1988) children have been devised, but are used far less frequently than the SSP.

2.2.2.3. Patterns of adult attachment

The Adult Attachment Interview (AAI) (Main & Goldwyn, 1984) was designed to measure the attachment status in late adolescents and adults. The AAI is a measure of the adult’s current state of mind in relation to their own attachment experiences with a focus on experiences of abuse and of loss as a child and an adult. Adults are classified into four categories; secure/autonomous (F); insecure/dismissive (D); insecure/preoccupied (E); or unresolved/disorganised (U) (for review see Hesse, 1999; Main, 1996). Secure adults have a clear and balanced view of their early relationships, including their own contributions.
Dismissing adults have limited childhood memories and views on attachment related issues, and may either dismiss the importance of attachment or may paint an idealistic picture of their childhood. Preoccupied adults are, as the name suggests, preoccupied with and over analytical of past relationships. Unresolved adults demonstrate one of the previous three representations but also demonstrate disorganisation of speech and thought when discussing traumatic childhood issues such as loss or abuse. The AAI has been found to predict the subsequent attachment of an infant to that adult, accounting for approximately half the variance in infant attachment classification (van Ijzendoorn, 1995). Secure adults tend to have secure infants, dismissing adults tend to have avoidant infants, preoccupied adults tend to have ambivalent infants, and unresolved adults tend to have disorganised infants. The parent’s current state of mind in relation to their attachment experiences has been proposed as a mechanism for intergenerational transmission of parenting patterns (Hesse, 1999). This proposition has found empirical support with Schuengel and associates (1999) in a study of unresolved maternal loss, demonstrating insecure attachment representations in mothers with unresolved loss were associated with maternal frightening behaviour and disorganised attachment. Further, this study also suggests that maternal secure attachment representation is protective against transmission of disorganised attachment.

2.2.2.4. Development of self regulation

For the infant, the development of organised attachment behaviours leads to the further organisation and self regulation of emotional experiences (Carlson, 1998). Emotional regulation involves the regulation of arousal, with attention, emotional memory, and the cognitive interpretations of events being important (Lopez et al., 2004). In a secure relationship the carer helps the child to constructively cope with both negative and positive arousal, with a well regulated infant experiencing a range of emotions as being acceptable to share with a social partner (Stern, 1985). For the child to learn to manage their own
emotional and accompanying physiological arousal requires the assistance of their caregiver in recognising what is internal and what is external (Carlson & Sroufe, 1995; Gianino & Tronick, 1988). An infant needs to learn how to control not only their own internal arousal by using self soothing behaviours, but also to develop regulatory strategies to cope with interactions with social partners. The sensitive carer is able to determine from infant cues such as smiles, frowns, and general state of alertness, the level of interaction the infant is able to cope with from moment to moment (Tronick & Gianino, 1986). But if the carer’s interaction with the infant does not fit with the infants internal state a mismatch will occur, which causes distress in the infant. When a mismatch occurs during interactions the infant may focus attention internally to regulate the negative emotions generated by the interaction. If this mismatch occurs regularly a dominant pattern of withdrawing from interactions may occur which then alter interactions with others (Guedeney & Fermanian, 2001; Tronick & Gianino, 1986). Further, insecure children have less attentional flexibility as they are more vigilant about parental mood and availability and incorporate these strategies into their internal working model and subsequent dealings with others (Bowlby, 1980). Avoidant children develop an overly rigid regulation of emotions, ambivalent children experience a dysregulation of emotion, while disorganised/disorientated children experience breakdowns in their ability to self regulate emotion which may lead to dissociative experiences (Carlson & Sroufe, 1995). Given the association of the attachment system with the development of emotional self regulation it would be expected the attachment system would be associated with the HPA axis.

2.2.2.4.1. Attachment and cortisol
The initial study conducted by Megan Gunnar into cortisol reactivity of 66 infants during the SSP did not find differences between attachment classifications and levels of cortisol (Gunnar, Mangelsdorf, Larson, & Hertsgaard, 1989). In this study cortisol was collected at
home, before the start, and at the end of the laboratory session. In contrast, a later study of 41 infants conducted by Spangler and Grossman (1993), in which they collected saliva samples immediately before and 15 and 30 minutes after the SSP concluded, found significant group differences between attachment classifications. Fifteen minutes after the conclusion of the SSP disorganised infants had significantly higher cortisol levels than all other categories. Further, after 30 minutes, infants’ rated as insecure had higher cortisol compared to secure infants. The difference between the two studies was thought to reflect the differences in the collection of the post SSP samples with the later collection in the Spangler study allowing time for the full effect of the procedure on cortisol levels to be found. Higher cortisol levels were subsequently found in disorganised infants post SSP, with avoidant children having the lowest cortisol (Hertsgaard, Gunnar, Erickson, & Nachmias, 1995). No pre-test was conducted in this study and therefore low cortisol levels found in the avoidant children may have been due to low stress during the SSP or from lower basal levels. A further study by Gunnar and colleagues (Gunnar, Brodersen, Nachmias, Buss, & Rigatuso, 1996) of 73 infants with saliva collected before the SSP and 45 minutes later demonstrated that behaviourally inhibited children (wary of novelty) had increased cortisol only if they were also insecurely attached. This finding has recently been replicated in a study of 76 toddlers with cortisol measured before and after a stressful problem-solving task (Schieche & Spangler, 2005). These studies have led these authors to propose that security of attachment acts as a buffer against stress. The increased level of cortisol found following the SSP is congruent with the view that these infants have difficulty coping with stress (Main, 2000). Maltreated children, of which a large percentage have a disorganised attachment, are often reported as having increased levels of cortisol (for review see Tarullo & Gunnar, 2006).

In addition to attachment, differences in carer behaviour have also been found to impact on child cortisol levels. Elevated cortisol levels have been found in infants of depressed mothers
(Hessl et al., 1998). However, depressed adolescents with mothers with a history of depression demonstrated elevated cortisol, whereas those without depression but with chronic family stress or an avoidant mother showed signs of hypocortisolism (Ronsaville et al., 2006). Maternal stress over the first four years of a child’s life has also been linked to increased child basal cortisol at age 4 years of age (Essex et al., 2002), as has low socioeconomic status (Lupien et al., 2000, 2001). Infants whose mothers anticipated stress and soothed them before inoculation did not demonstrate an increase in cortisol levels, whereas infants who were not calmed before injection did show increased cortisol levels (Braarud & Stormark, 2005). Sensitive mothers were found to have similar cortisol responses to their child’s response during a physical challenge undertaken by the child. Insensitive mothers did not (Sethre-Hofstad, Stansbury, & Rice, 2002). Overall, less sensitive parenting has been associated with increased infant cortisol. A similar story is found with care external to the family.

In the extreme example of external care, a lack of daily diurnal rhythm in cortisol production has been found for infants raised in environments where opportunities to form attachment to a carer are limited, such as orphanage reared infants (Gunnar & Donzella, 2002). In studies of shorter separations from parents, such as the use of daily child care, temperamentally vulnerable children have been found to have increased cortisol in relation to poor quality of child care (Gunnar & Donzella, 2002). In addition, many infants and toddlers demonstrate increases in cortisol across the day when in child care but show the expected decrease across the day when at home (Watamura, Donzella, Alwin, & Gunnar, 2003). Conversely, child care has been found to buffer the negative effects of maternal work stress on child basal cortisol production (Chryssanthopoulou, Lucas, & Jessop, 2005).
Overall, prospective longitudinal studies in relation to variations in cortisol as a response to varying qualities of care are only beginning and it is as yet unknown whether variations, particularly in relation to normative environmental experiences, are related to later psychopathology. However, as mentioned earlier, individual differences in the activity of the HPA system are thought to be associated with differences found in susceptibility to both physical and mental health problems (Goodyer et al., 2001; Hellhammer et al., 2004). Further, insecure attachment classifications during infancy, particularly disorganisation, have been associated with poorer developmental outcomes.

2.2.2.5. Attachment and the development of psychopathology

From a developmental perspective, infancy is a period where developmental processes are highly susceptible to environmental influences and where a wide range of behavioural outcomes are possible (Carlson & Sroufe, 1995). As children develop, this influence reduces and the flexibility of the system lessens. Bowlby proposed that characteristics of the infant-carer relationship in the first few years of life may have long term implications for the infant’s development of future intimate relationships, self understanding, and psychopathology (Bowlby, 1969/1982). Further, attachment is thought to effect later mental health and well being by the way it shapes both the child’s internal working memory and their emerging personalities and social skills (Thompson, 1999). In addition, caregiving behaviours can also impact on children’s academic performance. Carers encourage and guide children to learn how to self regulate and monitor learning tasks with a progressive shift from parent to child of planning, monitoring and evaluating, with deficits in these executive functions being associated with under achievement (Moss, St-Laurent, & Parent, 1999). Overall, as reviewed below children with disorganised attachments have the poorest outcomes in relation to psychopathology and developmental outcomes compared to the other attachment categories.
2.2.2.5.1. Internalising and externalising problems

A secure attachment is thought to be a protective factor against the later development of psychopathology, while children with insecure attachments are thought to be more vulnerable to later life stressors (Carlson & Sroufe, 1995; Egeland & Carlson, 2004). Extremely disturbed attachment patterns in childhood are termed ‘attachment disorders’ and may develop following child maltreatment and neglect, or repeated changes in primary carers (American Psychiatric Association, 1994). While most children with an attachment disorder will demonstrate an insecure pattern of attachment in the SSP, very few children with an insecure attachment will meet the criteria for an attachment disorder. Different types of attachment disorders have been described and special clinical assessments are required for their diagnosis (Zeanah, 1996; Zeanah, Mannen, & Lieberman, 1993). In addition to attachment disorders, insecure attachment patterns are implicated in the development of depressive, anxiety, behavioural, and personality problems during childhood, adolescence and adulthood.

A range of longitudinal studies have found insecure attachment in infancy is associated with increased levels of moodiness, depressive symptoms and aggressive behaviour in childhood and adolescence (for reviews see Carlson & Sroufe, 1995; Egeland & Carlson, 2004; Greenberg, 1999). For example, young children’s ability to control negative emotion (NICDH, 2004), depressive symptoms in middle childhood (Renken, Egeland, Marvinney, Sroufe, & Mangelsdorf, 1989), and in adolescents (Kobak, Sudler, & Gambler, 1991) have been negatively associated with insecure attachment relationships. Other studies have found major separations (including permanent parental loss) or disruptions with attachment figures were associated with depression (Carlson & Sroufe, 1995). In relation to externalising behaviours, gender differences have been reported. For instance, boys but not girls with insecure attachments in infancy were more likely to demonstrate aggression or other
behavioural problems at 6 years compared to secure boys (Lewis, Feiring, McGuffog, & Jaskir, 1984). However, the development of behavioural problems was also influenced by stressful life events. In the Minnesota longitudinal study insecure attachment predicted aggressive behaviour for boys, whereas, insecurity and harsh parenting practices and stressful life events were required to predict aggression in both boys and girls (Renken et al., 1989). In addition, this study found that avoidant attachment in infancy was related to aggressive antisocial behaviour while ambivalent attachment was related to more internalising problems. Neither attachment pattern predicted outcomes for girls. High rates of insecure attachment have been reported in children who meet the diagnosis for oppositional defiant disorder (for review see (Greenberg, 1999). Disorganised attachment has been found to be related to aggressive behaviour, particularly in conjunction with maternal psychosocial problems (Lyons-Ruth, Alpern, & Repacholi, 1993; Lyons-Ruth & Block, 1996). In addition, a meta-analysis of 12 studies found disorganised attachment to be associated with externalising behavioural problems (van Ijzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). Given the high levels of disorganised attachment in maltreated children outcomes for this group are also relevant. Overall it has been shown that maltreated children have difficulties regulating emotion, have greater interpersonal difficulties, and demonstrate symptoms of anxiety, depression and aggressive behaviour (Coster, Gersten, Beeghly, & Cicchetti, 1989; Egeland & Sroufe, 1981; Egeland, Sroufe, & Erickson, 1983).

Studies of maltreated children have reported differing patterns of neuroendocrine functioning associated with different types of emotional behavioural problems. This in turn results in internalising disorders being associated with high levels of basal cortisol, and aggressive externalising behaviours being associated with either high or low levels of basal cortisol. (Cicchetti & Rogosch, 2001b; Lopez et al., 2004; Tarullo & Gunnar, 2006). Several other studies have supported the association between low cortisol and externalising behaviour.
problems in clinical populations. McBurnett and associates (McBurnett, Lahey, Rathouz, & Loeber, 2000) reported low cortisol levels in clinic referred boys were associated with persistence and early onset of aggressive behaviours. Goozen and colleagues (van Goozen, Mattys, Cohen-Kettenis, Buitelaar, & van Engeland, 2000) found a weaker HPA response to stress in clinic referred children with disruptive behaviour disorders compared to normal matched controls. However, a recent study of children in the general population found a small association between self reported disruptive behaviours and higher cortisol levels (Sondeijker et al., 2006). These authors concluded that HPA axis functioning may be more relevant for high risk or clinical samples rather than the general population.

The only direct evidence linking early attachment to adult psychopathology is from the study of adolescents linking disorganised attachment and dissociation (Carlson, 1998) and linking ambivalent attachment and anxiety (Warren, Huston, Egeland, & Sroufe, 1997). In reviewing this area, Dozier and colleagues suggest these two studies are persuasive as the attachment patterns and outcome demonstrate a ‘phenotypic similarity’ which is understandable in terms of our current theories of sensitized neurobiological circuits (Dozier, Stovall, & Albus, 1999). Apart from these two studies, there is a large body of work that suggests that a range of adult outcomes are connected with poor quality care during childhood. In a review of this area Dozier, Stovall and Albus (1999) concluded that internalising disorders tend to be associated with parental rejection and loss; antisocial problems are related to parental rejection combined with harsh parenting style and poor limit setting; and borderline personality disorder is often linked to neglect.

2.2.2.5.2. Developmental abilities

Secure attachment has been found to promote greater sociability with peers and adults, increase compliance, and facilitate effective emotional regulation (for reviews see Carlson &
Sroufe, 1995; Thompson, 1999). As well it has been found that insecure attachments result in lower levels of sociability, poorer relationships, and greater levels of behavioural difficulties in both the preschool and school years. Disorganised primary school children have been found to have poorer self esteem than children in other attachment categories (Moss et al., 1999). Sroufe and Waters (1977) proposed that securely attached infants may have better developmental outcomes due to their ability to explore their environment and cope with novel settings in a more regulated manner. Early studies from their laboratories supported this view with securely attached young children demonstrating a greater level of sophisticated play, and more enthusiasm and less frustration during problem solving tasks. However Thompson (1999) suggests the greater level of play competence in secure infants cannot be unequivocally attributed to attachment status but might also be related to other aspects of the infant-parent relationship. This view fits with recent research that has demonstrated faster acquisition of language skills (Silven, Niemi, & Voeten, 2002), and executive function (Landry, Miller-Loncar, Smith, & Swank, 2002; Landry, Smith, Swank, & Miller-Loncar, 2000), and compliance (Lehmann, Steier, Guidash, & Wanna, 2002), for children whose mothers demonstrate greater levels of sensitivity and structuring during play sessions.

Although maternal sensitivity was thought to be a key component in the development of secure attachment (Ainsworth et al., 1978), meta-analysis has since determined that parental sensitivity is clearly important but is not the sole factor for the development of security (DeWolff & van Ijzendoorn, 1997). It is possible that a carer who may not be optimally sensitive to their child’s emotional needs may still be able to be responsive and supportive in a teaching environment, particularly if the attachment system is not activated. However, a study of attachment and maternal tutoring found mothers of secure children gave their infants more positive and less negative feedback, were less likely to interfere, and gave appropriate level interventions. These interventions were based on the child’s previous success or failure,
suggesting that secure infants had mothers who were more able to recognize their child’s level of competence (Meins, 1997). Nevertheless, attachment security and the ability to structure a child’s learning environment have not always been linked. For example, analysis of a high risk sample found secure boys with behavioural problems had mothers who were less effective teachers and unable to provide appropriate structure and support than mothers of secure boys without behavioural problems (Urban, Carlson, & Sroufe, 1991).

There have been few associations found between intellectual development and insecure attachment (Thompson, 1999). On the other hand, several studies specifically investigating disorganised attachment have reported significant findings. A recent study by Goodman and associates (Goodman, Hans, & Bernstein, 2005) found disorganised attachment was associated with lower quality of communication at age 2 years. In support of this finding, Lyons-Ruth and colleagues (Lyons-Ruth, Repacholi, McLeod, & Silva, 1991) found that mothers of disorganised infants initiated less communication and less verbal scaffolding during play. In a longitudinal study following children through early primary school Moss and associates (1999) found children with disorganised attachments performed significantly below those with other attachment classifications in relation to math scores but not language. This is in line with several studies by Jacobsen and colleagues (Jacobsen, Edelstein, & Hofmann, 1994; Jacobsen & Hofmann, 1997) who found disorganised children to have poorer deductive reasoning skills and poorer overall grade averages. Moss and colleagues (1999) propose that deductive and abstract reasoning skills may be particularly vulnerable to interference from poor self esteem and high anxiety. In contrast, studies of maltreated children, who have high levels of disorganised attachment, have found poorer development of expressive language compared to non-maltreated children (Coster et al., 1989).
2.2.2.6. Carer behaviours

As can be seen from the above sections, differences in attachment are thought to be strongly related to parental behaviours. Studies that have compared both maternal and infant characteristics have found infant characteristics, such as temperament, to have much less influence (Morton & Browne, 1998; Sroufe, 1985; van den Boom, 1994; van Ijzendoorn et al., 1992). Maternal sensitivity and positive maternal representations of their infants are two maternal characteristics that have been associated with secure attachment. While low carer sensitivity is associated with insecure attachments, hostile-intrusive and frightened behaviours are thought to be associated with disorganised patterns of attachment (Lyons-Ruth et al., 2004; Main & Hesse, 1990).

Ainsworth’s (1978) original conception of maternal sensitivity has been demonstrated to be associated with secure attachment, but as mentioned above this global measure has not been found to be the sole predictor of secure attachment (DeWolff & van Ijzendoorn, 1997; van Ijzendoorn, 1995). Biringen, Robinson and Emde (1998) expanded the concept of sensitivity by adding an affective component as well as subscales for maternal structuring, intrusion, and hostility. Studies using the Emotional Availability scales have found relationships with both infant and adult patterns of attachment (Aviezer, Joel, & Ziv, 1999; Easterbrooks, Biesecker, & Lyons-Ruth, 2000; Oyen, Landy, & Hillburn-Cobb, 2000; Ziv, Aviezer, Gini, Sagi, & Koren-Karie, 2000). For example, lower sensitivity and less than optimal structuring and intrusive behaviour was associated with ambivalent attachment in infancy (Ziv et al., 2000). This study also found mothers with higher socio-economic status (SES) had higher emotional availability, although lower SES mothers of secure infants displayed higher sensitivity than higher SES mothers of insecure infants. Aviezar and colleagues (1999) found greater maternal sensitivity was related to both secure infant and adult patterns of attachment. Using a different measure for sensitivity Adam, Gunnar and Tanaka (2004) reported that lower
levels of warmth and responsiveness were found in mothers rated as dismissive on the AAI, but only when they demonstrated depressive symptoms (Adam, Gunnar, & Tanaka, 2004). Of interest only low to moderate depressive symptoms were required to see this effect. An intervention study of maltreated children placed in foster care found improved behaviour and a restoration of normal cortisol patterns in children placed with foster carers who had been trained to be more sensitive and responsive, compared to foster carers without training (Fisher, Gunnar, Chamberlain, & Reid, 2000). This demonstrates the impact of carer behaviour on both basal cortisol and behavioural problems. A recent meta-analysis of intervention programs with disorganised children found that programs that started when the infants were approximately 6 months old and focussed primarily on improving maternal sensitivity had the best outcomes, compared to broader programs (Bakermans-Kranenburg, van Ijzendoorn, & Juffer, 2005).

Instead of expanding the concept of sensitivity these researchers have addressed a key element of sensitivity; the ability of the carer to be able to see things from the child’s perspective (Ainsworth, 1969; Fonagy et al., 1995; Fonagy, Steele, Steele, Moran, & Higgit, 1991; Koren-Karie, Oppenheim, Dolev, Sher, & Etzion-Carasso, 2002; Lieberman, 1997; Oppenheim & Koren-Karie, 2002; Zeanah & Benoit, 1995). Fonagy and associates (see Fonagy & Target, 1997) relate maternal reflective functioning to attachment security, whereas Zeanah and Benoit (1995) and Oppenheim and Koren-Karie (2002) have devised different instruments to assess maternal insightfulness. Both of which have found associations between the mother’s insightfulness and attachment security, with specific types of maternal insightfulness classifications being related to specific types of infant attachment classifications. A recent study using Zeanah’s Working Model of the Child found that prenatal representations of the child were also related to later attachment security (Huth-Bocks, Levendosky, Bogat, & vonEye, 2004). Further, Oppenheim and Koren-Karie (2002)
identified maternal anger, worry and lack of acceptance of the child as barriers to insightfulness. Looking at distorted maternal attributions of the child, Lieberman (1997; Silverman & Lieberman, 1999) has proposed that negative attributions of the child can lead to self fulfilling prophecies with the child eventually internalising the negative attributions leading to poorer developmental outcomes. While lower maternal sensitivity has been found to be associated with insecure patterns of attachment, it has been found to have less association with infant disorganised attachment (van Ijzendoorn, 1995). However, a recent meta-analysis of therapeutic intervention found those that focussed solely on improving maternal sensitivity were more effective at reducing levels of disorganised attachment than those that also focussed on support and maternal representation (Bakermans-Kranenburg et al., 2005). This study also found that disorganised attachment patterns were easier to alter when it was the child who was at risk due to adoption, prematurity or irritability, compared to parents who were at risk.

All of the risk factors found to be associated with disorganised attachment, including psychosocial and parental unresolved loss or trauma during childhood identified by the AAI, have implicated negative carer-infant interactions and parental behaviour as a causal link (Lyons-Ruth & Jacobvitz, 1999). Main and Hesse (1990) originally hypothesised that maternal frightened and/or frightening behaviour leads to infant disorganisation. But a range of studies found that only frightening behaviour was required for disorganised attachment to occur and was only related to D-insecure subtype not D-secure (Lyons-Ruth, Bronfman, & Parsons, 1999; Schuengel, Bakermans-Kranenburg, & van Ijzendoorn, 1999). This led Lyons-Ruth and colleagues (Lyons-Ruth, Bronfman, & Atwood, 1999) to propose that a broader range of maternal behaviours were associated with disorganised attachment. They hypothesised that parents, like disorganised children, may demonstrate contradictory behaviours, as well as fail to respond to, and regulate, their infant’s fearful arousal. Both
these types of behaviours were potentially disorganizing regardless of whether the parent
directly demonstrated frightened or frightening behaviour. Longitudinal research including
these behaviours as well as Main and Hesse’s original frightened and frightening behaviours
have found associations between a range of hostile and helpless parental behaviours that they
believe are strongly associated with the development of both D-insecure and D-secure
infants. (Lyons-Ruth et al., 2004).

Lyons-Ruth and associates (2004) identified two groups of mothers with disorganised infants.
Both groups of parents demonstrated affective communication errors and disoriented
behaviours. As previously found, one group of mothers displayed frightening or intrusive
behaviour patterns in their interactions with their infants. These children also often combined
avoidant and ambivalent attachment strategies and obtained a sub-classification of D-
insecure. The second group of mothers primarily demonstrated withdrawing, fearful, and
inhibited behaviours and were unlikely to be overtly hostile or intrusive. These infants still
demonstrated proximity seeking and other comfort seeking behaviours when upset and were
given a sub-classification of D-secure. These mothers were more prevalent in middle class
samples. Both groups of infants were at elevated risks of negative developmental outcomes.
Further to this, a recent study by David and Lyons-Ruth (2005) has found that with higher
levels of frightening behaviour girls classified as D-secure tended to approach their mothers,
while mothers withdrawal behaviour was associated with approach behaviours from both
genders. Maternal intrusiveness using the Emotional Availability scales (Biringen, Robinson,
Emde, 1998) has also been associated with disorganised attachment status in the infant
(Swanson, Beckwith, & Howard, 2000). In a low-income sample maternal hostility was
found to be significantly associated with infant difficulty with emotional regulation during a
challenge task (Little & Carter, 2005). Preoccupied mothers have been found to be higher on
intrusive-angry behaviour but this was independent of emotional variables such as negative
and positive affect or anxiety (Adam et al., 2004). However, maternal mental health has been found to interfere with the development of secure attachment.

2.2.3. Impact of Maternal Mental Health on the Mother-infant Relationship

Maternal mental health problems which render the mother emotionally unavailable or inconsistently available to her infant are thought to impact on the development of the infant-mother attachment system in a similar way to the impact of major separations or parental loss (Cummings & Cicchetti, 1990). Severe mental health problems such as psychosis (Cowling, 1999), and serious Axis II problems such as borderline personality disorder have been found to impact significantly on the infant-carer relationship (Crandell, Patrick, & Hobson, 2003; Fonagy et al., 1995). However, the majority of research in this area has been conducted in relation to more prevalent problems such as maternal postnatal depression and anxiety.

2.2.3.1. Depression

Women have a threefold higher rate of onset of depression within five weeks of childbirth compared to any other period in their adult life (Cox, Murray, & Chapman, 1993). A meta-analytic study based on 59 studies found that stressful life events, marital conflict, and prior psychiatric or psychological problems were significant predictors of postnatal depression (O'Hara & Swain, 1996), although most demographic factors showed no consistent association with postnatal depression. In contrast several studies have found that multiparous women had significantly poorer mental health in the postnatal period than primiparous women suggesting that increased psychological distress may be related to increased demands on the mother (Skari et al., 2002). In addition qualitative studies have suggested that the mother’s feelings of isolation and loneliness, the repetitive nature of home duties, conflict with role identity, and anxiety about being a good mother, may play a role in the
development of postnatal depression (Romito, Saurel-Cubizolles, & Lelong, 1999; Small, Astbury, Brown, & Lumley, 1994).

A range of studies has consistently found an increased risk of insecure attachment in infants of depressed mothers (for recent review and meta-analyses see Atkinson, Paglia, Coolbear et al., 2000; Martins & Gaffan, 2000; L. Murray & Cooper, 2003). For example in a meta-analytic study of low risk samples Martins and Gaffan (2000) found overall that secure attachments fell from 62% to 42%, while avoidant attachments and disorganised attachments rose from 12% to 19% and 17% to 28% respectively, with the rise in disorganisation being the most consistent result across studies. An earlier meta-analysis of disorganised attachment only found a weak association between depression and disorganisation (van Ijzendoorn et al., 1999). This analysis included a large number of high risk samples where factors such as poverty, maltreatment and drug abuse contributed significantly. Sroufe (1982) has proposed that organised insecure attachment patterns are adaptive at least in the short term. A study by Radke-Yarrow and colleagues (1995) of children with depressed parents demonstrated this adaptability. They found the avoidant infants of mothers with depression did not show problematic behaviour at 6 years, whereas secure infant of severely depressed mothers had a concerning level of affective symptoms. Other studies have found maternal stress and marital discord interacted with maternal depression and increased problems (Atkinson, Paglia, & Coolbear, 2000; Coyl, Roggman, & Newland, 2002). Stronger links between insecure attachment and depression have been found in clinical samples compared to community samples (Atkinson, Paglia, & Coolbear, 2000). These authors suggest this may be due to lower severity of symptoms and shorter periods of depression found in community samples, with clinical samples on average spending 20% of their life in a depressive episode, and when not depressed they demonstrate residual dysfunction. In this meta-analysis mothers
with postnatal depression demonstrated the smallest effect size with insecure attachments, while the highest had DSM-IV anxiety disorders as well as self reported depression.

In addition to links with insecure attachment, maternal depression has also been associated with less optimal cognitive function and motor development, and increased levels of behavioural and emotional problems in offspring (for review Murray & Cooper, 2003) with boys being more at risk of poorer outcomes than girls (for example, Milgrom, Westley, & Gemmill, 2004; Shaw & Vondra, 1995). What is more, children of depressed mothers have been found to be less able to recognize and express a range of emotions (Arsenio, Sesin, & Siegel, 2004; Reissland & Shepherd, 2006). Infants of depressed parents have been found to be less able to self quieten and demonstrate less interaction with the carer and others (Sameroff, Seifer, & Zax, 1982). Reduction in maternal sensitivity has been proposed as the mechanism linking maternal depression and child outcome (Atkinson, Paglia, & Coolbear, 2000). In line with this hypothesis Milgrom, Westley, and Gemmill (2004) found that poorer maternal responsiveness in depressed mothers when the infant was 6 months old was related to later cognitive deficits. In contrast, a recent study of depressed mothers by Stanley, Murray, and Stein (2004) has found that reduced maternal responsiveness when infants were 2 months was predictive of poorer performance on a learning task for the whole group but not specifically for the depressed group. One possibility for the differences between these two studies is in the timing of measuring maternal responsiveness. As Stanley and associates (2004) suggested, behavioural development in the first few months of life is likely to be progressing in a species specific biological process and serious deviation in the environment may be required to alter the child’s developmental trajectory. Atkinson and colleagues (2000) and van Ijzendoorn and colleagues (1997) have also suggested that maternal sensitivity may be an important predictor for the child outcomes only if this sensitivity remains stable over time. In the case of transitory depressive episodes this is not likely to be
the case. Further, the studies have not looked at interactional effects. Differences in economic factors may also play a role. The NICHD study found a negative relationship between depression, economic stress and the quality of the infant-mother relationship (NICDH, 1999). The most common symptoms reported by depressed women with young children are low mood, anxiety, irritability and loss of energy (Pound, Puckering, Cox, & Mills, 1988). Christine Puckering (Puckering, 2004) proposes that this combination of symptoms suggests that postnatal depression, as currently measured, is often a mixture of depressive and anxiety symptoms. This is a view shared by Stephen Matthey in a recent review of the area (Matthey, 2004).

2.2.3.2. Anxiety

Until recently anxiety has mainly been studied prenatally and depression postnatally, with authors such as O’Connor suggesting that antenatal anxiety may be the major cause for negative child outcome not postnatal depression (Glover & O’Connor, 2002; O’Connor et al., 2005; O’Connor, Heron, Golding et al., 2002). However, as Margaret Oates has reasonably suggested, anxiety found during the antenatal period is unlikely to disappear following the birth of the infant unless the anxiety was specific to the pregnancy or to the birth (Oates, 2002). Therefore symptoms of anxiety in the postnatal period could also be related to later developmental outcomes. As reviewed above, studies of prenatal anxiety have shown significant associations with child development outcomes, even after postnatal factors have been controlled (O’Connor et al., 2005; van den Bergh et al., 2005). However not all variance is accounted for and some studies have demonstrated postnatal effects. A study by O’Connor, Herron and Glover (2002) found that postnatal depression had a separate and additive effect to that seen with prenatal anxiety (O’Connor, Heron, & Glover, 2002). What is unclear from these studies is the impact on the infant-mother relationship.
Several recent studies have found that postnatal anxiety is at least as prevalent as postnatal depression, if not higher (Fisher, Feekery, & Rowe-Murray, 2002; Matthey et al., 2003; Wenzel, Haugen, Jackson, & Robinson, 2003). An Australian study by Matthey and colleagues (2003) concluded that a history of anxiety was a greater risk factor for affective problems postpartum than a previous history of depression. These results would suggest that many of the problems found with postnatal depression are likely to be similar for postnatal anxiety. Congruent with this view, a recent study of low birth weight infants found that higher levels of maternal anxiety were associated with reduced infant facial responsivity during infant-mother interactions (Schmucker et al., 2005). In addition a study found clinic referred anxious mothers to be more intrusive, overprotective, and controlling in their interactions with their infants and they were rated overall as being less sensitive than control mothers (Warren et al., 2003). Further, a longitudinal study of maternal stress measured in the earlier postnatal period and again when the infants were 4 years old found that infants who had stressed mothers in both early and later childhood had increased cortisol levels and greater mental health symptoms (Essex et al., 2002).

Of particular interest to this study is the impact of prior maternal trauma on the infant-mother interaction, attachment and subsequent child outcomes. Given that half the population of Australian women have experienced at least one significant trauma across their life span, and up to a quarter of these can be expected to develop significant PTSD symptoms, it is reasonable to hypothesise that this high level of trauma may be an underlying cause for the anxiety and depression found in antenatal and postnatal studies.

2.2.4. PTSD and Parenting

A review on the impact of trauma on parenting by Appleyard and Osofsky (2003) reported that empirical evidence in this area is scant but clinical evidence indicates that symptoms of
PTSD are associated with poor interpersonal functioning, poor ability to parent effectively, and reduced ability to be sensitive to their children’s needs. Most of the research in the PTSD area is from war-related trauma with a particular focus on men. However, given that mothers are often the primary carer, particularly in the preschool years, it would be expected that PTSD in mothers would have a greater impact on the important carer-infant relationship and subsequent child development.

Symptoms of posttraumatic stress such as irritability and emotional numbing can be very detrimental to interpersonal relationships and family functioning (McFarlane & Bookless, 2001). For example a study of fire fighters eight months after a major bushfire in Australia found 80% reported being more irritable with their families, 50% were more withdrawn and fought more with family members, while 65% avoided discussing their problems (McFarlane, 1988a). A high degree of discord with spouses has been reported in studies of male war veterans (Beckham, Lytle, & Feldman, 1996; Johnson et al., 1996; Jordan, Marmar, Fairbank, & Schlenger, 1992; Riggs, Byrne, Weathers, & Litz, 1998) and people who develop PTSD following motor vehicle accidents (Blanchard, Hickling, Taylor, & Loos, 1995). Further, associations between PTSD and intimate partner violence and emotional abuse have been reported in studies on war-veterans (Byrne & Riggs, 1996; Samper, Casey, King, & King, 2004). In addition increased levels of domestic violence and child abuse have been reported following a large scale natural disaster (Goenjian, 1993).

Affective responsiveness and problem solving were found to be significantly less in families of male Vietnam veterans with PTSD compared to Vietnam veterans without PTSD and matched non-veteran controls (Davidson & Mellor, 2001). This study also found that children of veterans with PTSD rated their families as dysfunctional, while children of non-PTSD veteran rated their families as borderline, and children of non-veterans rated their families as
normal. Two studies of male veterans have found a significant negative association between overall PTSD stress symptoms and symptoms of avoidance and emotional numbing (DSM-IV ‘C’ criteria symptoms) and parenting satisfaction, when the effects of partner violence, depression and alcohol abuse controlled (Ruscio, Weathers, King, & King, 2002; Samper et al., 2004). A study of mothers with a history of complex childhood and adult traumas has also found that high rates of trauma exposure were related to decreased parenting satisfaction (Banyard, Williams, & Siegel, 2003).

2.2.4.1. Impact of PTSD on effective parenting
Several studies have found general connections between PTSD and parenting outcomes. Jordan and associates (1992) found that over half of the 1,200 male Vietnam veterans in their study scored in the highest range for parenting problems. Veterans were less likely to get along with their children, obtained less enjoyment from parenting, and were less satisfied with their children’s development than non-veterans. Reduced parenting skills have been found to be related to maternal trauma symptoms in a study of domestic violence victims (Gorde, Helfrich, & Finlayson, 2004), and a history of complex childhood and adult trauma (Banyard et al., 2003). This later study found maternal trauma was associated with increased reports of maternal depression, increased levels of child neglect and physical punishment, as well as increased reports to child protection services (Banyard et al., 2003). Parental PTSD has also been found to be associated with child abuse in survivors of the Holocaust (Yehuda et al., 2001), and in the maltreatment of children at a younger age (Famularo, Fenton, Kinscherff, Ayoub, & Barnum, 1994).

Fearon and Mansell (2001) propose that PTSD symptoms of re-experiencing, and avoidance, disrupt parenting behaviour by redirecting limited attentional resources away from the normal regulation of care taking behaviour. Further, emotional responses such as fear and
anger may lead to behavioural responses which are not congruent with caregiving behaviour. Symptoms of vigilance and an excessive focus on threat cues are thought to reduce the ability to interact in a more playful manner (Meares, 1999), whereas avoidance symptoms can lead to overprotection of children. This may result in reduced social interaction and learning experiences (Silow, 1993). Although one of the few studies directly addressing maternal childhood abuse, PTSD and parenting found that reports of maternal exposure to different types of childhood traumas were associated with altered parent-infant interactions more so than current PTSD symptoms (Lyons-Ruth & Block, 1996). This study was based on 45 mother-infant dyads from low-income American families in which the majority of the mothers had experienced harsh, violent or abusive upbringings. They found two different patterns of parenting behaviour in relation to different types of childhood experiences. Firstly, if the mother had experienced sexual or physical abuse during her childhood she was less emotionally engaged with her infant. Those mothers who had experienced the most severe cases of sexual abuse demonstrated the least involvement with their children, in terms of both greater emotional withdrawal and flatter affect. Secondly, maternal hostile and intrusive behaviours toward her infant were associated with her own childhood history of severe physical abuse, witnessing family violence and harsh punishment. On the other hand, the child’s resistant or angry behaviour toward the parent was associated with the mother’s childhood experience of physical abuse and witnessing family violence, and therefore associated with the mother’s intrusive behaviour. However, current trauma symptoms were only related to maternal hostile-intrusive behaviour. This study also found PTSD to be associated with a breakdown of carer-infant attachment bond.

2.2.4.2. Impact of PTSD on attachment

In relation to PTSD, the activation of the carers attachment system may in itself trigger intrusive memories and activate avoidant behaviours, particularly in the case of childhood
trauma. If deactivation of the attachment system occurs the caregiver may only be able to carry out caregiving behaviours by disconnecting emotionally (Fearon & Mansell, 2001; Lyons-Ruth & Block, 1996). Conversely PTSD may result in parental over-protection that may result in a reduction of the child’s exploration of the environment and place too great an emphasis on the carer. This may occur with D-secure infants but the opposite is proposed for parents of D-insecure infants who may promote premature autonomy (Lyons-Ruth et al., 2004).

Lyons-Ruth and Block’s study of very high risk mothers (1996), found that maternal trauma experience did not predict secure or insecure attachment patterns but did differentiate between the types of insecure attachments found. Insecure infants of women who had experienced abuse or were exposed to family violence during their childhood were more likely to display a disorganised pattern of attachment which was associated with frightening behaviour and the worst child developmental outcomes, while infants of mothers who had experienced less violent upbringings (including neglect) were more likely to display avoidant attachment patterns that have poorer developmental outcomes than secure attachments. An avoidant attachment pattern indicates the mothers had difficulty in comforting the infants when they were in need. The lack of ambivalent attachment patterns suggest that overprotection was not occurring in this group. Overall, the study had very high levels of insecure attachments. They were a low socioeconomic group with only 26.8% of mothers not reporting childhood trauma and all were classed as ‘high risk’ and received weekly home visiting services from government agencies. Overall, more than 63.4% of the infants in the total sample demonstrated insecure attachment patterns compared to 35-40% in low risk samples.
Of interest, is the Lyons-Ruth and Block study (1996) where a greater proportion of women without a background of child maltreatment (82%) had insecure attachments compared to women who had (56.7%). Given the high risk nature of this group and the high level of insecure infants, childhood trauma was not the only factor contributing to the high level of insecure attachment in the offspring of the mothers with childhood abuse experience. Other factors such as high levels of ongoing environmental stress and adult trauma experiences that were not reported in this study may also impact the infant-carer relationship and attachment outcome. Further, Lyons-Ruth and Block found that mothers of disorganised infants either reported very high levels of current posttraumatic stress symptoms or very low levels of current symptoms. Lyons-Ruth and Block proposed that some women may not be aware of their dissociative experiences. In addition, they found that women who had experienced physical abuse in childhood reported low symptoms, whereas women who had experienced childhood sexual abuse reported high levels. Given the trauma experiences occurred during childhood, those without current symptoms may represent women with lifetime PTSD who may no longer report specific posttraumatic stress type symptoms, or whose symptoms oscillate over time. This finding indicates that current self reported symptomatology, particularly for chronic PTSD, may not be a good indicator of current or future problems.

2.2.4.3. Impact of parental PTSD on child outcomes

Studies on child outcomes following trauma have given inconsistent results. Following natural and industrial disasters studies have found that poorer parental mental health and parental functioning post disaster were related to greater levels of PTSD symptoms and internalising symptoms in the children (Brenton, Valla, & Lambert, 1993; Green et al., 1991). The study of Green and colleagues (1991) found that this effect was the greatest in the youngest children and postulated that the trauma had interfered with the carer-infant attachment system, which is of utmost importance in times of emotional need. Several studies
of Vietnam veterans have found lower self esteem and greater emotional and psychiatric problems in their children (Harkness, 1993; Jordan et al., 1992; Rosenheck & Nathan, 1985). Although, an Australian study of Vietnam veterans did not find a statistically significant difference in self esteem or PTSD between offspring of veterans with PTSD compared to veterans without the disorder or non-veterans (Davidson & Mellor, 2001). However the authors noted that there was considerably more variance in the scores for the offspring of fathers with PTSD than the other two groups. A study by Kilpatrick and Wilson (1998) of children’s reaction following traumatic events found that children whose mothers reported posttraumatic stress symptoms had higher levels of internalising problems, more PTSD symptoms, and lower social competence (Rossman, Bingham, & Emde, 1997). Further, although not directly related to PTSD, a study by Essex and associates (2002) found a history of maternal stress during early childhood related to increased afternoon cortisol, poorer transition to kindergarten and greater internalising and externalising problems. In this study maternal stress was a composite measure of maternal depressive symptoms, family expressed anger, parenting stress, maternal role overload, and financial stress.

2.2.4.4. Intergenerational effects of PTSD
As described earlier, low basal cortisol levels have been proposed as a mechanism for the higher levels of PTSD and symptoms of the disorder found in the offspring of parents who have PTSD (see Yehuda, 2002; Yehuda et al., 2005). However as also described above, parental behaviour, particularly during early childhood is also thought to impact on the development of later psychopathology (Cicchetti & Toth, 1995). Researchers investigating PTSD in war veterans and Holocaust survivors found PTSD type symptoms to be present in the survivors’ offspring (Barocas & Barocas, 1983; Rosenheck & Nathan, 1985), as well as offspring having a greater risk of developing the disorder following their own exposure to trauma (Solomon, Kolter, & Mikulincer, 1988). These researchers attributed this higher level
of PTSD in offspring to ‘learned’ responses to trauma. In a study by Yehuda and colleagues (2001) offspring of Holocaust survivors reported: that their feelings, concerns and experiences were often minimised by their parents; they grew up to believe the world was a dangerous place; and blamed themselves for their parent’s mental health problems. In addition this study also found the offspring of Holocaust survivors had experienced greater levels of child abuse. Reports of childhood emotional abuse were strongly associated with PTSD in the adult offspring. Yehuda and associates proposed the avoidant and emotional numbing symptoms experienced by the parents resulted in the lack of appropriate emotional connectivity between the parents and infants (Yehuda et al., 2001). The parental symptoms were reported by the children and as such represented parental symptoms the offspring had witnessed over their lifetime. Emotional abuse was also related to low cortisol. In fact all those who reported significant levels of emotional abuse had low cortisol. The finding of low cortisol in 9-month old infants of mothers with high current symptoms of posttraumatic stress following the World Trade Centre attacks led Yehuda and colleagues to propose that the transgenerational effects of trauma, particularly the risk factor of low cortisol, were more likely to be due to genetic or epigenetic events as described earlier, or early social regulation (Yehuda et al., 2005). As described above, the early life interactions between an infant and caregiver shape the infant’s attachment behaviour. In particular the research by Lyons-Ruth and Block (1996) demonstrated that when maternal trauma experiences were associated with insecure attachment, it was likely the child would display a disorganised pattern of attachment.

The study by Lyons-Ruth and Block (1996) found sexual abuse in the mother’s childhood was related to reduced emotional involvement with her infant, whereas childhood physical abuse and witnessing parental violence was related to maternal intrusiveness and hostile behaviour toward her infant. Yet the only association between current PTSD symptoms and
maternal or infant behaviour at home or in attachment security, was for maternal hostile and intrusive behaviour. Overall the study led Lyons-Ruth to propose that disorganised attachment was the result of withdrawing-frightened and frightening behaviour by the mother resulting in the breakdown of an organised attachment pattern (Lyons-Ruth et al., 2004). Reduced emotional involvement has recently been associated with inconsistent parental care during childhood. Krpan and associates (2005) found mothers who had experienced inconsistent care, defined as not having continuous care of at least one primary caregiver until at least the age of 12 years, engaged in significantly more instrumental care of their infants and significantly less affectionate touching, compared to mothers who had consistent parenting. The majority of the mothers in this study who had experienced inconsistent care in their own lives were young teenage mothers. Further, as discussed earlier, parental unresolved state of mind has been associated with disorganised attachment in their infants and has been proposed as a mechanism for intergenerational transmission of parenting patterns (Hesse, 1999; Schuengel et al., 1999). Taken together, these results suggest that childhood trauma and loss may lead to a reduced emotional involvement and an increased level of intrusion and hostility in interactions with their offspring. Most studies assessing trauma and parenting have used high risk samples where other competing social problems may contribute significantly to the poorer outcomes found.

2.3. Summary and Study Aims
Outcomes of human development, as well as susceptibility to mental health disorders and disease, are thought to be the result of a complex interplay between genetic endowment and environmental influences. Recent research in the area of epigenetics has found various chemical mechanisms that may explain how the environment can alter the phenotypic expression of genes without altering the DNA, and which may be heritable, at least in the short term (for reviews see Crews & McLachlan, 2006; Peaston & Whitelaw, 2006).
Environmental factors such as stress, drugs and hormones acting during embryogenesis, as well as early life experiences, such as parental care, have been shown to shape the individuals phenotypic expression of genes as well as their behavioural repertoires (Crews & McLachlan, 2006). Animal studies have demonstrated that both prenatal stress and early maternal behaviour can alter the stress reactivity and behaviour of offspring, largely through the effects on the hypothalamic-pituitary-adrenal (HPA) axis in specific areas of the brain (Meaney, 2001). The current longitudinal study investigates these competing influences of biology and environment in relation to the impact of trauma and posttraumatic stress disorder (PTSD) experienced by the mother on the developmental outcomes of her offspring.

The studies by Yehuda and associates have demonstrated a possible non-genomic transgenerational link between low cortisol and the later development of PTSD in offspring. Offspring of Holocaust survivors with the disorder and low cortisol also have higher rates of the disorder as adults and low basal cortisol (Yehuda et al., 2000). These studies were confounded by the high levels of maltreatment also found, which could account for both the higher levels of PTSD and the low cortisol (Yehuda et al., 2001). A later study of the pregnant mothers traumatized during the attack on the World Trade Centre found an association between the cortisol levels in the mothers and the infants, with infants of mothers with higher current PTSD symptoms having lower cortisol (Yehuda et al., 2005). In addition infants whose mothers were in the third trimester of pregnancy at the time of the attack were more likely to have low cortisol levels implicating the in utero programming of the HPA axis as proposed by Seckl (2001). Also it should be noted that maternal cortisol and PTSD were associated with the infant’s distress to novelty (Brand et al., 2006). The measuring of the HPA axis occurred when the infants were 9 months old and could also have been influenced by postnatal factors such as maternal behaviour. It is also unknown if the infants cortisol was affected directly by the trauma or by the mother’s response to the trauma. The current study
seeks to address this by assessing basal cortisol levels in mothers who had experienced trauma before conception. In addition, basal cortisol levels in relation to infant attachment status in unknown.

It is clear from animal studies (Meaney, 2001) and a growing human literature that postnatal carer behaviour can also impact on the regulation of infant cortisol (Gunnar & Donzella, 2002). The cluster of behaviours associated with posttraumatic stress disorder, namely re-experiencing, avoidance and numbing, and hyperarousal, as well as ongoing mental health problems associated with the disorder could be expected to disrupt the important infant-mother attachment and the child’s development of self regulation. The development of an insecure pattern of attachment, particularly disorganisation, has been associated with more reactive cortisol responses following stress, but no studies have reported on basal levels of cortisol in relation to attachment status. Yet, maltreated children, many of whom have a disorganised attachment pattern, have been reported as having high basal cortisol (Tarullo & Gunnar, 2006). The Lyons-Ruth and Block study (1996) found high risk mothers who had experienced child abuse or were exposed to family violence were more likely to have infants that had disorganised attachments due to maternal hostile-intrusive or frightened behaviour, whereas those with less violent childhoods (including neglect) were more likely to have avoidant infants. However this study had a high level of insecure attachments regardless of trauma history presumably due to the low SES of the group and the associated risks. In addition mothers of disorganised infants reported either very high or very low levels of current symptoms of the disorder which may have been due to the oscillating nature of the symptoms, their inability to recall, or the changing nature of PTSD symptoms over time. Lyons-Ruth and Block did not report on lifetime PTSD, the adult experiences of trauma, cortisol levels or child outcomes. The current study aims to collect a lifetime history of
trauma, PTSD and ongoing trauma and other mental health symptoms starting in the prenatal period from a low risk group of mothers.

Aspects of maternal behaviour such as maternal sensitivity and structuring, and insecure attachment patterns have been associated with poorer development of self regulation and an increase in emotional and behavioural problems (for reviews see Carlson & Sroufe, 1995; Thompson, 1999). However research into antenatal anxiety implicates high maternal cortisol in the development of cognitive, attentional, emotional and behavioural difficulties in offspring (Glover & O'Connor, 2002; O'Connor et al., 2005; van den Bergh et al., 2005). In addition emerging evidence is also implicating high child basal cortisol levels and the development of behavioural problems and attentional difficulties (O'Connor et al., 2005). But this large longitudinal study did not collect cortisol from the children until early adolescence. Low cortisol levels have been implicated in problems of aggressive behaviour but again cortisol has not been collected until after serious behaviours have developed (McBurnett et al., 2000; van Goozen et al., 2000). In reviewing this area Gunnar and Vazquez (2001) have hypothesised that low or flattened basal cortisol may impact on the child’s ability to sustain attention to their learning environment. The current study aims to collect cortisol from the infants at 12 months of age and monitor cognitive and behavioural development.

The overall aim of this study is to assess the impact of the maternal experience of trauma and PSTD before conception, on the mothers’ and infants’ basal cortisol levels, subsequent mother-infant interactions, and child cognitive, emotional and behavioural outcomes. The study was conducted with a community sample of low risk middle class mothers to reduce the effect of confounding variables such as poverty and low education, as well as identify markers for targeted intervention in this easily missed group. As reviewed above the majority of research has looked at the impact of postnatal depression and perinatal anxiety on
parenting and child outcomes. Given the pervasive nature of trauma experience in our community it is a reasonable assumption that much of the depression and anxiety that is being assessed in pregnant women and mothers of young infants is related to previous trauma experience. In addition maternal trauma experience may account for the 15% of children in middle class samples who develop disorganised attachment patterns. Few studies have directly assessed maternal PTSD and child outcomes. The current study aims:

1. To investigate the relationship between prior maternal trauma, PTSD and ongoing symptoms of the disorder and the pattern of basal cortisol production in both the mother and the infant (Chapter 5).

2. To determine whether prenatal or postnatal environmental experiences best predict child basal cortisol (Chapter 5).

3. To investigate whether prior maternal trauma history or symptom level negatively impacts on the mother-infant interaction, and ultimately her attachment with her child. The association between maternal behaviour, infant attachment status and basal cortisol levels will also be investigated (Chapter 6).

4. To determine whether prior maternal trauma history, PTSD, ongoing symptom level, or infant basal cortisol negatively impacts on the child’s subsequent development of cognitive processes, and internalising and externalising behaviours (Chapter 7).

5. To determine whether prenatal or postnatal environmental experiences best predict child cognitive and behavioural outcomes (Chapter 7).
3. **Study Design and Methods**

The first section of this chapter covers the overall design of the research program, the recruitment of the participants, ethics approval, and the procedures followed. An extensive method section follows, describing all the assessments and questionnaires used throughout the study including the statistical methods employed.

3.1. **Study Design**

This study is the second phase of a prospective longitudinal research project initiated by Dr Clara Bookless and conducted within the Department of Psychiatry, The University of Adelaide, The Queen Elizabeth Hospital, Woodville South, South Australia. A longitudinal design was selected to enable a clearer understanding of the variability of maternal mental health over time and its association with the on-going infant-mother interaction and subsequent child developmental outcomes. Phase one commenced in early 2002 and was carried out by Master of Psychology students, Felicity Linke (2002) and Jacinta Lowe (2003). In phase one a community sample of pregnant mothers was recruited during their last four weeks of pregnancy. A community sample was selected over a clinical sample to enable findings to be generalised to the broader community. A middle-class low risk sample was recruited to reduce confounding variables such as poverty and education found in high risk community samples. Data was collected at three time points, with the first occurring pre-birth (T1), and when the infants were 2-3 weeks old (T2), and 3-4 months old (T3). During phase one data was collected on the mother’s mental health and trauma experience, perceptions of parenting, and early measures of child behaviour. The current study (phase two) was designed to collect interactional and physiological data relating to the mother-infant dyad, as well as a variety of child development measures assessing the infant’s cognitive, and
behavioural development from the infants at 13-14 months (T4), 19-20 months (T5), and 24-25 months of age (T6). At each of these time points additional information was also collected on the mother’s mental health and their perception of their own parenting. The time points and the measures selected where chosen to address the hypotheses outlined in Chapter 2, accounting for the age and developmental stage of the infants at the start of phase two, and practical considerations such as the amount of testing feasible for both mother and child at any one time. For clarity of reporting the assessment periods will be referred to as T1 or pre-birth, T2 or 2 weeks, T3 or 3 months, T4 or 13 months, T5 or 19 months, and T6 or 24 months.

3.1.1. Recruitment

Ethics approval for phase one was obtained from the Women’s and Children’s Hospital (W&CH), Adelaide, and The Adelaide University (Linke, 2002; Lowe, 2002). Recruitment was conducted by Ms Felicity Linke and Ms Jacinta Lowes during February and March 2002. Women were eligible for the study if they were aged at least 18 years, were between 28 weeks gestation and full term at time of recruitment, without obstetric complications or medical risk, and resided in metropolitan Adelaide. Mothers of premature infants (less than 37 weeks gestation) and infants found to have serious health concerns were excluded from the study. Two methods were used to establish a research group and resulted in a total number of 64 women recruited to the study. The first method involved a media release asking for volunteers to participate in a study about mother and baby relationships. The media release was distributed by The University of Adelaide. This release was subsequently run in both newspapers and radio. Forty nine (76.6%) of the study participants responded to the media campaign and directly contacted the research team. The second method involved the researchers making a direct approach to pregnant women attending the antenatal clinic at the W&CH. This second method recruited an additional 13 (20.3%) women to the study. Two
(3.1%) additional mothers volunteered and joined the study at the fourth assessment period. These women had heard about the study from friends who were participants in the study. Both these women had children born during the same time frame as the other women in the study, but entered the study when their infants were 14 months of age. These women were no different demographically from the other women in the study, and as the majority of the other women in the study had actively volunteered it is unlikely that the inclusion of these women would bias the results. However, statistical analyses were carried out with and without these women to check for biases. Overall approximately 80% of the women in the study actively contacted the researchers to be involved in the study.

3.1.2. Ethics Approval and Grant Support

Phase two of the study was conducted from Department of Psychiatry, The Adelaide University based at The Queen Elizabeth Hospital. Ethics approval for the current study (phase two) was obtained from the North Western Adelaide Health Service, Ethics of Human Research Committee, on the 1st of April 2003 (Application Number 2003020), and The University of Adelaide Human Research Ethics Committee on 31st of March 2003 (Project Number H-08-2-3). Protocols were put in place for both women and children whose scores on mental health and developmental screening instruments that indicated that intervention may be required. Women with current mental health concerns were to be discussed with Professor McFarlane and referred for further assessment if deemed necessary. Children found to have developmental delays were to be referred to an appropriate service.

This phase of the longitudinal study was supported by grants from both The Variety Club of South Australia ($15,000; June 2003) and the Channel 7 Children’s Research Foundation ($10,000; June 2003). Jacqueline Beall was also awarded the Jean Gilmore Grant ($3,000)
from The Australian Federation of University Women, South Australia Inc. (June 2003) to travel to the United States for training purposes.

3.1.3. Procedure

The second phase of the longitudinal study, which is the backbone of this thesis, was split into three assessment time points (T4, T5, and T6). When the infants were approximately 12 months old the mothers were contacted by telephone and phase two of the study described and the family commitment explained. Participants were then asked if they were willing to participate. If they were able to continue in the study, an appointment was made for the researcher to conduct the first session in their home. If the participant was unable to be contacted by telephone, new contact details were obtained where possible, via the telephone directory. If this was unsuccessful a letter was send to their last known address asking them to contact the research team.

The assessments at T4 consisted of two sessions scheduled one week apart and were conducted when the infants were 13-14 months of age. Two sessions were conducted as the number of procedures planned would have placed too much demand on the infants and mothers in a single session. The first session was carried out in the home of the participant. The home setting was chosen to re-engage with the mother and infant. On arrival the mothers were given a Participation Information Sheet to read (Appendix A.1) and the study was explained again. If the mother was happy to proceed she was given three separate consent forms to sign, one for herself and one for her child agreeing to participate in the study (Appendix A.2 and A.3, respectively). The third consent form was to give consent for several measures to be videotaped. The mother was given two options. Firstly, to give consent for the videotape to be used for research and teaching purposes within the Department of Psychiatry (Appendix 2.4). The second option, gave broader consent to use the videotape not only
within the department but also for educational purposes outside the Department of Psychiatry (Appendix A.5). The mother was required to sign only one of these forms. In addition a form from The University of Adelaide Human Research Ethics Committee detailing their contact information in the event the participant wished to obtain independent information or file a complaint was left with the mother (Appendix A.4).

The assessments completed in the home included a developmental assessment of the infant and a detailed mental health history of the mother. This naturalistic setting provided a relaxed atmosphere that was suitable for both the methods used. The mother was also given a set of questionnaires to complete and bring to the second session to be conducted at The Queen Elizabeth Hospital. The questionnaires included measures of current maternal mental health, perceptions of parenting, and information relating to current life stressors and social connectedness. In addition, the mother was given a saliva kit which included directions on how to collect a sample of her own and her child’s morning and evening saliva, for the later measurement of cortisol levels.

The second session consisted of two assessments that were conducted at hospital to ensure that all children and parents were exposed to the same environmental stimuli. Firstly, the infant-mother dyad was videotaped during a 10 minute play session which was later coded using the Emotional Availability scales (Biringen, Robinson, Emde, 1998). Secondly, the infant was videotaped during a set interaction with the researcher which was later rated for infant distress to novelty. Both the home and laboratory sessions were approximately 1 hour duration, with the infant components completed first to reduce fatigue. If saliva and questionnaires were not returned at the second session, additional arrangements were made for the researcher to collect them from the participant’s home. On completion of the session
mothers were given a brief report on their child’s development based on the assessment completed in the child’s home the week before.

The fifth assessment period (T5) was conducted at The Queen Elizabeth Hospital when the infants were 19 months of age. Before the assessment, the mothers were telephoned and an appointment made for them to attend hospital, and it was explained that they would be involved in a specific laboratory procedure. A set of questionnaires were posted out with the instructions to complete and bring to their appointment. The questionnaires again included measures of maternal mental health, perceptions of parenting, and information relating to current life stressors and social connectedness. On this occasion the infant’s language development was assessed before the assessment of infant attachment (Ainsworth, Bell, & Stayton, 1972). The assessment session was approximately 1 hour. If the questionnaires were not brought to the assessment session arrangements were made for collection. A brief report on the child’s language development was posted to the mother within two weeks of the assessment being completed.

The sixth assessment period (T6) was conducted when the children were 24 months of age. On this occasion the mothers were telephoned before they were sent a set of questionnaires relating to their mental health, the child’s behavioural, emotional and language development, current life stressors, social connectedness, and their perceptions of parenting. A stamped and return addressed envelope was also included in the package. If the questionnaires were not returned within two weeks, a weekly reminder call was made. When the questionnaires were received the mothers were contacted to thank them for their participation, to ask if they would like an overview of the study results when available, and to ask if they could be contacted again in the future.
3.2. Methods

The methods used in this study are described below in four main sections relating to psychosocial measure specific to: 1) the mother; 2) the infant; 3) the mother-infant dyad; 4) the physiological marker cortisol. Mother specific measures are further divided into four subsections: 1) Personal information; 2) Mothers’ current mental health; 3) Lifetime mental health problems and trauma exposure; 4) Mothers’ perceptions of parenting. The infant specific measures cover three general areas: 1) Behavioural measures; 2) Cognitive measures; 3) Temperament. Within each section the methods are described in order of collection starting from the earliest time point. Assessments were carried out either in the participant’s home or in a laboratory setting at The Queen Elizabeth Hospital. Table 3.1 provides an overview of the methods used in this study but collected in phase one by Linke (2002) and Lowe (2003). These methods will only be described in brief. Table 3.2 provides a summary of all the methods used at each assessment period in phase two and will be described in greater detail in the following text. Copies of questionnaires that are freely available are included in Appendix A. Commercially available questionnaires are not included as this infringes copyright. For these questionnaires example questions will be included in the description.

Many of the assessments used require training in the use of psychometric testing, while some require specialised training. Felicity Linke and Jacinta Lowe had completed the clinical assessment and placement components of their Master of Psychology (Clinical) before conducting the collection of data for this study. Jacqueline Beall is a registered psychologist with experience in the clinical use of psychometric testing with both children and adults. During the course of the current study she trained in the use of instruments that required specialist training, such as the coding of infant attachment, which required travelling to America. Where additional training was required for assessments, specific information will
be supplied below. In addition Jacqueline Beall has extensive work experience in laboratory based medical research and carried out the required biological assays.

Table 3.1. Overview of the methods used in phase one by Linke (2002) and Lowe (2003)

<table>
<thead>
<tr>
<th>T1</th>
<th>Time 2</th>
<th>Time 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 Weeks gestation</td>
<td>Infants 2 weeks</td>
<td>Infants 3 months</td>
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<tr>
<td><strong>Maternal measures</strong></td>
<td><strong>Maternal measures</strong></td>
<td><strong>Maternal measures</strong></td>
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<tr>
<td>Personal information</td>
<td>Personal information</td>
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<tr>
<td>-Demographics</td>
<td>-Health of child</td>
<td>-Health of child</td>
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<tr>
<td>-Social connectedness</td>
<td>-Child care</td>
<td>-Child care</td>
</tr>
<tr>
<td>-Ongoing stress</td>
<td>-Ongoing stress</td>
<td>-Ongoing stress</td>
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<tr>
<td>-Social connectedness</td>
<td>-Social connectedness</td>
<td>-Social connectedness</td>
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<td><strong>Current mental health</strong></td>
<td><strong>Current mental health</strong></td>
<td><strong>Current mental health</strong></td>
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<tr>
<td>-GHQ-28</td>
<td>-GHQ-28</td>
<td>-GHQ-28</td>
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<tr>
<td>-PCL-C</td>
<td>-PCL-C</td>
<td>-PCL-C</td>
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<tr>
<td>-DES</td>
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<tr>
<td><strong>Mental health (lifetime)</strong></td>
<td><strong>Mental health (lifetime)</strong></td>
<td><strong>Mental health (lifetime)</strong></td>
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<tr>
<td>-CIDI subscale</td>
<td>-PTSD</td>
<td>-TAQ</td>
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<tr>
<td><strong>Maternal perceptions</strong></td>
<td><strong>Maternal perceptions</strong></td>
<td><strong>Maternal perceptions</strong></td>
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<td>-MABS</td>
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<td><strong>Infant measures</strong></td>
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<td>-NBAS</td>
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<td><strong>Dyadic Measures</strong></td>
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<td>-ADBB</td>
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Note: ADBB = Alarm Distress Baby Scale (Guedeney, 2001); DES = Dissociative Experiences Scale (Bernstein & Putman, 1986); GHQ = General Health Questionnaire (Goldberg, 1978); IES = Impact of Events Scale (Horowitz, Wilner & Alvarez, 1979); MABS = Mother and Baby Scale (Wolke, 1995); NACS = Neurological and Adaptive Capacity Assessment (Amiel-Tison et al., 1982); NABS = Neonatal Behavioural Assessment Scale (Brazelton & Nugent, 1995); PCL-C = Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers, et al.,1994); TAQ = Traumatic Antecedence Questionnaire (Herman, Perry & van der Kolk, 1989)
### Table 3.2. Overview of methods used in phase two

<table>
<thead>
<tr>
<th>Time 4 Infants 13 months</th>
<th>Time 5 Infants 19 months</th>
<th>Time 6 Infants 24 months</th>
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<tbody>
<tr>
<td><strong>Maternal measures</strong></td>
<td><strong>Maternal measures</strong></td>
<td><strong>Maternal measures</strong></td>
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<td><em>Personal information</em></td>
<td><em>Personal information</em></td>
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<td>- Health of child</td>
<td>- Health of child</td>
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<td>- Child care</td>
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<td>- Child care</td>
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<td>- Ongoing stress</td>
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<td>- Ongoing stress</td>
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<tr>
<td>- Social connectedness</td>
<td>- Social connectedness</td>
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<td><strong>Current mental health</strong></td>
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<td>- GHQ-28</td>
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<td>- PCL-C</td>
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<td>- EPDS</td>
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<tr>
<td><strong>Mental health (lifetime)</strong></td>
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<tr>
<td>- CIDI subscales</td>
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<tr>
<td>- Depression</td>
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<td>- Anxiety</td>
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<td><strong>Maternal perceptions</strong></td>
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<td>- PAI</td>
<td>- PSI</td>
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<td><strong>Infant measures</strong></td>
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<td>- GMDS-Revised</td>
<td>- RLDS-III (TQEH)</td>
<td>- LDS</td>
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<td><em>Temperament</em></td>
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<td>- Distress to Novelty</td>
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<td><strong>Dyadic measures</strong></td>
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<td>- EA Scales (TQEH)</td>
<td>- SSP (TQEH)</td>
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<td><strong>Biological measures</strong></td>
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<td>- Cortisol (saliva)</td>
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Note: CBCL = Child Behaviour Checklist (Achenbach & Rescorla, 2000); EA = Emotional Availability Scales (Biringen, Robinson & Emde, 1998); EAS = Emotionality Activity and Sociability (Buss & Plomin, 1984); GMDS = Griffiths Mental Development Scales (Griffiths & Huntley, 1996); EPDS = Edinburgh Postnatal Depression Scale (Cox, Holden & Sagovsky); LDS = Language Development Scales (Achenbach & Rescorla, 2000); PAI = Personal Appraisal Inventory (Bookless, Clayer, & McFarlane, 2000); PSI = Parenting Stress Index, (Abidin, 1990); PCRI = Parent Child relationship Inventory (Gerard, 19940); RLDS = Reynell Language Development Scales (Edwards et al., 1997); SSP = Strange Situation Procedure (Ainsworth et al., 1978); TQEH = The Queen Elizabeth Hospital
3.2.1. Mother Specific Measures

A variety of information was gathered from the mothers at each assessment period via the use of a personal information questionnaire. The mothers’ ongoing mental health was also monitored at each assessment period. In addition specific information pertaining to trauma experiences and lifetime diagnoses of mental health problems were conducted at specific time points.

3.2.1.1. Personal information

Personal information questionnaires were devised by Linke (2002) and Lowe (2003). At the first assessment period demographic information was collected in relation to family structure, number of children, income, maternal and paternal age, education, employment, and country of origin. At the second assessment information was collected about the birth process, gestation time, child’s weight, and Apgar scores. At subsequent assessments information was collected on the child’s health and ongoing health problems, the child’s main caregivers, ongoing life stressors, and social connectedness (Appendix B.1).

3.2.1.1.1. Mothers’ report of children’s health

The mother was asked to rate her child’s health on a 5-point Likert-scale from ‘excellent’ to ‘poor’. For analysis, a dichotomous variable was constructed by collapsing the categories into ‘good to excellent’, and ‘fair to poor’. In addition the mother was asked if her child had any of 16 specific health problems on a regular basis since the last assessment. The health problems were nervousness/anxiety, influenza/common cold, virus infections, bowel/stomach problems, injury, asthma, continual crying, problems sleeping, sleeping too much/fatigue, diarrhoea, vomiting, allergies, visual impairments, hearing impairments, croup, skin problems, and other (please specify).
3.2.1.1.2. Child care arrangements

The mother was also asked how they would best describe their household: two parent family; single parent family; blended family; or other. Also whether this had changed since the previous assessment. Questions were asked about who the study child’s main carer was, how many hours a week the child’s father and other regular carers spent in direct care of the child, and whether the mother had returned to work, and if so when, and how many hours per week.

3.2.1.1.3. Ongoing stress

Mothers were asked to complete a checklist of life stressors from assessment T4 onward. The purpose of this was to obtain an ongoing history of such stressors. These stressful events were: marital conflict, marital separation/divorce; boyfriend/girlfriend problems; problems with child; problems with family; bereavement; financial problems; unemployment; work/study problems; illness/accident/surgery; domestic violence; physical health problems; alcohol/drug problems; mental illness; sexual problems; legal/criminal problems; sexual assault; physical assault/threat; car problems; problems with baby’s father; accommodation problems; problems with family of origin; problems with family of baby’s father; mental health problems or problems with their nerves; and any other problems. A total Life Stress score for each time point was computed by summing the number of stressors endorsed. These items were also used to screen for any further trauma exposure. Marital conflict and boyfriend problems were combined to form one ‘relationship stress’ variable. Furthermore, for analysis a ‘chronic relationship stress’ variable was created when marital stress was endorsed on more than one occasion.

3.2.1.1.4. Social connectedness

Questions were asked at each time point about the mother’s social network and whether or not they had a confidant. The social network questions asked about the number of neighbours
they visited, number of close friends, how often they got together with friends and family, and how many community groups or organisations they belonged to. In relation to a confident, the mothers were asked to state who was the person they would most likely discuss important matters with: spouse/partner; boy/girl friend; parent; sibling; child; other family member; co-worker; neighbour; friend; advisor; acquaintance; no-one; don’t know.

3.2.1.2. Lifetime mental health problems and trauma exposure

The mothers’ lifetime mental health history and trauma experience was determined by two semi structured interviews: the Composite International Diagnostic Interview; and the Traumatic Antecedence Questionnaire. The measure of lifetime posttraumatic stress disorder (not current PTSD) was chosen as studies by Yehuda (see Yehuda et al., 2000) have indicated that historical information may be of more value than current symptoms in understanding current responses to the environment.

3.2.1.2.1. Composite International Diagnostic Interview-2.1 (CIDI 2.1)

Composite International Diagnostic Interview-2.1 (CIDI-2; World Health Organisation, 1997) is a structured interview that systematically asks the necessary questions to arrive at a DSM-IV (American Psychiatric Association, 1994) or ICD-10 (World Health Organisation, 1993) diagnosis for a wide range of psychiatric disorders. All material related to the CIDI is copyright to the World Health Organisation (WHO) and the monitoring and upgrading of the CIDI is performed by an advisory committee on behalf of the WHO. The CIDI was originally designed for use in epidemiological studies of mental disorders, but has also been used extensively for research and clinical purposes (Wittchen, 1994).

Large field trials of the earlier versions of the CIDI have demonstrated good inter-rater reliability and test-retest reliability and acceptable validity (Wittchen, 1994) The test-retest
reliability for the CIDI-2.1 ranged from acceptable to excellent, with those questions with lower reliability being rewritten for the final version (Andrews & Peters, 1998). The interviewer-administered computer version is untested but should be the same or better than the interviewer-administered pen and paper version (Andrews & Peters, 1998).

The lifetime computerised version of the CIDI-2 was used in this study, with the researcher conducting the interview. The interviewers received in-house training on the use of the CIDI from staff of Professor McFarlane, Department of Psychiatry, The University of Adelaide. This department has extensive experience in large research studies using this instrument.

3.2.1.2.1.1. Posttraumatic stress disorder (PTSD)

The CIDI subscale for PTSD was administered by Lowe (2003), using the pen and paper version, when the infants were 3 months old. The mothers were first asked if they had experienced any of the following trauma in their lifetime: 1) Direct combat experience in a war; 2) A life threatening accident; 3) A flood, fire, or natural disaster; 4) Witnessed someone being badly injured or killed; 5) Rape; 6) Sexual molestation; 7) Seriously physically attacked or assaulted; 8) Threatened with a weapon, held captive or kidnapped; 9) Tortured or victim of terrorists; 10) Domestic violence; 11) Witnessed domestic violence; 12) Any other extremely stressful event; 13) A great shock because one of the above events has happened to someone close. The domestic violence questions are not in the original CIDI but were included to reduce the ‘other’ category. If the participant had experienced a significant trauma they were then asked if they felt terrified or helpless when the trauma occurred. All the symptom questions were asked regardless of meeting specific criteria for PTSD. Lifetime diagnoses of the disorder using the Diagnostic and Statistical Manual Fourth Edition (DSM-IV) (American Psychiatric Association, 1994) criteria were originally carried out (Lowe, 2003). However, Lehmann and colleagues (manuscript in preparation) argued that the DSM-
IV criteria are too restrictive leading to a high number of false negatives. Overall they concluded that an ICD-10 diagnosis represented an important clinical group with significant disability. For this study both the DSM-IV and ICD-10 criteria were calculated and used as grouping variables.

The differences between DSM-IV and ICD-10 criteria are summarised in Table 3.3. In brief DSM-IV requires that six specific criterion (A to F) are met. Criterion A requires the exposure to a preceding identifiable trauma (A1) and to have experienced feelings of fear or helplessness (A2). In contrast, ICD-10 requires the clinician to make a subjective appraisal of the persons experience to determine whether their experience was of exceptional severity likely to cause persistent distress. Criterion B requires the presence of traumatic memories, with both DSM-IV and ICD-10 requiring the reoccurrence of intrusive memories, dreams, or flashbacks. Significant differences are seen between DSM-IV and ICD-10 on criterion C. DSM-IV requires the presence of both actual avoidance and psychological numbing. Psychological numbing includes inability to recall important aspects of the trauma, diminished interest in significant activities, feelings of detachment from others, restricted range of affect, and a shortened sense of future. In contrast ICD-10 only requires actual or preferred avoidance to be credited for criterion C. Criterion D is also significantly different between the two diagnostic tools with a disagreement about the importance placed on hyperarousal. The presence of at least two symptoms of hyperarousal are mandatory for DSM-IV. In contrast ICD-10 requires the presence of either the inability to recall important aspects of the traumatic event (D1) or the experience of two or more symptoms of physiological arousal (D2). In essence ICD-10 requires the presence of intrusive memories, avoidance, and failure to remember or the presence of hyperarousal symptoms, where as DSM-IV requires the presence of intrusive memories, avoidance and numbing (which may include failure to remember), as well as hyperarousal. DSM-IV requires the symptoms to be
Table 3.3 Differences in the DSM-IV and ICD-10 diagnostic criteria requirement for the diagnosis of posttraumatic stress disorder (PTSD)

<table>
<thead>
<tr>
<th>DSM-IV PTSD Criteria</th>
<th>ICD-10 PTSD Criteria</th>
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<tr>
<td>A1. Exposure to trauma</td>
<td>A. Exposure to trauma</td>
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<td>A2. Emotional reaction to trauma</td>
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<tr>
<td>B. Persistent re-experiencing traumatic event in one or more of following ways: B1. Intrusive recollections</td>
<td>B. Persistent re-experiencing of traumatic event in one of following ways: i. Intrusive flashbacks</td>
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<tr>
<td>B2. Distressing dreams</td>
<td>ii. Vivid memories</td>
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<td>B3. Acting or feeling as trauma was recurring</td>
<td>iii. Experiencing distress when reminded</td>
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<td>B4. Psychological distress when reminded</td>
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<td>B5. Physiological reactivity when reminded</td>
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<td>C. Persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness. Requires three of following: C1. Avoidance of thoughts, feelings, or conversations associated with trauma</td>
<td>C. Actual or preferred avoidance of circumstances resembling or associated with the traumatic event</td>
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<td>C2. Avoidance of activities, places, or people associate with the trauma</td>
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<tr>
<td>C3. Inability to recall important aspects of the trauma</td>
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<td>C4. Diminished interest or participation in significant activities</td>
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<td>C5. Feeling detached from others</td>
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<td>C6. Restricted range of affect</td>
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<td>C7. Sense of foreshortened future</td>
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<td>D. Persistent symptoms of increased arousal. Requires two of the following: D1. Difficulty falling asleep or staying asleep</td>
<td>Either D1 or D2.</td>
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<tr>
<td>D2. Irritability or outbursts of anger</td>
<td>D1. Inability to recall some important aspects of the traumatic experience</td>
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<tr>
<td>D3. Difficulty concentrating</td>
<td>D2. Persistent symptoms of increased physiological arousal. Requires two of the following: i. Difficulty falling asleep or staying asleep</td>
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<tr>
<td>D4. Hypervigilance</td>
<td>ii. Irritability or outbursts of anger</td>
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<tr>
<td>D5. Exaggerated startle response</td>
<td>iii. Difficulty concentrating</td>
</tr>
<tr>
<td></td>
<td>iv. Hypervigilance</td>
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<tr>
<td></td>
<td>v. Exaggerated startle response</td>
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<tr>
<td>E. Duration of disturbance of at least 1 month.</td>
<td>E. Onset of symptoms within 6 months of the trauma.</td>
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<tr>
<td>F. Disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning.</td>
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present for at least one month without any restriction on the timing of onset (Criterion E). In contrast, ICD-10 puts no restriction on length of time of symptoms but restricts onset to within six months. Criterion F requires the personal appraisal of significant disruption or impairment in social, occupational or other important functioning. ICD-10 does not have an equivalent to criterion F.

3.2.1.2.1.2. Depression and anxiety

The subscales for lifetime DSM-IV diagnoses of both depression and anxiety were conducted at T4 when the children were 13 months old. The depression subscale includes diagnostic criteria for: major depression-single episode; major depression-recurrent; and dysthymia. The anxiety subscale allowed the diagnosis of: simple phobia; social phobia; agoraphobia; and generalised anxiety disorder (GAD). The interview was conducted in the participant’s home using the computer version administered by the researcher. The CIDI-Auto computes diagnosis and supplies a summary of diagnoses met.

3.2.1.2.2. Traumatic Antecedence Questionnaire (TAQ)

The Traumatic Antecedence Questionnaire (TAQ) is a 100 item semi structured questionnaire that is designed to assess childhood histories of abuse and disruptions in parental care (Herman, Perry, & van der Kolk, 1989). The TAQ attempts to obtain information about the interviewee’s primary care takers, family discipline, family alcoholism, domestic violence, and emotional, physical and sexual abuse and neglect across early childhood (0-6 years), mid-childhood (7-12 years) and adolescence (13-18), and adulthood (18+). A composite measure of trauma is constructed by adding the positive scores in each category of trauma at each developmental stage (Herman et al., 1989; Appendix B.2).

Very little reliability and validity data is available for the TAQ. Reliability of total TAQ scores has been reported to be high (interclass correlations = .94; Triffleman, Marmar,
Most studies that have used the TAQ to measure level of childhood trauma have found strong positive associations between childhood trauma and substance abuse (Triffleman et al., 1995), borderline personality disorder (Herman et al., 1989), and dissociative disorders (Saxe et al., 1993).

The TAQ was administered to the mothers, when their infants were 3 months old, to gain an understanding of family difficulties faced by the mothers’ during their own upbringing (Lowe, 2003). Each question is asked for the three age ranges and the answer uses a 4-point Likert scale from ‘0’ (never/not at all) to ‘3’ (often/very much) and includes a ‘don’t know’ category. Don’t know responses were calculated as ‘0’, but tagged. When calculating the subscales the average was calculated by dividing the sum by the number of numerical valid values, excluding the “don’t know” responses. A dummy variable was created for the responses that included ‘don’t know’ answers and no systematic bias was detected. Several new variables were created. The age groups of 0-6 and 7-12 were combined leaving three age ranges: childhood, adolescence, and adulthood. In addition, two overall subscales were computed for each age group: 1) abuse and 2) disruption in parental care. The abuse domain combined physical, emotional, and sexual abuse as well as witnessing domestic abuse. The disruption to parental care included neglect, separation, and family chaos (secrets and alcohol abuse). The abuse domain was dichotomised by placing individuals into a higher category if they scored ‘3’ on any single abuse question indicating high level of severity or frequency, or if they scored greater than a third of the possible maximum for each subcategory indicating a broader range of problems at a lower severity or frequency. If they scored on any item with low intensity and low severity they were categorised as lower level abuse.

3.2.1.3. Mothers current mental health

The mothers mental health was monitored throughout the course of the longitudinal study. At each time point the mothers were asked to complete three questionnaires relating to their
mental health, namely: the 28 item General Health Questionnaire, the Posttraumatic Stress Disorder Checklist-Civilian Version, and the Dissociative Experience Scale. In addition, mothers were given the Impact of Events Scale when the infants were three months old (T3) and the Edinburgh Postnatal Depression Scale when the infants were 14 months of age (T4).

3.2.1.3.1. General Health Questionnaire 28 items (GHQ-28)

The General Health Questionnaire 28 items (GHQ-28) is a widely used, self administered screening instrument aimed at detecting psychological distress among adults in community and non-psychiatric clinical settings (Goldberg, 1978). Psychological distress refers to the range of problems between psychological health and psychological illness, and as such the questionnaire does not cover normal psychological functioning or severe disturbances. The questionnaire was developed to detect changes in normal functioning rather than life long traits and focuses on the respondent’s ability to continue ‘normal’ healthy functioning, as well as the appearance of new problems, and an increase in levels of distress. The respondent is asked to answer the questions in relation to the ‘past few weeks’ making it sensitive to transient problems. However, the length of time the respondent has experienced symptoms is not ascertained and therefore the GHQ can not be used to determine psychiatric disorders. Yet cut-off scores have been determined to enable classification of cases of psychological distress versus normal psychological functioning.

Studies with varying samples have determined the GHQ’s internal consistency, but consistent test-retest reliability has proved difficult to demonstrate due to the questionnaire’s sensitivity to change (Goldberg, 1978). The validity of the GHQ has been established by direct correlation of the GHQ with standard psychiatric assessments, as well as its ability to discriminate well between psychiatric and non-psychiatric patients with sensitivity and specificity in the region of 70-80% (Goldberg, 1978). The GHQ has been used extensively
with new mothers (Cooper, Campbell, Day, Kennerley, & Bond, 1988; Cox et al., 1993; Dudley, Roy, Kelk, & Bernard, 2001; Romito et al., 1999; Skari et al., 2002) with similar levels of sensitivity and specificity being reported (Nott & Cutts 1982). Higher levels of false positive have been found in respondents who have better social support and financial resources (Bell, Watson, Sharp, Lyons, & Lewis, 2005). Factor analytic studies of the GHQ-28 have found an overall general factor as well as four subscales. The subscales and example questions are: 1) Somatic symptoms—e.g. ‘Have you recently been feeling perfectly well and in good health?’; 2) Anxiety/insomnia—e.g. ‘Have you recently lost much sleep over worry?’; 3) Social dysfunction—e.g. ‘Have you recently felt on the whole you were doing things well?’; 4) Severe depression—e.g. ‘Have you recently been thinking of yourself as a worthless person?’ (Goldberg, 1978). Each subscale has seven items. The subscales were determined by factor analysis and represent dimensions of symptomatology and should not be regarded as psychiatric diagnoses. In addition the subscales are not independent of each other.

The GHQ-28 is published by NFER-Nelson and was purchased from the Australian Council for Education Resources (ACER), Camberwell, Victoria. Each of the 28 items has a four-point Likert scale ranging from ‘better than usual’, to ‘much worse than usual’ with items scored as 0-1-2-3, giving a minimum score of zero and a maximum score of 84, with higher scores indicating higher levels of psychological distress. Missing data was replaced with a conservative group mean. New continuous variables were created by combining the first three time points, pre-birth, 2 weeks, and 3 months for each subscale as well as the total score. These new variables were termed ‘perinatal’. The same process was conducted for the last three time points, when the infants were 13 months, 19 months and 24 months of age. These variables were termed ‘postnatal’ and relate to the mothers well being in the child’s second year of life.
To dichotomise the participants into case-no case, items were scored as 0-0-1-1. Most validity studies indicate the threshold score for caseness for the GHQ-28 is a total score between four and five (Goldberg, 1978). However studies using the GHQ with post partum women suggest a higher cut-off due to sleep disturbances in the post partum period (Nott & Cutts, 1982; Skari et al., 2002; Watson & Evans, 1986). In this study psychological distress was measured by a total GHQ-28 score, and cases of clinically important psychological distress was defined as a score of six and above. In addition, caseness for both severe depression and anxiety/insomnia subscales were determined using a cut-off of two and above (possible maximum 21) for the depression subscale, and three and above for the anxiety/insomnia scale (Skari et al., 2002). The higher cut-off for anxiety/insomnia subscale reflects the possible sleep disturbances that may occur with young infants. According to the study protocol, participants endorsing suicidal ideation were to be referred for psychiatric assessment.

3.2.1.3.2. Posttraumatic Stress Disorder Checklist-Civilian Version (PCL-C)
The Posttraumatic Stress Disorder Checklist-Civilian Version (PCL-C) is a 17 item self report inventory for the assessment of PTSD symptoms that have been experienced in the past month (Weathers, Litz, Huska, & Keane, 1994). The items address all criteria required for the diagnosis of PTSD (DSM-IV; American Psychiatric Association, 1994) giving an overall score as well as three subscales: 1) Re-experiencing symptoms—five questions; 2) Avoidance and emotional numbing—seven questions; 3) Hyperarousal—five questions. It was developed at the National Centre for PTSD using male Vietnam veterans and is freely available (Weathers, Litz, Herman, Huska, & Keane, 1993; Appendix B.3).

The PCL-C has demonstrated internal reliability for both the total scale as well as the three subscales (Cordova et al., 1995; Smith, Redd, DeHamel, Vickberg, & Ricketts, 1999; Weathers et al., 1993). Several studies have demonstrated convergent validity with a structured interview and other measures of PTSD (Cordova et al., 1995; Weathers et al., 1993).
1993), with a cut-off of 50 being the most efficacious. Validation studies in non-military populations of mixed gender have subsequently demonstrated good psychometric properties for the use of this instrument as a screening tool (Andrykowski, Cordova, Studts, & Miller, 1998; Blanchard et al., 1996; Cordova et al., 1995; Smith et al., 1999). Blanchard and colleagues’ (1996) validation study used a population of motor vehicle accident and sexual assault victims, predominately female, and best reflects the population in this current study. Factorial studies have found between two and four factors encompassing various combinations of the three subscales (Cordova et al., 1995; Smith et al., 1999; Weathers et al., 1993). Several studies have found individual items and the symptom sub scores of less value, particularly the hyperarousal items (Blanchard et al., 1996; Smith et al., 1999).

The mothers completed the PCL-C at each of the six assessment periods. It uses a five-point Likert scale (1-5) ranging from ‘not at all’ to ‘extremely’. The total score is a summation of the 17 item scores giving a minimum of 17 and a maximum of 85, with higher scores indicating higher difficulties with posttraumatic stress symptoms, and scores over 50 reaching ‘caseness’. However, to try and reduce the skewness of this measure, the Likert scale used for this study was from 0-4, giving a minimum of zero to a maximum of 68. This means the cut-off score for ‘caseness’ would be 33 instead of 50. Missing data was replaced using a conservative group mean for that data point. Subscale and individual item scores were not used in the analysis.

3.2.1.3.3. Dissociative Experience Scale (DES)

The Dissociative Experience Scale (DES) is a 28 item self report questionnaire designed as a screening instrument to detect dissociative disorders and to quantify dissociation in research studies and has demonstrated good split-half and test-retest reliability (Bernstein & Putnam, 1986; Ross, Joshi, & Currie, 1990). The questionnaire is freely available and has been used in a large number of studies (Appendix B.4). A meta-analytic validation of the DES found
excellent convergent validity with other measures of dissociation, as well as good predictive validity in relation to dissociative disorders, traumatic experiences and abuse (van Ijzendoorn & Schuengel, 1996). This study also found that the DES was sensitive to response and experimenter bias and was best averaged over several time points and judges. Questions are asked in relation to three areas: 1) Memory loss or the feeling of ‘coming to’; 2) Depersonalisation; 3) Experiences of intense absorption. Several studies designed to test the underlying structure of the questionnaire have supported this three dimensional structure while others have found a single dimension only is necessary to account for the data (for a review see Waller, Putnam, & Carlson, 1996).

The mothers completed the questionnaire at each of the six assessment periods. The instructions clearly indicate that the experiences in question refer to occurrences that happen in daily life but not while under the influence of alcohol or drugs. Each question asks the respondent to indicate the percentage of time that they experience a certain phenomenon with ‘0%’ indicating never and ‘100%’ indicating always. Missing data points were replaced by a conservative group mean for that point. The mean DES score is calculated and ranges between 0 and 100. Scores above 30 are indicative to dissociative disorders (Carlson et al., 1993).

3.2.1.3.4. Impact of Event Scale (IES)
The Impact of Event Scale (IES) is a self report checklist that was designed to measure the current psychological impact of a specific trauma or stressor on adults (Horowitz, Wilner, & Alvarez, 1979). It consists of 15 items, seven of which measure intrusive symptoms and eight which measure avoidance symptoms and is freely available (Appendix B.5). The measure has been shown to have good internal consistency as well as good split-half and test-retest reliability (Corcoran & Fischer, 1994; Horowitz et al., 1979). The overall scale has been found to have good internal consistency, content validity, convergent validity with other
measures of PTSD, and the ability to discriminate traumatised groups from non-traumatised
groups (Briere, 1997; Corcoran & Fischer, 1994; Eid, Thayer, & Johnsen, 1999; Herman et
al., 1989).

The IES was administered when the infants were 2 weeks of age (Linke, 2002). Mothers were
asked to complete the IES in relation to the birth of the study child. The questionnaire asks the
respondent to rate how a stressful incident, in this case the birth, distressed them over the
‘past 7 days’. It uses a 4-point scale 0-1-3-5, ranging from ‘not at all’ to ‘often’, with higher
scores reflecting more stressful impact. The intrusive subscale score ranges from 0 to 35, the
avoidance subscale scores from 0 to 40. Both subscales are summed for an overall distress
score. Scores over 26 indicate moderate to severe distress.

3.2.1.3.5. Edinburgh Postnatal Depression Scale (EPDS)
The Edinburgh Postnatal Depression Scale (EPDS) is a brief and reliable 10 item self report
instrument that was specifically developed for the screening of postnatal depression and is
freely available (Cox, Holden, & Sagovsky, 1987; Appendix B.6). A cut-off score of 12.5 has
been determined to yield the best specificity and sensitivity, with validity studies in the UK
and Australia yielding sensitivity scores ranging from 86 to100%, specificity ranging from 78
to 95.7%, and predictive value ranging from 43 to 75% (Boyce, 1993; Harris, Huckle,
Thomas, Johns, & Fung, 1989; L. Murray, Carothers, Andrew, 1990). The EPDS is a widely
used and well regarded screening instrument for postnatal depression and is used extensively
in the UK and Australia (Buist et al., 2005; Murray, Cooper, & Hipwell, 2003).

The EPDS was included in the study when the infants were 14 months of age (T4) to augment
the Depression scale of the CIDI.2 and the GHQ-28. The questionnaire asks how the mother
has been feeling over the ‘past 7 days’. Each item uses a 4-point Likert scale ranging from
‘yes, all the time’ to ‘no, not at all’. The responses are scored 0-1-2-3 with higher scores
indicating greater severity of the symptoms. Questions 1, 2, and 4 are scored in this order and the remaining questions are scored in the reverse order of 3-2-1-0. Scores are summed to obtain a total score with a minimum of 0 and maximum of 30. The cut-off used in this study was 12/13.

3.2.1.4. Mothers perceptions of parenting

The mothers’ perceptions of parenting were measured using a variety of instruments when the infants were 2 weeks, and 14, 19 and 24 months old (T2, T4, T5 & T6 respectively).

3.2.1.4.1. Mother and Baby Scale (MABS)

The Mother and Baby Scale (MABS) is a 64 item self-report questionnaire designed to measure maternal subjective experiences of parenting in the early postnatal period (Wolke, 1995). The MABS asks questions about two settings, between feeding and during feeding, and consists of neonate and parent domains. The neonate domain has five subscales: 1) Unsettled-irregular—15 items; 2) Irritability during feeding —8 items; 3) Alertness-responsiveness—8 items; 4) Alertness during feeding—5 items; 5) Easiness—5 items. Each item is rated on a 5-point scale ranging from 0 ‘not at all’ to 5 ‘very much/often’. The parent domain consists of three subscales: 1) Lack of confidence in caretaking—13 items; 2) Lack of confidence during feeding —8 items; 3) Global confidence—3 items. Each item is rated on a 7-point scale from -3 ‘very poor’ to +3 ‘very good’.

The internal consistency of the MABS is good with all scales demonstrating a Cronbach’s alpha of over 0.80 (Wolke, 1995). Convergent validity of the MABS has been demonstrated with good agreement between the MABS and 24 hour infant behaviour diaries, and objective measures such as the Neonatal Behavioural Assessment Scale (NBAS; Brazelton & Nugent, 1995), nurses’ ratings and direct observation (Wolke, 1995).
The mothers completed the MABS in their homes, when their infants were two weeks of age (Linke, 2002). The wording on several items was modified to make them suitable for administration after discharge from hospital (Appendix B.7).

3.2.1.4.2. Personal Appraisal Inventory (PAI)

The Personal Appraisal Inventory (PAI) is a self-report questionnaire that was originally developed to quantify the personal meaning of experiencing depression (Bookless, Clayer, & McFarlane, 2000; Bookless, McFarlane, & Clayer, 2001). For this study the wording of the PAI was altered to reflect the personal meaning of the experience of having a child. Given the changes in the population and the wording of the questionnaire there is no reliability or validity data available and the use of this questionnaire is exploratory. A factor analysis with varimax rotation was carried out and initially eight factors were isolated. The four factors accounted for the majority of the variance, clearly fitted within the aims of the questionnaire and had sufficient number of questions each for reliability. In contrast, the other four factors either had too few questions or had questions that also loaded on the other four factors. It was decided to reduce the questionnaire to the 16 items that loaded on these four factors, with four questions per subscale. The factor analysis was re-run to confirm the factor structure and accounted for 69.01% of the total variance. This factor was named Positive Growth as it represented positive changes to self beliefs (29.81% of the total variance). Higher scores represent greater positive change after becoming a parent. The questions ask about changes in how the mother views herself. For example, ‘As a result of having this child I have become a better person’. The second factor was termed Resources to Manage (18.18% of the total variance) with higher scores indicating more personal resources. The questions ask about ability to help oneself, for example; ‘To what extent do you think you can change or do something to improve your life if you wanted to?’ The third factor accounted for 12.5% of the variance and was called Impact on Goals and Commitments. The questions ask about how the child has impacted on the mothers’ ability to achieve their goals and commitments. For
example, ‘I think the experience of having this child has harmed my ability to achieve my goals.’ Higher scores on this scale indicate that goals and commitments have been jeopardised. The fourth factor was called Impact on Self Esteem and Relationships (8.53% of the total variance) as the questions related to impact of the child on the mothers self esteem and relationships. For example, ‘I think the experience of having a child has harmed my self esteem’. For all questions and the structure matrix from the factor analyse see Appendix B.8. The four scales were checked for internal reliability with all having an alpha of greater than .69.

Convergent validity was found with the PAI-16 correlating with appropriate scales from the Mother and Baby Scale (MABS), Parent Stress Index (PSI), and the Parent Child Relationship Index (PCRI) despite the instruments being administered at different times to the Personal Appraisal Index (PAI). Small to moderate correlations were found between the PAI impacts on self esteem scale and the MABS lack of confidence in caretaking ($r=.36, p<.05$) and lack of confidence during feeding ($r=.42, p<.01$). Moderate correlations were found between the parent and child domains of the PSI. The total child domain correlated with impact on goals ($r=.41, p<.01$) and the subscale demandingness negatively correlated with resources to manage ($r=-.44, p<.005$). The total parent domain correlated with both resources to manage and impact on goals ($r=-.31, p<.05$; $r=.43, p<.005$ respectively) while the impact on self esteem scale correlated with the depression subscale ($r=.43, p<.005$), and the role restriction subscale correlated with the impact on goals ($r=.45, p<.005$). The PCRI subscale of satisfaction with parenting correlated positively with the positive growth scale ($r=.49, p<.001$), and negatively with the impact on goals ($r=-.42, p<.005$).

The PAI was completed by the mothers when their infants were 13 months old. Items are rated on a 5-point Likert scale ranging from ‘0’ (strongly disagree) to ‘4’ (strongly agree). The scores were summed to obtain the three domain scores with a minimum of zero and a
maximum of 16. Given the exploratory nature of this measure individual items were also included in some analyses.

3.2.1.4.3. Parenting Stress Index (PSI)

The Parenting Stress Index (PSI) is a self report questionnaire developed to identify parent-child systems which are under stress and potentially lead to dysfunctional parenting and negatively impact on the child’s emotional and behavioural development (Abidin, 1990). The questionnaire consists of 120 questions and can be used with parents of children between 1 month and 12 years old. The questionnaire includes 101 items related to child temperament, parental personality, and family functioning. An overall stress index is calculated, as well as a parent and child domain. The parent domain assesses stress that results from parental functioning. It is comprised of 54 items that make up seven parental subscales: 1) Depression; 2) Attachment; 3) Role restriction; 4) Competence; 5) Social isolation; 6) Relationship with spouse; 7) Health. Scores in the child domain reflect sources of stress from child characteristics that make it difficult to fulfil the parenting role. It is comprised of 47 items which are used to construct six child subscales: 1) Acceptability; 2) Demandingness; 3) Mood; 4) Reinforces parent; 5) Adaptability; 6) Distractibility/hyperactivity. The remaining 19 optional items make up a life stress event scale that was not used in the current study.

The Parent Stress Index is a widely used measure of parental stress that provides normative data (Abidin, 1990) and has demonstrated reliability and validity for the total stress score as well as the parent and child domains (Abidin, 1990; Bigras, LaFreniere, & Dumas, 1996; Heinze & Grisso, 1996; Hutcheson & Black, 1996). High scores on the PSI have been shown to be related to insecure attachment, developmental delay and child behavioural problems (Abidin, 1990). Conversely, parenting intervention programs have demonstrated reductions in PSI scores (Armstrong, Fraser, Dadds, & Morris, 2000; Davis et al., 2005). Factor analytic studies support the subscale structure and demonstrate that each subscale measures moderately distinct sources of stress (Abidin, 1990). Lower income and education levels have
been found in some studies to be associated with higher PSI scores, but birth order is not 
(Heinze & Grisso, 1996)

The PSI is commercially available and is published by Psychological Assessment Resources 
Inc. Florida, USA, and was purchased through ACER, Camberwell, Victoria. Each mother 
was posted a PSI Item Booklet containing the 120 questions and the PSI Answer Sheet when 
the infants were 20 months old (T5). The questionnaire takes approximately 20 minutes to 
complete. The mothers were asked to focus on the study child throughout the questionnaire. 
The majority of the questions are written as statements and require the respondent to answer 
using a 5-point scale from ‘strongly agree’ to ‘strongly disagree’. The following are two PSI 
questions, the first from the parent domain and the second from the child domain. ‘Q30. I feel 
capable and on top of things when I am caring for my child.’ ‘Q21. My child looks a little 
different than I expected and it bothers me at times’ (Abidin, 1995, p. 2-3). Six questions 
require a numerical answer corresponding to the most appropriate statement. For example, 
‘Q40. When upset, my child is: 1. easy to calm down; 2. harder to calm down than I expected; 
3. very difficult to calm down; 4. nothing I do helps to calm my child’ (Abidin, 1995, p. 3). 
The PSI answer sheet automatically transfers the appropriate score to the correct subscale. 
Subscale columns are summed and the Domain and Total Stress scores calculated and 
converted into percentiles. Higher scores indicate higher levels of stress.

3.2.1.4.4. Parent-Child Relationship Inventory (PCRI)
The Parent-Child Relationship Inventory (PCRI) is a 78 item self report questionnaire 
designed to quantify parental attitudes towards parenting and their children and provides 
normative data for children from 3 to 15 years old (Gerard, 1994). The inventory provides 
seven content scale scores reflecting core features of parenting and the parent-child 
relationship. The content scales are: 1) Parent support; 2) Satisfaction with parenting; 3) 
Involvement; 4) Communication; 5) Limit setting; 6) Autonomy; 7) Role orientation. The two
validity scales assess are: 1) Social desirability; 2) Inconsistency of responding. Only the scale of autonomy was used in this study.

The PCRI was normed on a large diverse sample. The manual (Gerard, 1994) reports reliability for the content scales ranging from .70 to .88. The manual also reports good content validity and adequate construct and criterion validity, other studies have reported promising convergent validity although further independent evaluation is still required (Heinze & Grisso, 1996).

The PCRI is published by Western Psychological Services, Los Angeles, and was purchased through the ACER, Camberwell, Victoria. Each mother was posted the PCRI questionnaire when their infants were 24 months old. The questionnaire takes approximately 15 minutes to complete. The questions are written as statements that require the respondent to answer using a 4-point scale from ‘1’ (strongly agree) to ‘4’ (strongly disagree). The autonomy scale consists of 10 questions. Two examples of questions are, ‘Q8. Parents should protect their children from things that might make them unhappy.’ ‘Q25. Children should be given most of the things they want.’ (Gerard, 1994, p. 38). The scores are directly transferred to their appropriate subscale, with some items being reverse scored. The sub scores are summed and converted to $t$ scores, with higher scores indicating positive parenting practices.

This instrument was used when the infants were approximately 2 years of age even though the scale was designed for parents of children from 3 years of age. The reliability of the Autonomy scale was found to be adequate (alpha .65).
3.2.2. Infant Specific Measures

General information about the infant at birth was collected in the personal information questionnaire. A range of behavioural, cognitive and temperament measures were used throughout the longitudinal study and are presented in order of use.

3.2.2.1. Behavioural measures

Several infant neuro-behavioural measures were undertaken when the infants were 2 weeks, and at 25 months the mothers completed the Child Behaviour Checklist (CBCL).

3.2.2.1.1. Neurological and Adaptive Capacity Assessment (NACS)

Felicity Linke (2002) conducted the Neurological and Adaptive Capacity Assessment (NACS) on the infants when they were 2 weeks of age. The NACS is a structured examination which covers 16 neurological items and 3 behavioural items (Amiel-Tison, 1982). The neurological items assess the infant’s response to visual and auditory stimuli, primary reflexes, and active and passive tone. The behavioural items were: 1) Level of alertness; 2) Crying; 3) Ease of consolability. All items are scored on a 3-point scale (0-2) with ‘2’ indicating optimal performance. Felicity Linke was trained in the use of this assessment by an experienced paediatrician.

3.2.2.1.2. Neonatal Behavioural Assessment Scale (NBAS)

Felicity Linke (2002) conducted the Neonatal Behavioural Assessment Scale (NBAS) on the infants when they were 2 weeks old. The NBAS is a structured examination of infant behaviours in response to a variety of environmental stimuli (Brazelton & Nugent, 1995). Three items from the NBAS were used for this study: 1) Consolability; 2) Self quieting; 3) Hand-to-mouth. These three items together form an overall ‘calming’ factor (Kaye, 1978). Each item was scored on a 9-point scale, with higher scores indicating optimal performance. Felicity Linke was trained in the use of this assessment by an experienced paediatrician.
3.2.2.1.3. Child Behaviour Checklist (CBCL)

The Child Behaviour Checklist for Ages 1½-5 (CBCL; Achenbach & Rescorla, 2000) is a very commonly used self-administered 100 item questionnaire designed to obtain standardised ratings of behavioural, emotional, and social functioning of preschool children. The current study used the parent report form only, as not all children were attending regular external child care. This revised edition of the CBCL allows for assessment of younger children. The CBCL yields a total problem score and seven empirically based syndrome scores; 1) Emotionally reactive; 2) Anxious/depressed; 3) Somatic complaints; 4) Withdrawn; 5) Sleep problems; 6) Attention problems; 7) Aggressive behaviour. An internalising problem score is then determined by combining the first four syndrome scores, and an externalising problem score is computed by combining attention problems and aggressive behaviour syndrome scales. All scores are converted to t scores with clinical borderline and clinical significant scores being 65 and 70 respectively. Percentile scores are also available.

The manual provides extensive data on reliability and validity (Achenbach & Rescorla, 2000). The CBCL has good internal consistency and test-retest reliability (r=.85) when assessed by the same parent (Achenbach & Rescorla, 2000). However reliability between mothers and fathers, and between parents and teachers is much lower (.65 and .40 respectively). The CBCL has been found to discriminate between referred and non-referred children and scores have been found to correlate with other measures of behavioural problems in children.

The CBCL was purchased from ACER, Camberwell, Victoria, as part of the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach & Rescorla, 2000). Mothers were asked to complete the CBCL, in relation to the study child, when the child was 24 months old. The questionnaire takes approximately 20-minutes to complete. The parent is asked to respond to brief behavioural statements in relation to their child’s behaviours over the past 2 months. The respondent answers using a 3-point scale: ‘0’ (Not True), ‘1’
(somewhat or sometimes true), and ‘2’ (very true or often true); Examples of questions are, Q3 ‘Acts too young’; Q27 ‘Doesn’t seem to feel guilt after misbehaving’; Q30 ‘Gets upset when separated from parent’ (Achenbach & Rescorla, 2000, p.7). The externalising and internalising summary scores and the total behavioural scores were computed. CBCL scores were used both as a continuous and dichotomous variable. The continuous variable used is the raw score to allow for the fullest range of variation (Achenbach & Rescorla, 2000). The CBCL has established clinical cutoff points. However, for this study dichotomous variables were calculated by dividing the sample into high/low scores by using a 75 percentile split, with children receiving the top 25% of scores being placed in the high group.

3.2.2.2. Cognitive measures

A measure of the infants overall development was conducted when the infants were 13 months of age, and a measure of their language development was conducted when the infants were 19-20 and 24 months of age.

3.2.2.2.1. The Griffiths Mental Development Scales (GMDS)

The Griffiths Mental Development Scales (GMDS; Griffiths, 1986) is a widely used instrument for the assessment of an infants physical and cognitive development and was first developed in 1955. The revised scales for birth to 2 years (Griffiths & Huntley, 1996) updated test materials, question items, and score sheets, as well as re-standardised the instrument. The revised GMDS follows the same format as the original with five areas of development being assessed: 1) Locomotor—e.g., walks, stoops to pick up; 2) Personal-social—e.g. waves goodbye, claps hands in imitation; 3) Hearing-speech—e.g. single words, identify objects; 4) Eye-hand coordination—e.g. roll ball, hold wood blocks); 5) Performance—e.g. simple puzzles, bricks in and out of boxes. The test yields age equivalent scores, an overall general developmental quotient (GDQ) and subscale quotients scores, and percentile equivalents of the subscale quotient scores.
Extensive reliability, validity and standardisation data is reported in the manual (Griffiths & Huntley, 1996). The internal consistency for the 13-15 month olds was very good ($r=0.92$) and test-retest reliability was good for infants in their 2nd year (0.82), although subscales were less reliable. The standardisation is based on an English sample and uses a mean of 100 and standard deviation of 16.

The Griffiths instrument was purchased from ACER, Camberwell, Victoria. Before purchase proof of accreditation is required. Jacqueline Beall was trained by Dr Frances Gibson, Royal North Shore Hospital, Chatswood, NSW (See Appendix C.1 for certification). The infants were assessed in their homes when they were 13 months old. The administration guidelines in the manual were followed with assessments starting with the ‘performance’ scale. The assessment was stopped when a child had failed six consecutive items. The quotient scores were used in this study.

3.2.2.2.2. Reynell Developmental Language Scales (RDLS)

The Reynell Developmental Language Scale—III (RDLS-III; Edwards et al., 1997) is a new language test for children aged between 18 months and 7 years. It is based on the original Reynell scales (Reynell, 1969) but has undergone a major revision in line with current theory of language development (Edwards et al., 1997). It is a standardised language assessment based on a large normative sample of English-speaking children in the United Kingdom and has a specific set of stimuli (toys). It is divided into two domains: I, Comprehension Scale; II, Expressive Scale. The Comprehension Scale has 62 items organised in sections each with a specific linguistic focus. Sections used in this study were: 1) Comprehension of single words; 2) Comprehension of basic relations between words; 3) Understanding of attributes and spatial relations. The Expressive Scale has 62 items arranged in sections that focus on different aspects of language. Those used in this study were: 1) Naming single word objects,
2) Action words; 3) Spatial and attribute words. The scores can be interpreted as age equivalence levels, percentile scores, and standard scores.

The manual presents a range of psychometric properties of the test (Edwards et al., 1997). The comprehension and expressive scale have been found to correlate highly ($r=0.85$), and the internal reliability (split-half) was high, particularly in children less than 3 years old. Adequate convergent validity was found between the RDLS-III and two other language scales that measure related but different language skills. Of note, a gender difference was found in children up to the age of 3 years and 2 months of age, with girls obtaining higher scores than boys. The age equivalent, standard scores, and percentiles do not have separate scales for gender.

The children’s language development was assessed when they were 19- to 20- months of age in a laboratory setting at The Queen Elizabeth Hospital. This assessment was carried out soon after the children had arrived at the hospital, met the examiner and had settled. The child sat at an appropriate sized table across from the examiner and next to their mothers. The mothers were requested not to help their children, or to interrupt during the course of the assessment, unless asked specific questions by the examiner. The administration guidelines in the manual were followed. The comprehension scale was administered first (Edwards et al., 1997). The testing was stopped when a child failed to complete an entire section. Raw scores for both comprehension and expressive domains were used in all statistical analyses with gender used as a covariate.

3.2.2.2.3. Language Development Survey (LDS)

The Language Development Survey (LDS) is a parent report measure of the number of words spoken, and the average length of phrase spoken for children between 24-35 months of age, and is a part of the Achenbach System of Empirically Based Assessment (ASEBA;
The LDS was developed to evaluate language development in children less than 3 years of age due to difficulties of assessing some children in this age group. The LDS uses parent report of their child’s everyday speech and assesses two domains of language development, phrase length and size of vocabulary. To maximise and standardise parent reports a standardised format is used to collect the data. To determine the ‘average length of phrase’ the respondent is asked to print five of their child’s longest and best phrases or sentences. To determine the ‘vocabulary score’ the respondent is presented with a list of 310 words that are among the first words learnt by most children and asked to circle those words their child says spontaneously. Space is also available for additional words used by the child.

The ASEBA manual (Achenbach & Rescorla, 2000) reports good psychometric properties for the LDS, particularly the ‘vocabulary scale’. Several small studies have demonstrated very high test-retest reliability. Strong convergent validity has been reported in a number of studies cited in the manual. These studies used components from a variety of standardised intelligence and language tests concurrently with the LDS. Discriminatory validity using dichotomous classifications has shown adequate sensitivity and reliability. During the construction of the normative sample girls were found to have significantly higher vocabulary scores than boys and separate gender specific norms were developed.

The mothers were asked to complete the Language Development Survey when their children were 24 months of age. The survey was posted out with other questionnaires including the CBCL. The total number of words in each valid phrase was averaged to obtain the ‘average length of phrases’ and the gender appropriate percentile scores were calculated. Scores below the twenty first percentile are indicative of delayed phrase development. To calculate the ‘vocabulary score’ the number of words endorsed by the mother (up to a total of 315) was summed and the gender appropriate percentile score obtained. Scores below the twentieth
percentile suggest vocabulary delay. Statistical analyses using gender appropriate percentile scores were similar to using raw scores and co-varying for gender. To obtain the most variance in the scores it was decided to use the raw scores and co-vary for gender. The survey scores were also dichotomised by placing the bottom 25% of scores into ‘language delay’ and the remaining 75% to ‘normal’.

3.2.2.3. Temperament measure

Temperament is defined as inherited personality traits present in early childhood (Buss & Plomin, 1984). Two measures of aspects of temperament were used. The first was an examiner-rated dichotomous measure of fearful-not fearful. The second, the Emotionality Activity and Sociability (EAS) questionnaire was used as a parent report measure of child temperament.

3.2.2.3.1. Distress to novelty

When the infants were 13 months of age (T4) they engaged in a videotaped structured play session with the examiner at TQEH following the mother-infant play session. During the course of the session the examiner produced a series of novel surprise toys, such as wind up animals, pop up clowns, and noisy toys such as a quickly deflating balloon. Novel items were interspersed with more common toys such as balls and cars. The children were sitting next to their mothers throughout the session. The infants were rated as distressed/anxious if they displayed vigilat behaviour, motor quietening, became openly distressed, or sought their mother’s comfort when these novel items were introduced.

3.2.2.3.2. Emotionality Activity and Sociability (EAS) questionnaire

Emotionality Activity and Sociability (EAS) questionnaire (Buss & Plomin, 1984) is a widely used measure of temperament with self, parent, and teacher rating versions and as such is suitable for young children. In the current study the parent-rated version was used. The EAS
was originally developed from the Colorado Childhood Temperament Inventory and has undergone several revisions in line with revisions of Buss and Plomin’s original theory (1984). At the last revision a fourth dimension ‘shyness’ was added to the questionnaire. The four dimensions are: 1) Emotionality—measuring intensity of emotional reactions; 2) Activity—measuring the child’s intensity and frequency of movement; 3) Sociability—measuring the child’s preference for being with others rather than alone; 4) Shyness—measuring the child’s inhibited behaviour with strangers.

The EAS has been used extensively in temperament studies with children and has shown good psychometric properties (Boer, Westenberg, & Michiel, 1994; Buss & Plomin, 1984; Gasman et al., 2002; Maithiesen & Tambs, 1990). Inter-rater agreement between parents is good, and the internal consistency of the four scales and the test-retest reliability are satisfactory. Several studies have demonstrated the independence of emotionality, activity and shyness (Boer et al., 1994; Buss & Plomin, 1984). Sociability has been found to correlate with shyness in the young children but with activity in older children suggesting that sociability is separate from shyness (Boer et al., 1994).

The EAS is readily available (Buss & Plomin, 1984; Appendix B.9). It is a 20 item questionnaire and was completed by the mothers when their infants were 24 months old. Each item is rated on a 5-point Likert scale with ‘1’ (not characteristic/typical) to ‘5’ (very characteristic/typical). There are 5 items for each dimension. Items 7, 8, 12, 16, 17, and 20 require reverse scoring. The item scores in each dimension are averaged giving each dimension a final score between ‘1’ and ‘5’, with ‘5’ representing higher behavioural levels of each dimension. Dichotomous variables were created for each dimension by using a 50% split.
3.2.3. Mother-Infant Dyad Relational Measures

Three measures of mother-infant interaction were used in this study. The first, the Alarm Distress Baby Scale (ADBB; Guedeney & Fermanian, 2001), measures the sustained pattern of infant withdrawal during an interaction with the examiner. Even though this measure does not directly include the mother the infant’s behaviour is thought to be a reflection of the regular interactional pattern of the mother and infant. The other two measures, the Emotional Availability scales (EA; Biringen, 2000; Biringen, Robinson, Emde, 1998) and the Strange Situation Procedure (Ainsworth et al., 1978) include both the mother and infant in the assessment with behaviours rating yielding information about the interactional history of the carer-infant dyad.

3.2.3.1. Alarm Distress Baby Scale (ADBB)

Jacinta Lowe (2003) conducted a modified version of the Alarm Distress Baby Scale (ADBB; Guedeney & Fermanian, 2001) when the infants were 3 months old. This 8 item scale was designed to screen infants and toddlers for sustained withdrawal behaviours during interactions with the examiner. The 8 items are: 1) Facial expression; 2) Eye contact; 3) General level of activity; 4) Self stimulating gestures; 5) Vocalizations; 6) Briskness of response to stimulation; 7) Capacity to engage a relationship; 8) Capacity of the child to attract. Each item is scored on a 5-point scale with ‘0’ (absolutely normal) to ‘4’ (massively obvious abnormal behaviour). See Appendix B.10 for scoring criteria. Cut-off scores of five and above indicate problems in social interaction. The training material was obtained from Professor Antoine Guedeney, Department of Child and Adolescent Psychiatry, Hôpital Bichat-Claude Bernard, France. Additional training material was obtained from Dr Stephen Matthey, South West Sydney Area Health Service. The assessment was not able to be carried out during a structured baby health clinic visit as is the usual practice. Instead the assessment was conducted in the infant’s home. The home assessment was less stressful to the infants as they were not undressed, weighed and measured which may result in lower scores.
3.2.3.2. Emotional Availability (EA) scales

The mother-infant interactions were measured using the third edition of the Emotional Availability (EA; Infancy and Early Childhood Version 0-4 years) scales (Biringen, Robinson Emde, 1998). The mother and child are videotaped during a play session and their behaviours are subsequently coded. It is a global assessment method which relies on the observation of contextual clues and clinical judgment to infer the appropriateness of behaviour of both the caregiver and the infant. The EA scales attempts to measure the emotional signalling of the mother to her child, as well as the child’s emotional signalling to the parent, and the parent’s ability to understand their child’s emotional experiences and take them into account (Biringen, 2000). The EA scales are viewed as a measure of the relationship and is comprised of specific maternal and child scales. The individual scales are of varying range but are designed to be continuous.

The EA scales are composed of four maternal and two child scales. The maternal scales are:

1) Maternal sensitivity—mother’s positive affect and responsiveness to her child (based on Ainsworth’s sensitivity scale, Biringen, Robinson, Emde, 1998). It is measured on a 9-point scale which has five detailed descriptors (points 9, 7, 5, 3, and 1). To be given a nine (highly sensitive) the mother needs to demonstrate emotional communication which is ‘positive, appropriate, and congruent’ (Biringen, Robinson, Emde, 1998, p. 25). Ratings of five and below are viewed as problematic. To receive a rating of five the mother needs to demonstrate inconsistent behaviours. Ratings of three are given for harsh or very passive behaviour while a score of one indicates the mother demonstrated very few strengths while interacting with her child.

2) Maternal structuring—measures the mothers ability to support her child’s learning and set appropriate limits (5-point scale).

3) Maternal non-intrusiveness—refers to the mother’s ability to provide autonomy and be available without interference (5-point scale).

4) Maternal non-hostility—refers to the mother’s ability to regulate her negative emotion while in the presence of the child and looks at covert and overt behaviour (5-point scale). The two
child scales are: 1) Child responsiveness—measures the child’s responsiveness to the mother and their pleasure in the interaction (7-point scale). 2) Child involvement—refers to the child’s ability and interest in involving the mother in interactions (7-point scale). All scales are positive with higher scores reflecting more optimal interactions. An overall emotional availability score is obtained by summing all the subscales.

Training is required for the use of the EA scales. The training material was obtained from Dr Zeynep Biringen, Department of Human Development and Family Studies, Colorado State University, Fort Collins, CO 80523. The training material contains the manual, training and criterion tapes. In addition, Jacqueline Beall met Zeynep Biringen in Colorado and discussed assessment issues, and attended a one-half-day workshop on the EA scales that was conducted by Dr JoAnn Robinson. Good inter-rater reliability for the different EA dimensions has been reported (Biringen et al., 2005; Ziv et al., 2000), with higher reliability for longer assessment sessions (Biringen et al., 2005). Emotional availability has been found to be associated with attachment as measured by the Strange Situation Procedure (Aviezar et al., 1999; Biringen et al., 2005; Easterbrooks et al., 2000; Swanson et al., 2000; Ziv et al., 2000) and by the Adult Attachment Interview (Biringen et al., 2000).

The mother-infant dyads were videotaped when the infants were 13 months old. The session was conducted in a laboratory at The Queen Elizabeth Hospital. The mother and child were seated at child appropriate table and chairs and given a selection of age appropriate play items such as building blocks and stacking toys. The toys were also conducive to single or joint play. The researcher and video camera were situated in the corner of the room where the faces of both mother and child could be easily recorded. The recorded session went for 10 minutes with the first 5 minutes being a free play session. In the second 5 minute block, the mother was instructed to teach her child a task such as stacking, or pushing the buttons on a ‘pop up toy’. Tapes were coded at a later date. The total EA and subscale scores were used as
continuous variables. Dichotomous variables were created with the bottom 25% of cases being termed ‘low’ EA. The inter-coder reliability was assessed with approximately 20% of the videotaped sessions being sent to trained coder Ms Tania Tripolini, Department of Psychology Macquarie University, for external coding. Correlations for all the adult scales were above $r = .91$, but were lower for the child scales, child responding $r = .89$, and child involvement $r = .77$. Correlations for the total emotional availability scores were $r = .88$.

3.2.3.3. Strange Situation Procedure (SSP)

Attachment classification is determined by the behaviour of young children (12-20 months) in the Strange Situation Procedure (SSP; Ainsworth et al., 1978). This measure was designed by Ainsworth and colleagues (1978) to elicit a range of attachment behaviours during increasing levels of stress and is viewed as the standard measure of infant attachment (van IJzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004). The SSP is a laboratory based videotaped assessment. It is very structured with the mother and child moving through 8-episodes of 3-minutes each: 1) The parent-child dyad is introduced to the room; 2) Parent settles the infant to play then sits down; 3) A stranger enters the room, introduces self and plays with the infant; 4) The parent leaves the room—first separation during which the stranger can comfort child if required; 5) The parent returns and the stranger leaves the room—first reunion where the mother settles child if needed and returns them to play; 6) Parent leaves child alone—second separation; 7) Stranger returns—can try to comforts child if needed; 8) The parent returns—second reunion where the mother settles the child if needed and returns them to play.

Ainsworth’s system allows for three classifications based on the organised pattern of behaviour of the infant, particularly during the two reunion episodes: 1) Secure (B)—child uses mother as a secure base to explore environment; 2) Insecure-avoidant (A)—child displays little secure base behaviour or affect; 3) Insecure-ambivalent (C)—infant is overly
focused on secure base behaviours and is unable to explore environment. Both reunions are scored on the child’s proximity and contact-seeking behaviour, contact-maintenance, resistant behaviour, and avoidant behaviour. These four scales are rated on a 7-point scale, each with detailed descriptors of behaviour, frequency and timing. The A-B-C coding is determined by differential patterns of these scales. Coding of the Strange Situation Procedure is explained in detail by Ainsworth and colleagues (Ainsworth et al., 1978).

An additional classification was developed by Main and Solomon (1990) which classifies the infant in terms of their disorganised behaviour (D). These infants show a diverse array of behaviours that suggest the child lacks a discernable attachment strategy. This classification scheme arranges behaviours in seven categories: 1) Sequential displays of contradictory behaviour patterns—e.g. strong attachment behaviour followed by freezing or dazed behaviour; 2) Simultaneous display of contradictory behaviour patterns—e.g. child clings to parent while strongly averting gaze; 3) Undirected, incomplete, and interrupted movements and expressions—e.g. when upset moves away from parent; 4) Stereotypies, asymmetrical movements, mistimed movements and anomalous postures—e.g. rhythmical movements such as rocking without apparent visible function; 5) Freezing, stilling and slowed movements and expressions—e.g. child sits completely still, as in a daze, with arms held out; 6) Direct indices of apprehension regarding parent—e.g. child dashes away from door as the parent returns; 7) Direct indices of disorganisation or disorientation—e.g. brightly greeting the stranger upon immediate return of parent. Disorganised behaviour can be scored at any time during the SSP, but more weight is given to behaviours that occur during the reunion episodes. Disorganised behaviours are rated between ‘1’ (no signs) and ‘9’ (strong, frequent or extreme D behaviours). An overall decision on the ‘D’ category is given by rating the frequency, and strength of behaviours, with some behaviours automatically classifying a child, while others of lower severity require more frequent presentations. For a detailed description of this classification system see Main and Solomon (1990).
The SSP requires a significant amount of training and additional work to reach reliability. Jacqueline Beall attended a two week attachment training course for ‘A-B-C, and D’ coding run by Professor Alan Sroufe and Dr Elizabeth Carlson at the University of Minnesota, and on return to Australia gained reliability in coding the A-B-C, and D classifications (see Appendix C.2 for certification). Reliability and validity of the SSP are well established (for an overview see Solomon & George, 1999).

The mother-infant dyads were assessed using the SSP when the infants were 19 months old. The laboratory had a partition constructed at one end with a one-way mirror. The interactions were videotaped from behind the partition. To enable the mothers to view their infants when they left the room a television monitor was set up outside the room which displayed what the video camera was filming. The ‘stranger’ was a member of staff who had not previously met either the mother or the child. Due to the size of the room and the placement of the door it was decided that the stranger would stay in the room on the second reunion but would move away and not interrupt the reunion. This adaptation has been successfully used before (Crittenden, 1992). The tapes were first rated for A-B-C then for D. The analyses used the separate classifications of A-B-C as well as the dichotomous variables of secure-insecure, organised-disorganised.

3.2.4. Physiology Measure

The hypothalamic-pituitary-adrenal (HPA) system plays a key role in coordinating a person’s physiological reaction to environmental challenges. The adrenal glucocorticoid hormone cortisol is a principal hormone in this system and is readily measured in saliva or blood. The collection of saliva, compared to blood, is non invasive and can be collected relatively easily from infants. Saliva samples were collected from both the infant and mother when the child was 13 months of age.
3.2.4.1. Salivary cortisol testing

Saliva collection and testing was completed following instructions from Salimetrics LLC, State College, Pennsylvania, USA.

3.2.4.1.1. Saliva collection

Two salivary samples were collected from the infant and the mother pairs without the use of stimulants. The mother collected her infant’s saliva by suctioning the saliva from the infant’s mouth using a plastic pipette then transferring the saliva into a collection vial. The mothers collected their own samples by expectoration down a plastic straw directly into a vial (passive drool). One sample each was collected from both the mother and the infant within 30 minutes following their respective morning awakening, and a second sample each within 30 minutes of their respective retirement in the evening. The mothers were supplied with detailed instructions (Appendix B.11) and a simple collection kit which comprised a small plastic lunch box containing four colour coded labelled collection vials (red lids for mother, blue lids for child; 2ml Wheaton Cryule®, VWR Scientific Products, catalogue number: 66008-956), two disposable 2 ml plastic transfer pipettes (Samco Scientific Corporation, San Fernando, California, catalogue number: 222;), and two short plastic straws (obtained from supermarket, cut in four). The box also contained a tight fitting piece of foam rubber with four holes cut out for the vials to ensure the vials sat upright.

The saliva kits were delivered to the family home. The mothers were asked to collect the saliva samples on the day before their scheduled visit to the hospital when the children were 13 months of age. The instructions requested that both the mother and the infant did not have a major meal within one hour of collection; to avoid alcohol for 24 hours before collection; to avoid dairy products and acidic or high sugar drinks during the 30 minutes before collection; not to brush teeth three hours before collection; to rinse mouth out with water 10 minutes before collection; to document any medications used; and to store saliva samples at 4 degrees
Celsius. The samples were then transported to the hospital by the mother. On arrival the samples were frozen at -20 degree Celsius until the cortisol assays were performed.

3.2.4.1.2. Saliva assays

The saliva cortisol was measured using the High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (for research purposes) produced by Salimetrics LLC, State College, Pennsylvania, USA. The kit contains microtitre plates that are coated with rabbit antibody to cortisol. The cortisol added to the plates (saliva samples and controls) competes with horseradish peroxidase for the antibody binding sites. The unbound cortisol is washed away and the bound cortisol peroxidase is measured by the addition of a substrate that turns the peroxidase blue (tetramethylbenzidine). This reaction is stopped with sulphuric acid, which turns the reaction yellow. The amount of peroxidase bound cortisol present is determined (optical density) and is inversely proportional to the amount of cortisol in the sample. Salimetrics advise that samples should not be included if there is insufficient saliva for duplicates, if the saliva is acidic (assay does not work efficiently if Ph is below 4; Ph indicator in kit), or if there are visible traces of blood. The presence of blood or acidic saliva can lead to inflated levels of cortisol. The kits were purchased from Abacus Diagnostics, Yeerongpilly, Queensland.

The assays were performed in the laboratory of Dr Prue Cowled, Department of Surgery, Basil Hetzel Institute. The assays were carried out in duplicate according to the kit instructions with each microtitre tray including six dilutions of cortisol, with zero and non-specific binding wells to enable the construction of a standard curve. High and low controls were also included in each tray. The optical density of the individual wells was read at 450 nm using a Microplate Reader (Bio-Rad Benchmark Plus; Bio-Rad Life Science Group, Hercules, CA). The reader was operated by the software package Microplate Manager.
Version 5.2 (Bio-Rad). This software also constructed the standard curve and calculated the amount of cortisol present in each sample in ug/dL.

3.2.5. Statistical Analyses

The statistical analyses were conducted using the statistical package SPSS version 11.0 for Windows. A large database was established and data screened for errors, outliers, and missing data. Outliers were checked with original data for computational error. A range of statistical procedures were used throughout this study with significance set at 0.05 (2-tailed). In general parametric methods were used. Group differences were tested using *t* tests and one-way analysis of variance (ANOVA). Post hoc analyses were conducted using the least square difference (LSD) with group differences only viewed as significant if there was a significant overall ‘F’. In several instances, multiple analyses of variance (MANOVA) were used when group differences were sought where the measure had more than one scale or covariance was necessary. Repeated measures designs were used for some analyses where data was available from each time point (maternal mental health). In these cases missing data was replaced using a conservative group mean (Tabachnick & Fidell, 1989). The relationships between variables were analysed using bivariate correlations (Pearson’s *r*) and multiple regressions were used to determine which measures predicted child outcomes. Regression analyses were also used to determine which variables best predicted cortisol and child developmental outcome measures. Nonparametric tests were used when group sizes were too small, the variables violated psychometric test assumptions or categorical data was used. Group differences were analysed using the rank tests of Mann-Whitney (2 groups) and Kruskal-Wallis (3 groups). Categorical data was tested for significant differences using chi-square.
4. Sample Description and Trauma Groups

Chapter 4 is divided into six main sections covering, sample numbers, demographics, trauma groupings, group comparisons for both mother and infant specific measures, and lastly mental health comparison between the women who remained in the study and those who withdrew. The chapter initially reports on sample numbers across the longitudinal study, including withdrawals. The demographic section describes both the mothers and children, and comparisons are made with those who withdrew from the study. The mothers’ trauma history is then analysed and the mother-infant dyads divided into groups based on the trauma experience and PTSD status of the mother. Trauma group comparisons are made in relation to the mothers’ family history, mental health, and life stressors. In addition trauma group comparisons are made for infant birth and neonatal development measures, infant health and temperament. Finally, comparisons in relation to trauma history and mental health are made between the participants who remained in the study and those who withdrew.

4.1. Sample Numbers

Given the longitudinal nature of this study the number of subjects available at each time point varied. The number of subjects involved in the study over the six assessment time points is summarised in Figure 4.1. Sixty two women participated in the first assessment, which was conducted during the third trimester of their pregnancy. Seven of these women did not participate in the second assessment when their infants were 2 weeks old. Three women were excluded due to their babies being born less than 37 weeks gestation (Linke, 2002). No reasons for withdrawal were reported for the other four women. An additional three women declined to continue at time point three when the infants were 3 months of age (Lowe, 2003). Before the fourth assessment three women were unable to be contacted by phone and did not
respond to postal invitations to participate, another mother declined to participate citing work commitments. An additional three mothers initially agreed to participate in the fourth assessment but later withdrew, two citing work commitments, and the other with concerns about her current anxiety problems. Overall, a total of 17 women had withdrawn from the study by the beginning of the fourth assessment, when the infants were 13 months of age. Two new mothers, with the correct aged infants, joined the study at the fourth assessment period making a total of 47 women who started assessment four. Three women withdrew from the study before the fifth assessment when the infants were 19-20 months of age. Two of these women were unable to be contacted, and the other withdrew due to work and study commitments. All remaining 44 participants completed the fifth and sixth assessment stages involved with the current study, although some individual assessments were missed due to illness. Over all, 20 of the 64 women (31.2%) withdrew from the study over the course of the two years of the study.

In the data analyses the number of participants varies between 47 and 44 depending on when the data was collected. In addition, some analyses will include data collected by Linke (2002) and Lowe (2003) from the earlier three time periods. In these cases 42 women have data spanning all six assessment time points, and 45 women have data covering the first four assessment periods. The demographic data is based on the 47 women who completed assessment four. The demographic and maternal mental health status of the 20 women who withdrew from the study will be compared to the 44 who completed the study.

4.2. Sample Description and Demographics

The sample is initially described in relation to the mother using information collected before the birth of the infants. Comparisons are made between those mothers who remain in the study and those women who withdrew. Descriptions of the infants are made in relation to
Assessment 1  
Mothers in third trimester of pregnancy

3 excluded due to premature infants
4 withdrew

Assessment 2  
Infants 2-3 weeks old

Assessment 3  
Infants 3-4 months old

3 withdrew

Assessment 4  
Infants 13-14 months old

3 unable to contact
3 withdrew before the completion of Assessment 4
2 unable to contact

Assessment 5  
Infants 19-20 months old

Assessment 6  
Infants 24-25 months old

2 new mothers with correctly aged infants volunteered

Figure 4-1. Flow diagram of subject recruitment and withdrawals. Yellow boxes represent assessment periods conducted by Linke (2002) and Lowe (2003). Blue boxes represent the current study.
birth data as well as developmental data collected when the infants were 2 weeks and 13 months of age.

4.2.1. Mothers

The mean age of the mothers at the time of the birth of the child involved in this study was 31.8 years (SD 4.4) with a range from 21 to 41 years of age. The mean age of the fathers at the same time point was 35.1 (SD 7.1) years of age with a range from 24 to 53 years. Marital status, number of children, and family income are summarised in Table 4.1. Forty six (97.9%) of mothers were married or living with their partners at the time of the child’s birth, one mother was single, with one couple separating by the time their child was 24 months old. For 22 (46.8%) mothers the child involved in this study was their first child, 25 (53.2%) had more than one child. The median range for gross family income after the birth of the child was $50,000 to $70,000 per annum. This ranged between less than $30,000 to more than $70,000.

Birth country, education and employment status of both the mother and her partner are summarised in Table 4.2. Over 80% of the women and their partners were born in Australia with the other 20% being born in Europe or North America. Approximately 90% of the mothers and 85% of fathers had completed year 12 or gone onto further study, with approximately 60% of mothers and 40% of their partners having completed university. Before the birth of the child in this study over 80% of fathers and 42% of mothers were employed full time or self employed, 10.7% of fathers and 23.4% of mothers were employed part time or on a casual basis, and 31.9% of mothers described their employment as home duties.

4.2.1.1. Comparisons between study mothers and withdrawals

No significant demographic differences were found between the 44 women who completed the study and the 20 mothers who withdrew from the study for the variables of maternal and paternal age, maternal or paternal education level, maternal or paternal income, and the
Table 4.1. Family marital status, number of children, and annual gross income after the birth of the study child.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency (N=47)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marital status (at birth of child)</strong></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>35 (74.5)</td>
</tr>
<tr>
<td>Living with partner</td>
<td>11 (23.4)</td>
</tr>
<tr>
<td>Single parent family</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td><strong>Number of children in family</strong></td>
<td></td>
</tr>
<tr>
<td>One (child in study)</td>
<td>22 (46.8)</td>
</tr>
<tr>
<td>Two</td>
<td>17 (36.2)</td>
</tr>
<tr>
<td>Three</td>
<td>6 (12.8)</td>
</tr>
<tr>
<td>Four</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td>Five</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td><strong>Annual gross family income</strong></td>
<td></td>
</tr>
<tr>
<td>Less than $30,000</td>
<td>4 (8.5)</td>
</tr>
<tr>
<td>$30,001 to $50,000</td>
<td>15 (31.9)</td>
</tr>
<tr>
<td>$50,001 to $70,000</td>
<td>12 (25.5)</td>
</tr>
<tr>
<td>More than $70,000</td>
<td>16 (34.0)</td>
</tr>
</tbody>
</table>

number of children in the family. However, women were significantly more likely to withdraw from the study if they did not live with a partner ($\chi^2 = 8.36, p<.01$), or if their partner was unemployed ($\chi^2 = 4.00, p<.05$). In addition there was a trend for the mother to withdraw if paternal income was less than $30,000 per annum ($\chi^2 = 3.69, p<.10$). These variables were measured when the women were in the third trimester of pregnancy. The descriptive statistics and significance levels for these comparisons are summarised in Table 4.3.
Table 4.2. Birth country, education level, and employment status before the birth of the study child, for both the mother and father.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mother ($N=47$)</th>
<th>Father ($N=47$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$ (%)</td>
<td>$n$ (%)</td>
</tr>
<tr>
<td><strong>Birth Country</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>40 (85.2)</td>
<td>38 (80.9)</td>
</tr>
<tr>
<td>Europe</td>
<td>6 (12.7)</td>
<td>7 (14.9)</td>
</tr>
<tr>
<td>North America</td>
<td>1 (2.1)</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td>Unknown</td>
<td>0 (0.0)</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed year 11 or less</td>
<td>5 (10.6)</td>
<td>4 (8.5)</td>
</tr>
<tr>
<td>Completed year 12-13 or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAFE/Apprenticeship</td>
<td>14 (29.8)</td>
<td>20 (42.6)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>28 (59.6)</td>
<td>20 (42.6)</td>
</tr>
<tr>
<td>Unknown</td>
<td>0 (0.0)</td>
<td>3 (6.4)</td>
</tr>
<tr>
<td><strong>Employment prior to birth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full time</td>
<td>17 (36.2)</td>
<td>32 (68.1)</td>
</tr>
<tr>
<td>Self employed</td>
<td>3 (6.4)</td>
<td>6 (12.8)</td>
</tr>
<tr>
<td>Part time or casual</td>
<td>11 (23.4)</td>
<td>5 (10.7)</td>
</tr>
<tr>
<td>Home duties</td>
<td>15 (31.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Student</td>
<td>1 (2.1)</td>
<td>1 (2.1)</td>
</tr>
<tr>
<td>Unknown</td>
<td>0 (0.0)</td>
<td>3 (6.4)</td>
</tr>
</tbody>
</table>

4.2.2. Infants

All mothers described themselves as the main carer of their child. All the infants in the study were born between 37-40 weeks gestation with a mean birth weight of 3.52 kg ($SD .42$) ranging from 2.74 to 4.42 kg, and 5-min Apgar scores were between 7 and 10. Twenty eight (59.6%) of the infants were male and 19 (40.4%) female. Using standardised assessments of neonatal behaviours (NACS and NBAS), Felicity Linke (2002) reported that at 2 weeks all infants had ‘excellent to good’ health. At 13 months of age the infants were assessed
Table 4.3. Comparison of demographic variables between participants who withdrew from the study and those who completed study

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Withdrawn (n=20)</th>
<th>Remain (n=44)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age ([M (SD)])</td>
<td>30.2 (5.5)</td>
<td>31.7 (4.3)</td>
<td>(t = .257)</td>
</tr>
<tr>
<td>Paternal age ([M (SD)])</td>
<td>32.2 (7.1)</td>
<td>35.0 (7.2)</td>
<td>(t = .160)</td>
</tr>
<tr>
<td>Number of children ([M (SD)])</td>
<td>0.9 (1.4)</td>
<td>0.7 (0.9)</td>
<td>(t = .516)</td>
</tr>
<tr>
<td>Not living with partner (%)</td>
<td>25.0</td>
<td>2.3</td>
<td>(\chi^2 = 8.359^{**})</td>
</tr>
<tr>
<td>Maternal education &lt; year 12 (%)</td>
<td>20.0</td>
<td>9.1</td>
<td>(\chi^2 = 2.520)</td>
</tr>
<tr>
<td>Paternal education &lt; year 12 (%)</td>
<td>17.6</td>
<td>9.8</td>
<td>(\chi^2 = 1.663)</td>
</tr>
<tr>
<td>Maternal unemployment (%)</td>
<td>35.0</td>
<td>34.0</td>
<td>(\chi^2 = .005)</td>
</tr>
<tr>
<td>Paternal unemployment (%)</td>
<td>16.7</td>
<td>2.4</td>
<td>(\chi^2 = 4.004^{*})</td>
</tr>
<tr>
<td>Maternal income &lt; $30,000 p.a. (%)</td>
<td>72.2</td>
<td>55.8</td>
<td>(\chi^2 = 1.431)</td>
</tr>
<tr>
<td>Paternal income &lt; $30,000 p.a. (%)</td>
<td>43.8</td>
<td>19.0</td>
<td>(\chi^2 = 3.687^{†})</td>
</tr>
</tbody>
</table>

Note: Statistical significance levels are indicated as **\(p<.01\), *\(p<.05\), †\(p<1.0\)

using the Griffiths Mental Development Scales. The infants mean developmental quotient was 98.60 \((SD = 7.96)\) with scores ranging between 82 and 114, placing all the infants within the ‘low average’ to ‘high average’ range, with 78% being within the ‘average’ range.

4.3. Maternal Trauma History and PTSD Diagnosis

Maternal trauma history was primarily collected using the PTSD section of the CIDI-2.1 (World Health Organisation, 1997). This provided an understanding of maternal trauma exposure, as well as subsequent symptom level and whether the mothers may or may not obtain a lifetime diagnosis of posttraumatic stress disorder. That is, whether at
some point in their lifetime they would have, given their symptom cluster, been given a
diagnosis of the disorder. Additional information around the mother’s family trauma history
was collected using the Traumatic Antecedence Questionnaire (TAQ) (Herman et al., 1989).

4.3.1. Maternal Lifetime Trauma Experience and Diagnosis of PTSD

The mother’s trauma history was collected when the infants were 3 months of age. This data
was not collected at earlier assessments to minimise the potential distress to women during
the vulnerable perinatal period (Lowe, 2003).

4.3.1.1. Trauma experience

Approximately 60% of women who completed the fourth assessment period had experienced
a significantly stressful traumatic event at some time in their lives. Of these women 50% had
experienced one trauma and 32.1% two trauma across their lifetime. The lifetime trauma
exposure of the women in the current study was compared with national data from the large
Australian National Survey of Mental Health and Wellbeing (Creamer et al., 2001; Table 4.4).
This study included adult women from a much wider age range (older) and included both
metropolitan and rural areas. The numbers of traumas experienced by women in the current
study were 10% higher than the national study, despite the restricted age range. The
percentage of women who had experienced a single trauma was equivalent, with the national
survey showing a greater number of women experiencing more than three traumas,
presumably reflecting the wider age range in the national data. Mothers had experience their
index trauma on average 16.06 (SD = 8.12, range 1 - 27) years before pregnancy.

There were two main differences between the current study and the national data in relation to
the types of traumas experienced by the women (Table. 4.5). Firstly, the women in the current
study had experienced fewer life threatening accidents, natural disasters, physical attack,
Table 4.4. Lifetime occurrence of traumatic experiences of women in the current study compared with a survey of Australian women (ANSMHW)

<table>
<thead>
<tr>
<th>Trauma experience</th>
<th>Current study</th>
<th>ANSMHW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=47)</td>
<td>(N=5936)</td>
</tr>
<tr>
<td></td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td>Any trauma</td>
<td>59.6 (28)</td>
<td>49.5 (3024)</td>
</tr>
<tr>
<td>No. of traumas (% of any traumas)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>50.0 (14)</td>
<td>53.1 (1559)</td>
</tr>
<tr>
<td>2</td>
<td>32.1 (9)</td>
<td>23.7 (723)</td>
</tr>
<tr>
<td>3</td>
<td>14.3 (4)</td>
<td>12.5 (388)</td>
</tr>
<tr>
<td>&lt;3</td>
<td>3.6 (1)</td>
<td>10.7 (254)</td>
</tr>
</tbody>
</table>

Note: ANSMHW = Australian National Survey of Mental Health and Well-being (Creamer, Burgess & McFarlane, 2001)

being threatened with a weapon, and ‘other traumas’, than those women in the national
survey. Secondly, and of specific interest for this study, there was a 2.4 fold greater
proportion of women in the current study who had experienced rape and sexual molestation
with 8.5% and 29.8% of current women (respectively) endorsing these two items compared
with 5.4% and 10.2% respectively in the national survey.

A life stress checklist was used from assessment four onwards to monitor the mothers
ongoing exposure to traumatic events (see Ongoing Stress, Chapter 3.2.1.1.3). No mother at
T4 or T5 assessments endorsed any items such as accidents, domestic violence, physical or
sexual abuse. At the T6 assessment however two mothers endorsed domestic violence, one
had previously experienced a trauma and had been allocated to the PTSD group, and the other had no previous trauma experience. No indication was given of the type, severity or frequency and this woman was included in the no trauma group in the earlier assessments but was excluded from any trauma group analyses using data from the last two assessment periods.

Table 4.5. Types of traumatic experiences of women in the current study compared with a survey of Australian women (ANSMHW)

<table>
<thead>
<tr>
<th>Trauma type</th>
<th>Current study (N=47)</th>
<th>ANSMHW (N=5936)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td>Direct combat in a war</td>
<td>0.0 (0)</td>
<td>0.9 (57)</td>
</tr>
<tr>
<td>Life threatening accident</td>
<td>6.4 (3)</td>
<td>13.6 (822)</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>4.2 (2)</td>
<td>12.7 (807)</td>
</tr>
<tr>
<td>Witness death or serious injury</td>
<td>14.9 (7)</td>
<td>16.1 (971)</td>
</tr>
<tr>
<td>Rape</td>
<td>8.5 (4)</td>
<td>5.4 (374)</td>
</tr>
<tr>
<td>Molestation</td>
<td>29.8 (14)</td>
<td>10.2 (656)</td>
</tr>
<tr>
<td>Physical attack</td>
<td>4.2 (2)</td>
<td>7.6 (528)</td>
</tr>
<tr>
<td>Kidnap or threaten with weapon</td>
<td>4.2 (2)</td>
<td>7.0 (482)</td>
</tr>
<tr>
<td>Victim of terrorism</td>
<td>0.0 (0)</td>
<td>**</td>
</tr>
<tr>
<td>Experience domestic violence as child</td>
<td>12.8 (6)</td>
<td>**</td>
</tr>
<tr>
<td>Experience domestic violence as adult</td>
<td>10.6 (5)</td>
<td>**</td>
</tr>
<tr>
<td>Shock</td>
<td>4.2 (2)</td>
<td>12.0 (692)</td>
</tr>
<tr>
<td>Other</td>
<td>6.4 (3)</td>
<td>8.3 (501)</td>
</tr>
</tbody>
</table>

Note: ANSMHW = Australian National Survey of Mental Health and Well-being (Creamer, Burgess & McFarlane, 2001); ** not reported
4.3.1.2. Trauma symptoms and lifetime PTSD diagnosis

The PTSD symptoms are reported in relation to both the DSM-IV (American-Psychiatric-Association, 1994) and ICD-10 (World-Health-Organisation, 1993) diagnostic criteria (Table 4.6.). Comparisons between the two diagnostic systems are detailed in Chapter 3. Twenty eight women (59.6%) met both the DSM-IV and ICD-10 criteria for exposure to a trauma (Criterion A). Of these 28 women, four (14.3%) did not meet the DSM-IV A.2 criterion (feelings of fearful/helpless), and only three (10.7%) women did not report any re-experiencing symptoms (Criterion B). In relation to the DSM-IV criteria C of avoidance and general numbing only 10 (35.7%) of the trauma group met the required three or more symptoms. Unlike the DSM-IV, the ICD-10 criteria only requires actual or preferred avoidance and 17 (60.7%) of women met these less stringent criteria. Sixteen (57.1%) women met the DSM-IV criteria of symptoms lasting at least one month. Of note, five women reported their symptoms to be current. Twenty three (82.1%) women met the ICD-10 criteria for onset of symptoms within six months, with an additional woman (3.4%) designated as late onset. For the DSM-IV specific criteria F, eight (38.6%) women felt that their trauma experience had caused significant distress and impacted on the functioning of their lives. Overall, six women met the full criteria for a DSM-IV diagnosis of lifetime PTSD; this is 12.8% of the overall sample and 21.4% of those women who met the criteria for trauma exposure. Twelve women met the ICD-10 criteria for PTSD (including all six who made the DSM-IV diagnosis). This equates to 25.5% of total sample and 42.9% of those who had experienced a trauma. The ICD-10 classification yielded a 2-fold higher case number than the DSM-IV diagnosis, which is in line with other research findings of 2.5-fold increase in 12 month prevalence of PTSD using ICD-10 criteria over DSM-IV (Lehmann et al., manuscript in preparation).

The additional six women who were given a diagnosis of PTSD using the ICD-10 criteria all reported an emotional reaction to their trauma (DSM-IV criteria A2) and met criteria for
Table 4.6. Number of women who met each diagnostic criterion for both the DSM-IV and ICD-10 PTSD criteria

<table>
<thead>
<tr>
<th>PTSD criteria</th>
<th>PTSD criteria met</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DSM-IV</td>
</tr>
<tr>
<td></td>
<td>n/N (%)</td>
</tr>
<tr>
<td>A1. Trauma exposure</td>
<td>28/47 (59.6)</td>
</tr>
<tr>
<td>A2. Emotional reaction</td>
<td>24/28 (85.7)</td>
</tr>
<tr>
<td>B. Re-experiencing</td>
<td>25/28 (89.3)</td>
</tr>
<tr>
<td>C. Avoidance</td>
<td>10/28 (35.7)</td>
</tr>
<tr>
<td>D. Increased arousal</td>
<td>16/28 (57.1)</td>
</tr>
<tr>
<td>D1. Inability to recall</td>
<td>N/A</td>
</tr>
<tr>
<td>E. Duration or onset</td>
<td>16/28 (57.1)</td>
</tr>
<tr>
<td>F. Significant distress</td>
<td>8/28 (38.6)</td>
</tr>
</tbody>
</table>

**Diagnosis PTSD**

<table>
<thead>
<tr>
<th></th>
<th>% whole sample</th>
<th>% exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6/47 (12.8)</td>
<td>6/28 (21.4)</td>
</tr>
<tr>
<td></td>
<td>12/47 (25.5)</td>
<td>12/28 (42.9)</td>
</tr>
</tbody>
</table>


re-experiencing symptoms (DSM-IV criteria B), with the difference being in criteria C, D, E and F. Three women missed the DSM-IV diagnosis by one category, and one woman obtained the ICD-10 diagnosis due to the D1 criterion of inability to recall without the need to also experience hyperarousal. Criterion C was not met in two of the cases, criterion D in one case, criterion E in two cases, and criterion F in four cases. Of the 12 women with lifetime PTSD 10 (83.3%) had experienced rape, physical attack or sexual molestation. Furthermore, all of
the rape and physical attack victims also met the more stringent DSM-IV criteria. One woman who had experienced sexual molestation without rape reached the DSM-IV criteria, while half the other women who had been sexually molested made the ICD-10 criteria.

4.3.1.3. Trauma and PTSD status of women who withdrew
The trauma status of the mothers was first measured when their infants were 3 months of age. By this stage 10 women had withdrawn from the study and therefore their trauma history is unknown. The seven women who withdrew before the fourth assessment had experienced at least one significant trauma as measured by the CIDI with three of these women obtaining a diagnosis of posttraumatic stress disorder. Of the three participants that withdrew from the study between assessment four and assessment five, one had experienced no trauma, one had experienced trauma without subsequent problems, and one had acquired a lifetime diagnosis of PTSD (DSM-IV).

4.3.2. Trauma Groups
Using the trauma experience information from the PTSD section of the CIDI the sample was initially divided into two groups, those women who had not experienced a significant trauma (control; \( n=19 \)), and those who had experienced a significant trauma (trauma; \( n=28 \)).

The trauma group was subsequently subdivided into those who obtained a lifetime diagnosis of ICD-10 only and DSM-IV PTSD (PTSD; \( n=12 \)) and those who did not (trauma control; \( n=16 \)). The participant numbers in each group for assessment periods four, five and six are summarised in Figure 4.2. These groupings are used through the study. Some exploratory analyses between ICD-10 (PTSD ICD-10, \( n=6 \)) and DSM-IV (PTSD DSM-IV, \( n=6 \)) PTSD subjects will also be carried out. Group differences in relation to maternal and infant demographic characteristics, and known risk factors for parenting problems are described below.
4.4. Group Comparisons for Mother Specific Measures

This section analyses group differences in a range of variables that are specific to the mother, covering demographics, trauma history, and mental health, both past and present. Group differences are also explored in relation to other potential risk factors such as high levels of stress, and lack of social connectedness.
4.4.1. Demographics

There were no significant group differences found for maternal or paternal age, maternal and paternal employment, or maternal and paternal income, between the control and trauma group as a whole, nor between the control, trauma control and PTSD groups. Although, there were significant group differences found for paternal education. Over 70% of the partners of the women in the control group had completed tertiary education compared to less than 30% in the trauma group ($p<.005$). Further to this, no partner of the women in the PTSD group had completed tertiary education compared to 72.3% in the control group and 46.7% in the trauma control group ($p<.005$). There were no significant differences in tertiary education for the women in the control and trauma groups, but there was a trend toward mothers in the PTSD group having less tertiary education, with 33.3% completing tertiary education compared to approximately 68% in both the control and trauma control groups ($p=.10$).

In relation to caregiving, all mothers in the study identified themselves as the main carer, with no significant group differences for the number of hours the father cared for the child per week. There were also no significant differences between groups in relation to mother’s return to work, or the number of hours per week a child spent in care outside of extended family care.

The variable ‘number of children’ was dichotomised into one child and more than one child. There were no significant differences found between trauma groups for first time mothers (primiparous) and mothers who had more than one child (multiparous). But, there were approximately 60% multiparous mothers in the trauma group compared to 40% in the control group. When the groups were split three ways the trauma control group had approximately 60% multiparous mothers compare to 50% in the PTSD group and 40% in the control group.
4.4.2. Mothers Family Trauma History

The mothers were administered the Traumatic Antecedence Questionnaire (TAQ; Herman et al., 1989) by Jacinta Lowe (2003) during the third assessment to gain an understanding of the mothers’ childhood, adolescent, and adult experiences of abuse and disruptions in parental care. Their overall experiences of abuse are summarised in Table 4.7. Emotional abuse was the most frequent type of abuse reported with 37.2% of women reporting emotional abusive experiences during adolescence, with 17% reporting lower level and 19.1% reporting higher levels. The level of sexual abuse is in line with the data collected on the CIDI with 14.9% of the women experiencing sexual abuse before the age of 13, and 14.9% of women experiencing sexual abuse during adolescence. Physical abuse was the least prevalent type of abuse in this sample with only three (6.4%) women reporting exposure in childhood and one in adolescence (2.1%).

Given the low numbers of women in several of the abuse categories the four categories were combined to form overall abuse variables for childhood, adolescence and adulthood. Dichotomous variable of abuse/no abuse were created for each age group. Seventy five percent of women who had experienced abuse in childhood also experienced abuse in adolescence. Although few women reported family related abuse in adulthood, 75% of those had also experienced abuse in adolescence. These results suggest the women who reported abuse were likely to have experienced abuse across at least two adjoining life stages. To gain an understanding of which trauma group these women belonged to a one way ANOVA was conducted using the continuous variables. The results are summarised in Table 4.8. As expected the women who had reported trauma experiences on the CIDI had experienced significantly more abuse than the no trauma group. During childhood both the trauma control and the PTSD groups reported significantly more abuse than the control group but were not significantly different from each other. This pattern changed during adolescence and
adulthood with the women who had experienced trauma and developed subsequent PTSD reporting significantly more abuse than either the control or trauma control groups, indicating that at least during adolescence and adulthood the PTSD group had experienced more

Table 4.7. Summary of maternal family trauma experiences across their life span as measured by the TAQ

<table>
<thead>
<tr>
<th>Maternal age and type of trauma</th>
<th>Frequency and/or severity of trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None (N) (%)</td>
</tr>
<tr>
<td></td>
<td>Lower (N) (%)</td>
</tr>
<tr>
<td></td>
<td>Higher (N) (%)</td>
</tr>
<tr>
<td><strong>Childhood (0-12)</strong></td>
<td></td>
</tr>
<tr>
<td>Physical abuse</td>
<td>44 (93.6) 0 (0.0) 3 (6.4)</td>
</tr>
<tr>
<td>Sexual abuse</td>
<td>40 (85.1) 3 (6.4) 4 (8.5)</td>
</tr>
<tr>
<td>Emotional abuse</td>
<td>33 (70.2) 6 (12.8) 8 (17.0)</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>45 (95.7) 1 (2.1) 1 (2.1)</td>
</tr>
<tr>
<td><strong>Adolescence (13-18)</strong></td>
<td></td>
</tr>
<tr>
<td>Physical abuse</td>
<td>46 (97.9) 0 (0.0) 1 (2.1)</td>
</tr>
<tr>
<td>Sexual abuse</td>
<td>40 (85.1) 5 (10.6) 2 (4.3)</td>
</tr>
<tr>
<td>Emotional abuse</td>
<td>30 (63.8) 8 (17.0) 9 (19.1)</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>37 (78.7) 8 (17.0) 2 (4.3)</td>
</tr>
<tr>
<td><strong>Adulthood (19+)</strong></td>
<td></td>
</tr>
<tr>
<td>Physical abuse</td>
<td>47 (100) 0 (0.0) 0 (0.0)</td>
</tr>
<tr>
<td>Sexual abuse</td>
<td>45 (95.7) 2 (4.3) 0 (0.0)</td>
</tr>
<tr>
<td>Emotional abuse</td>
<td>37 (78.7) 6 (12.8) 4 (8.5)</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>39 (83.0) 8 (17.0) 0 (0.0)</td>
</tr>
</tbody>
</table>

Note: TAQ = Traumatic Antecedence Questionnaire (Herman et al., 1989)
Table 4.8. Trauma group comparisons for TAQ summary scores

<table>
<thead>
<tr>
<th>Measures and age categories</th>
<th>Trauma group means (SD) N=47</th>
<th>F Statistic (df = 2,44)</th>
<th>Group differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n=19)</td>
<td>Trauma control (n=16)</td>
<td>PTSD (n=12)</td>
</tr>
<tr>
<td>Abverse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood (0-12)</td>
<td>.10 (.22)</td>
<td>1.24 (1.81)</td>
<td>1.06 (1.45)</td>
</tr>
<tr>
<td>Adolescence (13-18)</td>
<td>.18 (.27)</td>
<td>0.63 (.86)</td>
<td>1.29 (1.14)</td>
</tr>
<tr>
<td>Adulthood (19+)</td>
<td>.16 (.27)</td>
<td>0.08 (.18)</td>
<td>0.74 (1.06)</td>
</tr>
<tr>
<td>Disruption in parental care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood (0-12)</td>
<td>5.49 (1.91)</td>
<td>5.56 (1.82)</td>
<td>6.49 (2.41)</td>
</tr>
<tr>
<td>Adolescence (13-18)</td>
<td>3.40 (1.14)</td>
<td>3.49 (1.41)</td>
<td>5.01 (2.40)</td>
</tr>
</tbody>
</table>

Note: TAQ = Traumatic Antecedence Questionnaire (Herman et al., 1989); Statistical significance levels are indicated as ***p<.001, **p<.01, *p<.05
frequent and/or more severe family orientated abuse than the women in the trauma control group. Overall, the PTSD group had significantly higher levels of trauma across all ages, whereas the trauma control group only had significant levels during childhood. This pattern was maintained for both emotional abuse and sexual abuse when analysed separately. A similar pattern also occurred using the dichotomous variables, which do not take into account severity, with twice as many women in the PTSD group having experienced abuse in childhood and adolescence than in the trauma control group. The women’s experiences in relation to disruption of parental care during their childhood and adolescence were analysed by combining the women’s experiences of neglect, significant separations and family chaos. Disruption in parental care was not significantly different for any group during childhood. Yet, during adolescence the PTSD group had experienced significantly more disruption than either the control or the trauma control group.

4.4.3. Birth Trauma
The Impact of Events Scale (IES; Horowitz et al., 1979) was administered when the infants were 2 weeks old to gauge the impact of the birth experience on the mothers. There was no significant difference between the mean total scores for those women who had experienced a previous trauma ($M = 5.96, SD = 8.28$) and those who had not ($M = 6.17, SD = 8.40$). When the sample was split into three the scores indicated greater group differences with the trauma control group ($M = 3.93, SD = 4.56$) reporting the least impact and the PTSD group ($M = 8.50, SD = 11.09$) reporting the most impact. However these differences did not reach significance due to the large variance within each group. Overall the trauma control group reported the fewest symptoms and had the smallest spread of scores.

4.4.4. Maternal Lifetime Mental Health History
The CIDI was also used to measure lifetime occurrences of depressive and anxiety symptoms. The depression subscale yielded diagnoses of major depression (single or
recurrent), and dysthymia. The anxiety subscale diagnosed problems of simple phobia, social phobia, agoraphobia, panic, generalised anxiety disorder, and obsessive compulsive disorder.

The rates of lifetime diagnoses of depression and anxiety are summarised in Table 4.9.

Table 4.9. Frequency of lifetime occurrence of anxiety and depression by trauma groups

<table>
<thead>
<tr>
<th>Axis-1 diagnosis</th>
<th>Trauma groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n=19)</td>
<td>T C (n=16)</td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Any depression</td>
<td>6 (31.6)</td>
<td>5 (31.2)</td>
</tr>
<tr>
<td>Major depression</td>
<td>3 (15.8)</td>
<td>1 (6.2)</td>
</tr>
<tr>
<td>(recurrent)</td>
<td>3 (15.8)</td>
<td>4 (25)</td>
</tr>
<tr>
<td>Major depression (single)</td>
<td>[1 (5.3)]</td>
<td>[3 (18.8)]</td>
</tr>
<tr>
<td>[Postnatal depression]</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Dysthymia</td>
<td>1 (5.3)</td>
<td>5 (31.3)</td>
</tr>
<tr>
<td>Any anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple phobia</td>
<td>1 (5.3)</td>
<td>3 (18.8)</td>
</tr>
<tr>
<td>Panic disorder</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>General anxiety disorder</td>
<td>0 (0.0)</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td>Social phobia</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Obsessive compulsive</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Any diagnosis</td>
<td>7 (36.8)</td>
<td>9 (56.2)</td>
</tr>
<tr>
<td>one diagnosis</td>
<td>7 (36.8)</td>
<td>8 (50.0)</td>
</tr>
<tr>
<td>two diagnoses</td>
<td>0 (0.0)</td>
<td>1 (6.2)</td>
</tr>
</tbody>
</table>

Note; CIDI = Composite International Diagnostic Interview-Version 2.1 (World Health Organisation, 1997)
4.4.4.1. Depression

Overall, 17 women (36.2%) reported severe enough symptoms across their lifetime to warrant the diagnosis of major depression. Seven of these women (14.9%) reported recurrent episodes of major depression while ten women (21.3%) had experienced a single episode of depression. Six women (12.8%) experienced a depressive episode following the birth of their current child. None of the 47 women were diagnosed with dysthymia. Fifty percent of the PTSD group had experienced at least one episode of depression, and the trauma control and control groups both had over 30% with a history of depression.

4.4.4.2. Anxiety

Eleven women (23.4%) had experienced anxiety problems some time in their life. Eight mothers (17%) were diagnoses with a simple phobia, two (4.2%) women were diagnosed with generalised anxiety disorder (GAD) and one woman was diagnosed with panic disorder with recent symptoms. No women were diagnosed with social phobia, agoraphobia, or obsessive compulsive disorder (OCD) across their lifetime. The PTSD group had five women (41.6%) with an anxiety disorder with the majority having a simple phobia. The trauma control group had five women (31.3%) with anxiety problems, and the control group had one (5.3%). Excluding diagnoses of PTSD, both the PTSD and trauma control groups had over 56% of women with any diagnosis of depression or anxiety and the control group had 36.8%.

4.4.4.3. Comorbidity and posttraumatic stress disorder

Over 58% of the PTSD group had a comorbid diagnosis of either depression or anxiety. A quarter of the PTSD women had one additional diagnosis, while a third had two additional diagnoses. Eighty percent of the women with DSM-IV PTSD diagnosis had at least one other anxiety or depressive problem. One woman in the trauma control group had comorbid lifetime anxiety and depression diagnoses.
4.4.5. Maternal Current Mental Health

The mothers’ mental health was monitored across the course of the study. A specific measure of postnatal depression (PND) was used at the fourth assessment period. Three measures of maternal mental health were used at each assessment point. The mothers’ psychological well being was measured using the General Health Questionnaire (GHQ-28; Goldberg, 1978), and possible ongoing PTSD symptoms were measured using the Posttraumatic Stress Disorder Checklist-Civilian Version (PCL-C; Weathers, et al., 1993) and the Dissociative Experiences Scale (DES; Bernstein & Putman, 1986).

4.4.5.1. Postnatal depression

A specific measure of postnatal depression (PND) was not administered at either the second or third assessment periods (infants 2 week and 3 months respectively). However the major depression component of the CIDI-2 retrospectively administered when the infants were 13 months of age indicated that six out of 47 (12.8%) women had most likely suffered from PND after the birth of their current infant. When the infants were 13 months of age the mothers were administered the Edinburgh Postnatal Depression Scale (EPDS; Cox et al 1987). All those detected on the EPDS had been detected on the CIDI. Using the recommended cut-off score of 12/13 two women were found to still have symptom levels that were suggestive of depression, a further two women had scores of 12 and another was taking antidepressant medication. Of the six women who experienced depression postnatally, one had never experienced trauma, three were in the trauma control group, and two in the PTSD group (Table 4.9). Five of the women had at least one other child. Of the four women who still had high EPDS scores (over 11) at 13 months, two were in the trauma control group and two were in the PTSD group. The woman who was on antidepressants was in the control group. Only one of the six mothers had had previous depressive episodes. From the personal information questionnaire given to the women at each time point, three of the six women with PND acknowledged that they had problems over the past six months and had sought
treatment. The other three women did not acknowledge they had difficulties in this area. One mother, not rated at case level for depression on either the EPDS or the CIDI, reported that she may have had mild PND over the past six months. This mother had experienced a previous episode of major depression.

4.4.5.2. General psychological distress

The General Health Questionnaire (GHQ-28; Goldberg, 1978) was administered at each assessment point and analysed as both a continuous and dichotomous variable. A cut-off of above five was selected to identify women showing clinically important psychological distress. To analyse more specific symptoms of significant depression and anxiety two binomial variables were created for caseness. A case of depression was classified as obtaining a subscale score of greater than one. A case of anxiety was classified as obtaining a score of two or greater.

The means and standard deviations for the GHQ total and subscale scores for each trauma group are summarised in Table 4.10. One way ANOVA demonstrated significant differences between the PTSD group and the control group for anxiety/insomnia before the birth of the child, between the PTSD group and both the control and trauma control groups for social dysfunction at 2 weeks post birth, and for depression when the infants were 24 months of age. When the infants were 13 months the trauma control group had significantly higher levels of anxiety/insomnia than the control group, although as seen below no mother reached caseness for anxiety at this time point. Using a repeated measures ANOVA an overall significant difference, $F(2,44) = 4.44, p<.05$, was found with the PTSD group reporting significantly more psychological distress across the six assessment periods than both the trauma control ($p<.05$), and control ($p<.01$) groups. This pattern was repeated for the subscales of depression and social dysfunction. The anxiety/insomnia subscale also showed
Table 4.10. Mean and standard deviations for General Health Questionnaire total and subscale scores for each trauma group.

<table>
<thead>
<tr>
<th>Assessment period and measure</th>
<th>Control</th>
<th>Trauma control</th>
<th>PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=19</td>
<td>n=16</td>
<td>n=12</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td><strong>T1. Pre-birth</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>3.83 (2.83)</td>
<td>4.13 (3.52)</td>
<td>6.58 (5.16)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>1.28 (1.52)</td>
<td>1.47 (1.71)</td>
<td>1.17 (1.71)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>0.78 (0.62)</td>
<td>1.40 (1.89)</td>
<td>2.50 (2.47)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.06 (0.23)</td>
<td>0.06 (0.25)</td>
<td>0.42 (0.99)</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>1.72 (1.28)</td>
<td>1.20 (1.05)</td>
<td>2.50 (2.02)</td>
</tr>
<tr>
<td><strong>T2. Infants 2 weeks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>4.50 (3.53)</td>
<td>2.93 (2.93)</td>
<td>6.34 (3.45)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>1.94 (2.04)</td>
<td>1.47 (1.86)</td>
<td>2.17 (1.80)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>1.00 (1.10)</td>
<td>0.67 (1.13)</td>
<td>2.42 (1.50)*</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.00 (0.00)</td>
<td>0.07 (0.24)</td>
<td>0.08 (0.29)</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>1.56 (1.92)</td>
<td>0.73 (0.67)</td>
<td>1.60 (1.35)</td>
</tr>
<tr>
<td><strong>T3. Infants 3 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>3.05 (3.70)</td>
<td>2.00 (3.20)</td>
<td>6.92 (6.27)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>1.12 (1.56)</td>
<td>0.87 (1.54)</td>
<td>2.25 (2.56)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>0.81 (1.27)</td>
<td>0.67 (1.13)</td>
<td>2.17 (2.17)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.29 (0.93)</td>
<td>0.00 (0.00)</td>
<td>0.50 (0.90)</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>0.82 (1.21)</td>
<td>0.47 (0.81)</td>
<td>2.00 (2.17)*</td>
</tr>
<tr>
<td><strong>T4. Infants 13 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>1.67 (2.24)</td>
<td>3.53 (4.32)</td>
<td>3.75 (4.41)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>1.11 (1.59)</td>
<td>1.73 (2.49)</td>
<td>1.83 (2.29)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>0.17 (0.50)</td>
<td>1.40 (1.89)*</td>
<td>1.00 (1.54)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.01 (0.02)</td>
<td>0.08 (0.25)</td>
<td>0.17 (0.58)</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>0.39 (0.76)</td>
<td>0.33 (1.01)</td>
<td>0.75 (1.76)</td>
</tr>
<tr>
<td><strong>T5. Infants 19 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>3.39 (4.87)</td>
<td>2.53 (3.20)</td>
<td>5.27 (8.64)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>1.61 (1.94)</td>
<td>0.73 (1.34)</td>
<td>1.54 (2.39)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>0.89 (1.29)</td>
<td>1.33 (1.70)</td>
<td>1.54 (2.43)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.11 (0.31)</td>
<td>0.20 (0.75)</td>
<td>0.73 (1.55)</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>0.78 (1.90)</td>
<td>0.27 (0.57)</td>
<td>1.45 (2.53)</td>
</tr>
<tr>
<td><strong>T6. Infants 24 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ total</td>
<td>2.12 (3.36)</td>
<td>3.78 (4.32)</td>
<td>5.82 (5.70)</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>0.76 (1.43)</td>
<td>1.50 (1.89)</td>
<td>2.00 (1.91)</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>0.94 (1.72)</td>
<td>1.57 (2.30)</td>
<td>1.64 (2.10)</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.12 (0.46)</td>
<td>0.00 (0.00)</td>
<td>1.00 (1.86)*</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>0.29 (0.73)</td>
<td>0.71 (1.06)</td>
<td>1.18 (1.70)</td>
</tr>
</tbody>
</table>

Note: GHQ = General Health Questionnaire (Goldberg, 1978) One way ANOVA *p<.05
an overall group difference, with the post hoc analysis indicating the PTSD group was significantly different from the control group but not the trauma control group. There were no significant group differences for somatic symptoms.

The numbers of cases of psychological distress for the three trauma groups and as a whole for each assessment period are summarised in Table 4.11. The highest number of cases occurred when the infants were 2 weeks of age (38.3%). The pre-birth period was also high with 31.9% of women being designated a case at this time. By the time the infants were 3 months this percentage had dropped to 20% and remained around this level until the last assessment period when the infants were 24 months of age when the percentage again rose to 31.9. This last rise may, in part, be accounted for by the 13 (27.7%) mothers who were pregnant or had had a subsequent infant. In relation to the trauma groups, significantly more cases of psychological distress were found in the PTSD group when the infants were 3 months of age, $\chi^2(2, N = 47) = 7.04, p<.05$, and neared significance when the infants were 2 weeks of age, $\chi^2(2, N = 47) = 5.65, p<.1$. No significant differences were found at any other assessment points.

Using the GHQ depression case variable it was found that very few women were identified as having significant depressive symptoms. Three women endorsed two or more depression items on the GHQ pre-birth (1 = trauma control, 2 = PTSD group), two when the infants were 2 weeks of age (1 = trauma control, 1 = PTSD group), four at 3 months (1 = control, 3 = PTSD), one at 13 months (PTSD), three at 19 months (1 = trauma control, 2 = PTSD), and four at 24 months (1 = control, 3 = PTSD). Overall there were 13 different women who endorsed recent depressive symptoms at some time during the first two years of their infant’s life. Only three of these women reached caseness for depression on more than one occasion. Correlations between the T4 continuous GHQ-28 total and subgroup scores and the continuous EPDS total score showed the highest correlations between the subscale of social
Table 4.11. Case levels of psychological distress as measured by the GHQ-28 (cut-off 5/6) for each trauma group and as a whole group across the six assessment periods.

<table>
<thead>
<tr>
<th>Assessment time and GHQ cases</th>
<th>Trauma groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n=19)</td>
<td>Trauma control (n=16)</td>
</tr>
<tr>
<td></td>
<td>(n (%))</td>
<td>(n (%))</td>
</tr>
<tr>
<td><strong>T 1. GHQ</strong></td>
<td>6 (31.6)</td>
<td>5 (31.3)</td>
</tr>
<tr>
<td>Depression</td>
<td>0 (0.0)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0 (0.0)</td>
<td>4 (25.0)</td>
</tr>
<tr>
<td><strong>T2. GHQ</strong></td>
<td>6 (31.6)</td>
<td>4 (25.0)</td>
</tr>
<tr>
<td>Depression</td>
<td>0 (0.0)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>2 (10.5)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td><strong>T3. GHQ</strong></td>
<td>2 (10.5)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Depression</td>
<td>1 (5.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>2 (10.5)</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td><strong>T4. GHQ</strong></td>
<td>2 (10.5)</td>
<td>5 (31.3)</td>
</tr>
<tr>
<td>Depression</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>T5. GHQ</strong></td>
<td>4 (21.1)†</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Depression</td>
<td>0 (0.0)</td>
<td>1 (6.3)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>3 (15.8)</td>
<td>3 (18.7)</td>
</tr>
<tr>
<td><strong>T6. GHQ</strong></td>
<td>3 (15.8)†</td>
<td>6 (37.5)</td>
</tr>
<tr>
<td>Depression</td>
<td>1 (5.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>4 (21.1)</td>
<td>4 (25.0)</td>
</tr>
</tbody>
</table>

Note: T1 = pre-birth; T2 = infants 2 weeks; T3 = infants 3 months; T4 = infants 13 months; T5 = infants 19 months; T6 = infants 24 months; GHQ = General Health Questionnaire (Goldberg, 1978); \(\chi^2\) ** \(p<.01\), *\(p<.05\), † \(p<.1\)

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dysfunction and total EPDS score ($r = .62, p < .001$), severe depression ($r = .49, p < .01$), and GHQ total score ($r = .46, p < .01$). A more modest correlation was found with the anxiety/insomnia subscale ($r = .33, p < .05$). Of the four women who scored 12 or over on the EPDS three reached caseness on the GHQ at T4 (a total of 11 women reached GHQ caseness at T4), one reached caseness for severe depression, and two reached caseness for anxiety/insomnia. The woman with the highest EPDS did not make caseness on the total or depression and anxiety subscales. The other two women who had been identified as having prior PND and did not reach caseness on the EPDS also did not reach caseness for the GHQ.

Approximately half the group (24 women) endorsed three or more anxiety/insomnia symptoms on the GHQ for at least one assessment period, with 29.8% (14) endorsing this level of symptoms at more than one assessment, suggesting that overall the women in this study were exhibiting higher levels of anxiety than depression. Significantly higher caseness for Anxiety/Insomnia symptoms was found for the PTSD group at both the initial pre-birth and the 2 week assessment periods. Overall, anxiety caseness was at its highest in these earlier assessments for the trauma groups, was low for all groups at 13 months, and rose again when the infants were 19 months and 24 months of age, but evenly across all groups.

4.4.5.2.1. Multiparous compared to primiparous mothers

As a whole, no significant differences were found in levels of psychological distress between women with one child and those with two or more. Yet, differences emerged when the GHQ scores were assessed for trauma groups as well as primiparous and multiparous women. There were significant differences for mothers with more than one child, but not first time mothers, for GHQ caseness at 2 weeks, $\chi^2(1, N = 47) = 6.90, p < .05$, and 3 months, $\chi^2(1, N = 47) = 7.91, p < .05$. At the 2 week period 83.3% of mothers with two or more children rated as a case in the PTSD group compared to the trauma control (22.2%) and control (60%) groups. At the 3- to 4 months assessment 66.7% of the PTSD group with more than one child reached
GHQ caseness compared with 10% for the trauma control and 14.3% for the control groups.

The anxiety caseness variable was significantly different for mothers with two or more children and a lifetime diagnosis of PTSD, \(\chi^2(1, N = 47) = 15.45, p<.001\), with 83.3% (5 of 6) women meeting criteria for anxiety caseness compared to 9.1% (1 of 11) in the trauma control group and none of those who had not experienced a trauma.

4.4.5.3. Current trauma symptoms

Two measures were used at each assessment period to assess current PTSD symptoms. Firstly, the Posttraumatic Stress Disorder Checklist-Civilian Version (PCL-C; Weathers, et al., 1993) is an instrument specifically designed to measure current symptoms of the disorder. Secondly, the Dissociative Experiences Scale (DES, Berntein & Putman, 1986) which is designed to measure dissociative symptoms that can be a feature of PTSD.

4.4.5.3.1. Posttraumatic Stress Disorder Checklist-Civilian Version (PCL-C)

The range of possible scores for the PCL is a minimum of zero to a maximum of 68, with a case cut-off score of 32/33. Four mothers reached case level and were therefore considered to have significant levels of current PTSD symptoms as they scored greater than the clinical case cut-off (32) on at least one assessment period. One mother reached caseness at assessment one, two at assessment two and three, and one at assessment four and five. No mother reached caseness at assessment six. All four current trauma symptom cases were in the PTSD group and also met the more stringent DSM-IV diagnosis. Two of these four women reported current symptoms during the CIDI-PTSD interview, while the other three who reported current symptoms during the CIDI did not reach cut-off for the PCL. The four PCL cases were identified as outliers and contributed to the significant positive skew found for this variable. To be able to use this measure in multivariate and regression analyses this variable underwent a log-transformation. However for ease of presentation and interpretation, and non-transformed means and standard deviations will be reported.
Overall, mothers’ responses were low indicating that they were reporting low levels of current PTSD symptoms. The non-transformed means and standard deviations of PCL scores for each assessment period are reported in Table 4.12. The assessment period with the highest mean PCL score was pre-birth for the PTSD group (\(M = 15.33, SD = 11.90\)) with a range from 0 to 37. A repeated measure ANOVA demonstrated a significant reduction in scores over time, \(F(2,44) = 12.07, p < .01\), but no significant group by time interaction indicating that scores in all groups reduced over the six time points. A significant group difference was found, \(F(2,44) = 4.23; p < .05\), with the PTSD group having significantly higher PCL scores than the other two groups \((p < .05)\).

4.4.5.3.2. Dissociative Experiences Scale (DES)

The possible scores on the DES range from a minimum of zero through to 100 with scores above 30 representing a case. Only one mother was classified as a case, and she reached caseness at each time point that she participated in. This mother had experienced a trauma and had subsequently obtained a diagnosis of PTSD and also demonstrated caseness on the PCL for three out of the four assessment occasions for which she was available (withdrew before T5), but was not one of the five mothers who reported current PTSD symptoms on the CIDI. This case was identified as an outlier. Like the PLC this measure demonstrated a significant positive skew and was log-transformed, although non-transformed descriptive data is be presented in Table 4.13. Unfortunately the log-transformed DES variables demonstrated a negative skew and were not used in any further analyses.

Overall, mothers endorsed very few dissociative symptoms with the highest mean score being before birth for the PTSD group \((M = 11.37, SD = 10.12)\), with a range from a minimum of 2.14 to a maximum of 39.29. The mean scores and range for the DES are reported in Table 4.13. A repeated measure ANOVA found a significant reduction in scores over time, \(F(2,44) = 17.53, p < .001\), but no time by group interaction indicating the reduction...
Table. 4.12. Means and standard deviations for PCL-C scores over the course of the study

<table>
<thead>
<tr>
<th>Assessment period</th>
<th>Groups</th>
<th></th>
<th>Groups</th>
<th></th>
<th>Groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Trauma control</td>
<td>PTSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n=19)</td>
<td>(n=16)</td>
<td>(n=12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>Range</td>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1. Pre-birth</td>
<td>5.63 (4.62)</td>
<td>6.34 (5.93)</td>
<td>15.33 (11.89)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-15</td>
<td>2-26</td>
<td>0-37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2. Infant 2-3 weeks</td>
<td>4.35 (3.50)</td>
<td>4.61 (6.16)</td>
<td>13.17 (12.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-15</td>
<td>0-23</td>
<td>0-38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3. Infants 3-4 mths</td>
<td>5.38 (5.95)</td>
<td>4.34 (4.06)</td>
<td>12.17 (11.65)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-25</td>
<td>0-16</td>
<td>0-35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T4. Infants 13-14 mths</td>
<td>2.17 (2.03)</td>
<td>4.00 (4.56)</td>
<td>10.58 (11.67)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-7</td>
<td>0-17</td>
<td>0-38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T5. Infants 19-20 mths</td>
<td>4.13 (4.86)</td>
<td>4.61 (6.01)</td>
<td>7.54 (9.43)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-17</td>
<td>0-26</td>
<td>0-34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T6. Infants 24-25 mths</td>
<td>5.62 (5.91)</td>
<td>4.57 (5.52)</td>
<td>7.36 (6.24)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-22</td>
<td>0-22</td>
<td>0-21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: PCL-C= Posttraumatic Stress Disorder Checklist-Civilian Version(Weathers et al., 1994); non transformed data reported

in scores over time occurred in all groups. A near significant group difference was found, $F(2,44) = 3.01; \ p=.059$, with the PTSD group having significantly higher scores than the control but not the trauma control groups ($p<.05$).
Table 4.13. Descriptive statistics for DES scores at each assessment period.

<table>
<thead>
<tr>
<th>Assessment period</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n=19)</td>
</tr>
<tr>
<td></td>
<td>Mean (SD) Range</td>
</tr>
<tr>
<td>T1. Pre-birth</td>
<td>4.31 (2.83) .36-9.64</td>
</tr>
<tr>
<td>T2. Infant 2-3 weeks</td>
<td>4.01 (3.31) .36-10.36</td>
</tr>
<tr>
<td>T3. Infants 3-4 mths</td>
<td>3.47 (2.65) .00-8.21</td>
</tr>
<tr>
<td>T4. Infants 13-14 mths</td>
<td>4.19 (3.97) .00-15.36</td>
</tr>
<tr>
<td>T5. Infants 19-20 mths</td>
<td>3.24 (2.46) .00-9.29</td>
</tr>
<tr>
<td>T6. Infants 24-25 mths</td>
<td>3.91 (4.11) .00-15.35</td>
</tr>
</tbody>
</table>

Note: DES= Dissociative Experience Scale (D. P. Bernstein et al., 1994)

4.4.6. Life Stressors

From the fourth assessment period onwards mothers were asked to indicate if they had experienced stress from 25 potential stressful life events since the last assessment. The most commonly endorsed stressor was financial problems with 31.9% of women endorsing this item when their infant was 13 months of age, 14.9% at 19 months, and 29.8% when the
infants were 24 months. Approximately a quarter of the mothers reported marital conflict at each of the fourth (25.5%), fifth (21.3%), and sixth (23.4%) assessment periods. A similar level of mothers reported difficulties with their children. Work problems, unemployment and problems with their family were also commonly endorsed. Descriptive statistics for the total number of stressors for each of the three trauma groups are summarised in 4.14. A repeated measures ANOVA showed a significant trauma group effect, $F(2,44) = 3.13, p=.05$) with the PTSD group reporting significantly more stressors over time than the no trauma group ($p<.05$).

Table 4.14. Means and standard deviations of maternal life stressors for each trauma group

<table>
<thead>
<tr>
<th>Assessment time and trauma group</th>
<th>Total life stressors ($N=47$)</th>
<th>Mean ($SD$)</th>
<th>Range (0-25)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T4. Infants 13-14 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.73 (2.10)</td>
<td>0-8</td>
<td></td>
</tr>
<tr>
<td>Trauma control</td>
<td>2.19 (2.14)</td>
<td>0-6</td>
<td></td>
</tr>
<tr>
<td>PTSD</td>
<td>4.00 (3.57)</td>
<td>0-11</td>
<td></td>
</tr>
<tr>
<td><strong>T5. Infants 19-20 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.44 (1.61)</td>
<td>0-4</td>
<td></td>
</tr>
<tr>
<td>Trauma control</td>
<td>1.86 (1.71)</td>
<td>0-6</td>
<td></td>
</tr>
<tr>
<td>PTSD</td>
<td>2.91 (2.54)</td>
<td>0-8</td>
<td></td>
</tr>
<tr>
<td><strong>T6. Infants 24-25 months</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.87 (2.10)</td>
<td>0-8</td>
<td></td>
</tr>
<tr>
<td>Trauma control</td>
<td>3.00 (2.66)</td>
<td>0-10</td>
<td></td>
</tr>
<tr>
<td>PTSD</td>
<td>3.45 (3.09)</td>
<td>0-9</td>
<td></td>
</tr>
</tbody>
</table>

Note: Life stress = stressors experienced by mother since the previous assessment
Highly significant moderate correlations were found between the total life stress score and the GHQ total score from the corresponding assessment period, with the highest correlation being at T5 ($r=.61$, $p<.001$) and the lowest T4 ($r=.52$, $p<.001$). All the GHQ subscales had significant moderate correlations with the Life Stress score at each assessment point, with the exception of Severe Depression at T5.

4.4.6.1. Relationship stress
Eighteen (38.3%) mothers reported stress with their partner on at least one of the four times this was assessed (T2, T4, T5 & T6), with 10 (21.3%) women reporting more chronic spousal stress by endorsing this item on more than one occasion. Higher percentages of mothers in the trauma group than the control group reported spousal stress, but this did not reach significance at any of the four assessment times. However when the groups were analysed for chronic relationship stress, significantly fewer women in the control group reported spousal stress compared with the trauma group ($p<.05$) and the trauma control and PTSD groups ($p<.05$).

4.4.6.2. Parenting stress
Parenting stress was measured by the Parent Stress Index (PSI; Abidin, 1995) when the children were 19 months old. The PSI subscales, child and parent domains, and total stress scales were treated as both continuous variables and dichotomous variables. Dichotomous variables were created by selecting the top quartile as ‘cases’. The overall group means for the total stress, parent domain, and child domain were within expected ranges from the data published by Abidin (1995) and are summarised in Table 4.15. There were no significant differences in responding between primiparous and multiparous mothers.
Table 4.15. PSI descriptive statistics for the current study compared with the expected range

<table>
<thead>
<tr>
<th>PSI scales</th>
<th>Current study</th>
<th>Abidin 1995 a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=44</td>
<td>N=460</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Total stress</td>
<td>218 (32)</td>
<td>229 (39)</td>
</tr>
<tr>
<td></td>
<td>172-306</td>
<td></td>
</tr>
<tr>
<td>Child domain</td>
<td>99 (13)</td>
<td>104 (19)</td>
</tr>
<tr>
<td></td>
<td>74-126</td>
<td></td>
</tr>
<tr>
<td>Parent domain</td>
<td>119 (22)</td>
<td>126 (28)</td>
</tr>
<tr>
<td></td>
<td>78-184</td>
<td></td>
</tr>
</tbody>
</table>

Note: a= normative data for 2 year olds published in the PSI manual (Abidin, 1995, p.73)

4.4.6.2.1.  Relationship between PSI and maternal mental health

Correlations between continuous PSI subscales and GHQ summary scores were computed for all time points. Significant correlations were only found for the concurrent time period and are reported in Table 4.16. Small significant correlations were found between the total stress, child and parent domains and the GHQ summary scores. It is of interest that there were moderate and highly significant correlations between the parent subscale of health and all the GHQ summary scores. Yet, the parent subscale of depression did not correlate with any of the GHQ scores including severe depression, suggesting the health subscale is more of a reflection of the mothers’ psychological well being than the depression subscale. The parent subscale of spouse had small but consistent correlations with the GHQ summary scores suggesting those women who lacked support from their spouses had greater psychological distress. The parent scale of Isolation also positively correlated with social dysfunction and total GHQ scores, and competence correlated with severe depression. In the child subscales demandingness correlated with severe depression.
Table 4.16. Correlations between concurrent GHQ summary scores, ongoing life stress measure and PSI summary scores

<table>
<thead>
<tr>
<th>Measures</th>
<th>CD</th>
<th>Distract</th>
<th>Adapt</th>
<th>RP</th>
<th>Demand</th>
<th>Mood</th>
<th>Accept</th>
<th>PD</th>
<th>Comp</th>
<th>Isolate</th>
<th>Attach</th>
<th>Health</th>
<th>RR</th>
<th>Depress</th>
<th>Sp</th>
<th>TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHQ scales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somatic</td>
<td>.281</td>
<td>.102</td>
<td>.220</td>
<td>.126</td>
<td>.233</td>
<td>.116</td>
<td>.143</td>
<td>.381*</td>
<td>.183</td>
<td>.290</td>
<td>.099</td>
<td>.518**</td>
<td>.122</td>
<td>.220</td>
<td>.396*</td>
<td>.374*</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.321*</td>
<td>-.013</td>
<td>.142</td>
<td>.154</td>
<td>.209</td>
<td>.286</td>
<td>.106</td>
<td>.293</td>
<td>.235</td>
<td>.210</td>
<td>.162</td>
<td>.442**</td>
<td>.043</td>
<td>.199</td>
<td>.312*</td>
<td>.247</td>
</tr>
<tr>
<td>Dysfunction</td>
<td>.271</td>
<td>.196</td>
<td>.231</td>
<td>.157</td>
<td>.192</td>
<td>.185</td>
<td>.174</td>
<td>.335*</td>
<td>.146</td>
<td>.317*</td>
<td>.186</td>
<td>.442**</td>
<td>.086</td>
<td>.211</td>
<td>.316*</td>
<td>.359*</td>
</tr>
<tr>
<td>Depression</td>
<td>.307*</td>
<td>.132</td>
<td>.126</td>
<td>.096</td>
<td>.304*</td>
<td>.172</td>
<td>.078</td>
<td>.330*</td>
<td>.337*</td>
<td>.230</td>
<td>.147</td>
<td>.305*</td>
<td>.049</td>
<td>.243</td>
<td>.282</td>
<td>.335*</td>
</tr>
<tr>
<td>Total</td>
<td>.307*</td>
<td>.115</td>
<td>.214</td>
<td>.157</td>
<td>.255</td>
<td>.216</td>
<td>.150</td>
<td>.382*</td>
<td>.237</td>
<td>.303*</td>
<td>.167</td>
<td>.505**</td>
<td>.090</td>
<td>.244</td>
<td>.367*</td>
<td>.386*</td>
</tr>
<tr>
<td>Life stress</td>
<td>.442*</td>
<td>.138</td>
<td>.254</td>
<td>.220</td>
<td>.431**</td>
<td>.350*</td>
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<td>.498**</td>
<td>.356*</td>
<td>.430**</td>
<td>.234</td>
<td>.400**</td>
<td>.255</td>
<td>.359*</td>
<td>.333*</td>
<td>.520**</td>
</tr>
</tbody>
</table>

Note: N=44; PSI = Parent Stress Index; CD = Child Domain; Distract = Distractability; Adapt = Adaptability; RP = Reinforces Parent; Demand = Demandingness; Accept = Acceptability; PD = Parent Domain; Comp = Competence; Isolate = Isolation; Attach = Attachment; RR = Role Restriction; Depress = Depression; Sp = Spouse; TS = Total Stress; GHQ = General Health Questionnaire (Goldberg, 1978); * = p<.05; ** = p<.01
4.4.6.2.2. Relationship between PSI and maternal trauma

The PSI was correlated with the number of traumas a mother had experienced and PTSD symptoms retrospectively reported. The number of traumas experienced by the women showed significant correlations with the child domain subscales of reinforces the parent \( (r = .301, p < .05) \), and acceptability \( (r = .346, p < .05) \) demonstrating that a higher number of trauma experiences was associated with more worrisome scores in these subscales. Further, the higher the ‘B’ and ‘C’ DSM-IV trauma symptoms the more problems the mother had with the acceptability of the child \( (r = .305, p < .05; r = .351, p < .05; \text{respectively}) \), and parental depression \( (.319, p < .05; r = .375, p < .05) \). In addition, higher ‘B’, ‘C’, and ‘D’ symptoms were associated with poorer perception of parental competence \( (r = .311, p < .05; r = .386, p < .01; r = .311, p < .05; r = .386, p < .01; r = .361, p < .05) \). T-tests and ANOVAs were conducted to determine group differences between the control and trauma groups (Table 4.17 and Table 4.18). There were no significant differences found for the total stress, or the child and parent domain summary scores, although the PTSD group had higher scores for all three measures. Significant differences were found between the control and trauma groups for the child domain subscales of reinforces parent. On further inspection it was found there was a trend for the DSM-IV PTSD group to score higher on this subscale, \( F (2,40) = 2.47, p < .10 \), indicating that these mothers’ perceived their children to give them less positive reinforcement. A significant difference was also found for the acceptability subscale with the trauma group responses being higher than the control groups indicating that the women who had experienced a trauma reported that their child did not fit as well with their expectations. There was also a trend for the trauma mothers to report their children as having more negative mood. In the parent domain, trends were seen for both the competence and depression subscales with the trauma group reporting feeling less competent and having high levels of depression than the control group. In addition, the DSM-IV PTSD group reported greater depressive symptoms (although as mentioned above PSI depression subscale did not correlate significantly with the GHQ), and both the PTSD groups reported less competence.
Table 4.17. *t*-test results for PSI and control and trauma groups

<table>
<thead>
<tr>
<th>PSI scales</th>
<th>Control n=17</th>
<th>Trauma n=26</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Total stress</td>
<td>210.71 (30.78)</td>
<td>222.00 (32.88)</td>
<td>-1.23</td>
</tr>
<tr>
<td>Child domain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>96.06 (12.24)</td>
<td>99.92 (13.47)</td>
<td>-.95</td>
</tr>
<tr>
<td>Distractibility</td>
<td>25.47 (4.81)</td>
<td>25.19 (5.90)</td>
<td>.16</td>
</tr>
<tr>
<td>Adaptability</td>
<td>25.88 (4.04)</td>
<td>25.08 (3.51)</td>
<td>.69</td>
</tr>
<tr>
<td>Reinforces parent</td>
<td>7.65 (1.77)</td>
<td>9.04 (2.39)</td>
<td>-2.06*</td>
</tr>
<tr>
<td>Demandingness</td>
<td>17.12 (4.30)</td>
<td>19.27 (4.92)</td>
<td>-.147</td>
</tr>
<tr>
<td>Mood</td>
<td>9.41 (1.87)</td>
<td>10.58 (2.30)</td>
<td>-1.74†</td>
</tr>
<tr>
<td>Acceptability</td>
<td>10.00 (2.50)</td>
<td>11.77 (2.52)</td>
<td>-2.26*</td>
</tr>
<tr>
<td>Parent domain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114.65 (20.66)</td>
<td>122.08 (22.62)</td>
<td>-1.10</td>
</tr>
<tr>
<td>Competence</td>
<td>24.53 (5.61)</td>
<td>27.42 (5.34)</td>
<td>-1.70†</td>
</tr>
<tr>
<td>Isolation</td>
<td>12.47 (4.70)</td>
<td>12.73 (3.88)</td>
<td>-.20</td>
</tr>
<tr>
<td>Attachment</td>
<td>10.65 (2.55)</td>
<td>11.85 (2.63)</td>
<td>-1.49</td>
</tr>
<tr>
<td>Health</td>
<td>12.59 (3.54)</td>
<td>13.46 (2.80)</td>
<td>-.90</td>
</tr>
<tr>
<td>Role restriction</td>
<td>19.65 (4.31)</td>
<td>19.58 (5.16)</td>
<td>.05</td>
</tr>
<tr>
<td>Depression</td>
<td>16.82 (5.41)</td>
<td>19.96 (5.13)</td>
<td>-1.92†</td>
</tr>
<tr>
<td>Spouse</td>
<td>17.88 (3.35)</td>
<td>19.19 (3.90)</td>
<td>-1.14</td>
</tr>
</tbody>
</table>

Note: PSI=Parent Stress Index (Abidin, 1995); *=p<.05; †=p<.1
Table 4.18. Analysis of variance results for PSI and control, trauma control and PTSD groups

<table>
<thead>
<tr>
<th>PSI scales</th>
<th>Trauma groups</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Trauma control</td>
</tr>
<tr>
<td></td>
<td>$n=17$</td>
<td>$n=15$</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Total stress</td>
<td>210.71 (30.78)</td>
<td>219.07 (35.65)</td>
</tr>
<tr>
<td><strong>Child domain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>96.06 (12.24)</td>
<td>99.33 (14.43)</td>
</tr>
<tr>
<td>Distractibility</td>
<td>25.47 (4.81)</td>
<td>24.73 (5.97)</td>
</tr>
<tr>
<td>Adaptability</td>
<td>25.88 (4.04)</td>
<td>25.07 (3.77)</td>
</tr>
<tr>
<td>Reinforces parent</td>
<td>7.65 (1.77)</td>
<td>8.93 (2.58)</td>
</tr>
<tr>
<td>Demandingsness</td>
<td>17.12 (4.30)</td>
<td>19.40 (5.21)</td>
</tr>
<tr>
<td>Mood</td>
<td>9.41 (1.87)</td>
<td>10.53 (2.70)</td>
</tr>
<tr>
<td>Acceptability</td>
<td>10.00 (2.50)</td>
<td>11.67 (2.50)</td>
</tr>
<tr>
<td><strong>Parent domain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114.65 (20.66)</td>
<td>119.73 (24.34)</td>
</tr>
<tr>
<td>Competence</td>
<td>24.53 (5.61)</td>
<td>25.80 (5.36)</td>
</tr>
<tr>
<td>Isolation</td>
<td>12.47 (4.70)</td>
<td>12.53 (4.22)</td>
</tr>
<tr>
<td>Attachment</td>
<td>10.65 (2.55)</td>
<td>12.00 (2.70)</td>
</tr>
<tr>
<td>Health</td>
<td>12.59 (3.54)</td>
<td>13.47 (2.64)</td>
</tr>
<tr>
<td>Role restriction</td>
<td>19.65 (4.31)</td>
<td>20.47 (6.16)</td>
</tr>
<tr>
<td>Depression</td>
<td>16.82 (5.41)</td>
<td>19.33 (5.91)</td>
</tr>
<tr>
<td>Spouse</td>
<td>17.88 (3.35)</td>
<td>19.27 (4.08)</td>
</tr>
</tbody>
</table>

Note: PSI = Parent Stress Index (Abidin, 1995); *=p<.05; †=p<.1; 1=control group; 3=PTSD group
A similar pattern was found using the Dichotomous PSI variables. There were no significant group differences using the dichotomous (case/no case) variables for the Total Stress and child domain summary scores. But, the parent domain did show significant group differences, \( \chi^2(2, N = 40) = 6.39, p < .05 \), with the control group having fewer mothers scoring in the top quartile on this measure, indicating more mothers in both the trauma control and PTSD groups expressed higher levels of parental stress. Further analysis found that 60.0% of the DSM-IV PTSD mothers reported high levels of parenting stress, compared to 33.3%, 26.7% and 5.6% in the ICD-10 PTSD, trauma control and control groups respectively. The parent subscale of depression demonstrated a significant difference for the DSM-IV PTSD mothers, \( \chi^2(3, N = 43) = 9.49, p < .05 \), with 80% scoring in the top quartile on this measure. In addition, there was a trend toward a significant differences for the spouse subscale, \( \chi^2(2, N = 43) = 5.66, p < .10 \), with the PTSD groups having more women whose responses indicate that their partners were emotionally less supportive. In the child domain subscale the only near significant difference was found for the DSM-IV PTSD group, \( \chi^2(3, 39) = 7.67, p = .053 \), with 60% of mothers being in the top quartile for scores reflecting less reinforcement from their children.

4.4.7. Confidence in Parenting

Two measures were used to determine the mother’s confidence in her ability to parent. The Mother and Baby Scale (Wolke, 1995) was completed when the infants were 2 weeks old, and the Personal Appraisal Inventory (Bookless et al., 2000) was completed when the infants were 13 months old.

4.4.7.1. Mother and Baby Scale (MABS)

T-tests identified significant differences in scores on parent scales of lack of confidence in caretaking \( (t = 3.62; p < .005) \) and lack of confidence in feeding \( (t = 2.41; p < .05) \) for number of children, with first time mothers being less confident. Even though there were no significant
group differences between the trauma groups and primiparous and multiparous mothers, the numbers in each group were not even and it was decided to use number of children as a covariate for the parent domain scales. Analyses with and without the covariate did not alter significance but did alter the pattern of responding.

4.4.7.1.1. Relationship between MABS and maternal mental health

The MABS scores were correlated with the GHQ-28 (Goldberg, 1978) summary scores for both the pre-birth and the 2 week period. No significant correlations were found for the pre-birth period. Several significant positive correlations were found for the concurrent period (Table 4.19). The strongest positive correlations were found between total GHQ score and unsettled/irritable infant, and the GHQ social dysfunction scale and irritability during feeding, with higher GHQ scores corresponding to higher irritability. There was also a moderately strong negative correlation between the total GHQ score and lack of confidence during caretaking, indicating that higher maternal distress corresponded to less confidence. These results may be due either to the mother’s mental health colouring her perceptions of her infant or due to the infant reacting negatively to their mother’s state of mind.

4.4.7.1.2. Relationship between MABS and maternal trauma

The means and standard deviations for the total sample, and the trauma groups are shown in Table 4.20. No significant group differences were observed, although there was a consistent pattern of responding for the parent scales with the trauma control group being overall most confident in their parenting and the PTSD mothers the least confident. It was found that first time mothers in all groups scored less optimally on the lack of confidence in caretaking and lack of confidence during feeding scales compared to multiparous mothers. In contrast, the same pattern occurred for the global confidence scale only for the control and trauma control groups, with the PTSD mothers reporting similar levels of overall confidence regardless of
Table 4.19. Correlations between GHQ summary scores and MABS when infants were 2 weeks old

<table>
<thead>
<tr>
<th>GHQ</th>
<th>MABS scales</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UI</td>
<td>IDF</td>
<td>A</td>
<td>ADF</td>
<td>LCC</td>
<td>LCF</td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>.163</td>
<td>-.052</td>
<td>-.188</td>
<td>.066</td>
<td>-.370*</td>
<td>-.008</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>.349*</td>
<td>.016</td>
<td>.060</td>
<td>.205</td>
<td>-.287</td>
<td>.149</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>.372*</td>
<td>.465**</td>
<td>-.338*</td>
<td>-.123</td>
<td>-.302*</td>
<td>.352*</td>
</tr>
<tr>
<td>Severe depression</td>
<td>.116</td>
<td>.253</td>
<td>-.070</td>
<td>-.258</td>
<td>-.233</td>
<td>.283</td>
</tr>
<tr>
<td>Total</td>
<td>.397**</td>
<td>.192</td>
<td>-.224</td>
<td>.049</td>
<td>-.458**</td>
<td>.222</td>
</tr>
</tbody>
</table>

Note: N=44; GHQ = General Health Questionnaire (Goldberg, 1978); MABS = Mother and Baby Scales (Wolke; 1995); UI = Unsettled/Irritable; IDF = Irritable during Feeding; A = Alertness-Responsiveness; ADF = Alertness during Feeding; LCC = Lack of Confidence in Caretaking; LCF = Lack of Confidence during Feeding; GC = Global Confidence; * = p<.05; ** = p<.01

whether they had other children or not. In other words, the PTSD mothers had not gained confidence from previous experience.

4.4.7.2. Personal Appraisal Inventory (PAI)

The PAI was used when the infants were 13 months old to measure the personal meaning the mother gave to her experience of having a child. The four PAI scales were explored for differential responding by primiparous and multiparous mothers. No significant differences were found, although there was a trend with the positive growth scale for first time mothers to report more personal development since the birth of the study child than the multiparous mothers. Analyses were conducted with and without the ‘number of children’ as a covariate and no differences was found. The results reported here are without the covariate.
Table 4.20. Means and standard deviations of MABS scores for the total sample and the trauma groups

<table>
<thead>
<tr>
<th>MABS scales</th>
<th>Trauma groups</th>
<th>Total (N=45)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n=18) Mean (SD)</td>
<td>Trauma control (n=15) Mean (SD)</td>
</tr>
<tr>
<td>Neonate scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsettled</td>
<td>35.23 (11.90)</td>
<td>36.23 (12.12)</td>
</tr>
<tr>
<td>Irritable feeding</td>
<td>11.18 (7.32)</td>
<td>8.07 (6.05)</td>
</tr>
<tr>
<td>Alertness</td>
<td>28.47 (8.38)</td>
<td>27.00 (6.59)</td>
</tr>
<tr>
<td>Alertness feeding</td>
<td>12.82 (4.33)</td>
<td>12.47 (4.03)</td>
</tr>
<tr>
<td>Easiness</td>
<td>4.34 (3.01)</td>
<td>5.13 (3.89)</td>
</tr>
<tr>
<td>Parent scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conf. caretaking</td>
<td>14.62ª (2.19)</td>
<td>13.70ª (2.40)</td>
</tr>
<tr>
<td>Conf. feeding</td>
<td>7.49ª (1.42)</td>
<td>7.05ª (1.55)</td>
</tr>
<tr>
<td>Global confidence</td>
<td>4.30ª (0.73)</td>
<td>4.75ª (0.81)</td>
</tr>
</tbody>
</table>

Note: MABS=Mother and Baby Scale (Wolke, 1995) Total N=45 as MABS scores not available for the two women who joined the study at T4; ª=marginal means after co-varying for Number of Children

4.4.7.2.1. Relationship between PAI and maternal mental health

The PAI scales were correlated with the GHQ-28 (Goldberg, 1978) summary scores from the perinatal period and from the concurrent assessment (Table 4.21). Moderately strong positive correlations were found between the concurrent GHQ scales of social dysfunction, severe depression and total score and both the PAI scales of ‘impact on self esteem and relationships’ and the ‘impact on goals and commitments’ and negative correlations with ‘resources to manage’, indicating the higher the psychological distress the more the mother reported the child impacting on her self esteem and attainment of goals, and the lower her
ability to cope. In addition, perinatal GHQ scores of anxiety/insomnia, social dysfunction, severe depression and total scores were found to correlate with the same three PAI scales. No significant correlations were found for the positive growth scale.

Table 4.21. Correlations between GHQ summary scores and the PAI

<table>
<thead>
<tr>
<th>GHQ scale</th>
<th>PAI</th>
</tr>
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<td></td>
<td>PG</td>
</tr>
<tr>
<td><strong>Perinatal</strong></td>
<td></td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>-.223</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>.028</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>-.165</td>
</tr>
<tr>
<td>Severe depression</td>
<td>-.033</td>
</tr>
<tr>
<td>Total</td>
<td>-.142</td>
</tr>
<tr>
<td><strong>Time 4</strong></td>
<td></td>
</tr>
<tr>
<td>Somatic symptoms</td>
<td>-.028</td>
</tr>
<tr>
<td>Anxiety/insomnia</td>
<td>.143</td>
</tr>
<tr>
<td>Social dysfunction</td>
<td>-.109</td>
</tr>
<tr>
<td>Severe depression</td>
<td>.207</td>
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<tr>
<td>Total</td>
<td>.024</td>
</tr>
</tbody>
</table>

Note: N=45; PAI = Personal Appraisal Inventory (Bookless, Clayer & McFarlane, 2000); PG = Positive Growth; RM = Resources to Manage; Impact Goals = Impact on Goals and Commitments; Impact SE = Impact on Self esteem and Relationships; GHQ = General Health Questionnaire (Goldberg, 1978); GHQ Perinatal = T1, T2 and T3 scores; GHQ Second Year = T4, T5 and T6
4.4.7.2.2. Relationship between PAI and maternal trauma

There were no significant differences found between the control group and the trauma group as whole, nor between the control group and the trauma control and PTSD groups for the four PAI scales. As can be seen in Table 4.22 the PTSD group reported greater impact on their self esteem and their ability to meet goals and challenges more than both control groups, although this only neared significance for the impact on self esteem and relationships scale.

The trauma control group reported the least amount of personal growth. Analysis at the item level found a significant difference for Item 16; ‘As a result of having this child I have changed as a person’; with the PTSD group \((M = 2.75, SD = 0.28)\) reporting significantly more change than the trauma control \((M = 1.68, SD = 0.25; p<.01)\) and control groups \((M = 1.71, SD = 0.23; p<.01)\). No significant differences were found analysing the ICD-10 and DSM-IV PTSD groups separately, although there was a trend for the DSM-IV PTSD group to report that having a child had impacted on their goals more than the other three groups, and had a greater negative impact on self esteem compared to the control and trauma control groups.

Table 4.22. Means and standard deviations of PAI scale scores for the three trauma groups.

<table>
<thead>
<tr>
<th>PAI scales</th>
<th>Control</th>
<th>Trauma control</th>
<th>PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=18)</td>
<td>(n=15)</td>
<td>(n=12)</td>
</tr>
<tr>
<td>Positive growth</td>
<td>10.82 (3.63)</td>
<td>9.20 (3.63)</td>
<td>11.25 (3.79)</td>
</tr>
<tr>
<td>Resources to manage</td>
<td>12.29 (2.31)</td>
<td>11.33 (3.35)</td>
<td>11.17 (2.41)</td>
</tr>
<tr>
<td>Impact on goals</td>
<td>1.53 (2.03)</td>
<td>1.80 (1.66)</td>
<td>3.00 (3.64)</td>
</tr>
<tr>
<td>Impact on self esteem</td>
<td>2.29 (1.21)</td>
<td>2.60 (2.56)</td>
<td>4.08 (2.71)†</td>
</tr>
</tbody>
</table>

Note: PAI=Personal Appraisal Inventory; (Bookless, Clayer & McFarlane, 2000); †= \(p<.10\)
4.4.8. Social Connectedness

The risk factors of social isolation and the lack of a confidant were measured over the course of the study. Social isolation was measured by both the size of social networks and by the isolation subscale of the PSI (Abidin, 1995). Sixty four percent of the mothers knew at least one neighbour well enough to visit their home. All the mothers reported having at least three close friends, with 86.6% of mothers reporting that they socialised with friends at least once a month. In addition, 84.5% of mothers reported that they socialised with relatives at least once a month, and 77.8% belonged to a group or organisation such as a club, church or volunteer organisation. There were no significant difference between the three trauma groups and the size of their social networks or the frequency of contact. Using the isolation subscale of the PSI (T5) and an 80 percentile cut-off, eleven mothers were identified as being socially isolated from peers, relatives and other emotional support. No significant group differences were found with three women being in the control group, five in the trauma control group, and three in the PTSD group. Isolation is a risk factor for postnatal depression. Two of the mothers who were identified as potentially socially isolated had been identified as having postnatal depression.

At each time point the mothers were asked about a confidant. All mothers reported having a confidant with which to discuss important issues at each time point. At assessment four when the infants were 13-14 months of age 38 women (80.8%) reported that their spouse was their confidant, four (8.5%) women reported a family member, four (8.5%) women a friend, and one (2.1%) woman a work colleague. However of the 11 mothers at assessment four who indicated relationship stress seven of them also indicated their spouse was their confidant.

4.4.9. Group Comparison for Infant Measures

Groups were compared on a range of infant birth, neonatal, developmental, health and temperament measures.
4.4.9.1. Birth measures

Although not statistically significant, noticeable differences in the gender balance were seen between groups with approximately 75% boys in the control group and approximately 50% boys in both the trauma control and PTSD groups. Significant group differences were found for birth weight with the control group having the lowest weight babies at birth ($p < .05$). However all babies were within a very healthy weight range (3116 and 3913 grams). Birth weight below 2500 gm would be considered to be problematic in this type of study (O'Conner et al., 2005). There were no significant group differences for Apgar scores.

4.4.9.2. Neonatal development measures

No group differences were found for the summary scores of the neonatal Neurological and Adaptive Capacity Scale (NACS) assessment conducted by Felicity Linke (2002) when the infants were 2 weeks of age. But a significant group difference was found for the consolability subscale of both NACS and the Neonatal Behavioural Assessment Scale (NBAS). The consolability subscales from both the NACS and the NBAS were combined to a single variable (Linke, 2002). The control group ($M = 5.17, SD = 2.32$) had infants that required significantly more holding and rocking to calm them than the trauma group as a whole ($M = 7.12, SD = 2.20; t = -2.74, p < .01$). When compared across the three trauma groups the control group was significantly different, $F(2,39) =5.40, p < .01$, from the trauma control group ($M = 7.78, SD = 1.53; p < .005$) and neared significance for the PTSD group (both ICD-10 and DSM-IV; $M = 6.27, SD = 2.69; p < .10$), who both required the less intervention by the examiner to calm.

4.4.9.3. Child Development Quotient (GDQ)

When the infants were 13 months of age they were administered the Griffiths Mental Development Scales (GMDS; Griffiths & Huntley, 1996). The vast majority of infants were in the ‘average’ range (85-115) for age corrected general developmental quotients (GDQ).
The other two infants had GDQ’s that fell in the upper range of the ‘low average’ range. The scores on the subscales demonstrated a greater variability, which is expected in this age group. There were no significant gender differences. But, gender was used as a covariate for trauma group analyses.

4.4.9.3.1. Relationship to maternal trauma

The descriptive statistics for the infant general development quotient (GDQ) scores are shown in Table 4.23. Univariate analysis of variance was carried with the GDQ as the dependant variable and the trauma groups, gender, as well as the dichotomous infant withdrawal, and high-low emotional availability total score (EA) variables as fixed factors. No significant trauma, gender or infant withdrawal group differences were found. There was a trend towards a significant group difference, \( F(2,44) = 3.38, p<.10 \) for EA with the low EA group having lower scores \( M = 95.90, SD = 2.22 \) compared to the high EA group \( M = 101.50, SD = 2.00 \). There were no significant two or three way group interactions.

Table 4.23. Group statistics for the General Developmental Quotient measured at 13 months

<table>
<thead>
<tr>
<th>Groups</th>
<th>General Developmental Quotient*</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>98.57 (7.87)</td>
<td>98.80 (10.16)</td>
</tr>
<tr>
<td>( (n) )</td>
<td></td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Trauma control</td>
<td></td>
<td>101.22 (4.76)</td>
<td>98.71 (10.66)</td>
</tr>
<tr>
<td>( (n) )</td>
<td></td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>PTSD</td>
<td></td>
<td>97.00 (7.07)</td>
<td>96.14 (9.28)</td>
</tr>
<tr>
<td>( (n) )</td>
<td></td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Note: * = Griffiths Mental Development Scales (Griffiths & Huntley, 1996)
4.4.9.3.2. Relationship to ongoing maternal mental health

There were no significant correlations between infant GDQ scores and ongoing maternal psychological distress. In relation to specific ongoing trauma symptoms there was a small negative correlation between GDQ and PCL scores ($r = -0.300, p < 0.05$) reported pre-birth, suggesting a weak association between higher perinatal trauma symptoms and lower GDQ.

4.4.9.4. Infant health

Mothers were asked to rate their infants' health at each of the assessment periods. All infants were rated as having ‘good to excellent’ health between birth and when the children were aged 13 months. However, at the final two assessment periods eight different mothers rated their children as having ‘fair to poor’ health (four at T5 and three at T6). The types of health problems the mothers endorsed for these children included regular colds, viruses, sleep problems, allergies and skin problems. There were no trauma group differences found with this variable.

4.4.9.5. Infant temperament

Mothers completed the Emotionality, Activity and Sociability Questionnaire (EAS; Buss & Plomin, 1984) when the infants were 24 months of age. The temperament dimensions of emotionality, activity, sociability, and shyness were used as both continuous and dichotomous variables. Higher scores reflect higher dimensional behaviours. Temperament information was obtained for 42 of the infants. But, only 41 of these can be used in trauma group analyses as the trauma status of one mother who had recently reported domestic violence was unknown. In addition, children’s distress to novelty (dichotomous distress/no distress) was assessed at 13 months during an interaction with the examiner.
4.4.9.5.1. Relationship to maternal trauma

No significant differences on the continuous temperament dimensions were found using t-tests between the control and trauma groups. However, a one-way ANOVA identified a significant difference for shyness, $F(2,38) = 3.41, p<.05$, with post hoc analyses indicating the PTSD group children had significantly greater levels of maternally reported shyness than the trauma control group and neared significance for the control group (Table 4.24). In addition the emotionality scale, $F(2,38) = 3.53, p<.05$, was significantly higher for the PTSD group than the trauma control group, indicating greater emotionality in this group.

Table 4.24. Results of analysis of variance for the EAS and trauma groups

<table>
<thead>
<tr>
<th>EAS</th>
<th>Groups N=41</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (1)</td>
<td>Trauma control (2)</td>
</tr>
<tr>
<td></td>
<td>n=16</td>
<td>n=14</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Shyness</td>
<td>11.12 (2.82)</td>
<td>10.00 (3.74)</td>
</tr>
<tr>
<td>Emotionality</td>
<td>11.87 (3.09)</td>
<td>10.00 (4.23)</td>
</tr>
<tr>
<td>Sociability</td>
<td>18.56 (3.60)</td>
<td>17.07 (3.38)</td>
</tr>
<tr>
<td>Activity</td>
<td>21.31 (3.24)</td>
<td>21.07 (3.67)</td>
</tr>
</tbody>
</table>

Note: $N=41$; 2 mothers did not return questionnaire and one mother who experience domestic violence during the last six months of the study was not included; EAS = Emotionality, Activity and Sociability Questionnaire (Buss & Plomin, 1984)

A significant difference was also found with the shyness scale using the dichotomous variables with the three trauma groups. The control group had 44% of the children rated as ‘not shy’ and 56% as ‘shy’. In contrast, the trauma control group had over 15% in the ‘shy’ category whereas the PTSD group had over 72%, $\chi^2(2, N = 41) = 8.94, p<.05$. There was also
a trend toward significance for the emotional scale with the control and trauma control 
groups having 62.5% and 71.4% respectively in the ‘not emotional’ category, and by contrast 
the PTSD group having 27.3%. The distress to novelty variable was not found to significantly 
correlate with any of the EAS temperament subscales, nor was there any trauma group 
differences found.

4.4.9.5.2. Relationship to ongoing maternal mental health

Composite measures of mothers’ ongoing mental health during late pregnancy and first three 
months postnatally, and over the infants second year were correlated with the maternal rating 
of infant temperament (Table 4.25). Several significant correlations were found for 
emotionality which correlated positively with perinatal GHQ social dysfunction, severe 
depression, total GHQ, and GHQ somatic symptoms during the second year. On closer 
inspection of the individual time points, emotionality correlated with pre-birth GHQ social 
dysfunction ($r = .366, p<.05$), severe depression ($r = .337, p<.05$) and total ($r = .350, p<.05$), 
as well as concurrent GHQ somatic symptoms ($r = .467, p<.01$). No significant correlations 
were found for infant distress to novelty.

4.5. Mental Health Comparisons between Study Mothers and Withdrawals

Half of the 20 mothers who withdrew from the study reached caseness on the GHQ-28 at the 
prenatal assessment. Three of the four mothers who reached caseness on the PCL-C at the 
pre-natal assessment withdrew, as did the only person to reach caseness for the DES. The 
prenatal mean scores for the GHQ-28, PCL-C, and DES were compared between those 
women who had withdrawn from the study and those who remained in the study. These 
comparisons are summarised in Table 4.26. The scores were higher on all three measures for 
those women who withdrew from the study, indicating higher levels of mental health 
problems for these women. However the PCL-C was the only measure that reached
significance at the .05 level, suggesting that the mothers who withdrew had significantly higher levels of current PTSD symptoms than those who remained in the study.

Table 4.25. Correlations between EAS temperament ratings at 24 months and maternal mental health in the perinatal period and over the second year of the infants’ life

<table>
<thead>
<tr>
<th>Measure and timing</th>
<th>EAS temperament dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shyness</td>
</tr>
<tr>
<td><strong>Perinatal (T1+T2+T3)</strong></td>
<td></td>
</tr>
<tr>
<td>PCL</td>
<td>.209</td>
</tr>
<tr>
<td>GHQ somatic symptoms</td>
<td>.147</td>
</tr>
<tr>
<td>GHQ anxiety</td>
<td>.273</td>
</tr>
<tr>
<td>GHQ social dysfunction</td>
<td>.166</td>
</tr>
<tr>
<td>GHQ severe depression</td>
<td>.097</td>
</tr>
<tr>
<td>GHQ total</td>
<td>.238</td>
</tr>
<tr>
<td><strong>Second Year (T4+T5+T6)</strong></td>
<td></td>
</tr>
<tr>
<td>PCL</td>
<td>-.104</td>
</tr>
<tr>
<td>GHQ somatic symptoms</td>
<td>-.019</td>
</tr>
<tr>
<td>GHQ anxiety</td>
<td>-.071</td>
</tr>
<tr>
<td>GHQ social dysfunction</td>
<td>.003</td>
</tr>
<tr>
<td>GHQ severe depression</td>
<td>-.071</td>
</tr>
<tr>
<td>GHQ total</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: N= 42; EAS = Emotionality, Activity and Sociability Questionnaire (EAS; Buss & Plomin, 1984); T1 = pre-birth; T2 = infants 2 weeks old; T3 = infants 3 months old; T4 = infants 13 months old; T5 = infants 19 months old; T6 = infants 24 months old; PCL = Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers, et al., 1993); GHQ = General health Questionnaire (Goldberg, 1978)
Table 4.26. Comparison of maternal prenatal mental health between mothers who withdrew from the study and mothers who remained

<table>
<thead>
<tr>
<th>Maternal mental health</th>
<th>Withdrawn (n=20)</th>
<th>Remain (n=42)*</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>GHQ-28 total score</td>
<td>5.98 (4.98)</td>
<td>4.48 (3.36)</td>
<td>ns</td>
</tr>
<tr>
<td>PCL-C total score</td>
<td>17.75 (9.11)</td>
<td>8.17 (4.83)</td>
<td>p&lt;.05</td>
</tr>
<tr>
<td>DES total score</td>
<td>10.12 (10.88)</td>
<td>5.56 (4.07)</td>
<td>p=.084</td>
</tr>
</tbody>
</table>

Note: *N=42 as two mothers who joined study at T4 were not included in this analysis; GHQ = General health Questionnaire (Goldberg, 1978); PCL = Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers, et al., 1993); DES = Dissociative Experiences Scale (Bernstein & Putman, 1986)

4.6. Summary and Discussion

This longitudinal study was conducted over a 28 month period with the mothers being recruited pre-birth and followed with their infants over an additional five assessment periods until the children were 24 months of age. Sixty two women were originally recruited (Linke, 2002; Lowe, 2003) and an additional two joined after one year. The sample was drawn from the community with over 80% of the mothers’ actively responding to a media release asking for women in their third trimester of pregnancy to volunteer for a study into mother-infant relationships. Overall this proactive volunteering would suggest that the participants were altruistic, novelty seeking, had strong interest in mother-infant relationships or wanted help in this area, and were not socially phobic. Anecdotally, those women who had previous mental health problems volunteered to have additional contact with professionals, while others with trauma histories spoke positively about not allowing their past problems to impact on their parenting.
Over the duration of the study 20 mothers (31.25%) withdrew due to meeting exclusion criteria (premature infants), not responding to contact, or active withdrawal. The women who withdrew were less well resourced in terms of personal and financial support indicating the loss of women who were potentially more likely to have negative responses to stress. Research based on the Conservation of Resource Theory (Hobfoll, 2001) has demonstrated that the lower the persons resources the more reactive to stress they become (Sattler et al., 2002). Additionally, many of the women who withdrew had greater mental health problems, particularly trauma related symptoms and lifetime PTSD, representing the loss of women of particular interest to this study. This is similar to the ‘Avon Longitudinal Study of Parents and Children’ assessing antenatal anxiety and later child developmental outcomes, which found those who withdrew over the course of the study were more likely to be initially anxious and to have poorer psychosocial functioning (O'Connor, Heron, Golding, Glover, & Team, 2003).

As a whole the mothers who remained in the study were partnered, with both being Caucasian, well educated and employed. The families were financially comfortable, were not socially isolated, and approximately half were having their first child. The infants were all over 37 weeks gestation, had healthy birth weights, no known health problems, and were within the normal developmental range. Known risk factors for poor child development outcomes include family factors such as poverty, unstable family structure, low parental education, parental unemployment, and social isolation, as well as child factors such as birth complications, low birth weight, and health problems (Sroufe, Cooper, & DeHart, 1996). Based on these variables the sample would be described as a low risk middle-class community sample. At the same time, the trauma history of the mothers added a complexity to the sample.
The trauma history of the mothers demonstrated a higher than expected level of prior trauma experiences with approximately 60% of the mothers reporting at least one significant traumatic experience over their lifetime. The prevalence of trauma experience in the current study is comparable to the 50% found by Creamer, Burgess and McFarlane (2001) in a national survey of Australian women and the 69% of South Australian women aged between 21 and 40 found by Taylor and colleagues (1997). The differences found may be accounted for by sampling error and are unlikely to be significant. However the prevalence was considerably lower than found in U.S. community sample using the DSM-IV (Breslau & Kessler, 2001) and DSM-III-R (Resnick et al., 1993). These differences are not unexpected given the previous findings of Creamer, Burgess and McFarlane (2001).

Discrepancies were also found between the types of traumas experienced by women in the current study and those in the Australian national survey (Creamer et al., 2001) and the South Australian study conducted by Taylor and colleagues (1997). These differences may be accounted for by sampling error, although there are several other possible explanations. Firstly, the women in the current study had experienced fewer life threatening accidents and natural disasters, than those women in the national survey which may reflect the metropolitan nature and restricted age range of our sample. Secondly, the reduced levels of physical attacks and ‘other’ traumas were most likely due to the use of the domestic violence categories in the current study as the discrepancies were reduced when the domestic violence categories were collapsed back into ‘other’ and ‘physical attack’. Yet, the 2.4-fold greater proportion of women, a total of 38.3%, who had experienced rape or sexual molestation compared to the 15.6% in the national survey is not accounted for by obvious changes in categories or sample variation. Of note, several studies have found rape and molestation to be the trauma types for women most likely to result in PTSD (Breslau et al., 1991; Creamer et al., 2001; Kilpatrick et al., 1989; Resnick et al., 1993). So despite this sample being low risk based on demographic variables it was potentially at greater risk than a community sample.
for trauma related problems and PTSD. Explanations for this difference in trauma experience may be related to the recruitment strategy with the women’s trauma and mental health histories influencing their decision to volunteer. Ultimately, the combination of the low risk based on demographic variables and the high risk based on trauma history gave this study an advantage for assessing the impact of trauma on parenting and child outcomes without the added complications of other high risk confounding variables that complicate research in this area (De Bellis, Keshavan et al., 1999; De Bellis & Putnam, 1994).

The women were initially divided into two groups, those who had experienced a significant trauma (trauma group) and those who had not (control group). The Trauma group was further divided into those who obtained a lifetime diagnosis of PTSD using the ICD-10 criteria (PTSD group) and those who did not (trauma control group). The less stringent ICD-10 criteria was deemed appropriate for this study as PTSD in community samples is thought to be less intense than that found in clinical samples (Lehmann et al., Manuscript in preparation). Exploration of differences between the ICD-10 and the DSM-IV groups will be undertaken throughout the study. Despite less severity, community samples still carry significant levels of morbidity. Lifetime diagnoses were used as the women had experienced their traumas from childhood through to early adulthood. A lifetime diagnosis means that at some point following their trauma their symptom cluster would have been sufficient to receive a diagnosis. This does not mean that these women would have sufficient symptoms to reach a current diagnosis of PTSD. Less severe forms of PTSD are likely to remit over time with symptoms of intrusion and avoidance decreasing and affective and arousal problems remaining (McFarlane, 2000). One third of the women in the PTSD group reported significant current symptoms of the disorder. Importantly, the lack of current symptomatology does not preclude ongoing problems as a series of psychological and neurobiological changes are thought to occur in PTSD that have permanent sequela even when the disorder has remitted (McFarlane, 1996).
There were no significant group differences for the majority of demographic variables. The partners of the women with PTSD had significantly differ less education as well as showing a trend for the women in the PTSD group themselves to have less education. Lower levels of educational attainment have been found in adults who had experienced a natural disaster as a child (McFarlane & Van Hoof, 2006). First time mothers were not significantly different between groups but there were more multiparous mothers in the trauma control group.

Approximately 25% of the sample, and 42.9% of those who had experienced a trauma, received a lifetime diagnosis of PTSD and were placed in the PTSD group. Of these six met the more stringent DSM-IV diagnosis (12.8% overall, 21.4% who experienced trauma). The overall rate of DSM-IV PTSD found in this study is within the range published for DSM-III-R lifetime prevalence rates for community women of between 10.4-12.8% (Breslau et al., 1991; Breslau et al., 1997; Kessler et al., 1995; Resnick et al., 1993). Furthermore, the ICD-10 rate is in line with the 2.5-fold higher rates expected with the ICD-10 criteria compared to DSM-IV (Lehmann et al., manuscript in preparation). The 21.4% (DSM-IV) and 42.9% (ICD-10) of women in the current study who had experienced a trauma and subsequently developed PTSD was also congruent with reported DSM-III-R rates of 17.9-32% (Breslau et al., 1991; Breslau et al., 1997; Kessler et al., 1995; Resnick et al., 1993). The suburban subgroup of United States women in the Breslau study (1997) of United States women is the most comparable to the current study and found a PTSD (DSM-III-R) rate of 11% of the total sample and 32% of the traumatised women. Comparisons are unable to be made to the Australian National Survey (Creamer et al., 2001) as this study used 12 month prevalence rates as opposed to lifetime rates. Rape and physical attack were the most likely traumas to lead to a diagnosis of the disorder in this study. This is in line with other studies (Breslau et al., 1991; Creamer et al., 2001; Resnick et al., 1993).
Looking at the patterns of trauma and disruption specifically within the mothers’ families it was that found over 30% of the women had reported sexual abuse during their childhood or adolescence, and 35% reported emotional abuse in adolescence. In relation to trauma groups, the PTSD and trauma control groups were similar on abuse levels reported during childhood, but the PTSD group reported higher levels of abuse and family disruption during adolescence. Further, the PTSD group had more women who had experienced abuse in both childhood and adolescence. Traumatic stress in childhood and adolescence is thought to have a greater impact than trauma in later life as it can disrupt normal stages of development (Cicchetti & Rogosch, 2001b; De Bellis, Baum et al., 1999; Lipschitz et al., 1998) and is 1.5 times more likely to lead to a diagnosis of PTSD (Fletcher, 1996). In addition, there is increasing evidence that childhood trauma is a risk factor for victimisation in later life and that re-exposure can result in PTSD in the adult (Yehuda et al., 2001).

The PTSD group demonstrated over 58% comorbidity with depression or anxiety disorders. This increased to 80% for the DSM-IV PTSD subgroup. The rate of comorbidity in the DSM-IV sub-sample is comparable with other studies that have looked at lifetime prevalence of these disorders in relation to PTSD (DSM-III-R) (Breslau et al., 1991; Breslau et al., 1997). The lower rate of comorbidity in the whole PTSD group may be explained in part by the lack of social phobia, agoraphobia and obsessive compulsive disorder found in this sample. The 41.6% for any anxiety disorder in the PTSD group is lower than the 55% reported by Breslau and colleagues (1997). The recruitment method used to establish the sample would bias against women with these anxiety disorders. In addition, Lehmann and colleagues also demonstrated lower levels of comorbidity in people reaching the ICD-10 PTSD criteria as compared with the DSM-IV. Of the disorders found in the current sample, the 33% rate of simple phobia is nearly twice as high as expected for women in the general population (Breslau et al., 1997; Kessler et al., 1994). The Breslau (1997) study also reported high levels of simple phobia in the women with PTSD. Furthermore, the increased rate of simple phobias
in the Trauma group as a whole (25%) is in line with recent findings from a 20 year follow up of children exposed to bushfires (McFarlane & Van Hoof, 2006). The depression rate of 31.6% in the control group is higher than the expected 13-20% expected and the anxiety disorders much lower (Breslau et al., 1997; Kessler et al., 1994). The higher level of depression is unlikely to be due to a concentration of PND as the Breslau study (1997) is of women with young children and therefore would include similar episodes of PND. One possible explanation for these higher lifetime rates of depression may again be the recruitment method, as some women with previous mental health problems anecdotally indicated that they had volunteered to be a part of the study to afford themselves additional contact with professionals. The studies with lifetime prevalence rates do not separately report data on those with trauma experience but without PTSD. The trauma control group in this study had depression levels similar to the control group but higher anxiety levels (31.3%).

The rate of postnatal depression (PND) was found to be 12.8% which is congruent with rates of 10-15% found in epidemiological studies in Australia and the United Kingdom (Brooks, Doherty, & Speelemn, 2005; Cox et al., 1987; O'Hara & Swain, 1996). These six women were split among the three trauma groups, and five had at least one other child. Five (10.6%) women still reported significant depression symptoms or were taking antidepressant medication when their infants were 13 months of age, which is in line with reports of 10% of women still having signs of depression at 12 months (Murray et al., 2003). The strongest predictors for PND are previous episodes of depression and poor social support and lack of a confidant (Murray et al., 2003; Small et al., 1994). Overall, in the current study group every mother indicated she had a confidant, only two out of the eleven more socially isolated women had PND, and only one mother with PND had had a previous episode of depression. The mothers’ level of psychological distress across the course of the study was monitored using the GHQ-28. The highest levels of distress were found at the pre-birth assessment and when the infants were 2 weeks old, with 34% and 38% of the women respectively reaching
the 5/6 cut-off for caseness. These rates dropped to between 20 and 24% when the infants were between 3 and 19 months old, with the rate rising again to 34% when the infants had reached 24 months. The early results are comparable to those found by Skari and colleagues (2002) with 37% of Norwegian mothers reaching caseness within the first week of birth and reducing to 21% by 6 weeks, and 19% by 6 months. However, the 20-24% found between 13 and 19 months is much higher than the 10% found in a study of Italian and French women 12 months after birth (Romito et al., 1999), but is congruent with a South Australian study of community women (not specifically mothers), with women between 25 and 44 years with approximately 22 to 26% reaching caseness (Taylor et al., 2000). The later increase may be due to the 28% of mothers who were either pregnant again or had recently delivered a subsequent child by the last assessment. Group differences where found with the PTSD group having significantly more cases of psychological distress than both the control and trauma control groups when the infants were 3 months old, and significantly more cases of anxiety at the pre-birth assessment and when the infants were 2 weeks old. Anxiety and irritability have been found to be key symptoms in problem interactions with infants (Pound et al., 1988). Using the GHQ as a continuous variable with repeated measures analysis, the PTSD group had significantly higher levels of psychological distress across the course of the study. Further to this, multiparous women who were in the PTSD group were more likely to reach caseness for psychological distress than multiparous women in the other two groups and primiparous women in any group. This indicates that as demands became greater the women with a lifetime diagnosis of PTSD became more stressed. The subscales of severe depression and social dysfunction followed a similar pattern to the GHQ total score with the PTSD group having higher levels than both the control and trauma control groups across the six assessment periods. In contrast, for the anxiety/insomnia subscale significant differences were only found between the PTSD and control groups, with the trauma control group being closer to the PTSD group.
Ongoing life stressors, relationship problems and social isolation have been found to relate to higher GHQ scores in mothers of young infants (Romito et al., 1999). The mothers perceived level of ongoing life stressors was measured over the second year of the study. Approximately a third of the women reported financial problems, and a quarter reported relationship problems. Repeated measures analysis found that the PTSD group reported significantly more stressors in their lives than the control group. It is not know from this data if the PTSD group objectively had more life stressors or perceived similar levels as more stressful. However, together with the GHQ results it would suggest that the PTSD group had less psychological resources to cope than the other two groups. Both the PTSD and trauma control groups reported a significantly greater level of relationship stress than the control group. No group differences were found in relation to social isolation.

A range of measures were used across the course of the study to measure the mothers’ perceptions of parenting. Overall, negative parental perceptions correlated with higher levels of psychological distress. In the first few weeks of life there were no significant group differences for levels of child irritability, alertness and parental confidence, although there was a pattern of responding that indicates the trauma control group felt most confident at parenting and the PTSD group the least confident. At the 13 month assessment there was a trend for the mothers in the PTSD group to report that the birth had a greater negative impact on their self esteem and achieving their goals than both the other two groups. There was also a trend for the trauma control group to report less personal growth since the birth of their infant compared to both the control and the PTSD groups. At the 19 month mark, the trauma group as a whole found their infants significantly less reinforcing of them as parents. They were also less accepting of the child in terms of the child not meeting their expectations. When split three ways the PTSD mothers reported significantly less competence in parenting and a trend toward their children being less acceptable. Overall, the PTSD group perceived greater problems with parenting while the trauma control perceived the least.
Group differences were also found on several infant variables. There were no significant group differences for gender, but the control group had more boys than the other two groups. The infants in the control group had significantly lower birth weight, but all groups were within very healthy ranges. The infants in the control group also required significantly more intervention from the examiner to console, with the trauma control group needing the least. This may reflect parental practice with perhaps the control mothers routinely giving more physical attention to their infants when they cry and the trauma control group the least. As will be seen in later chapters reduced need for consoling may be part of a mother-infant biologically driven protective system. There were no group differences found for infant IQ.

In relation to mothers’ rating of infant temperament, the control group had approximately equal numbers of shy children, whereas the trauma control group had only 25% and the PTSD group had 75%. The PTSD mothers’ also reported their children as being more emotional. No associations were found between the measure of distress to novelty and any of the EAS temperament dimensions, trauma groups or maternal mental health. Brand and associates (2006) found that PTSD and current maternal symptoms of the disorder were related to maternal reports of higher infant distress to novelty. This measure may be associated with child emotionality used in the current study.

Taken as a whole, the recruitment method resulted in a sample of women and infants who were low risk on demographic and relational variables. But the recruitment included a higher proportion of mothers who had experienced rape or sexual molestation, higher rates of previous depressive episodes, and lower lifetime occurrence of certain anxiety disorders. Rates of lifetime PTSD were congruent with those reported in the literature. Those women with a diagnosis of PTSD had greater levels of ongoing distress and were more reactive to stress, but did not report high levels of current PTSD specific symptoms. The trauma control group had higher levels of anxiety and stress than the control group but not as high as the
PTSD group. The control group infants took the most intervention by the examiner to console and the trauma control group the least. Further, the mothers demonstrated differential patterns of viewing their children and their parenting experience with the control group being more positive, the trauma group less involved and less accepting of their infants, and the PTSD group feeling less competent and more attuned to perceived negative behaviour. The following chapters will compare trauma groups in relation to cortisol levels, types of mother-infant interactions, child developmental outcomes, and finally, discuss predictors for poorer child development.
5. **Relationship between Mother and Child Cortisol Levels**

The relevant literature in relation to the biological impact of trauma was reviewed in Chapter 2.1.2. with the subsections ‘Effects of PTSD on the HPA axis’ and ‘Intergenerational transmission’ being the most relevant to the investigations undertaken in the current chapter. Briefly, genetic and environmental influences are both thought to impact on an individual’s basal level production of cortisol as well as their response to stressors. Although not always consistent, a pattern of hypocortisolism has been found in patients with PTSD with lowered morning cortisol and total daily production, unless comorbid depression is found in which case there may be an increase in cortisol production, typically seen as a rise in the afternoon (Gunnar & Vazquez, 2001; Heim et al., 2000; De Bellis, Baum et al., 1999; Yehuda et al., 1996). Further, low cortisol has been identified as a risk factor for developing PTSD (Delahanty et al., 2003; McFarlane et al., 1997; Resnick et al., 1995). In addition, mothers are thought to play a critical role in aiding their children to develop emotional and physical self regulation. That is, the mother acts as an external regulator of the child’s stress response. However little is known about the interaction of the mother’s trauma experience on her infant’s cortisol or whether there is a relationship between maternal basal activity and that of her offspring.

A series of studies on PTSD in Holocaust survivors and their adult children suggested that low cortisol status, and therefore greater susceptibility to developing PTSD following trauma, may have been passed on from mother to child (Yehuda et al., 2001). However a high level of child maltreatment in this cohort was another possible reason for the low cortisol levels and PTSD in the adult offspring. A recent study of pregnant women directly exposed to the World Trade Centre terrorist attack (Yehuda et al., 2005) investigating the effects of trauma on mothers and their young infants cortisol levels reduced the confounding impact of the
child’s own life experiences. This study found maternal morning and evening cortisol significantly correlated with infant morning and evening cortisol. Moreover, it found women who were traumatised during pregnancy and displayed subsequent symptoms of PTSD had significantly lower basal cortisol than those who did not, and so did their infants, particularly if they were in the third trimester of pregnancy at the time of the trauma. Although this study was small it suggests that the mother’s trauma experience and/or her basal cortisol levels during pregnancy may be involved in the setting of the infant’s basal cortisol. This may be due to either glucocorticoid in utero programming (Seckl, 2001), or shared genetic susceptibility (Bartels et al., 2003). Although infants were approximately 9 months of age when the cortisol was collected, social regulation and parenting variables cannot be ruled out and will be addressed in the following chapter. Of significance for the current study, the Holocaust studies suggest that the trauma does not need to occur during pregnancy to impact on the child’s cortisol. In addition, studies of rat pups found that maternal behavioural changes resulting from stress during pregnancy were more obvious with subsequent litters (Meaney, 2001).

Both the Holocaust studies and the World Trade Centre study have methodological problems. The Holocaust studies were confounded by the adult children’s own life experiences, and parental PTSD being established by the adult child’s account. Yehuda and colleagues more recent study (2005) of the mothers traumatized by the World Trade Centre terrorist attacks, did not report a detailed history of the mothers’ lifetime trauma experiences, or use a clinical diagnostic interview to establish the PTSD status of the mother. The World Trade Centre study also compared traumatised mothers with current symptoms indicative of PTSD to traumatised mothers with lower symptom levels, but did not include a non-traumatised control group. The current study was designed to overcome these problems by recruiting mothers during pregnancy, establishing the lifetime trauma experience and PTSD status of the mother, monitoring their ongoing mental health, life experiences, and stress of the
mother, as well as the health and well being of the infant. In addition a low risk sample was recruited to avoid the added complications of poverty and associated stressors. The mother and infant basal cortisol was sampled when the infants were 13 months old when their basal level production should be stable. Important variables relating to the parent-infant interactions have also been measured and will be addressed in the next chapter.

The current study takes the next step in this area of research by investigating the relationship between maternal trauma that occurred before pregnancy and the pattern of cortisol production in both the mother and the infant without the confounding problems of using adult offspring. Morning and evening cortisol was measured from saliva samples of mothers and their 13-month-old infants. As reported in the previous two chapters the mothers were recruited during pregnancy, and their trauma and PTSD status established. The women who had experienced a significant trauma had experienced their index trauma (used to establish PTSD status) on average 15 years (range 1-27 years) before the birth of the study child. Although those women who had experienced multiple traumas may have experienced more recent traumas, no one reported experiencing a significant trauma between 1 year before birth of the study child and when the infants were 13 months of age. Both ongoing PTSD symptoms and general psychological distress were monitored over the course of the study. The mothers were divided into groups depending on their trauma experience and PTSD status (see Chapter 4.3.2). The presence of PTSD was established using both the ICD-10 criteria and the more stringent DSM-IV criteria (see Chapter 4.3.1.2). To have similar numbers, the groups were divided into those without trauma experience (control), those with trauma experience but no lifetime diagnosis of PTSD (trauma control), and those with PTSD (PTSD). It is unknown from the literature if a flattened cortisol response is also found in individuals who reach a diagnosis for PTSD using the more lenient ICD-10 criteria, although the Holocaust studies found sexual abuse without PTSD was related to high cortisol production (Yehuda, Schmeidler et al., 1998). Therefore even though group sizes are small,
exploratory analyses were also carried out for those who met the ICD-10 criteria only (PTSD-ICD-10) and those who also met the DSM-IV criteria (PTSD-DSM-IV).

The current study aimed to gain a better understanding of the effects prior maternal trauma may have on the mother’s basal cortisol production and that of her offspring. More specifically, it was hypothesised that:

1. there would be an association between mother and infant basal cortisol levels;
2. maternal PTSD would be associated with reduced patterns of basal cortisol production in the mothers and this would be associated with altered patterns of basal cortisol levels in the infants.

In addition perinatal and current maternal trauma symptoms and general mental health will be explored in relation to maternal basal cortisol production and that of her infant. Further, trauma experience, trauma symptoms, ongoing mental health, and maternal cortisol (for the infants) will be used to predict basal cortisol levels in the mother, and infants.

5.1. Results

The analyses were undertaken in five stages. The first section begins with initial descriptive statistics. The second stage investigated the relationship between the mother and infant cortisol patterns using intercorrelations. Thirdly, the impact of maternal trauma on both the mother and infant cortisol levels was analysed using correlations and multivariate analysis of variance. The fourth stage investigated the relationship between the mothers’ current PTSD symptoms, general mental health, and reported life stressors on both the mother and infants basal level cortisol production. Finally, regression analyses were used to determine the variables which best predicted both mother and infant cortisol levels.
5.1.1. Preliminary Analyses

During the initial investigation the cortisol measures were found to lack normal distribution, with a significant positive skewness and outliers identified across all measures. The child and mother morning, evening and total cortisol levels were transformed to a normal distribution using a natural logarithmic transformation. However one outlier remained with the mother having cortisol levels much greater than the other participants and outside the normal range (Salimetrics, 2004). The mother-child dyad, from the control group, was deleted from further cortisol analyses. The transformed variables were used for all analyses. Transformation was not necessary for the cortisol difference and ratio measures.

There were usable saliva cortisol results from both morning and evening samples for 39 children, 42 mothers, and 38 dyads. Therefore the number used for each analysis depended on the question being investigated. The untransformed means, standard deviations and ranges are presented in Table 5.1. The range of mother and infant morning and evening cortisol levels were within reported normal ranges (Salimetrics, 2004). Overall, the normal diurnal pattern was found for both the mothers and the infants, with the expected 10-fold decrease across the day for both the mothers and children. A large variation was found for individual subjects with the difference and ratio measures demonstrating a flattened cortisol pattern (little or no decrease across the day) for some mothers and children while others showed up to a 70-fold decreases over the day.

5.1.1.1. Associations with obstetric, antenatal and sociodemographic variables

Correlations were used to assess possible confounding relationships between birth and demographic factors. No significant correlations were found between the infant variables of gender, Apgar scores, birth weight, or birth type (Caesarean or vaginal) and child cortisol levels. In addition no significant correlations were found between sociodemographic measures of paternal age, maternal and paternal education, employment, income, number of
hours paid work of mother, or number of children in the family, and mother or child cortisol levels. These potential confounding variables were dropped from further analyses involving cortisol measures. However, as reported in other studies mother’s age did correlate with maternal morning ($r = .363$, $p<.05$) and maternal total cortisol ($r = .404$, $p<.01$) and was therefore used as a covariate with all maternal cortisol measures.

Table 5.1. Descriptive statistics for mother and child morning and evening saliva cortisol levels

<table>
<thead>
<tr>
<th>Saliva cortisol measures</th>
<th>N</th>
<th>Cortisol ug/dL</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Child morning</td>
<td>39</td>
<td>0.45 (0.29)</td>
<td>0.094-1.456</td>
</tr>
<tr>
<td>Child evening</td>
<td>39</td>
<td>0.10 (0.14)</td>
<td>0.003-0.802</td>
</tr>
<tr>
<td>Mother morning</td>
<td>42</td>
<td>0.37 (0.20)</td>
<td>0.100-1.052</td>
</tr>
<tr>
<td>Mother evening</td>
<td>42</td>
<td>0.07 (0.06)</td>
<td>0.010-0.328</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child morning+evening</td>
<td>39</td>
<td>0.55 (0.40)</td>
<td>0.14-2.26</td>
</tr>
<tr>
<td>Mother morning+evening</td>
<td>42</td>
<td>0.43 (0.21)</td>
<td>0.13-1.08</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child morning-evening</td>
<td>39</td>
<td>0.35 (0.22)</td>
<td>-0.01-1.02</td>
</tr>
<tr>
<td>Mother morning-evening</td>
<td>42</td>
<td>0.30 (0.22)</td>
<td>-0.04-1.03</td>
</tr>
<tr>
<td>Ratios</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child morning/evening</td>
<td>39</td>
<td>9.31 (12.08)</td>
<td>0.91-70.00</td>
</tr>
<tr>
<td>Mother morning/evening</td>
<td>42</td>
<td>9.88 (10.15)</td>
<td>.89-51.60</td>
</tr>
</tbody>
</table>

Note: morning saliva was collected within 30 minutes following morning rising; evening saliva was collected within 30 minutes before retiring in the evening; cortisol was measured using a Cortisol Enzyme Immunoassay Kit (Salimetrics, 2004)
5.1.2. Relationship between Mothers and Infants Cortisol Measures

The partial correlations between mother and infant morning, evening, total and difference values were explored, using mother’s age as a covariate (Table 5.2). The intercorrelations within the various infant measures and the mother measures are described separately before assessing intercorrelations between mother and infant cortisol levels. The child morning and the child evening cortisol levels showed a significant moderate positive correlation. This was in contrast to the lack of significant correlation between the maternal morning and evening cortisol levels. However similar patterns were found for both the child’s and mother’s relationship to their own total and difference scores, with morning cortisol levels strongly correlated to both. Child evening cortisol also demonstrated a moderately strong positive correlation with child total score but not child difference scores. On the contrary, maternal evening cortisol did not correlate with maternal total cortisol and demonstrated a small but significant negative correlation with maternal difference score indicating an inverse relationship with low evening cortisol being related to high differences. When mother and child cortisol levels were correlated significant relationships were found for only the child evening and the maternal evening cortisol. The child evening cortisol positively correlated with maternal evening and negatively with maternal difference, whereas the maternal evening cortisol also correlated with the child total cortisol. Overall, a relationship between child morning and evening cortisol was found but not mother morning and evening levels. In addition child evening and mother evening cortisol levels appear to be related but not their morning levels.

5.1.3. Mother and Infant Cortisol Levels and Maternal Trauma Experience

This section will firstly explore the correlational patterns within and between mother and child cortisol measures in the control and trauma groups, before analysing differences between group cortisol means using both multivariate and repeated measures designs.
Table 5.2. Pearson partial correlations between mother and infant morning, evening, total cortisol and difference scores, controlling for maternal age

<table>
<thead>
<tr>
<th>Cortisol measures</th>
<th>Child morning</th>
<th>Child evening</th>
<th>Child total</th>
<th>Child difference</th>
<th>Mother morning</th>
<th>Mother evening</th>
<th>Mother total</th>
<th>Mother difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child morning</td>
<td>1</td>
<td>.415*</td>
<td>.969**</td>
<td>.931**</td>
<td>.151</td>
<td>.306</td>
<td>.248</td>
<td>-.074</td>
</tr>
<tr>
<td>Child evening</td>
<td>.415*</td>
<td>1</td>
<td>.601**</td>
<td>.292</td>
<td>-.136</td>
<td>.467**</td>
<td>.031</td>
<td>-.362*</td>
</tr>
<tr>
<td>Child total</td>
<td>.969**</td>
<td>.601**</td>
<td>1</td>
<td>.890**</td>
<td>.090</td>
<td>.393*</td>
<td>.225</td>
<td>.155</td>
</tr>
<tr>
<td>Child difference</td>
<td>.931**</td>
<td>.292</td>
<td>.890**</td>
<td>1</td>
<td>.151</td>
<td>.219</td>
<td>.210</td>
<td>-.026</td>
</tr>
<tr>
<td>Mother morning</td>
<td>.151</td>
<td>-.136</td>
<td>.090</td>
<td>.151</td>
<td>1</td>
<td>.050</td>
<td>.956**</td>
<td>.874**</td>
</tr>
<tr>
<td>Mother evening</td>
<td>.306</td>
<td>.467**</td>
<td>.393*</td>
<td>.219</td>
<td>.050</td>
<td>1</td>
<td>.309</td>
<td>-.323*</td>
</tr>
<tr>
<td>Mother total</td>
<td>.248</td>
<td>.031</td>
<td>.225</td>
<td>.210</td>
<td>.956**</td>
<td>.309</td>
<td>1</td>
<td>.739**</td>
</tr>
<tr>
<td>Mother difference</td>
<td>-.074</td>
<td>-.362*</td>
<td>-.155</td>
<td>-.026</td>
<td>.874**</td>
<td>-.323*</td>
<td>.739**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: \( N = 43 \) for mothers, \( n = 40 \) for children, \( n = 39 \) for dyads; morning cortisol collected within 30 minutes of rising; evening cortisol collected within 30 minutes of retiring in the evening; Total = addition of morning and evening; Difference = morning – evening; \* = \( p < .05 \); ** = \( p < .01 \)
5.1.3.1. Relationship between mother and infant cortisol levels and trauma experience

The intercorrelations within mother and child cortisol measures and between mother and child measures were explored in relation to the control group who had not experienced severe trauma and the trauma group (Table 5.3.). The mother-mother and child-child intercorrelations were similar between the two groups. In contrast, the mother–infant correlations differed markedly between the control and trauma groups. In the control group the child morning cortisol significantly and positively correlated with maternal morning and maternal difference levels but not the maternal evening cortisol. In direct contrast, the trauma group child morning cortisol only correlated with maternal evening cortisol. Scatter plots of the child morning cortisol comparisons are shown in Figure 5.1. A similar contrast was found with the child evening cortisol with the control group demonstrating a positive correlation with mother morning and mother difference levels but not mother evening cortisol. However, in the trauma group child evening cortisol positively correlated with the maternal evening cortisol as well as negatively correlating with maternal difference levels. Opposing correlational patterns were also found for child total cortisol and maternal evening and maternal difference levels, as well as child difference levels and maternal morning and maternal difference cortisol levels. Overall, although there were no significant differences between the mother-mother and child-child intercorrelations between the control and trauma groups, there were significant differences in correlations between the child-mother correlations suggesting an interaction or influence of maternal trauma experience on the child cortisol production. A greater relationship was found between child and mother morning cortisol in the control group, and in contrast a greater relationship between the child morning and evening cortisol and the maternal evening cortisol in the trauma group. This is only partially consistent with the Yehuda and colleagues (2005) World Trade Centre study where significant correlations were reported between both mother and child morning cortisol and mother and child evening cortisol.
Table 5.3. Pearson partial correlations between mother and infant morning, evening, total cortisol and difference scores for the control and trauma groups

<table>
<thead>
<tr>
<th>Cortisol measures</th>
<th>Child morning</th>
<th>Child evening</th>
<th>Child total</th>
<th>Child difference</th>
<th>Mother morning</th>
<th>Mother evening</th>
<th>Mother total</th>
<th>Mother difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child morning</td>
<td></td>
<td>.471</td>
<td>.967**</td>
<td>.939**</td>
<td>.573*</td>
<td>-.221</td>
<td>.490</td>
<td>.648*</td>
</tr>
<tr>
<td>Child evening</td>
<td>.419</td>
<td></td>
<td>.671*</td>
<td>.219</td>
<td>.293</td>
<td>.278</td>
<td>.361</td>
<td>.233</td>
</tr>
<tr>
<td>Child total</td>
<td>.972**</td>
<td>.597**</td>
<td></td>
<td>.838**</td>
<td>.530</td>
<td>-.124</td>
<td>.478</td>
<td>.583*</td>
</tr>
<tr>
<td>Child difference</td>
<td>.926**</td>
<td>.301</td>
<td>.897**</td>
<td></td>
<td>.621*</td>
<td>-.351</td>
<td>.491</td>
<td>.722**</td>
</tr>
<tr>
<td>Mother morning</td>
<td>.137</td>
<td>-.216</td>
<td>.073</td>
<td>.117</td>
<td>.065</td>
<td></td>
<td>.959**</td>
<td>.933**</td>
</tr>
<tr>
<td>Mother evening</td>
<td>.434*</td>
<td>.561**</td>
<td>.534**</td>
<td>.367</td>
<td>-.026</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother total</td>
<td>.273</td>
<td>-.005</td>
<td>.255</td>
<td>.212</td>
<td>.944**</td>
<td>.272</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother difference</td>
<td>-.129</td>
<td>-.470*</td>
<td>-.220</td>
<td>-.105</td>
<td>.876**</td>
<td>-.409*</td>
<td>.713**</td>
<td></td>
</tr>
<tr>
<td><strong>Trauma group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The top and bottom diagonal represent the different trauma groups; control children n = 15, mothers n = 16; trauma control children n = 25, mothers n = 27; Total = addition of morning and evening; Difference = morning – evening; * = p<.05; ** = p<.01
Figure 5-1. Scatterplot of log transformed child morning cortisol levels correlated with their mother's log transformed morning, evening, and difference cortisol levels with mean fit line for both control and trauma groups.
Differences in cortisol production between mother and infant dyads for each trauma group can be seen in the drop line graphs in Figure 5.2. The trauma control and PTSD ICD-10 groups demonstrate a striking difference in variability between maternal and infant pairs for both morning cortisol and difference measure (morning – evening) compared to the control group (Panel 1 and 3). To investigate this further the absolute difference for each mother and infant pair was calculated for morning cortisol values (Table 5.4.). The divergence between mother and infant pairs for morning cortisol was found to be significantly different between the trauma groups, $F(3,34) = 3.82, p<.05$, with post hoc analysis revealing the ICD-10 PTSD group had significantly greater difference between mother and infant than the other three groups ($p<.05$). Though, all trauma groups had higher s and greater standard deviations than the control group. This variability was not apparent for the evening cortisol production (Panel 2).

Table 5.4. Descriptive statistics for absolute differences between mother and infant morning cortisol for each trauma group

<table>
<thead>
<tr>
<th>Trauma groups</th>
<th>n</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>$F$ ($df$ 3,34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>14</td>
<td>.12 (.08)</td>
<td>.01 - .26</td>
<td>3.824 *</td>
</tr>
<tr>
<td>2. Trauma control</td>
<td>13</td>
<td>.27 (.33)</td>
<td>.00 – 1.16</td>
<td>3&gt;1, 3&gt;2, 3&gt;4</td>
</tr>
<tr>
<td>3. PTSD (ICD-10)</td>
<td>5</td>
<td>.56 (.30)</td>
<td>.21 - .89</td>
<td></td>
</tr>
<tr>
<td>4. PTSD (DSM-IV)</td>
<td>6</td>
<td>.21 (.31)</td>
<td>.01 - .83</td>
<td></td>
</tr>
</tbody>
</table>

Note: N = 38; Absolute difference was calculated by subtracting child morning cortisol values from maternal morning cortisol values and removing the valance; * = $p<.05$
Figure 5-2. Drop line graphs of morning, evening, and difference saliva cortisol measures for each mother-child dyad in the control, trauma control, PTSD ICD-10, and PTSD DSM-IV groups.
Partial correlations of the trauma group were undertaken to determine whether any relationship existed between the child and mother cortisol measures (covaried with maternal age) and the number of traumas experienced, as well as maternal PTSD symptoms of re-experiencing, avoidance and numbing, and hyperarousal experienced posttrauma (Table 5.5). No significant correlations were found for PTSD symptoms and mother cortisol measures. Nevertheless, child morning and child difference levels showed significant negative correlations with mother hyperarousal symptoms, and child morning, total and difference levels negatively correlated with the DSM-IV criterion F. In addition, DSM-IV diagnosis negatively correlated with child morning cortisol. These correlations indicate that maternal reports of experiencing a high number of hyperarousal symptoms, acknowledging the trauma negatively impacted on their lives, and meeting the DSM-IV PTSD criteria were associated with lower morning cortisol, lower total cortisol over the day and smaller drop in diurnal pattern in the children. It is of interest that maternal trauma symptoms are showing clearer associations with the child cortisol levels than the mother’s cortisol levels.

5.1.3.2. Trauma group differences for mother and child cortisol levels

It is unknown from the literature whether any group differences in cortisol would be found with the ICD-10 classification as studies in this field generally compare DSM-IV PTSD to no PTSD. Given the differing patterns of cortisol production seen in the ICD-10 and DSM-IV PTSD groups (Figure 5.2.) it was expected that the combined DSM-IV and ICD-10 PTSD group would be unlikely to show significant mean group differences. The children and mother’s cortisol difference score were dichotomised into the bottom 10% of daily difference (flattened diurnal response) and the top 20% of daily difference (heightened diurnal response). The 10% of children from the total sample with the flattest cortisol pattern had mothers who belonged to the PTSD DSM-IV (which represented 50% of that group), or PTSD ICD-10 (16.7%) groups, $\chi^2 (3, N = 38) = 16.61, p<.01$, whereas the 10% of mothers with the lowest daily drop in cortisol belonged to the trauma group as a whole ($ns$).
Table 5.5. Pearson partial correlations between mother and infant cortisol measures, controlling for maternal age, and number of traumas and PTSD symptoms experienced post trauma

<table>
<thead>
<tr>
<th>CIDI – PTSD</th>
<th>Child morning</th>
<th>Child evening</th>
<th>Child total</th>
<th>Child difference</th>
<th>Cortisol Measures</th>
<th>Mother morning</th>
<th>Mother evening</th>
<th>Mother total</th>
<th>Mother difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. traumas</td>
<td>.362</td>
<td>.040</td>
<td>.348</td>
<td>.318</td>
<td>.027</td>
<td>.122</td>
<td>.090</td>
<td>-.047</td>
<td></td>
</tr>
<tr>
<td>No. B symptoms</td>
<td>-.321</td>
<td>.220</td>
<td>-.203</td>
<td>-.282</td>
<td>.104</td>
<td>-.023</td>
<td>.131</td>
<td>.090</td>
<td></td>
</tr>
<tr>
<td>No. C symptoms</td>
<td>-.284</td>
<td>-.004</td>
<td>-.214</td>
<td>-.156</td>
<td>-.127</td>
<td>-.199</td>
<td>-.161</td>
<td>-.094</td>
<td></td>
</tr>
<tr>
<td>No. D. symptoms</td>
<td>-.441*</td>
<td>-.049</td>
<td>-.396</td>
<td>-.462*</td>
<td>-.175</td>
<td>.004</td>
<td>-.139</td>
<td>-.172</td>
<td></td>
</tr>
<tr>
<td>E criteria</td>
<td>-.145</td>
<td>.092</td>
<td>-.079</td>
<td>.007</td>
<td>-.013</td>
<td>-.110</td>
<td>-.065</td>
<td>.044</td>
<td></td>
</tr>
<tr>
<td>F criteria</td>
<td>-.558**</td>
<td>.115</td>
<td>-.444*</td>
<td>-.478*</td>
<td>-.250</td>
<td>-.075</td>
<td>-.252</td>
<td>-.193</td>
<td></td>
</tr>
<tr>
<td>DSM-IV PTSD</td>
<td>-.424*</td>
<td>.092</td>
<td>-.311</td>
<td>-.390</td>
<td>-.331</td>
<td>-.093</td>
<td>-.320</td>
<td>-.272</td>
<td></td>
</tr>
</tbody>
</table>

Note: n = 27 for mothers, n = 25 for children, n = 24 for dyads; morning cortisol collected within 30 minutes of rising; evening cortisol collected within 30 minutes of retiring in the evening; Total = addition of morning and evening; Difference = morning – evening; * = p<.05; ** = p<.01; CIDI = Composite International Diagnostic Interview (World Health Organisation, 1997)
The 20% of mothers with the greatest reduction of cortisol across the day belonged to the trauma control (31.3%) and the PTSD ICD-10 (33.3%) groups, and control group (5.6%; ns). No group differences were found for heightened response for children. It was decided to explore the group differences using three grouping combinations. Analysis 1 used the control, trauma control and the combined ICD-10 and DSM-IV PTSD group. Analysis 2 used the control group, combined trauma control and ICD-10 PTSD group (trauma control-2), leaving the DSM-IV PTSD in a separate group, reflecting the groups most used in the literature. Analysis 3 used the control, trauma control, the ICD-10 PTSD, and DSM-IV PTSD groups separately. The results of analyses 2 and 3 need to be treated with caution as the individual PTSD groups are small resulting in uneven group sizes. The transformed means and standard deviations for each of these different analyses are reported in Table 5.6. Overall, mother morning and evening, and child morning mean cortisol levels are lowest in the PTSD groups, with the exception of the mother morning cortisol for the ICD-10 PTSD group (analysis 3). Child evening mean cortisol is lowest in ICD-10 PTSD group (analysis 3). However, using multivariate analysis the only significant group difference found was for child morning cortisol, analysis 2, $F(2,36)= 3.310, p<.05$, with post hoc analysis indicating that children in the PTSD DSM-IV group had significantly lower morning cortisol than both the control and trauma control-2 group children ($p<.05$). Near significant group differences were also found in analyses 1 and 3, with post hoc tests indicating that child morning cortisol for the combined PTSD group in analysis 1 and the PTSD (DSM-IV) group in analysis 3 were lower than the control and trauma control groups. No significant group differences were found for any of the maternal measures.

Group differences in diurnal cortisol production were assessed (separately for mothers and infants) using the morning and evening cortisol levels as a repeated measure factor in a multivariate ANOVA. The three different grouping combinations were used as individual fixed factors and maternal age was used as a covariate for the mother cortisol analyses. No
Table 5.6. Log-transformed means and standard deviations of mother and infant cortisol levels for different groups based on trauma experience and diagnosis of PTSD

<table>
<thead>
<tr>
<th>Groups</th>
<th>Cortisol measures ug/dL</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mother morning</td>
<td>Mother evening</td>
<td>Child morning</td>
<td>Child evening</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Analysis 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>-1.16 (.33)</td>
<td>-3.02 (.72)</td>
<td>-.94 (.30)</td>
<td>-2.82 (.71)</td>
</tr>
<tr>
<td>Trauma control</td>
<td></td>
<td>-.99 (.53)</td>
<td>-2.89 (.77)</td>
<td>-.76 (.50)</td>
<td>-2.65 (.90)</td>
</tr>
<tr>
<td>PTSD</td>
<td></td>
<td>-1.25 (.61)</td>
<td>-3.22 (.86)</td>
<td>-1.32 (.92)†</td>
<td>-2.88 (1.27)</td>
</tr>
<tr>
<td>Analysis 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>-1.16 (.33)</td>
<td>-3.02 (.72)</td>
<td>-.94 (.30)</td>
<td>-2.82 (.71)</td>
</tr>
<tr>
<td>Trauma control-2</td>
<td></td>
<td>-1.01 (.57)</td>
<td>-2.98 (.77)</td>
<td>-.83 (.63)</td>
<td>-2.85 (1.08)</td>
</tr>
<tr>
<td>PTSD (DSM-IV)</td>
<td></td>
<td>-1.43 (.48)</td>
<td>-3.22 (1.01)</td>
<td>-1.54 (.92)*</td>
<td>-2.47 (1.05)</td>
</tr>
<tr>
<td>Analysis 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>-1.16 (.33)</td>
<td>-3.02 (.72)</td>
<td>-.94 (.30)</td>
<td>-2.82 (.71)</td>
</tr>
<tr>
<td>Trauma control</td>
<td></td>
<td>-.99 (.53)</td>
<td>-2.89 (.77)</td>
<td>-.76 (.50)</td>
<td>-2.65 (.90)</td>
</tr>
<tr>
<td>PTSD (ICD-10)</td>
<td></td>
<td>-1.07 (.72)</td>
<td>-3.22 (.77)</td>
<td>-1.04 (.95)</td>
<td>-3.38 (1.45)</td>
</tr>
<tr>
<td>PTSD (DSM-IV)</td>
<td></td>
<td>-1.43 (.48)</td>
<td>-3.22 (1.01)</td>
<td>-1.54 (.92)†</td>
<td>-2.47 (1.05)</td>
</tr>
</tbody>
</table>

Note: \( N = \text{Analysis 1.} \) control mother \( n = 15 \), child \( n = 14 \); trauma control mother \( n = 15 \), child \( n = 14 \); PTSD mother \( n = 12 \), child \( n = 11 \); \( \text{Analysis 2.} \) control mother \( n = 15 \), child \( n = 14 \); trauma control-2 mother \( n = 21 \), child \( n = 19 \); PTSD (DSM-IV) mother \( n = 6 \), child \( n = 6 \); \( \text{Analysis 3.} \) control mother \( n = 15 \), child \( n = 14 \); trauma control mother \( n = 15 \), child \( n = 14 \); PTSD (ICD-10) mother \( n = 6 \), child \( n = 5 \); PTSD (DSM-IV) mother \( n = 6 \), child \( n = 6 \); * = \( p < .05 \); † = \( p < .10 \)

significant within-subjects effects, group differences or interaction effects for the mothers’ cortisol measures were found except for a significant between-subjects effect for maternal age, e.g. analysis 2, \( F(2,39) = 5.14, p < .05 \). When the same analysis was carried out excluding...
maternal age as a covariate a highly significant within subject difference was found for morning and evening cortisol demonstrating the observed diurnal drop of cortisol from morning to evening, analysis 2, $F(2,39) = 134.60, p<.001$.

All three analyses demonstrated a highly significant effect for child cortisol demonstrating the diurnal decrease across the day (e.g. analysis 2, $F(2,36)= 117.57, p<.001$). No group differences were found for the child morning and evening cortisol for analysis 1 with the combined ICD-10 and DSM-IV PTSD group. Although no significant group differences were found in analyses 2 and 3, a significant interaction effect was found. In both analyses the DSM-IV group demonstrated significantly reduced diurnal pattern of cortisol production across the day, analyses 2, $F(2,36) = 4.07, p<.05$; analysis 3, $F(3,35) = 3.06, p<.05$. The interaction effect found in the DSM-IV group is demonstrated in the line graphs presented in Figure 5.3 (analyses 2 and 3). This interaction effect remained when the analyses were recalculated without the one DSM-IV child who had high morning and evening cortisol. Further, these line graphs demonstrate the overall lower mean levels of cortisol in the PTSD groups for both mother and infant. In addition, analysis 3 demonstrates the differing patterns of the ICD-10 groups in both mother and child with morning cortisol levels similar to control groups but lower evening cortisol, indicating a larger drop across the day. The failure to demonstrate significant group differences is likely to reflect insufficient power with small group sizes and large variability in the trauma control and PTSD (ICD-10) groups.

### 5.1.4. Mother and Infant Cortisol Levels and Maternal Ongoing Mental Health

The relationship between mother and child cortisol levels and the mother’s ongoing mental health, including ongoing PTSD symptoms was explored. The transformed cortisol measures were correlated with the combined perinatal measures (T1, T2, & T3) for psychological well being (GHQ), and current trauma symptoms (PCL), as well the concurrent (T4) GHQ, PCL, and postnatal depression scores (EPDS). As reported in Table 5.7 maternal morning cortisol
Figure 5-3. Line graphs of mother and child mean morning and evening cortisol levels for the three trauma groups used in the repeated measures ANOVA.
Table 5.7. Pearson partial correlations between mother and infant cortisol measures and ongoing maternal mental health, controlling for maternal age

<table>
<thead>
<tr>
<th>Maternal mental health measures</th>
<th>Child morning</th>
<th>Child evening</th>
<th>Child total</th>
<th>Cortisol Child difference</th>
<th>Measures Mother morning</th>
<th>Mother evening</th>
<th>Mother total</th>
<th>Mother difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perinatal (T1+T2+T3)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ somatic symptoms</td>
<td>-.319</td>
<td>-.301</td>
<td>-.339*</td>
<td>-.354*</td>
<td>-.021</td>
<td>-.347*</td>
<td>-.021</td>
<td>.242</td>
</tr>
<tr>
<td>GHQ anxiety/insomnia</td>
<td>-.507**</td>
<td>-.138</td>
<td>-.453**</td>
<td>-.413*</td>
<td>-.168</td>
<td>-.379*</td>
<td>-.206</td>
<td>.016</td>
</tr>
<tr>
<td>GHQ social dysfunction</td>
<td>-.270</td>
<td>-.093</td>
<td>-.200</td>
<td>-.281</td>
<td>-.016</td>
<td>-.059</td>
<td>-.006</td>
<td>.149</td>
</tr>
<tr>
<td>GHQ severe depression</td>
<td>-.332</td>
<td>-.024</td>
<td>-.280</td>
<td>-.302</td>
<td>-.304</td>
<td>-.183</td>
<td>-.325</td>
<td>-.111</td>
</tr>
<tr>
<td>GHQ total</td>
<td>-.416*</td>
<td>-.089</td>
<td>-.368*</td>
<td>-.400**</td>
<td>-.106</td>
<td>-.263</td>
<td>-.125</td>
<td>.112</td>
</tr>
<tr>
<td>PCL</td>
<td>-.437**</td>
<td>.109</td>
<td>-.352*</td>
<td>-.470**</td>
<td>-.111</td>
<td>-.035</td>
<td>-.097</td>
<td>-.062</td>
</tr>
<tr>
<td><strong>Concurrent (T4)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHQ somatic symptoms</td>
<td>.081</td>
<td>-.002</td>
<td>.045</td>
<td>.040</td>
<td>-.151</td>
<td>-.118</td>
<td>-.182</td>
<td>-.133</td>
</tr>
<tr>
<td>GHQ anxiety/insomnia</td>
<td>-.163</td>
<td>-.070</td>
<td>-.181</td>
<td>-.142</td>
<td>-.236</td>
<td>.080</td>
<td>-.205</td>
<td>-.204</td>
</tr>
<tr>
<td>Maternal mental health measures</td>
<td>Child</td>
<td>Child</td>
<td>Child</td>
<td>Cortisol</td>
<td>Measures</td>
<td>Mother</td>
<td>Mother</td>
<td>Mother</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
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<td>----------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>morning</td>
<td>evening</td>
<td>total</td>
<td>difference</td>
<td>morning</td>
<td>evening</td>
<td>total</td>
<td>difference</td>
</tr>
<tr>
<td>GHQ social dysfunction</td>
<td>-.076</td>
<td>.062</td>
<td>.022</td>
<td>-.022</td>
<td>-.273</td>
<td>.161</td>
<td>-.223</td>
<td>-.190</td>
</tr>
<tr>
<td>GHQ severe depression</td>
<td>-.373**</td>
<td>.062</td>
<td>-.288</td>
<td>-.281</td>
<td>-.360*</td>
<td>-.113</td>
<td>-.360*</td>
<td>-.150</td>
</tr>
<tr>
<td>GHQ total</td>
<td>-.076</td>
<td>.035</td>
<td>-.062</td>
<td>-.063</td>
<td>-.305</td>
<td>.009</td>
<td>-.293</td>
<td>-.235</td>
</tr>
<tr>
<td>PCL</td>
<td>-.252</td>
<td>.181</td>
<td>-.134</td>
<td>-.224</td>
<td>-.280</td>
<td>.072</td>
<td>-.233</td>
<td>-.235</td>
</tr>
<tr>
<td>EPDS</td>
<td>-.209</td>
<td>.226</td>
<td>-.096</td>
<td>-.126</td>
<td>-.342*</td>
<td>.191</td>
<td>-.280</td>
<td>-.372*</td>
</tr>
</tbody>
</table>

Note: *n* = 27 for mothers, *n* = 25 for children, *n* = 24 for dyads; morning cortisol collected within 30 minutes of rising; evening cortisol collected within 30 minutes of retiring in the evening; Total = addition of morning and evening; Difference = morning – evening; Maternal and infant morning, evening and total scores were log-transformed; GHQ = General Health Questionnaire (Goldberg, 1978); PCL = Posttraumatic Stress Disorder Checklist-Civilian (Blanchard et al., 1996); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987); * = *p*<.05; ** = *p*<.01
did not significantly correlate with any of the perinatal mental health measures but demonstrated significant modest negative correlations with concurrent GHQ severe depression subscale and the EPDS total score. Concurrent GHQ severe depression also negatively correlated with maternal total cortisol and the EPDS with the maternal cortisol difference measure. On closer inspection of the data, only three mothers endorsed any items on the concurrent GHQ severe depression scale, suggesting the EPDS may be a more statistically sound measure of depressive symptoms at this time point. In contrast, the maternal evening cortisol levels negatively correlate with the mothers’ reports of perinatal GHQ somatic symptoms and anxiety/insomnia, but not with concurrent severe depression or EPDS. These results suggest that higher maternal concurrent depressive scores were associated with decreased maternal morning cortisol, with a corresponding increase in the total and difference scores. Consistent findings in the literature have demonstrated that severe depression is associated with higher evening cortisol. However, the current group do not meet criteria for current severe depression. Analysing the perinatal data separately, significant correlations between maternal evening cortisol and GHQ only occurred when the infants were 3 months old (T3). At this time maternal evening cortisol negatively correlated with GHQ somatic symptoms \( (r = -0.546, p<0.01) \), anxiety/insomnia \( (r = -0.408, p<0.05) \), and total score \( (r = -0.409, p<0.05) \), indicating that maternal reports of physical problems and anxiety 9 months earlier were associated with lower evening cortisol. Anxiety, insomnia and somatic symptoms are common in PTSD and may reflect changes in symptom expression over time.

The child cortisol levels demonstrated different patterns of correlations. There were no correlations with child evening cortisol for either perinatal or concurrent maternal mental health measures. However child morning cortisol demonstrated moderate negative correlations with perinatal GHQ anxiety/insomnia and total score, as well as a smaller significant negative correlation with concurrent GHQ severe depression but not EPDS. In
addition, child morning cortisol also demonstrated a significant negative correlation with perinatal PCL total score but not concurrent PCL, indicating that higher maternal perinatal PTSD symptoms were associated with lower morning cortisol in the infants. A scatter plot of child morning cortisol and perinatal PCL total score labelled by trauma groups is shown in Figure 5.4. Further analysis of the perinatal time points found significant negative correlations for child morning cortisol with maternal pre-birth GHQ anxiety/insomnia \((r = -.400, p < .05)\), pre-birth GHQ total \((r = -.380, p < .05)\), when infants were 2 weeks old GHQ anxiety/insomnia \((r = -.392, p < .05)\), and GHQ somatic symptoms \((r = -.390, p < .05)\), anxiety/insomnia \((r = -.408, p < .05)\), and total \((r = -.392, p < .05)\) when the infants were 3 months old. The child morning cortisol also negatively correlated at all three perinatal time points with the PCL \((T1, r = -.350, p < .05; T2, r = -.422, p < .05; T3, r = -.343, p < .05)\). The child total and difference scores reflect the morning cortisol correlations. Overall, these results indicate that the child morning cortisol level has an inverse relationship with maternal reports of anxiety, somatic problems and trauma symptoms across the perinatal period but not concurrently, with higher symptoms being associated with lower morning cortisol. In contrast, the negative relationship with maternal GHQ severe depression was only evident concurrently. As mentioned earlier only three mothers endorsed any depressive symptoms on the GHQ at this time. Of interest, concurrent depressive symptoms showed similar patterns in both mothers and children, whereas perinatal anxiety and somatic problems demonstrated a negative relationship with the maternal evening cortisol and the child morning cortisol. As reported in Chapter 4 significantly higher levels of psychological distress, anxiety, and trauma symptoms were reported in the perinatal period for the combined ICD-10 and DSM-IV PTSD mothers compared to both the trauma control and control groups, whereas there were no significant group differences for depression during this period.

In addition no significant correlations were found between maternal and child cortisol measures and maternal reports of ongoing life stressors, marital stress assessed using the PSI
Figure 5-4. Correlations between log transformed maternal perinatal PTSD symptoms and log transformed child morning cortisol ($r = -.437$).

spouse subscale and the dichotomous maternal report of marital problems. Maternal reports of ongoing infant health were also not related to either child or mother cortisol values. Although, Parenting Stress measured by the PSI four months after the cortisol sample was collected did show a small positive correlation with maternal evening cortisol indicating higher evening levels with higher parenting stress ($r = .316, p<.05$).

5.1.5. Predictors of Mother and Infant Cortisol Levels

Hierarchical regressions were used to gain an understanding of the different contributions of trauma experience and subsequent PTSD symptoms, perinatal mental health, and concurrent mental health variables on the mother and infant cortisol levels. In addition for the child
cortisol the genetic contribution from the mother was also important. Variables used were
decided from the correlational data presented above. Although not ideal, some predictor
variables did demonstrate significant intercorrelations. Even though number of traumas
experienced by the mother did not show significant correlation in the current study, it was
included in the regression analyses as this variable has been associated with PTSD and
cortisol in other studies. The concurrent GHQ severe depression variable was not used as
only a few women endorsed any item. This was replaced by the EPDS that had a better
spread of responses. Variables were added in blocks in order of occurrence, with maternal
cortisol and maternal age in the first block, followed by blocks of trauma related variables,
perinatal trauma and psychological distress symptoms, and finally concurrent depressive
symptoms. In this way only the unique variance contributed by the more recent variables,
over and above earlier variables, can be ascertained. Analyses were conducted for the sample
as a whole as well as for the control and trauma groups separately. Overall results were
similar for the total and trauma groups with the trauma samples accounting for a greater
amount of the variance. Due to the smaller sample size in the control group less variables
were used. In addition, where correlations had shown a different pattern for the control group
compared to the trauma group, variables better suited to the control group were used. Results
from the three groups are reported.

Hierarchical regressions were run separately for the dependant variables of mother morning
cortisol, mother evening cortisol, child morning cortisol and child evening cortisol. For the
maternal morning and maternal evening cortisol analyses maternal age was added in block
one, number of traumas and number of posttrauma hyperarousal symptoms in block two (not
applicable for control only analysis), perinatal somatic symptoms and perinatal anxiety
symptoms in block three (only the most appropriate one for the control alone analysis), and
concurrent depressive symptoms (morning) or parenting stress (evening) in block four. This
model accounted for 25.2% of the variance in maternal morning cortisol in the whole group
and 54.5% in the trauma only sample (Table 5.8). Maternal age (block 1), and perinatal mental health (block 3) made significant changes to the regression accounting for 30.9% and 16.2% of the variance in maternal morning cortisol for the trauma sample. By the final stage of the model maternal age and perinatal GHQ somatic symptoms demonstrated significant beta coefficients for the trauma sample (Table 5.9). Increases in maternal age and somatic complaints were associated with increased morning cortisol. Interestingly, a reduced model accounted for 38.3% of the variance in the control group, with both age and somatic symptoms showing a negative association. This pattern is opposite to the trauma group and indicated that higher maternal age and somatic symptoms were associated with lower morning cortisol in the control group.

Maternal evening cortisol demonstrated a different pattern with maternal age having no significant predictive value, whereas perinatal maternal mental health (block 3) and concurrent parenting stress (block 4) accounted for significant variation. Overall the model accounted for 35.2% of the variance in the total sample, 51.1% in the trauma sample, and 42.6% in the control sample, with perinatal symptoms accounting for 17.2%, 23.4% and 34.0% respectively, and concurrent parenting stress accounting for 15.5%, 22.3% and 8.3% in the respective groups (Table 5.10). Perinatal somatic symptoms and parenting stress both demonstrated significant beta coefficients in the total and trauma groups, whereas perinatal anxiety was the only variable to demonstrate a significant beta coefficient in the final model for the control group (Table 5.11). The addition of concurrent depressive symptoms to the model did not increase the predictive power of the model. Parenting stress and somatic symptoms demonstrated different effects with high parenting stress being associated with higher evening cortisol whereas high somatic symptoms are associated with lower evening cortisol. Of interest, GHQ Somatic Symptoms were positively associated with mother morning cortisol for the total and trauma samples with higher symptoms being related to higher morning cortisol. The same pattern and magnitude of prediction was found for
Table 5.8. Hierarchical regression analyses for the dependent variable maternal morning cortisol for the total sample and trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>R²</th>
<th>ΔR²</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total N = 42</strong></td>
<td>Block 1 Age</td>
<td>.132</td>
<td>.132</td>
<td>6.071</td>
<td>.018</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.178</td>
<td>.046</td>
<td>1.057</td>
<td>.358</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ somatic symptoms; Perinatal anxiety/insomnia</td>
<td>.225</td>
<td>.048</td>
<td>1.106</td>
<td>.342</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.252</td>
<td>.026</td>
<td>1.233</td>
<td>.274</td>
</tr>
<tr>
<td><strong>Trauma N = 27</strong></td>
<td>Block 1 Age</td>
<td>.309</td>
<td>.309</td>
<td>11.205</td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.343</td>
<td>.033</td>
<td>.578</td>
<td>.569</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ somatic symptoms; Perinatal anxiety/insomnia</td>
<td>.504</td>
<td>.162</td>
<td>3.422</td>
<td>.052</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.545</td>
<td>.041</td>
<td>1.788</td>
<td>.196</td>
</tr>
<tr>
<td><strong>Control N = 15</strong></td>
<td>Block 1 Age</td>
<td>.175</td>
<td>.175</td>
<td>2.759</td>
<td>.121</td>
</tr>
<tr>
<td></td>
<td>Block 2 Perinatal GHQ somatic symptoms</td>
<td>.353</td>
<td>.178</td>
<td>3.297</td>
<td>.094</td>
</tr>
<tr>
<td></td>
<td>Block 3 Concurrent EPDS</td>
<td>.383</td>
<td>.029</td>
<td>.470</td>
<td>.508</td>
</tr>
</tbody>
</table>

Note: CIDI = Composite International Diagnostic Interview (World Health Organisation, 1997), PTSD = posttraumatic stress disorder; criteria ‘D’ symptoms = hyperarousal; GHQ = General Health Questionnaire (Goldberg, 1978); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987)
Table 5.9. Block 4 beta weights, t tests and significance levels for independent variables predicting maternal morning cortisol for the whole sample and the trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Age</td>
<td>.343</td>
<td>2.202</td>
<td>.034</td>
</tr>
<tr>
<td>N = 42</td>
<td>Number of traumas</td>
<td>.157</td>
<td>.854</td>
<td>.399</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>-.100</td>
<td>-.466</td>
<td>.644</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ somatic symptoms</td>
<td>.231</td>
<td>1.186</td>
<td>.244</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.172</td>
<td>-.703</td>
<td>.487</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>-.201</td>
<td>-1.111</td>
<td>.274</td>
</tr>
<tr>
<td>Trauma</td>
<td>Age</td>
<td>.571</td>
<td>3.454</td>
<td>.003</td>
</tr>
<tr>
<td>N = 27</td>
<td>Number of traumas</td>
<td>.073</td>
<td>.471</td>
<td>.643</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>-.090</td>
<td>-.486</td>
<td>.632</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ somatic symptoms</td>
<td>.449</td>
<td>2.038</td>
<td>.055</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.130</td>
<td>-.447</td>
<td>.660</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>-.266</td>
<td>-1.337</td>
<td>.196</td>
</tr>
<tr>
<td>Control</td>
<td>Age</td>
<td>-.390</td>
<td>-1.587</td>
<td>.141</td>
</tr>
<tr>
<td>N = 15</td>
<td>Perinatal GHQ somatic symptoms</td>
<td>-.441</td>
<td>-1.832</td>
<td>.094</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.178</td>
<td>.729</td>
<td>.481</td>
</tr>
</tbody>
</table>

Note: Number of traumas and ‘D’ symptoms assessed using the Composite International Diagnostic Interview (CIDI-2, World Health Organisation, 1997); GHQ = General Health Questionnaire (Goldberg, 1978); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987)
Table 5.10. Hierarchical regression analyses for the dependent variable maternal evening cortisol for the total sample and trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total $N = 40$</td>
<td>Block 1 Age</td>
<td>.022</td>
<td>.022</td>
<td>.869</td>
<td>.357</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.024</td>
<td>.002</td>
<td>.032</td>
<td>.968</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ somatic symptoms; Perinatal anxiety/insomnia</td>
<td>.196</td>
<td>.172</td>
<td>3.639</td>
<td>.037</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent parenting stress</td>
<td>.352</td>
<td>.155</td>
<td>7.908</td>
<td>.008</td>
</tr>
<tr>
<td>Trauma $N = 25$</td>
<td>Block 1 Age</td>
<td>.048</td>
<td>.048</td>
<td>1.151</td>
<td>.294</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.055</td>
<td>.007</td>
<td>.079</td>
<td>.924</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ somatic symptoms; Perinatal anxiety/insomnia</td>
<td>.288</td>
<td>.234</td>
<td>3.118</td>
<td>.067</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent parenting stress</td>
<td>.511</td>
<td>.223</td>
<td>8.203</td>
<td>.010</td>
</tr>
<tr>
<td>Control $N = 15$</td>
<td>Block 1 Age</td>
<td>.002</td>
<td>.002</td>
<td>.032</td>
<td>.860</td>
</tr>
<tr>
<td></td>
<td>Block 2 Perinatal GHQ anxiety/insomnia</td>
<td>.343</td>
<td>.340</td>
<td>6.216</td>
<td>.028</td>
</tr>
<tr>
<td></td>
<td>Block 3 Concurrent parenting stress</td>
<td>.426</td>
<td>.083</td>
<td>1.593</td>
<td>.233</td>
</tr>
</tbody>
</table>

Note: CIDI = Composite International Diagnostic Interview (World Health Organisation, 1997), PTSD = posttraumatic stress disorder; criteria ‘D’ symptoms = hyperarousal; GHQ = General Health Questionnaire (Goldberg, 1978); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987)
Table 5.11. Block 4 beta weights, \( t \) tests and significance levels for independent variables predicting maternal evening cortisol for the whole sample and the trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>Beta</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Age</td>
<td>.149</td>
<td>1.028</td>
<td>.311</td>
</tr>
<tr>
<td>( N = 40 )</td>
<td>Number of traumas experienced</td>
<td>-.131</td>
<td>-.728</td>
<td>.472</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>.046</td>
<td>.229</td>
<td>.820</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ somatic symptoms</td>
<td>-.334</td>
<td>-1.981</td>
<td>.056</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.214</td>
<td>-1.078</td>
<td>.289</td>
</tr>
<tr>
<td></td>
<td>Concurrent parenting stress</td>
<td>.428</td>
<td>2.812</td>
<td>.008</td>
</tr>
<tr>
<td>Trauma</td>
<td>Age</td>
<td>.093</td>
<td>.534</td>
<td>.600</td>
</tr>
<tr>
<td>( N = 25 )</td>
<td>Number of traumas</td>
<td>.005</td>
<td>.031</td>
<td>.975</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>.099</td>
<td>.123</td>
<td>.903</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ somatic symptoms</td>
<td>-.502</td>
<td>-2.477</td>
<td>.023</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.068</td>
<td>-.281</td>
<td>.782</td>
</tr>
<tr>
<td></td>
<td>Concurrent parenting stress</td>
<td>.508</td>
<td>2.864</td>
<td>.010</td>
</tr>
<tr>
<td>Control</td>
<td>Age</td>
<td>.554</td>
<td>1.636</td>
<td>.130</td>
</tr>
<tr>
<td>( N = 15 )</td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.700</td>
<td>-2.792</td>
<td>.018</td>
</tr>
<tr>
<td></td>
<td>Concurrent parenting stress</td>
<td>.404</td>
<td>1.262</td>
<td>.233</td>
</tr>
</tbody>
</table>

Note: Number of traumas and ‘D’ symptoms assessed using the Composite International Diagnostic Interview (CIDI-2, World Health Organisation, 1997); GHQ = General Health Questionnaire (Goldberg, 1978); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987)

the mother cortisol difference score as the mother morning cortisol (not shown). Together these results suggest high somatic symptoms would be associated with a greater drop in cortisol across the day for the trauma sample. Variables directly related to trauma experience were not significant contributors to either maternal morning or evening cortisol levels.
However, child cortisol levels were associated with both maternal trauma experience and maternal cortisol levels.

For the dependent variables of child morning cortisol and child evening cortisol the model was altered slightly to reflect the significant correlations reported earlier in this chapter. Maternal age and maternal evening cortisol (maternal morning cortisol used for control group analysis) were entered in block 1, followed by the number of traumas experienced by the mother and the number of ‘D’ symptoms reported in relation to the index trauma (not relevant for the control group), block 3 included perinatal GHQ anxiety/insomnia and perinatal trauma symptoms (perinatal trauma symptoms not included for the control only analysis), with the final block containing concurrent depressive symptoms. The model accounted for 54.0% of child morning cortisol for the total sample, 70.8% for the trauma sample, and 34.3% for the control only sample (Table 5.12.). For both the total and trauma only samples maternal trauma experience (block 2) and perinatal mental health (block 3) demonstrated significant contributions to the model. In the trauma group trauma experience accounted for 36.4% of child morning cortisol and perinatal mental health a further 13.2%. The final model yielded significant beta coefficients for maternal age, number of traumas experienced by the mother, and the number of hyperarousal symptoms reported by the mother in relation to her worst trauma experience (Table 5.13.). The number of maternal traumas demonstrated a positive association with the child morning cortisol suggesting that the more traumas the mother had experienced the higher the child’s morning cortisol. Conversely, maternal age and the number of hyperarousal symptoms demonstrated a negative relationship, with children of older mothers having lower morning cortisol, as do children of mothers who experienced higher numbers of hyperarousal symptoms posttrauma. For the control group sample, maternal morning cortisol only demonstrated a near significant beta coefficient.
The regression results for the child evening cortisol are shown in Tables 5.14 and 5.15. In relation to child evening cortisol the model accounted for 27.9% for the whole sample, 37.4% for the trauma sample, and 24.8% for the control only sample. In the total and trauma samples mother age and evening cortisol (block 1) was the only block to account for significant R squared change, accounting for 24.2% of the variance in the total sample and 34.8% in the trauma sample. The beta coefficients (Table 5.14) indicated that both maternal evening cortisol levels and maternal age were near significant predictors of the child evening cortisol level. The control sample did not have any significant beta coefficients. The inclusion of the PSI parenting stress score had less predictive power in the model than concurrent depressive symptoms.

When child cortisol difference score was used as the dependent variable a pattern similar to child morning cortisol was obtained. However, both the perinatal PCL and number of D symptoms had a slightly greater predictive power ($t = -2.518, p<.05; t = -2.146, p<.05$; respectively) and maternal age had slightly less ($t = -1.949, p=.069$).

Different predictive relationships for maternal age were found for the maternal and child cortisol measures. Although maternal age was negatively associated with all the child dependent variables for the total and trauma samples and mother morning cortisol in the control sample, it was positively associated with maternal morning and difference scores in the total and trauma samples and unrelated to maternal evening cortisol in all samples. In addition, the amount of variance explained by maternal age differed for maternal morning cortisol for the trauma and control groups (30.9% and 17.5% respectively), and showed the opposite pattern for the child morning cortisol with maternal age accounting for 19.1% of the variance in the Trauma group and 33.0% in the control group.
Table 5.12. Hierarchical regression analyses for the dependent variable child morning cortisol for the total sample and trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>R²</th>
<th>Change statistic</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ΔR²</td>
<td>F</td>
<td>p</td>
</tr>
<tr>
<td>Total N = 38</td>
<td>Block 1 Age; Evening cortisol</td>
<td>.096</td>
<td>.096</td>
<td>1.865</td>
<td>.170</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.428</td>
<td>.331</td>
<td>9.546</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ anxiety/insomnia; Perinatal PCL</td>
<td>.525</td>
<td>.097</td>
<td>3.169</td>
<td>.056</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.540</td>
<td>.015</td>
<td>.979</td>
<td>.330</td>
</tr>
<tr>
<td>Trauma N = 24</td>
<td>Block 1 Age; Evening cortisol</td>
<td>.191</td>
<td>.191</td>
<td>2.486</td>
<td>.107</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.555</td>
<td>.364</td>
<td>7.774</td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ anxiety/insomnia; Perinatal PCL</td>
<td>.687</td>
<td>.132</td>
<td>3.581</td>
<td>.050</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.708</td>
<td>.021</td>
<td>1.126</td>
<td>.304</td>
</tr>
<tr>
<td>Control N = 14</td>
<td>Block 1 Age; Morning cortisol</td>
<td>.330</td>
<td>.330</td>
<td>2.709</td>
<td>.111</td>
</tr>
<tr>
<td></td>
<td>Block 2 Perinatal GHQ anxiety/insomnia</td>
<td>.338</td>
<td>.008</td>
<td>.117</td>
<td>.740</td>
</tr>
<tr>
<td></td>
<td>Block 3 Concurrent EPDS</td>
<td>.343</td>
<td>.005</td>
<td>.073</td>
<td>.793</td>
</tr>
</tbody>
</table>

Note: CIDI = Composite International Diagnostic Interview (World Health Organisation, 1997), PTSD = posttraumatic stress disorder; criteria ‘D’ symptoms = hyperarousal; GHQ = General Health Questionnaire (Goldberg, 1978); PCL = Posttraumatic Stress Checklist (Blanchard et al., 1996)
Table 5.13. Block 4 beta weights, $t$ tests and significance levels for independent variables predicting child morning cortisol for the whole sample and the trauma group only

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>Beta</th>
<th>$t$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Age</td>
<td>-.308</td>
<td>-2.287</td>
<td>.029</td>
</tr>
<tr>
<td>$N = 38$</td>
<td>Evening cortisol</td>
<td>.121</td>
<td>.751</td>
<td>.458</td>
</tr>
<tr>
<td></td>
<td>Number of traumas experienced</td>
<td>.594</td>
<td>3.729</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>-.513</td>
<td>-2.886</td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.259</td>
<td>-1.206</td>
<td>.237</td>
</tr>
<tr>
<td></td>
<td>Perinatal PCL</td>
<td>-.270</td>
<td>-1.564</td>
<td>.128</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.168</td>
<td>.989</td>
<td>.330</td>
</tr>
<tr>
<td>Trauma</td>
<td>Age</td>
<td>-.392</td>
<td>-2.633</td>
<td>.018</td>
</tr>
<tr>
<td>$N = 24$</td>
<td>Evening cortisol</td>
<td>.248</td>
<td>1.399</td>
<td>.181</td>
</tr>
<tr>
<td></td>
<td>Number of traumas experienced</td>
<td>.485</td>
<td>3.353</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>-.351</td>
<td>-2.166</td>
<td>.046</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.218</td>
<td>-1.782</td>
<td>.445</td>
</tr>
<tr>
<td></td>
<td>Perinatal PCL</td>
<td>-.387</td>
<td>-1.650</td>
<td>.118</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.203</td>
<td>1.061</td>
<td>.304</td>
</tr>
<tr>
<td>Control</td>
<td>Age</td>
<td>.321</td>
<td>1.004</td>
<td>.341</td>
</tr>
<tr>
<td>$N = 14$</td>
<td>Morning cortisol</td>
<td>.659</td>
<td>2.141</td>
<td>.061</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>.076</td>
<td>.250</td>
<td>.808</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>-.078</td>
<td>-.270</td>
<td>.793</td>
</tr>
</tbody>
</table>

Note: Number of traumas and ‘D’ symptoms assessed using the Composite International Diagnostic Interview (CIDI-2, World Health Organisation, 1997); GHQ = General Health Questionnaire (Goldberg, 1978); PCL = Posttraumatic stress disorder checklist (Blanchard et al., 1996); EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987)
Table 5.14. Hierarchical regression analyses for the dependent variable child evening cortisol for the total sample and trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>( R^2 )</th>
<th>Change Statistics</th>
<th>( \Delta R^2 )</th>
<th>( F )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ( N = 38 )</td>
<td>Block 1 Age; Evening cortisol</td>
<td>.242</td>
<td>( \Delta R^2 )</td>
<td>.242</td>
<td>5.595</td>
<td>.008</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.246</td>
<td></td>
<td>.004</td>
<td>0.088</td>
<td>.916</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ anxiety/insomnia; Perinatal PCL</td>
<td>.265</td>
<td></td>
<td>.018</td>
<td>0.389</td>
<td>.681</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.279</td>
<td></td>
<td>.014</td>
<td>0.593</td>
<td>.447</td>
</tr>
<tr>
<td>Trauma ( N = 24 )</td>
<td>Block 1 Age, Evening Cortisol</td>
<td>.348</td>
<td>( \Delta R^2 )</td>
<td>.348</td>
<td>5.615</td>
<td>.011</td>
</tr>
<tr>
<td></td>
<td>Block 2 Number of traumas; Number of CIDI PTSD criteria ‘D’ symptoms</td>
<td>.351</td>
<td></td>
<td>.003</td>
<td>0.042</td>
<td>.959</td>
</tr>
<tr>
<td></td>
<td>Block 3 Perinatal GHQ anxiety/insomnia; Perinatal PCL</td>
<td>.370</td>
<td></td>
<td>.018</td>
<td>0.247</td>
<td>.784</td>
</tr>
<tr>
<td></td>
<td>Block 4 Concurrent EPDS</td>
<td>.374</td>
<td></td>
<td>.004</td>
<td>0.110</td>
<td>.745</td>
</tr>
<tr>
<td>Control ( N = 14 )</td>
<td>Block 1 Age; Morning cortisol</td>
<td>.092</td>
<td>( \Delta R^2 )</td>
<td>.092</td>
<td>0.560</td>
<td>.587</td>
</tr>
<tr>
<td></td>
<td>Block 2 Perinatal GHQ anxiety/insomnia</td>
<td>.173</td>
<td></td>
<td>.080</td>
<td>0.971</td>
<td>.348</td>
</tr>
<tr>
<td></td>
<td>Block 3 Concurrent EPDS</td>
<td>.248</td>
<td></td>
<td>.076</td>
<td>0.907</td>
<td>.366</td>
</tr>
</tbody>
</table>

Note: CIDI = Composite International Diagnostic Interview (World Health Organisation, 1997), PTSD = posttraumatic stress disorder; criteria ‘D’ symptoms = hyperarousal; GHQ = General Health Questionnaire (Goldberg, 1978); PCL = Posttraumatic stress Checklist (Blanchard et al., 1996)
Table 5.15. Block 4 beta weights, $t$ tests and significance levels for independent variables predicting child evening cortisol for the whole sample and the trauma group alone

<table>
<thead>
<tr>
<th>Sample</th>
<th>Maternal predictors</th>
<th>Beta</th>
<th>$t$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>Age</td>
<td>-.299</td>
<td>-1.776</td>
<td>.086</td>
</tr>
<tr>
<td>$N = 38$</td>
<td>Evening cortisol</td>
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<td>1.702</td>
<td>.099</td>
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<tr>
<td></td>
<td>Number of traumas</td>
<td>.064</td>
<td>.322</td>
<td>.750</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>.010</td>
<td>.043</td>
<td>.966</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.258</td>
<td>-.960</td>
<td>.345</td>
</tr>
<tr>
<td></td>
<td>Perinatal PCL</td>
<td>.133</td>
<td>.615</td>
<td>.543</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.164</td>
<td>.770</td>
<td>.447</td>
</tr>
<tr>
<td>Trauma</td>
<td>Age</td>
<td>-.429</td>
<td>-1.966</td>
<td>.067</td>
</tr>
<tr>
<td>$N = 24$</td>
<td>Evening cortisol</td>
<td>.475</td>
<td>1.832</td>
<td>.086</td>
</tr>
<tr>
<td></td>
<td>Number of traumas</td>
<td>-.035</td>
<td>-.165</td>
<td>.871</td>
</tr>
<tr>
<td></td>
<td>Number of criteria ‘D’ symptoms</td>
<td>-.044</td>
<td>-.185</td>
<td>.856</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
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<td>-.718</td>
<td>.483</td>
</tr>
<tr>
<td></td>
<td>Perinatal PCL</td>
<td>.197</td>
<td>.574</td>
<td>.574</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.093</td>
<td>.331</td>
<td>.745</td>
</tr>
<tr>
<td>Control</td>
<td>Age</td>
<td>.004</td>
<td>.010</td>
<td>.992</td>
</tr>
<tr>
<td>$N = 14$</td>
<td>Morning cortisol</td>
<td>.211</td>
<td>.642</td>
<td>.537</td>
</tr>
<tr>
<td></td>
<td>Perinatal GHQ anxiety/insomnia</td>
<td>-.235</td>
<td>-.722</td>
<td>.488</td>
</tr>
<tr>
<td></td>
<td>Concurrent EPDS</td>
<td>.269</td>
<td>.952</td>
<td>.366</td>
</tr>
</tbody>
</table>

Note: Number of traumas and ‘D’ symptoms assessed using the Composite International Diagnostic Interview (CIDI-2, World Health Organisation, 1997); GHQ = General Health Questionnaire (Goldberg, 1978); PCL = Posttraumatic stress disorder checklist (Blanchard et al., 1996)
Overall, the regression analyses predicted 54.4% of morning basal level cortisol for previously traumatised women, with 30.9% predicted by the woman’s age and 16.2% by her mental health history approximately 12 months before sampling, particularly the level of somatic symptoms experienced, with higher cortisol levels being associated with higher age and physical complaints. Whereas women who had not had a significant trauma experience had lower morning cortisol if they were older and experienced physical complaints.

Approximately 51% and 43% of maternal evening cortisol was predicted for both the Trauma and control groups respectively, with anxiety, sleep problems and somatic symptoms 12 months prior, as well as concurrent parenting stress predicting the majority of the variance in the cortisol values. Parenting stress demonstrated a more significant role for the trauma groups compared to the control group with this measure accounting for approximately 44% of the predicted variance in the trauma group and 20% in the control group. For the child morning cortisol over 70% of the variance was predicted by the regression analysis, with the mothers age and evening cortisol accounting for 19.1%, the number of traumas experienced by the mother and the number of hyperarousal symptoms experienced posttrauma accounting for 36.4% of the variance and trauma symptoms experienced by the mother over the perinatal period accounting for a further 13.2%. Approximately 37% of the child evening cortisol for the trauma group was predicted by the model with maternal age and evening cortisol accounting for the majority of this.

5.1.6. Relationship of Infant Temperament to Maternal and Infant Cortisol
Maternal reported infant ‘sociability’ demonstrated a small positive correlation with maternal cortisol difference ($r = .349, p<.05$), suggesting infants of mothers with more active basal cortisol are more sociable. Multivariate analysis using both infant and mother cortisol measures as dependent variables, maternal age as a covariate and the EAS dichotomous dimensions as group variables found several significant group differences. Child shyness demonstrated significant group differences for mother morning cortisol, $F(1,39) = 4.71,$
Marginal means indicated that maternal ratings of shyness in children were associated with greater mother morning cortisol, as well as total cortisol and difference across the day.

There was a significant group difference for the dimension of sociability for child evening cortisol, \( F(1,39) = 11.04, p = .005 \), with the marginal means indicating that less sociable children have higher evening cortisol. In addition, a significant difference was also found for infant sociability and mother difference, \( F(1,33) = 4.52, p < .05 \), with less sociable children having mothers with lower cortisol drops from morning to evening. This was in line with the correlational data. Further, there was a significant interaction between sociability and emotionality dimensions for child evening cortisol, \( F(1,39) = 5.99, p < .05 \), with graphs indicating that children who were both unsociable and emotional had higher evening basal cortisol levels.

Infant ‘activity’ and distress to novelty were not associated with infant or maternal cortisol.

5.2. Summary and Discussion
The current study is one of the first to investigate the effects of maternal trauma experience before conception on the basal level cortisol production of her offspring. In addition the longitudinal design allowed information about the mothers’ mental health to be collected during pregnancy and the postnatal period, as well as concurrently when the mother and infant saliva samples were collected 13 months after birth. A detailed history of the women’s trauma experiences and lifetime PTSD was also obtained, which enabled the women to be divided into groups based on their trauma experience and whether they met a lifetime diagnosis for either the ICD-10 only or DSM-IV criteria for PTSD. This detailed trauma history and ongoing monitoring of maternal experience and mental health has allowed the
investigation of the relative impact of these separate variables on the mothers’ and infants’
current basal level cortisol production.

In the current study maternal age was positively associated with maternal morning cortisol,
with higher age being related to higher morning hormone levels. Interestingly the regression
analyses found different associations between maternal age and maternal cortisol for the
trauma and control groups, with the control sample demonstrating the opposite pattern with
lower maternal morning cortisol being associated with increased maternal age. A relationship
between maternal age and maternal cortisol has been found in other studies of mothers with
young children (Adam & Gunnar, 2001; Krpan, Coombs, Zinga, Steiner, & Fleming, 2005;
Yehuda et al., 2005). In line with the current study, a study of mothers of young children by
Adam and Gunnar (2001) found older women had marginally higher cortisol values. In
contrast, mature mothers as a group (26-42 years old) were found to have significantly lower
mean day time cortisol values compared to both young mothers (19-25 years) and teen
mothers (15-18 years; Krpan et al., 2005). Neither of these studies assessed prior maternal
trauma, although the Krpan study reported that mature and young mothers had experienced
more stable childhoods than the teen mothers. The World Trade Centre study of mothers
traumatised during pregnancy reported an association between maternal age and maternal and
infant cortisol but did not report whether the association was positive or negative (Yehuda et
al., 2005). Maternal age was also associated with the cortisol diurnal rhythm.

Cortisol demonstrates a well documented diurnal rhythm with the highest levels in the
morning and the lowest in the evening. In the current study this expected significant main
effect of time (decrease from morning to evening) was removed when maternal age was used
as a covariate. The diurnal decrease has been shown to be mostly due to higher morning
cortisol values (Adam & Gunnar, 2001; Stone et al., 2001). The use of maternal age as a
covariate reduced morning cortisol levels with increasing age. This loss of significance was
not found in the study by Yehuda and colleagues (2005) who reported a highly significant diurnal effect for cortisol while controlling for maternal age. The age range of mothers and type of association was not reported. General studies of young to middle aged adult populations have not reported associations between age and cortisol (Polk, Cohen, Doyle, Skoner, & Kirschbaum, 2005; Smyth et al., 1997; Stone et al., 2001), whereas studies of older adults have been mixed (Ice, Katz-Stein, Himes, & Kane, 2004). Of note, in the regression analysis of maternal morning cortisol, maternal age accounted for over half the variance in the trauma group but was much less important in the control group. This suggests that perhaps age related changes in cortisol may be accelerated in women whose stress systems have been put under pressure by severe trauma and as such may be an indicator of ‘biological scarring’ due to trauma experiences. The current study supports this idea as maternal age was not as important in predicting cortisol levels in the non-trauma control group. This notion is also supported by a recent study of incremental increased allostatic load in women with no trauma compared to those with trauma but no or low PTSD, and women with high PTSD symptoms (Glover, 2006).

Age was the only demographic variable in the current study to be associated with cortisol values. However other studies have found associations between cortisol and demographic factors other than age. Positive (Steptoe et al., 2003), negative (Cohen, Doyle, & Baum, 2006) and no associations (Dowd & Goldman, 2006) between socioeconomic factors and adult female cortisol levels have been reported. In relation to child cortisol, Lupien and colleagues have found that socioeconomic status is associated with higher cortisol levels in young children (Lupien et al., 2000, 2001). The current study did not find any association between economic factors and maternal or child cortisol, nevertheless, this is not surprising given the current study group were all in the middle to higher socioeconomic range. A large number of demographic variables such as race, marital status, occupation, and number of children were found not to be related to daily cortisol diurnal rhythm in mixed gender...
samples (Polk et al., 2005; Smyth et al., 1997). Yet, a study of mothers of young children (21-36 months) conducted in the United States did find number of children, and number of hours in the paid work force, were associated with lower morning cortisol (Adam & Gunnar, 2001). The lack of correlations in the current study with numbers of hours worked may be due to the younger age of the children and the middle class nature of the sample with many of the women only recently returning to part time work.

Few previous studies have looked at mother-infant dyad cortisol levels. As expected a relationship was found between mother and infant basal level cortisol. But, this relationship appears to be altered by the trauma experience of the mother. For those children whose mothers had not previously been traumatised, morning cortisol was positively related to morning cortisol in the mother, as well as the decline of the mother’s cortisol from morning to night. However for those children whose mothers had been significantly traumatised both their morning and evening cortisol correlated positively with the mothers evening cortisol, but not her morning cortisol. This suggests that maternal trauma experience impacted on the up regulation of the child’s cortisol levels. In addition, the child’s evening cortisol correlated negatively with the difference between the mother’s morning and evening cortisol, suggesting if the mother demonstrated a more flattened cortisol pattern the infant had a higher evening cortisol level, while those mothers’ with a large drop from morning to night would have infants with lower evening cortisol. These results are partially supported by Yehuda and colleagues (2005), in a sample of women who were simultaneously traumatised during the terrorist attacks on the World Trade Centre. They found that the maternal morning cortisol correlated with infant morning cortisol, and maternal evening cortisol correlated with infant evening cortisol. Similar level correlations were found in both studies, although the correlations in the World Trade Centre study were more highly significant. In the current study the regression analyses suggested that both mother and infant morning cortisol values, more so than their evening levels, appeared to be related more to maternal mental health.
reported 10 to 14 months earlier. In the World Trade Centre study all the pregnant mothers were simultaneously traumatised. Even though the mothers were reporting differing levels of posttraumatic symptoms at the time cortisol was collected, it is likely that closer to the trauma they would have all been experiencing acute trauma symptoms which may have resulted in similar patterns in maternal morning cortisol production. In addition, the control women in the current study, whose morning cortisol levels correlated with those of their infants, reported the least amount of mental health problems in the preceding 14 months period. In contrast, the trauma group in the current study experienced their index trauma between 2 and 28 years before cortisol testing. This suggests that the women in current study were at very different stages of posttraumatic stress symptom expression compared with each other, as well as those from women in the World Trade Centre study.

Less variability in evening compared to morning cortisol levels has been reported in mothers of young children (Adam & Gunnar, 2001). Although there was a greater variability between dyad morning cortisol values for all women who had experienced a significant trauma compared to those who had not, the loss of association between the maternal and infant pairs morning cortisol was most obvious for those women who reached the more lenient ICD-10 criteria for lifetime PTSD but did not meet the full criteria for the DSM-IV. There are at least three possible explanations for this divergence, inconsistent daily production of cortisol, insensitive parenting, and genetic factors. Firstly, a study by Smyth and colleagues (Smyth et al., 1997) of normal diurnal cortisol cycles in a community sample demonstrated that 31% had very inconsistent morning cortisol levels over several days of sampling. It is possible that the most divergent dyads in the current study represent this inconsistent group identified in the Smyth study, with perhaps the mothers’ and/or the infants’ being more reactive to environmental cues on a daily basis compared to the control dyads. Secondly, over the first years of life one of the mother’s roles is to act as an external regulator for the child’s stress reactions (Posner & Rothbart, 2000). If the mother is not sensitive to her infant’s emotional
needs the infant’s stress system may be more reactive. In support of this view, a study of cortisol reactivity found more sensitive mothers’ level of cortisol reactivity was attuned to that of her infants over the course of a stressful task (Sethre-Hofstad et al., 2002). Whether lack of association in mother-infant dyad basal morning cortisol is related to maternal sensitivity will be addressed in the following chapter. Thirdly, paternal genetic factors have not been addressed in this study and the child cortisol levels in the divergent pairs may be related to genetic inheritance of paternal genes controlling cortisol production. A meta twin study estimated that approximately 60% of the variance in morning cortisol was genetically inherited (Bartels et al., 2003). But, given the group specific nature of the divergence in the current study this is a less likely explanation. This finding warrants further investigation with repeated cortisol sampling from trauma and non-trauma samples, including fathers. The lack of repeated sampling is an important flaw in the current study.

The hypothesis that mothers with PTSD and their infants would have reduced basal cortisol production was only partially demonstrated. Overall, mothers with a lifetime diagnosis of PTSD (DSM-IV) had lower morning and evening cortisol levels compared to the rest of the women in the study, although the women who obtained an ICD-10 but not a DSM-IV lifetime diagnosis had evening cortisol levels as low as the DSM-IV PTSD group. Yet, due to low group numbers and high variability, no significant group differences were found for the maternal cortisol measures. Furthermore, veterans with PTSD had significantly lower cortisol during the sleep period and remained lower for longer, but showed comparable levels by wakening (Yehuda et al., 1996). This study measured cortisol every 30 minutes across a 24 hour period. In addition, a study of women who had experienced sexual assault in childhood had lower cortisol (sample every 15 minutes) in the afternoon and evening (Bremner et al., 2003). Another study by Young and associates (Young, Tolman, Witkowski, & Kaplan, 2004) found that the rise between awakening and 30 minutes after wakening was important in differentiating PTSD. This study also only found significant differences in cortisol for
women with recent PTSD but not past PTSD. Yehuda concluded that other studies of diurnal rhythm using only a few data points were difficult to decipher as variable results had been reported from lower levels, no difference and greater basal cortisol levels with differences perhaps being related to the longitudinal course, chronicity, or age of subjects. Given that the current sample had significant variation in timing of their trauma experiences, these factors may have lead to the differences between the current study and the Yehuda’s World Trade Centre study where there was a uniform timing of trauma.

Despite these problems, statistically significant group differences were demonstrated for offspring of mothers with PTSD (DSM-IV) in relation to morning cortisol levels. In addition both chi-square and repeated measure analyses demonstrated a significant flattening of the diurnal decrease across the day in the offspring of mothers with PTSD (DSM-IV). The results are again partially in line with the World Trade Centre study (Yehuda et al., 2005) which found mothers with higher concurrent PTSD symptoms had lower cortisol and so did their infants. In addition, the effect appeared to be more pronounced for the children than for the mothers. Maternal concurrent PTSD symptoms in the current study were not associated with either the mother or the infants’ cortisol, but concurrent depressive symptoms were related to maternal morning cortisol. In contrast, PTSD specific symptoms and anxiety during pregnancy and for at least the first three months postnatally, were related to the child’s morning cortisol, with higher symptoms being associated with lower morning cortisol. In addition, this association remained when the mothers symptoms posttrauma had already been accounted for. Again this lack of replication for the mothers’ basal cortisol may reflect the recency and uniform timing of the World Trade Centre study compared to the older nature and divergent timing of the trauma experiences in the current sample with more recent mental health symptoms asserting a greater effect on current basal cortisol levels.
Even though a strong diurnal rhythm in cortisol is thought to be normal, several investigators have found approximately 15% of adult community samples have a flattened cortisol pattern (Smyth et al., 1997; Stone et al., 2001). These studies concluded that it was unclear if there were any health consequences for those with flattened cortisol patterns. A more recent study found hypocortisolism to be protective against heart disease in the elderly (Hellhammer et al., 2004). However, studies on PTSD have identified low cortisol as a risk factor for developing PTSD post trauma (Anisman et al., 2001; Delahanty et al., 2003; McFarlane et al., 1997; Resnick et al., 1995) suggesting that the infants with hypocortisolism may be vulnerable to developing PTSD following trauma throughout their lives.

It was unknown from the literature what to expect for the ICD-10 PTSD group in relation to cortisol. There was significantly more variation between mother and infant morning cortisol values in this group. Additionally, there was a heightened cortisol response (greater decrease over the day) in a third of the ICD-10 PTSD and trauma control groups, suggesting a more reactive HPA axis in many traumatised individuals who displayed symptoms but did not reach the full criteria for DSM-IV lifetime PTSD diagnosis. This heightened cortisol response in those who did not reach a DSM-IV diagnosis of PTSD was also found in the studies of the female offspring of Holocaust survivors who had experienced sexual abuse (Yehuda et al., 2001). A large proportion of the women in the current study who did not reach the DSM-IV PTSD criteria had experienced prior sexual molestation. All rape victims met lifetime DSM-IV criteria for PTSD. This is in line with many studies that have found a high rate of PTSD following rape (Breslau et al., 1991; Creamer et al., 2001; Resnick et al., 1993).

Hierarchical regressions were used to gain an understanding of the additive associations of maternal age, trauma experience, perinatal trauma and mental health symptoms, and concurrent mental health and stress on both maternal and infant morning and evening cortisol.
levels. Using these variables over 50% of the variance of both the mothers’ morning and evening cortisol values were predicted. Neither maternal trauma history nor PTSD specific trauma symptoms over the past 12 months or concurrently predicted a significant amount of variance in either the maternal morning or evening cortisol values. Higher maternal age and higher perinatal somatic symptoms were associated with higher morning cortisol in previously traumatised women, and conversely, lower morning cortisol in non-traumatised women. In addition, age accounted for half the variance in the non-traumatised group compared to the traumatised group. For maternal evening cortisol perinatal somatic symptoms were significant for the trauma group whereas perinatal anxiety and insomnia was a better predictor for the control sample, with higher levels predicting lower cortisol. High current parenting stress was associated with higher evening cortisol values in traumatised women. In line with these results Adam and Gunnar (2001) found maternal morning cortisol contributed most strongly to individual differences. One of the few associations they found with maternal evening cortisol was higher evening cortisol for women without partners. Maternal perceptions of parenting stress using the PSI may also be associated with cortisol levels because the mothers with high evening cortisol levels feel they are not performing well in this domain. All other significant predictors for either maternal morning or evening cortisol were associated with maternal mental health reports collected 10 months earlier.

Seyle (1985) proposed that the activity of the endocrine system often reflects more recent life events and as such may not show earlier life events. More recent studies have reported associations between ongoing stressors such as poverty (Steptoe et al., 2003), unemployment (Ockenfels et al., 1995), work related stress (Adam & Gunnar, 2001), and morning cortisol levels. These types of stressors are unlikely to be transitory. The mothers in the current study with lifetime PTSD reported the greatest level of parenting stress over the course of the study and repeatedly reported (on different instruments) feeling less competent as parents. On the other hand, the reported levels of psychological health and trauma symptomatology
decreased over the course of the study. A recent study of state versus trait negative affect, where trait negative affect was a composite of seven state measures over a three week period before the cortisol sampling found that trait negative affect, but not state, was associated with waking cortisol levels (Polk et al., 2005). The current study found correlations between postnatal depressive symptoms over the past week and maternal morning cortisol. However in the regression analyses where the effect of prior occurring symptoms were taken into account first, depressive symptoms failed to remain significant, only accounting for approximately 4% of the variance in maternal morning cortisol. The significance of earlier mental health measures (10 months earlier) suggests that basal cortisol alters slowly over time in response to mental states, perhaps with the exception of the inconsistent group identified by Smyth and colleagues (1997).

It is of particular interest that in the trauma group high somatic symptoms are associated with high morning and low evening cortisol, suggesting a relationship with more active basal cortisol systems. But, on closer inspection of the data this was only true for several of the IVD-10 and trauma control group subjects. Others, particularly PTSD (DSM-IV) subjects had only low evening cortisol in relation to physical complaints. Somatic symptoms are commonly associated with PTSD (Davidson et al., 2004). In addition, fatigue and pain have also been found to be associated with hypocortisolism (Hellhammer et al., 2004). Somatic symptoms on the GHQ generally relate to energy levels and headache. The previously mentioned study of mature verses young and teenage mothers, found that high cortisol in teen mothers was related to high energy and vigour whereas in older mothers high cortisol was associated with greater fatigue and negative mood (Krpan et al., 2005).

Over 70% of the variance in child morning cortisol was predicted in children of traumatised mothers, with maternal trauma experience and hyperarousal symptoms posttrauma accounting for approximately half of the predicted variance. Re-experiencing symptoms such
as intrusive thoughts have previously been reported to be associated with lower morning cortisol levels in child victims of the Armenian earthquake (Goenjian et al., 1995). Associations between cortisol levels and hyperarousal symptoms have not previously been reported. Several studies have reported an increased risk of PTSD following trauma if the victim had experienced previous trauma (Delahanty et al., 2003; Resnick et al., 1995). In both these studies increased risk was also associated with low cortisol responsiveness posttrauma. In the current study increased numbers of traumas were associated with higher morning cortisol in the ICD-10 and trauma control group suggesting a greater level of cortisol reactivity in this group. Maternal age and evening cortisol, and perinatal trauma symptoms accounted for the other half of the variance predicted in the child morning cortisol. Maternal age has been discussed above, and given the moderate to strong genetic control of cortisol the association with maternal evening cortisol is also not surprising. Perinatal trauma symptoms were not associated with maternal cortisol but were consistently associated with child morning cortisol during pregnancy and up to 3 months postnatally. This association was over and above the association due to trauma experience and hyperarousal symptoms. Approximately 37% of the variance in child evening cortisol was predicted in the trauma group, with maternal age and maternal evening cortisol accounting for the majority of this. These variables were less important in the non-traumatised group with only a quarter of the variance being predicted. Overall these results suggest different variables are more predictive for some of the study groups than others, highlighting the need for larger group sizes to explore these differences.

Why is child morning cortisol showing a stronger connection to the trauma experience of the mother and her ongoing trauma symptoms than the mothers’ own cortisol? Perhaps as discussed above the mother’s current cortisol reflects her mental health some 10 months earlier. As the majority of the mothers experienced their traumas many years ago their cortisol no longer reflects their experience. However this only explains the mothers’ current
cortisol not the children’s cortisol levels. If current cortisol is a reflection on earlier psychological factors perhaps the children’s cortisol levels reflect 1) genetic factors; 2) epigenetic factors occurring in utero; or 3) earlier social regulation effects of parenting.

Genetic factors have been demonstrated to play a significant role in basal levels of cortisol (Bartels et al., 2003; Wust et al., 2004). In the current study positive associations were found between mother and infant cortisol values, although the associations changed with maternal trauma experience. In infants whose mothers had not experienced a significant trauma maternal morning cortisol was the only significant predictor of infant morning cortisol. Yet, in the offspring of traumatised women, maternal cortisol did not significantly account for variance in the infant cortisol. One possible explanation is that those women in the study with genetically low cortisol also had PTSD and therefore the association between PTSD symptoms and child cortisol is spurious. On the other hand, in the current study even though mothers with PTSD had lower cortisol a significant difference for maternal cortisol was not found. Moreover, in the hierarchical regression analyses of child cortisol levels, maternal cortisol was added to the equation first and did not account for the variance explained by maternal trauma symptoms. Alternately, the low cortisol in the offspring of the PTSD mothers may represent the genetically programmed naive pattern or unchallenged pattern of cortisol, before being clouded by years of psychological and physiological assaults. However, a large number of animal studies have demonstrated that environmental stress during the pre and postnatal periods has significant effects of the behaviour and stress response of offspring in later life (Meaney, 2001).

Epigenetic factors such as environmental stress have also been found to play a significant role in the inter-individual differences in gene expression (Crews & McLachlan, 2006; Jaenisch & Bird, 2003; Peaston & Whitelaw, 2006). Epigenetic effects have been implicated in the phenotypic expression of cortisol (Seckl, 2001; Weaver et al., 2004; Wust et al., 2004).
The in utero period (particularly the third trimester) has been suggested as a time for the mother’s cortisol levels to influence the level of her infant’s cortisol production via epigenetic pathways such as imprinting (Seckl, 2001). In the current study maternal trauma experience and subsequent hyperarousal symptoms accounted for over a third of the variance in the offspring’s morning cortisol production, accounting for both increases and decreases in cortisol production. The mothers with PTSD (DSM-IV) reported significantly greater levels of anxiety and PTSD symptoms in the third trimester than the other three groups, with the ICD-10 mothers reporting levels between the DSM-IV and control groups. These results are congruent with the World Trade Centre study where there was an association between maternal trauma symptoms and infant basal cortisol production, with a stronger association for those who were in the third trimester of gestation at the time of the terrorist attacks (Yehuda et al., 2005). It is also in line with the findings of decreased basal cortisol and PTSD in offspring of Holocaust survivors with low cortisol and PTSD (Yehuda et al., 2000). In contrast, longitudinal research into maternal anxiety during pregnancy found a significant link between maternal anxiety at mid and late pregnancy and increased morning cortisol levels in adolescent offspring (O'Connor et al., 2005). However in the current study, regression analysis demonstrated that the association between child morning cortisol and maternal anxiety was predominately accounted for by maternal posttraumatic stress symptoms. Maternal cortisol is known to increase during the third trimester of pregnancy (Berg & Wynne-Edwards, 2002) as does the accessibility of active maternal cortisol to the foetus via the placenta (Seckl, 2001). Given the mother’s cortisol level is not predicted by her trauma experience but the child’s is, this suggests an epigenetic event rather than in utero trans-placental metabolic setting of the infants cortisol level. Epigenetic inheritance is a possible mechanism with epigenetic changes to the mother’s cortisol expression being passed directly to the child (Crews & McLachlan, 2006; Peaston & Whitelaw, 2006; Pembrey, 2002). The work by Meaney and Szyf (2005) suggest that the glucocorticoid receptors (GR) may be a target for epigenetic events via a mechanism of DNA methylation. Yehuda and
associates (2006) suggest that this type of epigenetic event is likely to be more stable and reflect earlier life events more so than the level of cortisol produced, which may better reflect the accumulated effects of stress.

A recent study by Brand, Yehuda and colleagues (2006) found mothers who were more susceptible to PTSD after the World Trade Centre terrorist attacks had infants that were more easily distressed by novelty, with high infant distress associated with low maternal morning cortisol. The current study did not find this using an observed measure of distress to novelty. However shyness related to a maternal pattern of hypercortisolism, while less sociable children had mothers with a more flattened day time pattern, suggesting that the ICD-10 group has more shy children and the DSM-IV group more unsociable children. Higher child evening cortisol was significantly associated with children who were rated as both unsociable, as well as children who were both unsocial and emotional suggesting these children are still aroused at the end of the day. Children in the DSM-IV group had higher mean evening cortisol levels. The results are congruent with results found in Chapter 4 indicating that there were significantly more shy and emotional children in the PTSD group as a whole. Therefore children of PTSD mothers demonstrated greater emotionality and social withdrawal.

A recent study into maternal depression has also found similarities between maternal neurotransmitters and neurohormones. Prenatal biochemistry in depressed mothers (including cortisol) was found to be significantly related to postnatal infant biochemistry (Field, Diego, Hernandez-Rief et al., 2004). Further, maternal depression during the prenatal, but not postnatal period, has been shown to predict negative affect in children (Huot et al., 2004). In the current study the infant biochemistry was higher than the mother. On inspection of the current data this was the general trend in the control group but the opposite occurred in the PTSD (DSM-IV) group where most infants had lower morning cortisol than their
mothers. Given that cortisol is higher in depression and lower in PTSD the more exaggerated levels on the offspring warrants further investigation. However, until molecular genetic studies have characterised the complex phenotypes involved in the regulation of two major subtypes of HPA axis (hypercortisolism and hypocortisolism), and their differing responses to stress, it will be difficult to tease out the contribution of genetic, shared genetic vulnerabilities and epigenetic events to individual differences. Of note, the literature reports an increase in evening cortisol in depressed patients (Gold et al., 1988; Plotsky et al., 1998), however the current study did not see this suggesting that perhaps depression with trauma may show a trauma specific pattern that may require different treatment approaches.

A third explanation for the strong association between children’s morning cortisol and maternal trauma experience is the impact of maternal mental health directly on the infant across its first year of life. The first year of life is a critical period with the parent acting as an external stress regulator for the infant and aids them in controlling their own physiology (Posner & Rothbart, 2000). Parental insensitivity and inconsistency have been shown to be related to poorer child outcomes (Carlson et al., 2004). In both the current study and that of maternal anxiety by O’Connor and colleagues (2005) anxiety and posttraumatic stress symptoms were not only present during gestation but continued into the postnatal period. The mother’s anxiety was predictive of the child’s cortisol up to three months of age. Therefore early maternal behaviour cannot be ruled out. The work by Meaney and colleagues (2001) on rat pups demonstrated maternal behaviour in the first few weeks of life was associated with GR density in the hippocampus. No significant unique variance in child cortisol was predicted by maternal mental health in the child’s second year of life. The next chapter will investigate group differences in maternal behaviour across the first 18 months of life, and its impact on infant basal level cortisol.
Overall, morning cortisol level of offspring from traumatised women was found to be significantly predicted by maternal trauma experience and subsequent PTSD symptoms of hyperarousal. These results support the research of Yehuda (2005) and implicate an epigenetic transmission of environmental experience from the mother to her offspring via *in utero* programming of the HPA axis. Maternal age and maternal postnatal somatic symptoms (10 months earlier) were the most significant predictors of maternal morning cortisol, while postnatal somatic symptoms and current parenting stress were the most significant predictors of maternal evening cortisol. These results should be interpreted with caution due to the small sample sizes and the single morning and evening cortisol samples. The results found warrant further investigation using multiple time points across the day, replicated over several days. Nevertheless, the child results appear to be reasonably robust as the same type of pattern was found using a variety of statistical approaches. It is also important to note that differences in cortisol levels found here and in other studies of PTSD are within the normal range.

The following chapter initially investigates maternal postnatal behaviour in relation to PTSD and its impact on the infant-mother relationship, before investigating the impact on infant cortisol levels.
6. The Impact of Trauma on Infant-Carer Interactions

The introduction to this chapter is brief and only highlights key papers. A detailed review of the literature pertaining to the current chapter can be found in Chapter 2 under the headings of ‘Impact of Trauma on Parenting’ (2.2); and more specifically ‘PTSD and Parenting’ (2.2.4).

Maternal behaviour in the postnatal period has been demonstrated to impact on the mother-infant interaction and subsequent infant development in both animal (Meaney, 2001) and human (Carlson & Sroufe, 1995; Lyons-Ruth et al., 2004) studies. In a recent review of the literature, Appleyard and Osofsky (2003) noted that little empirical investigation had been undertaken specifically into the effects of trauma and PTSD on parenting, even though clinical evidence suggests that both trauma experience and posttraumatic stress disorder impacted negatively on interpersonal functioning and parenting ability. Fearon and Mansell (2001) propose that symptoms of the disorder such as re-experiencing direct attention away from care taking behaviours, while hypervigilance and avoidance may result in less playful interactions and overprotective behaviours. The current study aims to explore both maternal emotional withdrawal and hypervigilant/over-protective behaviour in relation to trauma experience and PTSD.

Lyons-Ruth and Block (1996) hypothesised that if trauma symptoms were activated by the mother’s interaction with her infant she may need to disconnect emotionally to be able to carry out the necessary caregiving behaviours. In their study of high risk women who had experienced child maltreatment, it was found that maltreatment was not associated with insecure attachment, but was associated with disorganised attachment patterns in their offspring. This study also found that disorganised attachment was related to both very high
and very low current maternal PTSD symptoms, suggesting that current symptom level was not a good predictor of outcome. The only maternal behaviours found to be associated with current trauma symptoms were hostility and intrusiveness. Lyons-Ruth, Bronfman and Parsons (1999) identified a range of disrupted communication behaviours that differentiated between organised and disorganised infants. Lyons-Ruth and associates (2004) then went on to described two types of parental behaviours that lead to disorganised infant attachment, frightening or intrusive behaviours, and withdrawn, fearful or inhibited behaviour, with this latter pattern more often found in middle class mothers.

Research into the offspring of the Holocaust survivors with PTSD suggests both reduced emotional interaction and hypervigilence/over-protection occurs with parental PTSD (Yehuda et al., 2001). Offspring reported emotionally closed parents who often minimised their children’s feelings, concerns and experiences, as well as engendering a sense of the world as a dangerous place. In addition, Yehuda and colleagues found that offspring of Holocaust survivors with PTSD experienced significantly more child abuse than those without PTSD. This led Yehuda and associates to propose the avoidant and numbing symptoms experienced by the parents resulting in the lack of an appropriate emotional connection between parents and infants. This study also found emotional abuse was related to low basal cortisol in the adult offspring. In line with this finding a study by Krpan and colleagues (2005) found high maternal day time (10am – 2pm) basal cortisol was related to more affectionate behaviour toward their infants. The current study aims to explore the impact of trauma experience (not restricted to childhood trauma), PTSD, and ongoing trauma symptoms on maternal behaviour and the mother-infant interactions and maternal perceptions to determine whether trauma is associated with reduced mother-infant emotional interactions and hypervigilance/over-protective behaviours. Both infant and maternal basal cortisol will also be explored in relation to maternal behaviour.
The current study aimed to investigate the impact of trauma on maternal emotional interactions with her infant using three different measures across the first 20 months of the infant’s life, namely; infant withdrawal; dyadic emotional availability; and infant attachment status. When the infants were 3 months of age Lowe (2003) measured infant withdrawal during an interaction with the examiner using a modified Alarm Distress Baby Scale (ADBB; Guedeney & Fermanian, 2001). No significant effects of trauma were found when the control and whole trauma group were compared, or when those with PTSD (DSM-IV) were compared to those without the disorder. The current study will reanalyse this data in relation to the control, trauma control, and separate PTSD groups, and in relation to later mother-infant interactions and attachment. Disorganised attachment has been associated with disrupted communication between mother and infant (Lyons-Ruth, Bronfman, & Parsons, 1999), therefore this mismatch in communication may lead to a sustained pattern of early infant withdrawal that may be detectable in the early postnatal period. When the infants were 13 months of age the mother-infant interactions were coded using the Emotional Availability scales (Biringen, Robinson, Emde, 1998). The scales of interest for the current study are the overall score of emotional availability, and the specific maternal scales of sensitivity, intrusiveness and hostility. When the infants where 19 months of age the infant attachment status in relation to their mother was determined using the Strange Situation Procedure (SSP; Ainsworth, 1978). It was hypothesised that:

1. infant withdrawal would be associated with maternal PTSD compared to mothers who had not experienced a trauma and those who had experienced a trauma but who did not develop the disorder.

2. maternal lifetime PTSD would be associated with reduced overall emotional availability, and reduced maternal sensitivity. Given the middle class nature of the sample it was unknown whether a significant increase in intrusiveness and hostility would be found.

3. maternal lifetime PTSD would be associated with disorganised attachment.
4. infant withdrawal at 3 months would be associated with reduced emotional availability at 13 months, and disorganised attachment at 19 months.

Further, ongoing trauma symptoms, and general psychological distress would also be investigated to determine the impact on current functioning. In addition, maternal and infant basal cortisol would be explored in relation to these infant-maternal interactional measures.

Two different measures were used to investigate maternal hypervigilance and maternal over-protectiveness. To investigate the proposal that PTSD may be associated with maternal hypervigilance the congruence between an observer rating of infant behaviour and the mothers’ perceptions was explored. It was proposed that a hypervigilant and over-protective mother would interpret her infant’s behaviours differently from less concerned mothers. To investigate the proposal that PTSD was associated with maternal over-protection the level of autonomy that mothers reportedly would give their children was compared across trauma groups. Specifically, the current study hypothesised that if symptoms of the disorder were related to hypervigilance and over-protection then mothers who had experienced significant PTSD symptoms following trauma would be more likely to:

5. interpret their infants behaviour more negatively compared to mothers who have not experienced a trauma or had not experienced significant PTSD symptoms following trauma.

6. give her child less autonomy than children of mothers who have not experienced a trauma or who have not experienced significant PTSD symptoms post trauma.

6.1. The impact of Trauma on Mother-Infant Interactions

Firstly this section will assess the impact of trauma on infant withdrawal, followed by emotional availability, and attachment. The relationship between each of these measures and ongoing maternal mental health and maternal and infant basal cortisol, and maternal perceptions of parenting will also be investigated.
6.1.1. Infant Withdrawal at 3 Months of Age

Infant withdrawal was measured by Lowe (2003) using a modified Alarm Distress Baby Scale (ADBB; Guedeney & Fermanian, 2001). The original scale was developed to use during a routine well baby clinic visit. Lowe conducted a semi structured interaction with the infant during a home visit. The infant withdrawal scores were analysed as a dichotomous variable with and without trauma and with and without PTSD. The current analyses use infant withdrawal as both a continuous and a dichotomous variable, and explores the relationship with between control, trauma control and PTSD groups.

6.1.1.1. Relationship between withdrawal and maternal trauma

A significant negative correlation was found between the continuous infant withdrawal variable and the number of DSM-IV PTSD re-experiencing symptoms reported post trauma \((r = -.475, p<.05)\), as well as a trend for a negative association between withdrawal and a DSM-IV diagnosis of PTSD \((r = -.326, p<.10)\). Counter to expectations these results suggest that the mothers with a higher number of ‘B’ symptoms and a lifetime diagnosis of PTSD (DSM-IV) had infants that were less likely to be withdrawn. Unexpectedly, significant group differences were found for the PTSD (ICD-10) only group compared to the other three groups for both types of withdrawal variables (Table 6.1). This result only partially supports the hypothesis that infant withdrawal would be associated with maternal lifetime PTSD, with the majority of infants whose mothers reached a lifetime ICD-10 but not DSM-IV diagnosis of the disorder being categorised as withdrawn. No group differences or interactional effects were found for infant gender.

6.1.1.2. Relationship between withdrawal and maternal mental health

There were no significant correlations between current or perinatal psychological distress, nor ongoing symptoms of posttraumatic stress.
Table 6.1. ANOVA and chi-square analyses of infant withdrawal and trauma groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean (SD)</th>
<th>% Withdrawn</th>
<th>ANOVA</th>
<th>Statistic</th>
<th>Sig.</th>
<th>Post hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control</td>
<td>1.39 (2.14)</td>
<td>11.1% (2/16)</td>
<td>$F=5.05$</td>
<td>$p=.005$</td>
<td></td>
<td>3&gt;1, 3&gt;2, 3&gt;4</td>
</tr>
<tr>
<td>2. Trauma control</td>
<td>2.53 (3.09)</td>
<td>20.3% (3/12)</td>
<td>$\chi^2=16.01$</td>
<td>$p=.001$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PTSD (ICD-10)</td>
<td>5.83 (3.12)</td>
<td>83.3% (5/6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. PTSD (DSM-IV)</td>
<td>1.00 (1.55)</td>
<td>0% (0/6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Total $N = 40$; Withdrawn infants $N = 10$

6.1.1.3. Relationship between infant withdrawal and biological measures

Independent samples t-tests found a significant group difference for maternal evening cortisol ($t = 2.29$, $p<.05$) with the levels for the mothers without withdrawn infants (log transformed $M = -2.89$, $SD = .86$) being significantly higher than that of the mothers of withdrawn infants ($M = -3.39$, $SD = .46$). Perhaps this indicates a greater range of cortisol reactivity. There were no significant group differences for any of the infant cortisol measures. However as reported in Chapter 5 (see Table 5.4 and Figure 5.2), the ICD-10 group had the greatest variation between the mother-infant dyads basal morning cortisol levels suggesting that one or both had inconsistent daily levels of cortisol. A comparison between mother and infant cortisol differences for withdrawn and not withdrawn infants found a non-significant trend toward withdrawn children having greater variability between mother and infant morning basal cortisol.

To further investigate the relationship between infant withdrawal and the ICD-10 group the Neurological measures (NACS and NBAS) carried out at 2 weeks of age were investigated. As reported in Chapter 4.4.9., these measures were investigated in relation to the combined
PTSD group. On re-analysis no significant differences specific to the ICD-10 group were found. Additionally, no significant group differences were found between withdrawn and non-withdrawn infants on any of the NACS or NBAS summary scores.

6.1.1.4. Relationship between infant withdrawal and maternal perceptions of parenting

Mothers of withdrawn infants demonstrated a trend of perceiving their infants to be easier \((t = -1.83, p<.10)\), and themselves to have greater confidence \((t = -1.78, p<.10)\) at the 2 weeks postnatal period. In addition they perceived themselves as having significantly less life stress \((t = 2.19, p<.05)\) measured on the PSI when the infants were 19 months of age.

6.1.2. Emotional Availability at 13 Months of Age

Forty seven mother-infant dyads completed the play session used for scoring the emotional availability of the mother-infant pair. The descriptive statistics for the whole sample are shown in Table 6.2 with lower scores representing less optimum performance. The parental non-hostility scale had the lowest range of scores with only three mothers scoring below four (range 1-5) and no mother demonstrating overt hostility. This may reflect the 10-minute non-threatening play setting used to measure emotional availability. No significant differences were found for infant gender or number of children.

6.1.2.1. Relationship between trauma and emotional availability

There were no significant correlations between DSM-IV posttrauma symptoms and any EA scale. The initial group analysis investigated the overall effect of trauma experience on EA total and subscale scores using multivariate analysis of variance controlling for concurrent postnatal depression (EPDS) and general psychological well being (GHQ). The results are shown in Table 6.3 with the trauma group demonstrating less optimum scores on all scales. A significant difference was found for the total EA score, parental sensitivity, parental
Table 6.2. Descriptive statistics for the Emotional Availability scale scores for the total sample

<table>
<thead>
<tr>
<th>EA scales</th>
<th>(EA range)</th>
<th>Statistics</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Minimum</td>
<td>Maximum</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(6-40)</td>
<td>27.83</td>
<td>5.71</td>
<td>13.5</td>
<td>36.5</td>
<td></td>
</tr>
<tr>
<td>Parental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>(1-9)</td>
<td>6.01</td>
<td>1.53</td>
<td>3.0</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Structuring</td>
<td>(1-7)</td>
<td>3.66</td>
<td>.84</td>
<td>1.5</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Non-Intrusiveness</td>
<td>(1-5)</td>
<td>3.87</td>
<td>1.01</td>
<td>2.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Non-Hostility</td>
<td>(1-5)</td>
<td>4.69</td>
<td>.51</td>
<td>3.0</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>(1-7)</td>
<td>5.01</td>
<td>1.22</td>
<td>1.5</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Involvement</td>
<td>(1-7)</td>
<td>4.81</td>
<td>1.42</td>
<td>1.5</td>
<td>7.0</td>
<td></td>
</tr>
</tbody>
</table>

Note: \(N=47\); EA scales = Emotional Availability scales (Biringen, Robinson, Emde, 1998)

non-intrusiveness and child involvement scales. The GHQ demonstrated a significant effect on both the child scales of responsiveness, \(F(2,42) = 4.49, p<.05\) and involvement, \(F(2,42) = 5.14, p<.05\). A significant effect of EPDS was found on parental non-intrusiveness, with higher depressive scores relating to less intrusion. The same pattern of significance was found without the use of the covariates with the exception of child involvement, which was not significant suggesting the ongoing level of maternal distress impacts on how much the child engages their mother in their activities.
Table 6.3. Multivariate analysis of variance comparing the Emotional Availability scale scores between control and trauma groups, controlling for concurrent mental health

<table>
<thead>
<tr>
<th>EA scales</th>
<th>Group Means (SD)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control n=18</td>
<td>Trauma n=27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29.72 (5.11)</td>
<td>26.55 (6.01)</td>
</tr>
<tr>
<td><strong>Parental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>6.64 (1.34)</td>
<td>5.65 (1.58)</td>
</tr>
<tr>
<td>Structuring</td>
<td>3.83 (.786)</td>
<td>3.48 (.85)</td>
</tr>
<tr>
<td>Non-Intrusiveness</td>
<td>4.14 (.94)</td>
<td>3.63 (1.03)</td>
</tr>
<tr>
<td>Non-Hostility</td>
<td>4.81 (.35)</td>
<td>4.65 (.58)</td>
</tr>
<tr>
<td><strong>Child</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>5.36 (1.11)</td>
<td>4.83 (1.29)</td>
</tr>
<tr>
<td>Involvement</td>
<td>5.11 (1.45)</td>
<td>4.59 (1.43)</td>
</tr>
</tbody>
</table>

Note: *N = 45; EA scales = Emotional Availability scales (Biringen, Robinson, Emde, 1998); ns = non significant; ¹ = medium effect size (Cohen, 1988)

To gain an understanding of the differences between the trauma groups, particularly the ICD-10 and DSM-IV PTSD groups for emotional availability, the group statistics were scrutinized separately (Table 6.4). Unexpectedly, both the trauma control and the ICD-10 PTSD groups were found to consistently have lower scores than both the control and the DSM-IV PTSD groups. In fact, the DSM-IV group had the highest emotional availability scores of all groups. It was therefore decided to conduct further multivariate analyses pooling the trauma control and ICD-10 groups. A multivariate analysis (controlling for EPDS and GHQ) was conducted with the overall model demonstrating significant differences for the total emotional availability score, *F(2,42)= 3.24, p<.05*, parental sensitivity, *F(2,43) = 3.49, p<.05*, parental non-intrusiveness *F(2,42) = 3.67, p<.05*, child responsiveness, *F(2,42) = 2.61, p<.05*, and
Table 6.4. Descriptive statistics of the Emotional Availability scale scores for the control, trauma control, PTSD (ICD-10), and PTSD (DSM-IV) groups

<table>
<thead>
<tr>
<th>EA scales</th>
<th>Group Means (SD)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control n=18</td>
<td>TC n=15</td>
<td>ICD-10 n=6</td>
<td>DSM-IV n=6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29.72 (5.11)</td>
<td>25.43 (5.53)</td>
<td>24.83 (7.14)</td>
<td>31.08 (4.42)</td>
</tr>
<tr>
<td><strong>Parental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>6.64 (1.34)</td>
<td>5.27 (1.61)</td>
<td>5.50 (1.52)</td>
<td>6.75 (1.21)</td>
</tr>
<tr>
<td>Structuring</td>
<td>3.83 (.786)</td>
<td>3.37 (.88)</td>
<td>3.33 (.82)</td>
<td>3.92 (.80)</td>
</tr>
<tr>
<td>Non-Intrusiveness</td>
<td>4.14 (.94)</td>
<td>3.57 (1.03)</td>
<td>3.00 (.84)</td>
<td>4.42 (.80)</td>
</tr>
<tr>
<td>Non-Hostility</td>
<td>4.81 (.35)</td>
<td>4.53 (.67)</td>
<td>4.67 (.61)</td>
<td>4.92 (.20)</td>
</tr>
<tr>
<td><strong>Child</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness</td>
<td>5.36 (1.11)</td>
<td>4.57 (1.16)</td>
<td>4.83 (1.57)</td>
<td>5.50 (1.26)</td>
</tr>
<tr>
<td>Involvement</td>
<td>5.11 (1.45)</td>
<td>4.40 (1.30)</td>
<td>4.17 (1.75)</td>
<td>5.50 (1.26)</td>
</tr>
</tbody>
</table>

Note: N = 45; TC = trauma control; EA scales = Emotional Availability scales (Biringen, Robinson, Emde, 1998); PTSD = posttraumatic stress disorder; ICD-10 = Composite International Diagnostic Interview-Version 2.1 (CIDI-2; (World Health Organisation, 1997); DSM-IV = Diagnostic and Statistical Manual, Fourth Edition (American Psychiatric Association, 1994)

child involvement, $F(2,42) = 3.01, p<.05$. These results do not support the hypothesis that mothers with lifetime PTSD would be less emotionally available to their infants. In fact it is the more resilient mothers—those who have been traumatised but did not develop the more distressing DSM-IV PTSD, that were less emotionally available, less sensitive, and more intrusive in their interactions with their infants, and whose infants were less responsive and involving of the parent. These results are significant while controlling for concurrent
symptoms of depression and psychological distress and therefore the association between the trauma groups and dyadic emotional availability can be assumed to be independent of concurrent mental health. Furthermore, no significant interaction effects were found if concurrent GHQ and EPDS were dichotomised (median split) and used as fixed variables. No significant gender interactions were found.

6.1.2.2. Relationship between EA and maternal ongoing mental health

The EA scales were correlated with the maternal ongoing posttraumatic stress symptoms and general psychological health measures from pregnancy to measures administered concurrently to EA scales. Very few significant correlations were found. There were no significant correlations with current trauma symptoms at any time point. Small negative correlations were found for the concurrent GHQ total score and parental sensitivity \((r = -0.302, p<.05)\), child responsiveness \((r = -0.342, p<.05)\), and child involvement \((r = -0.353, p<.05)\), again indicating poorer EA with increasing psychological distress. Concurrent postnatal depressive symptoms (EPDS) demonstrated a small positive correlation with EA parental non-intrusiveness \((r = 0.348, p<.05)\), as found in the multivariate analysis.

6.1.2.3. Relationship between EA and biological measures

No correlations were found between the Emotional Availability scales and mother or infant cortisol levels. Also there were no significant differences were found in 2x2 contingency tables using dichotomous high-low cortisol and high-low emotional availability variables.

The infant consolability variable measured when the infants were 2 weeks (combination of NACS and NBAS consolability scales; Linke 2002) was found to have a moderately strong negative correlation with the total EA score \((r = -0.548, p<.001)\). All subscales except parental non-intrusiveness demonstrated similar correlations. Lower scores on infant consolability indicate that the infant required more rocking and handling, therefore the negative correlation
indicates infants from dyads with lower emotional availability at 13 months required less rocking and handling to console at 2 weeks post partum than dyads with high emotional availability at 13 months. This is a similar finding as reported in Chapter 4.4.9 where the control group was found to require greater levels of rocking and holding than the trauma groups, particularly the trauma control group.

6.1.2.4. Relationships between EA and maternal perceptions of parenting
There were no significant correlations between EA and the MABS administered at 2 weeks postpartum, or between EA and the PAI, which were administered concurrently. But there were several significant correlations with several subscales from the PSI that were administered in the following 4 months. The PSI subscales of acceptability, attachment, and role restriction all negatively correlated with non-hostility ($r = .475, p<.01; r = .388, p<.01; r = 3.19, p<.05$ respectively) indicating that mothers who reported problem scores on the PSI also demonstrated higher levels of maternal hostility toward their infants. It must be noted though that there was a limited range of scores for the non-hostility subscale with no mother demonstrating high levels of hostility.

6.1.3. Infant Attachment at 19 Months of Age
When the infants were 19 months of age the infants’ attachment to their mothers’ was assessed using Ainsworth’s Strange Situation Procedure (SSP, 1978). Attachment data was obtained from 40 infants. Of the four other infant-mother dyads completing this stage, two were unable to attend the hospital for the laboratory session, one due to recently having a second child, the other due to work commitments. The other two dyads attended the laboratory session but the session was not completed, one due to obvious infant illness, the other child displayed considerable distress on arrival to the laboratory and refused to enter the room. This child had completed all other assessments in her home. Of note this dyad was in
the ICD-10 PTSD group. The missed sessions were unable to be rescheduled due to other family commitments. During this data collection phase domestic violence experience was acknowledged on the ongoing stressor questionnaire by one mother. The women had not previously acknowledged any significant life traumas and had been in the control group. Due to the unknown PTSD status of this mother the dyad was dropped from the trauma group analyses leaving 39 infants. Overall approximately 67% of the 39 dyads were rated as having a secure attachment and 33% insecure (Table 6.5). Over half of the insecure attachments were in the ambivalent category, with approximately a quarter being avoidant and a quarter being disorganised. Of note, the child dropped from the analysis (due to parental domestic violence) demonstrated a disorganised pattern of attachment. The overall figures for the 40 infants are in line with two recent Australian studies that have used the 4-way classification system. These studies found approximately 60% secure, 8-10% avoidant, 19-24% ambivalent, and 9-10% disorganized (Harrison et al., 2002; Gibson & Ungerer 2000).

Table 6.5. Percentage of A-B-C-D attachment categories found in the different trauma groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Avoidant (A)</th>
<th>Secure (B)</th>
<th>Ambivalent (C)</th>
<th>Disorganised (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n=14)</td>
<td>7.1 (1)</td>
<td>71.4 (10)</td>
<td>21.4 (3)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Trauma control (n=15)</td>
<td>6.7 (1)</td>
<td>73.3 (11)</td>
<td>20.0 (3)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>PTSD (n=10)</td>
<td>10.0 (1)</td>
<td>50.0 (5)</td>
<td>10.0 (1)</td>
<td>30.0 (3)</td>
<td></td>
</tr>
<tr>
<td>Total (N=39)</td>
<td>7.7 (3)</td>
<td>66.7 (26)</td>
<td>17.9 (7)</td>
<td>7.7 (3)</td>
<td></td>
</tr>
<tr>
<td>Total a (N=40)</td>
<td>7.5 (3)</td>
<td>65.0 (26)</td>
<td>17.5 (7)</td>
<td>10.0 (4)</td>
<td></td>
</tr>
</tbody>
</table>

Note: a = Total includes the mother who was excluded due to recent domestic violence
6.1.3.1. Relationship between attachment and trauma groups

The percentages of attachment status for each trauma group are summarised in Table 6.5. There were no significant group differences in relation to secure versus insecure categories but the types of insecure categories varied depending on the trauma groups. All the disorganised attached infants were in the PTSD group, with one being in the ICD-10 and two in the DSM-IV subgroups. Similar levels of avoidant attachment were found in all groups. However the PTSD group had lower levels of secure and ambivalent attachments. The ambivalent and avoidant groups were combined to increase the numbers in each cell. A marginally significant group difference was found, $\chi^2(2, N = 39) = 9.44$, $p = .05$, with the PTSD group having higher levels of disorganised and lower levels of securely attached infants, supporting the hypothesis that disorganised attachment would be related to lifetime PTSD.

6.1.3.1.1. Description of mothers with disorganised infants

The numbers in the disorganised group are too small to conduct any meaningful statistical analyses. Below is a description of the four individual mother’s trauma experience, mental health and perceptions of parenting.

The first mother was 30 years old when she gave birth to her only child. The mother had been physically assaulted and raped when she was 20 years old and reported being terrified and helpless at the time. In addition she had been involved in a life threatening accident and witnessed someone killed or seriously injured (age of these experiences unknown), as well as experiencing domestic violence and the death of a full term infant during her adult life. Her responses on the Traumatic Antecedence Questionnaire (TAQ) indicated a benign childhood, although her father died during her middle childhood. She reported the rape and the more recent miscarriage as her most significant traumas. Her lifetime PTSD (DSM-IV) diagnosis was based on the rape, with her symptoms stopping several years earlier. Following the infant
attachment assessment session she initiated a very emotional conversation about both the rape and the miscarriage. She also reached a DSM-IV diagnosis for recurrent major depression, and simple phobia with the onset for both occurring in her late teens. Both she and her infant had relatively higher levels of both morning and evening cortisol with a flattened diurnal pattern. She reached caseness on the GHQ pre-birth, 2 weeks and 3 months postnatally, and on the PCL before birth. She did not report a significant level of depressive symptoms at any assessment. Throughout the postnatal period her reported level of psychological distress reduced. Her infant was not withdrawn at 3 months, the dyad displayed high emotional availability at 12 months, and the child gained an underlying A-B-C attachment category of secure. This mother’s responses on the Personal Appraisal Inventory (PAI) placed her in the bottom quartile for positive growth despite this being her first child, and the bottom quartile for resources to manage, and in the top quartile for child threatens goals and challenges, and child threatens self esteem and relationships. The mother was in the top quartile for total parental stress on the Parent Stress Index (PSI), and scored in the clinically significant range on child demandingness and adaptability, and parental isolation. Six months after attachment was measured this mother’s responses on the autonomy scale of the Parent Child Relationship Inventory (PCRI) were in the lowest and least optimal 15%. This mother also reported experiencing high levels of ongoing stressors and chronic maternal stress.

The second was aged 33 years at the beginning of the study and had three children including the index child. She had experienced sexual molestation that occurred repeatedly over a period of weeks when she was aged 12 years. She had felt helpless but not frightened during these episodes. She reached a lifetime diagnosis of PTSD (DSM-IV) and reported current symptoms. She had experienced a previous episode of major depression at age 31 years, and was diagnosed with a specific phobia. The TAQ suggests her childhood was relatively benign, with the exception of the sexual molestation that was unclear whether this occurred
within or outside the family. Both mother and infant cortisol levels were low in the morning
and the evening, demonstrating a flattened diurnal pattern. This mother did not reach
caseness on any mental health measure pre-birth, she reached caseness for psychological
distress 2 weeks postnatally, which settled over the following 12 months. At 19 months
postnatal she reached caseness for both GHQ (all subscales) and PCL and was still high 5
months later. Her infant was not withdrawn at 3 months, and the dyad showed good
emotional availability at 13 months. However the infant was coded as having a disorganised
pattern of attachment with a subcategory of insecure-ambivalent (D/C). The mother reported
her infant to be settled and alert, and at 13 months felt her infant was a serious challenge to
her goals. When her child was 19 months her responses on the PSI indicated serious
parenting stress, with her scores reaching clinical significance in the child domain for
distractibility, reinforces parent, demandingness, and mood, as well as high scores on
acceptability. In the parent domain she reached clinically significant levels for competence,
isolation, health, role restriction, depression, and spouse, indicating stress in most facets of
parenting. The mother’s responses did not indicate difficulties with allowing her child
autonomy. This mother also reported chronic marital stress.

The third mother was 31 years old when her child was born. She had been physically
assaulted and robbed at knife point overseas in early adulthood. A friend with her sustained a
knife wound. She reported being terrified and helpless at the time. In addition she had
witnessed someone being badly injured or killed, and had experienced domestic violence as
an adult. Her responses to the TAQ suggested a history of unfair punishment and emotional
abuse. This mother obtained an ICD-10 lifetime diagnosis of PTSD. She did not meet criteria
E or F for the DSM-IV. That is, she reported that her symptoms lasted less than 1-month and
that they did not interfere with her life. She did not obtain a lifetime diagnosis of depression
or other anxiety problems. She did not reach caseness on the PCL over the course of the
study, but she did reach caseness for GHQ at 2 weeks, 13 months, and 19 months postnatally,
with high symptoms on the somatic and anxiety subscales. She did not report significant depressive symptoms. The mother’s cortisol was in the low range for both morning and evening, while her infant was in the middle range. This infant was withdrawn at 3 months, the dyad had low emotional availability across all subscales at 13 months, and demonstrated an organised attachment style of avoidance. The mother described her 2 week old infant as easy and alert, at 13 months she felt she had experienced a high level of positive growth, had good resources to manage and her goals and self esteem were not challenged by her child. At 19 months postnatal this mother scored in the clinical range in the child domain for mood suggesting her child was unhappy and cried a lot. In addition unfavourable scores were also obtained on the subscales of reinforces the parent and acceptability. At 25 months this mother reported a moderate level of child autonomy. She had reported low to moderate ongoing stressors, including marital stress, over the study period.

The fourth mother was not included in the trauma group analyses as her posttraumatic stress status was unknown. At the beginning of the study this mother had not experienced any significant trauma across her lifetime, nor had she experienced any mental health problems. However, this changed across the course of the study. Particularly from when her child was 19 months of age she reported marital conflict, bereavement, and ill health, and by the age of the child at 24 months she was also reporting domestic violence and difficulties with her partner’s family. This mother reached caseness on the GHQ at pre-birth and 2 weeks postnatally, then again at 19 and 24 months. She did not reach caseness on the PCL. She had scored at the base level for both until the child was 24 months of age when her scores on the PCL increased. Both mother and infant had high morning cortisol levels and average decreases across the day when measured at 13 months of age. Her infant was not withdrawn at 3 months, the dyad displayed moderate to high levels of emotional availability at 13 months, and an underlying organised attachment pattern of ambivalence at 19 months. She described that her 2 week old infant as alert, unsettled, and difficult. At 13 months she
indicated that she had experienced little personal growth, had few resources to manage, and that her goals were challenged by having a child. At 19 months she reported clinical levels of parenting stress in the child domain with the subscales of demandingness and mood being problematic; in addition scores on acceptability and distractibility subscales were also very high. In the parent domain the subscale of health was in the 5\textsuperscript{th} percentile. At 24 months the mother’s responses did not indicate problems with autonomy.

6.1.3.2. Relationship between attachment and maternal mental health

Dichotomous GHQ variables for total, anxiety and depression, for each of the first five assessment periods were used in 2x3 or 2x2 contingency tables with A-B-C, secure-insecure and organised-disorganised attachment variables. Mothers of secure infants (48.1\%) were significantly more likely to reach caseness for GHQ total scores during gestation than mothers’ of insecure infants (7.7\%); $\chi^2(1, N = 39) = 6.31, p<.05$. When the infants were 2 weeks of age 75\% of mothers of disorganised infants reached caseness for anxiety (2/3 cut-off) compared to 16.7\% of mothers’ of organised infants, $\chi^2(1, N = 39) = 7.01, p<.01$. No other significant relationships were found. No significant differences were found for postnatal depression measured either by the GHQ severe depression scale or by the EPDS. In addition, no significant differences were found for caseness on the PCL over the first five assessment periods and attachment status. These results should be interpreted with caution as the numbers in some cells were small.

6.1.3.3. Relationship between attachment and cortisol

No correlations or significant secure-insecure group differences were found using cortisol as a continuous variable. Nor were any found using dichotomous cortisol measures (lowest or highest quartile). The numbers of subjects in the avoidant, ambivalent and disorganised categories were too small for any meaningful analysis.
6.1.3.4. Relationships between maternal perceptions and attachment

One way ANOVAs were conducted for A-B-C attachment groups and all maternal perceptions measures. No significant differences were found for secure-insecure attachment status. However for organised-disorganised attachment, the PSI child domain subscale of acceptability was highly significant, \( t = -3.17, p < .005 \), and neared significance for reinforces the parent \( t = -1.94, p = .06 \), with mothers of disorganised infants endorsing statements that indicate their child does not live up to their expectations and does not give them enough positive reinforcement. Lack of acceptance of the infant has been identified as a barrier to insightfulness (Oppenheim & Koren-Karie, 2002). Caution needs to be taken in interpreting these results as the numbers of mothers in the disorganised group is small.

6.1.4. Relationship between Infant Withdrawal, Maternal Emotional Availability and Attachment Status

Infant withdrawal measured at 3 months negatively correlated with total emotional availability \( r = -.315, p < .05 \), and both child responsiveness \( r = -.314, p < .05 \) and child involvement \( r = -.358, p < .05 \) measured at 13 months. These correlations indicate that earlier infant withdrawal was associated with less dyadic emotional availability at 13 months, particularly with lower levels of child interactions. No significant group differences were found using \( t \)-tests with either withdrawal or EA as a dichotomous variable. Although a significant difference, \( \chi^2(2, N = 39) = 7.81, p < .05 \) was found using both as dichotomous variables in a 2x3 contingency table with withdrawn-not withdrawn infants versus high-medium-low emotional availability. Approximately 43% of non-withdrawn infants belonged to high emotionally available dyads at 13 months (23% medium, 34% low), while none of the withdrawn infants were in a high emotionally available dyad (60% medium, 40% low).

Chi-square tests were also conducted for A-B-C, secure-insecure, and organised-disorganised attachment groups, and withdrawn-not withdrawn infant measure conducted at 3 months of
age. No significant differences were found. Although not significant, 50% of avoidant infants had been withdrawn at three months, compared to 25% ambivalent, and only 15.4% secure infants.

Using a one-way ANOVA total EA scores were found to be significantly lower, $F(2,37) = 3.66, p<.05$, for dyads with avoidant infants ($M = 21.25, SD = 5.72$) compared to secure (mean $28.70, SD 6.06$), and ambivalent infants ($M = 29.67, SD = 2.64$). On all EA subscales avoidant infant dyads scored below the secure and ambivalent categories with only the parental sensitivity, $F(2,37) = 3.91, p<.05$, and parental structuring reaching significance, $F(2,37) = 4.71, p<.05$. These results were congruent with analysis of dichotomised Emotional Availability scale scores, low (bottom quartile) and high (top 75%) scores. These variables were used in 2x3 or 2x2 contingency tables with either A-B-C attachment, secure-insecure, or organised-disorganised attachment variables. Significant group differences were found for A-B-C attachment status with 75% of avoidant infants having low EA total scores, compared to 22.2% secure infants and no ambivalent infants, $\chi^2(2, N = 39) = 8.94, p=.01$. This same pattern was repeated for parental sensitivity. All Avoidant infants had mothers who scored in the bottom quartile for parental structuring, $\chi^2(2, N = 39) = 12.32, p<.005$. Seventy five percent of avoidant children scored in the lowest quartile for responding to their mothers compared to 22.2% of secure, and 11.1% of ambivalent infants, $\chi^2(2, N = 39) = 6.37, p<.05$.

No significant differences were found between EA dichotomous variables and secure-insecure or organised-disorganised attachment variables. In particular higher levels of intrusiveness and hostility were not found in mothers of disorganised infants. Overall, low emotional availability, parental sensitivity and structuring, as well as low child responsiveness were all related to avoidant attachment status.

Only eight of the ten children who were rated as withdrawn at 3 months of age completed the assessment of infant attachment. One of the withdrawn infants did not complete the
attachment session as she became distressed on her arrival at the hospital. The other was unable to attend due to her mother’s work commitments. Of the eight infants rated as withdrawn at 3 months of age four had secure attachments at 19 months of age, with only one of these dyads demonstrating emotional availability total scores in the lowest quartile at 13 months. Of the four insecure attached infants, two were coded as ambivalent with neither obtaining a low rating on emotional availability. The other two obtained an attachment coding of Avoidant, and both had EA total scores in the lowest quartile. One of the children coded as Avoidant was also coded as disorganised. These results only partially support the hypothesis that early infant withdrawal would be related to later EA and avoidant attachment, with one quarter of the infants classified as withdrawn at 3 months maintaining the same pattern of interaction over the course of 16 months.

6.1.5. Relationship of Infant Temperament to Measures of Mother-Infant Interaction
Examiner ratings of infant distress to novelty were assessed from the infants distressed or anxious responses to novel toys during a play interaction with the examiner when the infants were 13 months old. In addition, maternal ratings of temperament in relation to the domains of ‘emotional-not emotional’, ‘social-not social’, ‘shy-not shy’, and ‘active-not active’ were obtained when the infants were 24 months of age. Chi-square analyses of these measures with ‘withdrawn-not withdrawn’ found a significant result for the examiner rated distress to novelty measure with 57% of those being classified as distressed at 13 months also being classified as withdrawn at 3 months, compared to only 16% of those classified as not distressed, $\chi^2(2, N = 45) = 5.61, p<.05$. There were no significant differences found for the mother rated temperament dimensions, although there was a greater percentage of children rated as ‘not social’ at 24 months who had been rated as withdrawn (27.3%) compared to those who were rated as Social (10.5%).
No significant relationships between dichotomous infant temperament variables and continuous EA variables were found in multivariate analysis. However several associations were found using both temperament and EA and attachment measures as dichotomous variables in two by two, or two by three contingency tables. There was a significant group difference for shyness, $\chi^2(1, N=42) = 4.40, p<.05$, with fewer ‘shy’ children (10.5%) compared to ‘not shy’ children (39.1%) being found in the low EA group, with a similar pattern being found for EA parental sensitivity. There was also a trend for shy children to be more involving of their mothers during interactions, $\chi^2(1, N = 42) = 5.13, p<.10$. Although, there was no relationship between shyness and attachment status.

There was a trend toward a greater number of children rated as having high emotionality, $\chi^2(1, N = 40) = 3.41, p<.10$, being coded as insecure (47.1%) compared to secure (19.0%) in the SSP. Further, a significant difference was found for emotionality and the 3-way coding of the SSP, $\chi^2(2, N = 40) = 6.11, p<.05$, with 52.9% of ‘emotional’ children being rated as secure, 23.5% as avoidant, and 23.5% as ambivalent, compared to 81.0% secure, 0% avoidant and 19.0% ambivalent for the children rated as ‘not emotional’. These findings are congruent with Ainsworth and associates original attachment study (Ainsworth et al., 1978) where infants found to be avoidant in the SSP displayed a high level of emotional behaviour in the home setting when the attachment system is not activated. Although not significant, 75% ($n=3$) of disorganised infants were rated as having high emotionality compared to 40% in the organised category. There was no association between emotionality and emotional availability total or subscales.

There were no significant differences found for the temperament dimensions of sociability and activity.
6.2. The Impact of Trauma on Hypervigilance and Over-protectiveness

As reported above, no increased posttrauma symptoms, or ongoing trauma symptoms reported from pregnancy, total PCL or subscales, were found to be associated with negative mother-infant interactions. Firstly this section investigates maternal hypervigilance by assessing different patterns of congruence between trauma groups for maternal reports of the baby’s behaviour on the Mothers and Baby Scale (MABS; Wolke, 1995) and the examiner assessed Neurological and Adaptive Capacity Scale (NACS; Amiel-Tison, 1982). Both these measured were carried out by Linke (2002) when the infants were 2 weeks old. Secondly, the relationship between maternal over-protection and trauma was explored using the mother’s self reported level of autonomy given to her child (PCRI, Gerard, 1994).

6.2.1. Maternal Hypervigilance

Correlations between the MABS and NACS were first explored for the whole sample and then mothers with and without other children. No correlations were found for the group as a whole or for primiparous mothers. In contrast, for the multiparous mothers the MABS easiness scale was found to positively correlate with NACS alertness scale ($r= .44, p<.05$) and negatively correlate with NACS crying scale ($r=-.44, p<.05$) suggesting these more experienced mothers as a group were better at reading infant cues.

Analysing correlations by trauma groups identified moderate to high positive correlations for control group mothers between the mothers’ rated MABS easiness scale and the examiner rated NACS alertness item, with high alertness being equated with infant easiness (see Table 6.6). No correlations were found for the trauma control group. Moderate to high positive correlations were found for the PTSD mothers between the MABS irritability During Feeding scale and the NACS Neurological subscale and the NACS total score. In addition, near significant negative correlations were also found with the same NACS items and maternal perception of infant easiness. Looking further at the NACS items that correlated with the
Table 6.6. Correlations between maternal perceptions of infant behaviour and examiner ratings

<table>
<thead>
<tr>
<th>Groups and NACS subcales</th>
<th>MABS Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unsettled</td>
</tr>
<tr>
<td>Controls</td>
<td>n=17</td>
</tr>
<tr>
<td>Alertness</td>
<td>-.326</td>
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<tr>
<td>Crying</td>
<td>-.236</td>
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<tr>
<td>Irritability</td>
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<tr>
<td>Adapt-Capacity</td>
<td>-.354</td>
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<tr>
<td>Neurological</td>
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<tr>
<td>Total</td>
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<td>Trauma control</td>
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</tr>
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<td>Alertness</td>
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<tr>
<td>Crying</td>
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<tr>
<td>Irritability</td>
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<td>Adapt-Capacity</td>
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<td>PTSD</td>
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<td>Irritability</td>
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<tr>
<td>Adapt-Capacity</td>
<td>.191</td>
</tr>
<tr>
<td>Neurological</td>
<td>.416</td>
</tr>
<tr>
<td>Total</td>
<td>.390</td>
</tr>
</tbody>
</table>

Note: MABS = Mothers and Baby Scale (Wolke, 1995); NACS = Neurological and Adaptive Capacity Scale (Amiel-Tison, 1982); * = at least one variable constant; † = p<.10; * = p<.05; ** = p<.01
PTSD mothers MABS ratings, it was found that both unsettled/irregular infant behaviour and irritability during feeding correlated strongly and positively with two reflex items, recoiling lower limbs \( (r = .604, p<.05; r = .848, p<.01) \) and active contraction of neck flexors \( (r = .782, p<.01; r = .845, p<.01) \). The positive nature of the correlations indicated that optimum reflexes were covarying with higher levels of maternal reports of unsettledness and irritability, suggesting that the PTSD mothers were incorrectly interpreting normal infant reflexes as negative. The reflex items scores were found to be similar across all groups in both frequency and range. It was speculated that the way the mother perceives her infant’s reflexes may be mediated by her trauma experience and maternal hyperarousal indicating hypervigilance and misinterpretation of normal infant recoil reflexes as negative withdrawal from mother. This interpretation supports the hypothesis. However an alternative explanation may be required.

Significant correlations between both maternal re-experiencing ‘B’ trauma symptoms and hyperarousal ‘D’ posttrauma symptoms and NACS Neurological subscale \( (r = .4.35, p<.05; r = .492, p<.05 \) respectively) and total NACS scores \( (r = .455, p<.05; r = .501, p<.05 \) respectively) were found. On further investigation neither of ‘B’ or ‘D’ symptoms correlated with either the NACS infant low limb or neck reflex. However, both pre-natal and concurrent current PTSD symptoms did demonstrate a small positive correlation with the infant’s neck reflex \( (r = .324, p<.05; r = .336, p<.05, \) respectively). Further, concurrent GHQ total scores correlate with both reflexes \( (r = .322, p<.05; r = .304, p<.05) \), and concurrent anxiety/insomnia strongly correlated with the leg reflex \( (r = .512, p<.001) \). These results suggest that, at least in part, the mother’s physiology, perhaps reactivity of sympathetic nervous system, may have been transmitted to her infant. Regardless of whether the mother is misinterpreting the infants reflex movements or these infants do have strong reflexes, the spread of infants reflex scores did not differ across groups suggesting that the PTSD mothers were more aware of their infants’ reflexes than the mothers without the disorder.
6.2.2. Maternal Over-protectiveness

The autonomy scale of the Parent Child Relationship Inventory (PCRI; Gerard, 1994) was administered when the children were 24 months old. *T*-tests revealed no significant difference between primiparous and multiparous mothers. No differences were found when conducting analyses of variance with or without number of children as a covariate, therefore the following results are reported without the covariate. Dichotomous high-low variables were created using an even split. There were no correlations between maternal ongoing mental health and the autonomy scale. The autonomy scores was correlated with the number of traumas experienced and the DSM-IV trauma symptom clusters reported to have occurred posttrauma. A marginally significant negative association was found between autonomy and the diagnosis of DSM-IV PTSD (*r* = -.305, *p* = .05). In addition, the number of traumas were negatively correlated with autonomy (*r* = -.343, *p* < .05) indicating that the higher the number of traumas experienced by a mother the less autonomy given to her child. There were no significant correlations between autonomy and specific ‘B’, ‘C’, or ‘D’ trauma symptom clusters. There was however a negative small to moderate correlation between the re-experiencing symptom cluster on the PCL before birth (*r* = -.435, *p* < .005), indicating that higher levels of intrusive symptoms during pregnancy were related to mother’s view on child Autonomy at 24 months of age. No significant correlations were found for hypervigilant or avoidant symptoms.

No significant group differences were found for autonomy scores between the control (*M* = 29.00; *SD* = 2.22) and trauma (*M* = 28.77; *SD* = 3.08) groups. One way analyses of variance were also conducted for the control, trauma control and PTSD groups (Table 6.7). Although no significant group differences were found the PTSD groups, particularly the DSM-IV group, demonstrated the lowest level of autonomy. Similar results were found using the PCRI dichotomous high-low variable. Although not significant, there was a trend for more mothers in the trauma groups to be in the low autonomy group (trauma control, 50%; ICD-10, 50%;
DSM-IV, 60%) compared to the control group (29.4%). Overall, the hypothesis that mothers with PTSD would allow their children less autonomy was only partially supported.

Table 6.7. Group comparisons for PCRI subscale of Autonomy

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>17</td>
<td>29.00</td>
<td>2.15</td>
<td>1.51</td>
<td>ns</td>
</tr>
<tr>
<td>Trauma control</td>
<td>14</td>
<td>29.57</td>
<td>3.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD (ICD-10)</td>
<td>6</td>
<td>28.67</td>
<td>1.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD (DSM-IV)</td>
<td>5</td>
<td>26.60</td>
<td>3.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Total N = 42; PCRI = Parent-Child Relationship Inventory (Gerard, 1994).

6.3. Summary and Discussion

The overall aim of this study was to investigate the impact of maternal trauma experience and posttraumatic stress disorder on maternal interactive behaviours with her infant. The results do demonstrate that both trauma experience and PTSD impact on parenting in different ways, but not always in line with the hypotheses. The middle class nature of this sample has enabled the study of trauma impact without the confounding variables found with poverty, and clinical samples. However this has also led to lower numbers being found in the less optimal categories for several key measures, which has limited the level of statistical investigation, and means that caution needs to be taken in generalising some of the results. Even though small numbers were found in certain groups a conscious decision was made not to pool trauma groups as significant group differences were found that would have been lost if the often used groupings of control versus trauma groups, or PTSD versus non-PTSD were used. Of particular importance the results highlighted the need to investigate trauma sub-
populations such as control, trauma control, ICD-10, and DSM-IV PTSD diagnoses. These results suggest that studies into PTSD require large sample sizes to allow the investigation of various sub-populations found within the wider trauma population.

The hypothesis that maternal PTSD would be associated with infant withdrawal at 3 months was only partially supported. Infant withdrawal was not related to the more stringent DSM-IV diagnosis of the disorder, but unexpectedly was related to the ICD-10 PTSD group with over 80% of the mothers having withdrawn infants at 3 months postnatally. This specific group is not usually identified in the literature and therefore there is no research with which to directly compare these results. Infant withdrawal was not related to maternal mental health, including trauma symptoms and psychological distress, from pre-birth, 2 weeks postnatally or concurrently. A recent Australian study by Matthey and associates (Matthey, Guedeney, Starakis, & Barnett, 2005) also found that infant withdrawal was not related to mother’s concurrent mood. However, they did find that infant withdrawal was related to whether the mother reported that she had felt more irritable, sad, anxious, or depressed since the birth.

A sensitive carer is able to determine the level of interaction the infant can cope with from moment to moment (Tronick & Gianino, 1986). This behavioural attunement or synchrony between the mother and the infant is thought to aid in the development of an infant’s self regulation of arousal and reflect maternal sensitivity (DeWolff & van Ijzendoorn, 1997; Fonagy & Target, 1997; Gianino & Tronick, 1988; Shore, 1996). Infant withdrawal has been demonstrated to be fairly stable over childhood and related to insecure attachment (Rubin & Lollis, 1988). The current study found a weak relationship between infant withdrawal at 3 months and the total emotional availability score and both the child domains of responsiveness to parent and involvement of parent. But maternal sensitivity or any other maternal behavioural scale was not found to be associated with infant withdrawal. This is in
contrast with a recent study of 2 month old infants where less optimal mother-infant interactions were associated with higher withdrawal scores (Puura, 2004). In addition, mismatch in maternal-infant interactions leading to a pattern of infant withdrawal was hypothesised to be associated with disorganised attachment. This is demonstrated in the work by Lyons-Ruth and colleagues where it was found that higher levels of communication disruptions were associated with disorganised attachment (Lyons-Ruth, Bronfman, & Parsons, 1999). This hypothesis was not supported as infant withdrawal was not found to be associated with disorganised attachment. Although not significant there was a greater association between infant withdrawal and insecure-avoidant attachment than the other attachment categories.

Together these results suggest there is a weak continuity of infant behaviour across early development with withdrawn infants at 3 months old being less interactive with their carers at 13 months, and demonstrating avoidant attachment patterns at 19 months. The lack of association between withdrawal and maternal behaviour may be due to the 10 month gap between the infant withdrawal measure and the measure of maternal-infant interactions and the compounded problem of measurement error. However other measures conducted at 2 weeks postnatally have been found to be associated with EA. It may also be due to the adaptation of the infant withdrawal measure from a clinic to a home setting. Furthermore, as proposed by Rubin and colleagues (Rubin, Hymel, Mills, & Rose-Krasnor, 1991) the infant temperament combined with the parent-infant interaction and parenting style, may interact in the development of emotional behavioural styles.

The infant temperamental dimension of distress to novelty assessed when the infants were 13 months was significantly associated with infant withdrawal, with approximately 60% of 13-month-olds in the ‘distressed’ category being rated as withdrawn at 3 months, compared to approximately 15% of those rated as Not Distressed. In addition there was a trend toward
more less sociable infants at 24 months being withdrawn at 3 months. There was no association found between shyness and withdrawal behaviour. Several studies have demonstrated both continuity and discontinuity of early behavioural inhibition from early infancy to primary school children (Calkins, Fox, & Marshall, 1996; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Fox, Schmidt, Calkins, Rubin, & Coplan, 1996). The numbers in the current study are too low to adequately investigate interactional effects between infant withdrawal, maternal behaviour and later infant attachment. Several studies by Gunnar (1990; Nachmias, Gunnar, Mangelsdorf, Parritz, & Buss, 1996) have demonstrated the protective effects of sensitive caregiving for behavioural inhibited infants. Fox and colleagues (Fox et al., 1996) propose that differences in temperamental fear are mediated via the amygdala. The association of infant withdrawal, ICD-10 PTSD mothers, and discrepant cortisol levels also implies a biological link with infant withdrawal.

From the earlier analysis of basal cortisol, measured at age 13 months, the ICD-10 group was found to have the greatest discrepancy between maternal and infant morning cortisol levels (see Table 5.4, and Figure 5.2). It was proposed that this discrepancy may reflect the mother, infant or both having inconsistent daily morning basal cortisol levels as identified by Smyth and colleagues (1997). This inconsistency in basal morning cortisol may indicate a greater reactivity to daily environmental cues than those with more consistent basal cortisol levels. The high level of infant withdrawal in the ICD-10 group may also indicate that the infants in this group become hyperaroused more easily and use withdrawal as a mechanism to reestablish homeostasis. Alternatively, it may indicate that there was a mismatch at the physiological level between infant and mother. Few studies have investigated physiological attunement between parents and their children. One study by Sethre-Hofstad, Stansbury and Rice (2002) found that sensitive mothers and their young children have significantly correlated cortisol responses to a challenge task compared to less sensitive mothers and their infants.
The hypothesis that lifetime maternal posttraumatic stress disorder would be associated with reduced maternal emotional availability at 13 months was not supported. In fact the results found that those women who had experienced a significant trauma but did not reach a DSM-IV diagnosis of the disorder demonstrated reduced emotional availability compared to both the DSM-IV PTSD and control groups, independently of concurrent mental health. This counter intuitive result is also consistent with results from the consolability variable rated at 2 weeks post partum. Consolability is the measure of how much rocking and handling an infant required from the examiner to settle after being distressed. The control group was found to have required greater levels of rocking and handling to settle and the trauma control group the least. In addition the higher emotionally available dyads at 13 months also required the most rocking and handling to settle at 2 weeks of age. Again these results appear counter intuitive but must be given credence as the Consolability and emotional availability measures were assessed over 12 months apart and by different examiners and measure very different constructs. Together these results suggest that mothers who demonstrated resilience to trauma also demonstrate reduced emotional interactions with their infants. It is unknown from this study whether the reduced emotional availability causes the reduced need for comfort in the infant or vice versa, or that the maternal trauma experience alters both the mother and the infant behaviour via an epigenetic event. Further the trauma control group mothers reported feeling most competent as parents and reported very low levels of ongoing trauma symptoms and psychological distress, in line with the control group.

Given the community nature of this sample these results appear to be consistent with the normal variation found in animal behaviour post trauma. In a series of studies Meaney and colleagues (for review see Meaney, 2001) have found natural variation in maternal rat behaviour with mothers who demonstrated high levels of licking and grooming and arched back nursing being associated with more positive outcomes such as increased glucocorticoid receptor levels in the hippocampus and amygdala, sensitivity to negative feedback, and
reduced plasma cortisol levels. The level of licking and grooming and arched back nursing can be increased by short term normal separations of the mother from her pups whereas, long term unnatural separation decrease this behaviour and leads to pups with more reactive stress responses and more fearful behaviour. Of particular interest to the current study is the study by Champagne and Meaney (2000) where they identified high and low licking and grooming and arched back nursing mothers and subjected them to restraint stress during the second half of pregnancy. They found that high licking and grooming and arched back nursing mothers were now indistinguishable from the low licking and grooming and arched back nursing mothers. This reduction in maternal behaviour also continued for subsequent litters. In a recent study of human mothers who had experienced inconsistent care during their childhoods (which would be equivalent to the long term unnatural separations in rats) demonstrated higher levels of instrumental care but less affectionate touching with their own infants (Krpan et al., 2005). Meaney (2001) proposes that for both animals and humans under conditions of increased environmental stress it is an adaptive advantage to increase the offspring’s stress reactivity and consequently their behavioural levels of vigilance and fearfulness. Further, as this occurs in the range of normal variation, he suggests that the ideal way to parent may differ with differing environmental demands. However, this epigenetic transmission of increased stress reactivity to the offspring may ultimately pay a cost in terms of health outcomes due to high stress reactivity (Meaney & Szyf, 2005).

A recent neuroimaging study that has compared combat veterans with PTSD, to combat veterans without the disorder (combat controls), and healthy age matched non-combat controls has found differential patterns of regional cerebral blood flow during script-driven imagery in the amygdala and medial frontal cortex (Britton, Phan, Taylor, Fig, & Liberzon, 2005). This study found that normal controls behaved as expected with amygdala activation. But counter to expectations, the combat controls demonstrated a deactivation of the amygdala, whereas the PTSD patients did not activate or deactivate the amygdala. Britton
and colleagues suggest this finding may have implications for understanding both the changes relating to the disorder as well as pathological changes following trauma that confer resilience. The combat controls also reported less negative emotions posttraumatic script compared to the PTSD group. The combat control group also rated the vividness of their recall of trauma scripts the lowest and the vividness of the neutral scripts the highest, suggesting they coped with intense memories by reduced vividness of recall, which the authors suggest may be an adaptive and protective response to trauma. The pattern of behaviour in the combat controls resembles that of the trauma controls in the current study, who demonstrate a reduction in emotional interactions and self report highly in relation to positive attributes but report low levels of problems. In contrast the PTSD group mothers report reduced parental competence, and report high levels of parenting and other ongoing stressors. Together with the animal studies the trauma control group behaviour may reflect the normal adaptation to trauma whereas in the PTSD group this mechanism has failed. The accompanying infant behaviour at 2 weeks would also be suggestive of an epigenetic transmission of reduced behavioural responding in the infant. Animal studies would suggest this transmission may occur during early infancy due to reduced maternal behaviour, however, given the 2 week old infant was demonstrating a reduced level of contact to be consoled suggests that an \textit{in utero} transmission was more likely.

In relation to the AAI, Adam, Gunnar and Tanaka (2004) found that insecure-dismissing mothers demonstrated the lowest level of warmth and responsiveness in their interactions with their infants compared to secure and insecure-preoccupied mothers, particularly if they also had reported moderate levels of depressive symptoms. Pianta and associates (Pianta, Egeland, & Adam, 1996) have shown that ‘dismissing’ adults tend to deny the presence of negative affect which is congruent with the trauma control group in the current study. The study by Adam and associates also found that insecure-preoccupied mothers demonstrated greater levels of anger and intrusiveness in their interactions, as well as the highest level of
both positive and negative emotionality. The current study found that trauma specific group findings were independent of maternal depressive symptoms. In addition, the current study found that the trauma control group also demonstrated the highest level of intrusive and hostile behaviours with their infants, although this again may be due to the measurement of intrusion and hostility during a non-stressful task.

The association between posttraumatic stress disorder and disorganised infant attachment in the current study would suggest that dampening down of the emotional availability as seen in the trauma control dyads may be protective against trauma related negative interactions. Despite low numbers of disorganised infants the general hypothesis that maternal PTSD would be associated with greater levels of disorganised attachment was supported. A lifetime diagnosis of PTSD was found to be related to disorganised attachment but not other insecure attachment patterns. This finding supports the work of Lyons-Ruth and Block (1996) who found disorganised attachment was related to childhood maltreatment. Caution is required in interpreting the results as very few children demonstrated a disorganised pattern of attachment. Like Lyons-Ruth and Block the current study did not find an association between current trauma symptoms and attachment. However the current study found that one quarter of mothers who met lifetime DSM-IV diagnostic criteria for a significant trauma experience (A1, A2) and PTSD symptoms of re-experiencing (B), numbing and avoidance (C) and hyperarousal (D) from a trauma that occurred before pregnancy had disorganised infants at 19 months post partum. The maternal trauma experiences that were associated with disorganised attachment in the current study all involved interpersonal violence occurring in either childhood or adulthood. This also means that two-thirds of the infants whose mothers reached a diagnosis of either ICD-10 or DSM-IV PTSD did not have children who were disorganised, which may be related to other protective factors such as the mothers own attachment security.
The study by Schuengel, Bakermans-Kranenburg, and van Ijzendoorn (1999) comparing maternal frightening behaviour between mothers with and without unresolved loss may be of relevance to the current study. These researchers found that ‘unresolved’ women who also obtained a secure rating on the Adult Attachment Interview (AAI) demonstrated the least frightening behaviours compared to the ‘unresolved-insecure’ (highest) and to both the ‘non unresolved-secure’ and ‘non unresolved-insecure’ groups. These results suggest that attachment security was protective against the transmission of disorganised infant attachment following psychological trauma. The adult attachment status of the mothers in the current study is unknown and warrants investigation.

Although numbers of disorganised infants were too low for any meaningful analysis, hostile and intrusive maternal behaviours did not appear to be associated with disorganised attachment in the infant. This may be related to the middle class nature of the sample (Lyons-Ruth, Bronfman, & Atwood, 1999; Lyons-Ruth et al., 2004). However the Lyons-Ruth studies found associations between hostile-intrusive behaviour and D-secure infants. An alternative explanation for the low levels of hostility and intrusiveness observed may be the use of the Emotional Availability (EA) scales for a 10 minute non-stressful play session. A recent study by Biringen and associates (Biringen et al., 2005) into both observation time and context of the EA scales supports this view. These authors found that observation times of 30-45 minutes were required to obtain moderate correlations between all EA subscales and attachment status, with the exception of non-hostility which required up to 2 hours for a well educated middle class sample. Further, maternal hostile behaviour was found to be better detected in a higher stress reunion context following a significant separation. Longer observation times and higher stress may also be needed to detect the withdrawing behaviours associated with mothers of D-secure infants. This current study only found a relationship between avoidant attachment and EA. Maternal sensitivity was not related to disorganised attachment, in fact the DSM-IV PTSD group had as high maternal sensitivity as the control
group. Meta-analysis has found only a weak association between maternal sensitivity and disorganisation (van Ijzendoorn et al., 1999). No association was found between emotional availability or attachment status and basal cortisol levels.

Of interest, a recent meta-analysis has found moderate effect sizes linking unresolved maternal representations and anomalous parental behaviour, unresolved maternal representations and disorganised infant attachment, and anomalous parental behaviour and disorganised infant attachment (Bakermans-Kranenburg, van Ijzendoorn, Moran, Pederson, & Benoit, 2006). However, this study found only a small amount of the relationship between unresolved parental state of mind and infant attachment was mediated through parental anomalous behaviours. These researchers propose that other infant, parent, environmental and genetic factors need to be explored. A history of maternal PTSD and accompanying biological vulnerabilities in both the mother and the infant warrants further investigation.

There was no direct association found between organised patterns of attachment and trauma groups. Although, when there was a breakdown in the maternal stress response there was an association between PTSD and disorganised attachment. Attachment is viewed as a biological based behavioural system that is closely associated with a range of other behavioural systems such as the fear system (Bowlby, 1969/1982). The current study suggests that when the stress system is not working optimally the organised nature of the infant attachment system may also be affected. This warrants further investigation.

The second general aim was to investigate whether any specific trauma symptoms were related to maternal hypervigilance and over-protectiveness. Overall, no links were found between specific trauma symptoms clusters of re-experiencing (B), avoidance and numbing (C), and hyperarousal (D) and maternal-infant interactions. This is in line with previous work by Lyons-Ruth and Block (1996). In an attempt to investigate whether maternal
hypervigilance was impacted on how the mother viewed her baby the congruence between an
examiner assessed neurological measure and the mothers perceptions of her 2 week old infant
measured at the same time were compared across trauma groups. Of interest, no significant
correlations were found between the trauma control mothers’ perceptions of their infants and
the objective neurological assessment undertaken at the same time. In contrast, the control
group appeared to interpret infant alertness as easiness, whereas the PTSD group interpreted
normally developed neurological reflexes as infant irritability. Overall this may indicate the
control group mothers were reinforced by alert responsive babies but the PTSD mothers were
hyperalert and focussing on what they perceive as negative behaviour, perhaps viewing the
recoiling of neck and limbs as infant withdrawing. Further, it was found that overall there
was a relationship between the mother’s retrospective reports of both B and D posttrauma
symptoms and the infants scores on the neurological subscale of the Neurological Adaptive
Capacity Assessment (Amiel-Tison, 1982), as well as correlations between the infant reflexes
and maternal prenatal and postnatal trauma symptoms and general psychological distress.
These results are suggestive of a link between the mother and infants physiology, perhaps at
the level of the sympathetic nervous system. A recent study investigating a range of
neuroendocrine markers found that prenatal maternal biochemistry was predictive of her
infant’s postnatal biochemistry (Field, Diego, Hernandez-Rief et al., 2004). No differences
were found in the ranges of scores on the neurological measures between groups. Overall, it
is unclear as to whether the PTSD mothers are being hyperalert and/or detecting higher levels
of irritability in their infants.

The hypothesis that mothers who have experienced posttraumatic stress disorder would be
more over-protective than the trauma control and control groups was only partially
supported. There was a weak association between mothers with higher numbers of trauma
experiences and those with a DSM-IV PTSD diagnosis to report allowing their infants less
autonomy. There were no associations between level of hyperarousal symptoms and over-
protectiveness as suggested by Fearon and Mansell (2001). Mothers reporting higher levels of intrusive (B) trauma symptoms during pregnancy were also more likely to reported giving lower levels of autonomy to their infant 2 years later. One difficulty in finding clear relationships between over-protectiveness and trauma experience may be due to differences in sub groups of trauma victims. For example, Lyons-Ruth and colleagues (2004) have proposed that mothers of D-insecure infants may actually promote age inappropriate levels of early autonomy.

In summary, infant withdrawal at 3 months was associated with ICD-10 but not DSM-IV maternal PTSD. It was speculated that these mothers and infants had hyperactive HPA axes. Infant withdrawal was also related to reduced infant emotional availability and infant distress to novelty at 13 months, and to a lesser degree avoidant infant attachment patterns and less sociability at 19 months demonstrating a weak continuity of withdrawal behaviour across the first 2 years of life. The most unexpected and interesting finding was that resilient mothers (those who had experienced a trauma but did not develop PTSD-DSM-IV) had the lowest dyadic emotional availability at 13 months, with both mother and infants displaying reduced emotional engagement during interactions. Convergent support for this result was found with the infants of non-traumatised mothers requiring a greater level of rocking and handling to settle at 2 weeks of age than the trauma group as a whole and in particular the resilient group. Together these results suggest that resilience to trauma is associated with reduced emotional interaction from both the mother and the infant. The deactivation of the amygdala in response to emotionally charged material has recently been found in a group of resilient combat veterans. It is proposed that these results, as seen with animal models, support the occurrence of an epigenetic event related to the maternal trauma which confers resilience to both the mother and infant. For the infant this epigenetic event may occur during pregnancy or very early in the postnatal period. As predicted maternal posttraumatic stress disorder was associated with disorganised attachment in the infant. Further research is warranted in
relation to maternal PTSD, maternal attachment, and genetic and epigenetic vulnerabilities and infant attachment. It is particularly important to investigate if maternal attachment is associated with biological resilience, and further investigate whether biological resilience to trauma is protective for the development of disorganised infant attachment. Overall there was some support for the view that maternal trauma is associated with hypervigilant and overprotective parenting practices. The next chapter will investigate the relationship between maternal trauma, PTSD, and child developmental outcomes.
7. Impact of Maternal Trauma on Child Developmental Outcomes

The sections of the literature review that are most salient to the current chapter are:
Biological Impact of Trauma (2.1.2), particularly the subsection Intergenerational
transmission of PTSD; Impact of Trauma on Parenting Behaviours (2.2), particularly
subsections Attachment and the Development of Psychopathology and Impact of Parental
PTSD on Child Outcomes. Briefly, associations between both prenatal and postnatal
environmental factors and negative child developmental outcomes have been reported. For
example studies have linked maternal anxiety during pregnancy to later behavioural problems
in children (O’Connor, Heron, & Glover, 2002; van den Bergh & Marcoen, 2004). On the
other hand, postnatal factors and poorer child outcomes have been linked via reduced
maternal sensitivity during mother-infant interactions. For example, reduced maternal
sensitivity in the first 6 months of the infants life has been linked with later child cognitive
deficits, in depressed (Milgrom et al., 2004) and non-depressed mothers (Stanley et al.,
2004). Boys were found to be at greater risk than girls (Milgrom & Westley, 2002). Problems
in carer-infant interactions have also been found to be associated with the development of
emotional and behavioural difficulties during childhood and adolescence.

A range of studies have found insecure attachment to be associated with internalising and
externalising behavioural problems in children (Carlson & Sroufe, 1995; Egeland & Carlson,
2004), whereas disorganised attachment has been associated with externalising behaviour
(van Ijzendoorn et al., 1999). Specifically, infant ambivalent attachment has been linked with
anxiety (Warren et al., 1997). Poorer emotional and behavioural problems have also been
found in children of depressed mothers (Milgrom & Westley, 2002; Murray & Cooper,
2003). In relation to cortisol and behaviour, several studies using clinical populations have
found an association between low basal cortisol and externalising behaviour in children.
In addition Gunnar and Vazquez (2001) have speculated that low morning cortisol may also reduce a child’s ability to sustain attention and therefore impact on their learning.

Little empirical work has been carried out specifically on the effects of posttraumatic stress disorder on parenting and child outcomes (Appleyard & Osofsky, 2003). Several studies have found higher levels of parenting problems in Vietnam veterans (Davidson & Mellor, 2001; Jordan et al., 1992) and greater levels of psychopathology in their children (Harkness, 1993; Rosenheck & Nathan, 1985). Although not all studies have found this to be so (Davidson & Mellor, 2001). Following natural disasters poorer parental functioning has been linked with increased internalising problems in children (Brenton et al., 1993; Green et al., 1991), while studies of maternal trauma occurring during their own childhood have been associated with increased levels of child maltreatment (Banyard et al., 2003; Famularo et al., 1994; Yehuda et al., 2001) and disorganised attachment (Lyons-Ruth & Block, 1996). These later studies have been confounded by other risk factors such as high poverty. However, studies of disorganised infant attachment and maltreated children have found increased levels of regulating emotion problems, interpersonal difficulties, and aggressive behaviours (Coster et al., 1989; Egeland & Sroufe, 1981; Egeland et al., 1983; van Ijzendoorn et al., 1999).

Overall, studies into PTSD and child outcomes have not investigated the relationship between PTSD, cortisol, ongoing mental health, parent-infant interactions and subsequent child outcomes. Given the unexpected result of lower emotional availability found in the trauma control group this chapter will also investigate where possible the differences between control, trauma control, and both ICD-10 only and DSM-IV PTSD groups.

The aim of this chapter is to investigate whether previous maternal trauma experiences negatively impacts on the child’s emerging language development at 19 and 24 months of
age, and emotional and behavioural self regulation at 24 months of age, in a middle class well educated sample. Further, this study aims to explore the relationships between maternal trauma experience, PTSD, ongoing maternal mental health, cortisol, and mother-infant interactions, as well as determine which variables best predicted poorer language development and emotional and behavioural problems. Specifically, it is hypothesised that:

1. maternal trauma experience will be related to poorer infant language development.
2. the impact of maternal trauma on language development will be mediated through mother-infant interactions and ongoing maternal mental health.
3. maternal PTSD will be associated with poorer emotional and behavioural outcomes.
4. the impact of maternal PTSD on child self regulation will be mediated through both ongoing maternal mental health and attachment.
5. low infant morning cortisol will be associated with externalising behaviours and poorer language acquisition.

In addition, gender differences will be explored where possible. However because several child outcome measures were maternal report comparisons of child outcomes with measures of maternal perceptions were not carried out.

7.1. Infants

There were 28 males (59.6%) and 19 females (40.4%) in the total group. As described in Chapter 4 there was a non-significant tendency for more male infants to be in the control group \(n = 14, 73.7\%\) compared with the trauma group as a whole \(n = 14, 50\%\). All infants reached at least 37 weeks gestation and no medical complications were reported. All infants included in the study were developing within the normal range at 13 months of age.

7.2. Language Development

Infant language development was assessed by the researcher using the Reynell Developmental Language Scales III (RDLS; Edwards et al., 1997) when the infants were 19
months of age and by maternal report using the Language Development Survey (LDS; Achenbach & Rescorla, 2000) when the infants were 24 months of age. The RDLS scales of Comprehension and Expressive language correlated modestly with LDS phrase length (r = .389, p<.05; r = .409, p<.01; respectively) and moderate to highly with LDS vocabulary (r = .597, p<.001; r = .606, p<.001; respectively). There were no correlations between infant temperament and language.

7.2.1. Examiner Assessed Language Development at 19 Months of Age
Valid scores from the Reynell Developmental Language Scales (RDLS; Edwards et al., 1997) measured when the infants were 19 months of age were available for 44 infants. The manual reported that up to the age of 3 years both the comprehension and expressive scales demonstrate differences in scores by gender, with girls scoring in the higher range. In the current study higher mean scores were found for girls on both scales, although neither scale reached significance (Table 7.1). There were modest but highly significant correlations between infant IQ (Griffiths Developmental Quotient measured at 13 months) and both comprehension (r = .396, p<.01) and expressive (r = .413, p=.005). Group analyses for the language scales were covaried for infant gender and IQ.

Table 7.1. Descriptive statistics of Reynell Developmental Language Scales by gender

<table>
<thead>
<tr>
<th>Language Scale</th>
<th>Gender</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female (n=19)</td>
<td>Male (n=25)</td>
</tr>
<tr>
<td>Comprehension</td>
<td>13.84 (5.35)</td>
<td>10.84 (6.83)</td>
</tr>
<tr>
<td>Expressive</td>
<td>5.84 (4.55)</td>
<td>4.08 (4.52)</td>
</tr>
</tbody>
</table>

Note: Reynell Developmental Language Scales III (Edwards et al., 1997)
7.2.1.1. Relationship to maternal trauma

No significant correlations were found between the DSM-IV PTSD symptoms reported post trauma and the Reynell comprehension and expressive language scales. Multivariate analyses with both comprehension and expressive language as dependent variables, with infant gender and developmental quotient as covariates, were carried out for the trauma group as a whole (Analysis 1), as well as by PTSD diagnosis (Analysis 2). The marginal means and standard errors for both comprehension and expressive language scores are shown in Table 7.2. The overall models for both analyses were highly significant with both gender and IQ being significant for both comprehension and expressive language, $F(2,41) = 7.54, p<.01; F(2,41) = 5.32, p<.05; F(2,41) = 11.22, p<.01; F(2,41) = 12.05, p<.01$; respectively for analysis 1. Analysis 1 demonstrated a significant group difference for both comprehension, $F(1,42) = 7.34, p<.05$, and expressive language, $F(1,42) = 5.52, p<.05$, with the trauma group demonstrating significantly lower levels of both comprehension and expressive language development compared to the control group. Analysis 2 also demonstrated a significant difference for the comprehension scale, $F(2,41) = 2.93, p<.05$, while the expressive language scale demonstrated a trend toward significance $F(2,41) = 2.65, p<.10$. As can be seen from the marginal means (Table 7.2) the picture is less clear for the individual trauma groups. For the comprehension scale both the trauma control and the PTSD (DSM-IV) groups are significantly lower than the control group. However, the PTSD (ICD-10) group is showing scores between the control group and the trauma control and PTSD groups. For the expressive language scales the trauma control group is significantly lower than the control group with both PTSD groups in between. These differences may reflect true differences or may be due to the low numbers in the individual PTSD groups. Overall the trauma control group is consistently lower than the control group on both comprehension and expressive language scales supporting the hypothesis that maternal trauma experience would be related to poorer language development in the infants.
Table 7.2. Estimated marginal means of the Reynell comprehension and expressive language variables, covaried for gender and IQ, for the control and trauma group as a whole, and in relation to PTSD diagnosis

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Comprehension</th>
<th>Expressive</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>RDLS Estimated Marginal Means (SE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analysis 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>18</td>
<td>14.81 (1.28)*</td>
<td>6.52 (.93)*</td>
</tr>
<tr>
<td>Trauma</td>
<td>26</td>
<td>10.27 (1.05)</td>
<td>3.65 (.77)</td>
</tr>
<tr>
<td><strong>Analysis 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>18</td>
<td>14.81 (1.28)*</td>
<td>6.52 (.93) †</td>
</tr>
<tr>
<td>Trauma control</td>
<td>15</td>
<td>9.94 (1.39)</td>
<td>2.69 (1.00)</td>
</tr>
<tr>
<td>PTSD (ICD-10)</td>
<td>6</td>
<td>12.60 (2.03)</td>
<td>4.67 (1.67)</td>
</tr>
<tr>
<td>PTSD (DSM-IV)</td>
<td>5</td>
<td>8.54 (2.43)</td>
<td>5.45 (1.76)</td>
</tr>
</tbody>
</table>

Note: Total $N = 44$; $SE =$ Standard Error; RDLS = Reynell Developmental Language Scales-III (Edwards et al., 1997); *= $p < .05$; †= $p < .10$

In relation to gender, boys in the trauma group had a greater reduction in mean scores for both comprehension and expression compared to the girls, with the girls in the trauma group resembling the boys in the control group. No significant interaction effect was found when the gender variable was used as a fixed factor in the multivariate analysis. This may be due to lack of power. Using dichotomous comprehension and expressive language variables (delayed = lowest quartile), chi-square analysis was marginally significant for boy’s comprehension, $\chi^2(1, N = 44) = 3.34, p = .051$, with 50% of boys in the trauma group also being in the delayed group compared to only 15.4% of the control group. For expressive language 42.9% of boys were in both the trauma and delayed group while 15.4% were in the
control and delayed group, although this did not reach significance. There were no significant differences for the girls, although the opposite pattern was found for expressive language with 40% of the control group being delayed and only 14.3% of the trauma group. Inspecting the comprehension and expressive language means for the separate trauma groups suggested that boys in the PTSD group had language levels around the same level as the trauma control group while girls with mothers with the disorder had language levels similar to the control group. Unfortunately the sample size is too small to investigate this difference further.

7.2.1.2. Relationship to ongoing maternal mental health
The Reynell comprehension and expressive language scores were partially correlated with maternal mental health measures, with infant gender and IQ as covariates. No measures of ongoing maternal mental health correlated with the comprehension or expressive language variable.

7.2.1.3. Relationship to measures of mother-infant interaction
This section assessed the associations between Reynell language scales and infant consolability (2 weeks), infant withdrawal (3 months), emotional availability (13 months) and infant attachment security (19 months). There were significant negative correlations between infant consolability (2 weeks) and Reynell expressive language ($r = -.435, p < .01$). There were no significant correlations between infant withdrawal and either language scale.

Multivariate analyses were carried out as above with Reynell comprehension and expressive scales as dependent variables and gender and IQ as covariates. Again both covariates were significant. There was a significant difference for expressive language, $F(2,41) = 3.48$, $p < .05$), and marginal significance for comprehension $F(2,41) = 3.06, p = .06$) for high, medium and low total emotional availability (EA) groups, measured at 13 months. As can be seen from the marginal means in Table 7.3 the high EA group infants have significantly
higher levels of expressive language compared to the low EA group, and marginally significant higher comprehension skills compared to both the medium and low EA groups. In relation to the EA subscales all the high groups out-scored the medium and low groups. However, only parental sensitivity reached significance for the expressive scale (Table 7.3), with the infants with highly sensitive mothers having significantly better developed language expression skills, $F(2,41) = 5.22, p<.05$.

Table 7.3. Estimated marginal means of the Reynell Comprehension and Expressive language variables, covaried for gender and IQ, for the high, medium and low emotional availability groups

<table>
<thead>
<tr>
<th>EA Groups</th>
<th>n</th>
<th>RDLS*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Comprehension</td>
</tr>
<tr>
<td>Total EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>17</td>
<td>14.85 (1.37)$\dagger$</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>10.91 (1.58)</td>
</tr>
<tr>
<td>Low</td>
<td>15</td>
<td>10.05 (1.48)</td>
</tr>
<tr>
<td>Parental Sensitivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>19</td>
<td>13.99 (1.37)</td>
</tr>
<tr>
<td>Medium</td>
<td>15</td>
<td>10.76 (1.46)</td>
</tr>
<tr>
<td>Low</td>
<td>10</td>
<td>10.67 (1.89)</td>
</tr>
</tbody>
</table>

Note: Total $N = 44$; $SE =$ Standard Error; * = Reynell Developmental Language Scales-III (Edwards et al., 1997); EA = Emotional Availability Scales (Biringen, Robinson, Emde, 1998) ** = $p<.01$, * = $p<.05$; $\dagger = p<.10$
Attachment security was measured concurrently with language skills and the marginal means are reported in Table 7.4. A significant difference was found for secure infants compared to insecure infants, $F(1,38) = 4.73, p<.05$, for comprehension, and a trend toward significance for expressive language, $F(1,38) = 2.89, p<.10$, with secure infants demonstrating better developed language skills. However, secure infants only demonstrated a trend toward having significantly higher comprehension compared to the insecure subgroups of avoidant and ambivalent infants, $F(2,37) = 2.41, p=.10$. Expressive language did not reach significance. Of note, the avoidant children demonstrated the lowest levels of comprehension while the ambivalent infants demonstrated the lowest level of expressive language. A larger sample may have found a significant difference between the subgroups. There were no significant differences between organised and disorganised infants on the Reynell language scales.

7.2.1.4.  Relationship to maternal and infant cortisol

Multivariate analyses with both comprehension and expressive language as dependent variables, with infant gender and developmental quotient as covariates, was carried out for the median split (low-high) infant and mother morning and evening cortisol groups. No significant group differences were found (Table 7.5). But there was a trend for infants in the high morning cortisol group (measured at 13 months) to have better developed expressive language, $F(1,36) = 2.76, p=.11$, at 19 months, compared to infants in the low morning cortisol group. In addition, high infant morning cortisol and high mother evening cortisol demonstrated higher levels of language comprehension, although they did not reach significance.

7.2.1.5.  Predictors of language development at 19 months of age

Hierarchical regression, with biological measures entered first and maternal mental health and mother-infant interactional measures entered second yielded similar results to the
Table 7.4. Estimated marginal means of the Reynell comprehension and expressive language variables, covaried for gender and IQ, for the attachment groups of secure-insecure, secure-avoidant-ambivalent, and organised-disorganised

<table>
<thead>
<tr>
<th>SSP Categories</th>
<th>n</th>
<th>Comprehension</th>
<th>Expressive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure</td>
<td>27</td>
<td>13.45 (1.04)*</td>
<td>5.53 (.80) †</td>
</tr>
<tr>
<td>Insecure</td>
<td>13</td>
<td>9.46 (1.50)</td>
<td>3.21 (1.12)</td>
</tr>
<tr>
<td>Secure</td>
<td>27</td>
<td>13.45 (1.04) †</td>
<td>5.53 (.80)</td>
</tr>
<tr>
<td>Avoidant</td>
<td>4</td>
<td>8.38 (1.05)</td>
<td>4.52 (2.13)</td>
</tr>
<tr>
<td>Ambivalent</td>
<td>9</td>
<td>9.94 (1.87)</td>
<td>2.61 (1.39)</td>
</tr>
<tr>
<td>Organised</td>
<td>36</td>
<td>12.06 (.96)</td>
<td>4.71 (.70)</td>
</tr>
<tr>
<td>Disorganised</td>
<td>4</td>
<td>12.96 (2.92)</td>
<td>5.39 (2.13)</td>
</tr>
</tbody>
</table>

Note: Total N = 40; SE = Standard Error; RDLS = Reynell Developmental Language Scales-III (Edwards et al., 1997); SSP = Strange Situation Procedure (Ainsworth et al., 1978); ** = p <.01, * = p <.05; † = p <.10

standard method of entering all variables simultaneously. Therefore the results are reported using the standard simultaneous regression. Variables were selected for each regression based on the above reported relationships. However infant gender, infant IQ, maternal trauma experience, infant consolability (2 weeks), dyadic emotional availability (13 months), infant attachment security (19 months), and infant and mother morning cortisol were all associated with Reynell language scores. The variable numbers needed to be limited due to the sample size. Emotional availability scores were significantly correlated with both infant consolability
Table 7.5. Estimated marginal means of the Reynell comprehension and expressive language variables for infant and mother high-low groups, covaried for gender and IQ

<table>
<thead>
<tr>
<th>Cortisol</th>
<th>n</th>
<th>RDLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(SE)</td>
</tr>
<tr>
<td></td>
<td>Comprehension</td>
<td>Expressive</td>
</tr>
<tr>
<td>Infant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>Low 19</td>
<td>10.53 (1.35)</td>
</tr>
<tr>
<td></td>
<td>High 18</td>
<td>13.42 (1.35)</td>
</tr>
<tr>
<td>Evening</td>
<td>Low 21</td>
<td>12.27 (1.32)</td>
</tr>
<tr>
<td></td>
<td>High 19</td>
<td>11.71 (1.39)</td>
</tr>
<tr>
<td>Mother</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>Low 20</td>
<td>12.34 (1.32)</td>
</tr>
<tr>
<td></td>
<td>High 22</td>
<td>11.90 (1.26)</td>
</tr>
<tr>
<td>Evening</td>
<td>Low 20</td>
<td>10.72 (1.28)</td>
</tr>
<tr>
<td></td>
<td>High 20</td>
<td>13.53 (1.28)</td>
</tr>
</tbody>
</table>

Note; RDLS = Reynell Developmental Language Scales-III (Edwards et al., 1997); SE = Standard Error; †= p<.10

and attachment security. Infant consolability and EA total scores were moderately correlated. Emotional availability did not account for any additional variance with Consolability and attachment security in the equation, therefore EA was dropped from the analyses. Child morning cortisol dichotomous high-low variable was used as it was associated with both comprehension and expressive language, whereas mother morning cortisol was only associated with expressive language. Using the six variables infant gender, IQ, morning cortisol, consolability, attachment security, and maternal trauma experience reduced the listwise sample number to 30.
The model predicted approximately 69.2% of the child’s language comprehension at age 19 months (Table 7.6). Variables that showed significant beta coefficients were gender, infant IQ, maternal trauma experience, and high-low child morning cortisol. In addition, infant attachment security neared significance. The negative beta coefficient indicated that both trauma experience and insecure attachment status were associated with lower language comprehension, while the positive beta coefficient for gender and cortisol indicated that girls and children in the high morning cortisol group had better developed language comprehension. Approximately 30% of the variance was accounted for by the variables other than gender and IQ.

The same model accounted for 64% of the variance on the infant expressive language scale, with gender, infant IQ, child morning cortisol and maternal trauma experience having significant to marginally significant beta coefficients, and infant consolability trending toward significant beta coefficients. Approximately 34% of the variance was accounted for by variables other than gender and IQ. Of interest, if EA or consolability are included in the model separately they both demonstrate a significant beta coefficient, with the positive coefficient for EA indicating that those dyads with higher emotional sensitive interactions had better expressive language skills, whereas the negative coefficient for consolability indicated that infants who required more rocking and holding to quieten at 2 weeks were associated with better expressive language development. Overall, at 19 months approximately 65% of the variance in the infants’ language comprehension and expression scores was accounted for by infant gender, IQ, consolability, morning cortisol, attachment, and maternal trauma experience, with approximately 30% of the variance being accounted for by variables other than infant gender and IQ.
Table 7.6. Regression analysis of RDLS comprehension and expressive language variables

<table>
<thead>
<tr>
<th>RDLS</th>
<th>Dependant variable</th>
<th>Predictor variables</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$R^2$</td>
</tr>
<tr>
<td>Comprehension</td>
<td></td>
<td></td>
<td>.692</td>
</tr>
<tr>
<td>$N=30$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td></td>
<td>.484</td>
</tr>
<tr>
<td></td>
<td>Infant IQ</td>
<td></td>
<td>.550</td>
</tr>
<tr>
<td></td>
<td>No trauma/trauma</td>
<td></td>
<td>-.448</td>
</tr>
<tr>
<td></td>
<td>Consolability$^a$</td>
<td></td>
<td>-.104</td>
</tr>
<tr>
<td></td>
<td>Secure/insecure¹</td>
<td></td>
<td>-.225</td>
</tr>
<tr>
<td></td>
<td>Child morning cortisol (H/L)$^2$</td>
<td></td>
<td>.263</td>
</tr>
</tbody>
</table>

|          |                   |                     | $R^2$  | $F$ | Sig. |
| Expressive language |                   |                     | .640  | 6.509 | .000 |
| $N=30$   |                   |                     |        |      |      |
|          | Gender            |                     | .304  | 2.141 | .044 |
|          | Infant IQ         |                     | .570  | 4.155 | .000 |
|          | No trauma/trauma  |                     | -.311 | -2.021| .056 |
|          | Consolability$^a$ |                     | -.259 | -1.814| .083 |
|          | Secure/insecure¹ |                     | -.181 | -1.357| .188 |
|          | Child morning cortisol (H/L)$^2$ | | .283  | 2.072 | .050 |

Note: RDLS = Reynell Developmental Language Scales-III (Edwards et al., 1997); IQ = General Developmental Quotients, Griffiths Mental Development Scales (Griffiths & Huntley, 1996). $^a$ = Combined NACS and NBAS Consolability measures (Linke, 2002); $¹$ = Strange Situation Procedure (Ainsworth et al., 1978); $²$ = dichotomous 50% split High – Low
7.2.2. Maternal Report of Language Development at 24 Months of Age

The children’s language development was assessed at 24 months using the Language Development Survey (Achenbach & Rescorla, 2000). Means and standard deviations for males and females are shown in Table 7.7. Average phrase length ($r = .450$, $p < .005$) and total vocabulary ($r = .510$, $p < .001$) were positively correlated with infant IQ. Raw scores for both total Vocabulary score and average phrase length were used and covaried for gender and IQ. Variables were also dichotomised by placing the lowest 25% in the ‘delayed’ group compared to ‘normal’ development.

Table 7.7. Descriptive statistics of Achenbach Language Development Survey raw scores by gender

<table>
<thead>
<tr>
<th>LDS</th>
<th>Gender</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Male ($n=23$)</td>
</tr>
<tr>
<td>Phrase Length</td>
<td>4.16 (1.65)</td>
<td>3.28 (1.81)</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>217.00 (63.78)</td>
<td>166.39 (87.83)</td>
</tr>
</tbody>
</table>

Note: LDS = Language Development Survey (Achenbach & Rescorla, 2000)

7.2.2.1. Relationship to maternal trauma

No significant correlations were found between the DSM-IV PTSD symptoms reported post trauma and the language survey. Multivariate analysis with both phrase length and vocabulary as dependent variables, with infant gender and developmental quotient as covariates, was carried out for the Trauma group as a whole (analysis 1), as well as by PTSD diagnosis (analysis 2). The marginal means and standard errors for both phrase length
and vocabulary scores are shown in Table 7.8. The overall model for both analyses was highly significant with both gender and IQ being significant for both phrase length, $F(3,37) = 6.09, p<.05$; $F(3,37) = 8.82, p<.01$; respectively, and vocabulary, $F(3,37) = 12.76, p<.01$; $F(3,37) = 11.78, p<.001$; respectively. There were no significant trauma group differences (analysis 1) found for vocabulary, although phrase length neared significance, $F(1.39) = 2.89, p<.10$). As can be seen in Table 7.8 the PTSD (DSM-IV) and control groups had the highest mean scores for phrase length and the PTSD (ICD-10) and trauma control groups the lowest. For the vocabulary scale the PTSD (DSM-IV) demonstrated the highest scores with the trauma control the lowest. The large variation and small group numbers both impact on the power of these analyses. In line with the Reynell expressive scale the vocabulary scale was the lowest for the trauma control group. There were no significant differences between dichotomous delayed-normal language survey variables and trauma groups. These results only give partial support to the hypothesis that maternal trauma experience is associated with poorer child language development. No significant interaction was found using gender as a fixed factor, nor were any significant differences found using the dichotomous delay-normal variable for either gender or trauma-no trauma groups. However, inspecting the means for the separate trauma groups suggested that boys in the PTSD group had language levels around the same level as the trauma control group while girls with mothers with the disorder had language levels similar to the control group. This is a similar pattern found with the Reynell language variables at 19 months, unfortunately the sample size is too small to investigate this difference statistically.

7.2.2.2. Relationship to ongoing maternal mental health

The Language Development Survey (LDS) scales, covaried with infant gender and IQ, were correlated with combined maternal mental health measured from perinatal period and over the infant’s second year of life. No significant correlations were found for either of the
Table 7.8. Estimated marginal means of the LDS average phrase length and total vocabulary raw scores, covaried for gender and IQ, for the control and trauma group as a whole, and in relation to PTSD diagnosis

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>LDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phrase length</td>
</tr>
<tr>
<td>Analysis 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>4.14 (.38)</td>
</tr>
<tr>
<td>Trauma</td>
<td>25</td>
<td>3.32 (.30)†</td>
</tr>
<tr>
<td>Analysis 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>4.14 (.38)</td>
</tr>
<tr>
<td>Trauma control</td>
<td>14</td>
<td>3.00 (.40)</td>
</tr>
<tr>
<td>PTSD (ICD-10)</td>
<td>6</td>
<td>3.35 (.64)</td>
</tr>
<tr>
<td>PTSD (DSM-IV)</td>
<td>5</td>
<td>4.19 (.67)</td>
</tr>
</tbody>
</table>

Note: Total N = 41; SE = Standard Error; LDS = Language Development Survey (Achenbach & Rescorla, 2000); † = p<.10

current posttrauma symptom measures. Although, there was a significant correlation between perinatal GHQ anxiety (r = .376, p<.05), and perinatal GHQ total (r = .417, p<.01) and the LDS vocabulary scale. Investigating the individual perinatal assessments found the significant correlations for the GHQ total in the pre-birth period (r = .394, p<.05) and when the infants were 2 weeks old (r = .332, p<.05). The positive direction of the correlations indicates higher GHQ scores were related to higher vocabulary scores. This is in line with the above results where the DSM-IV PTSD group reported the highest infant vocabulary, as well as being the group who reported the highest level of mental health symptoms.
There were no significant correlations found between LDS scores for infants consolability at 2 weeks, or infant withdrawn at 3 months of age. Multivariate analysis again found significant differences for infant gender and IQ. In addition, there were a range of significant findings for the Emotional Availability (EA) scale measured at 13 months of age. As can be seen in Table 7.9 all ‘high’ EA groups demonstrated higher LDS scores for both vocabulary and phrase length for all the scales, but not all comparisons reached significance. Dyads in the high EA group had mothers who reported significantly higher infant vocabulary scores at 24 months compared to low EA dyads, $F(1,40) = 3.94, p=.05$, and demonstrated a trend toward longer phrase length, $F(1,40) = 2.81, p=.10$. A similar pattern was found for the parental sensitivity scale with the mothers who demonstrated significantly higher levels of sensitivity reporting higher infant vocabulary scores $F(1,40) = 5.20, p<.05$, and near significance for phrase length $F(1,40) = 3.22, p<.10$. The high parental structuring variable only demonstrated a trend toward significance for the language survey vocabulary scale, $F(1,40) = 3.28, p<.10$, whereas mothers who demonstrated higher levels of intrusiveness and hostility reported significantly shorter average phrase length for their infants, $F(1,40) = 4.22, p<.05; F(1,40) = 4.79, p<.05$, respectively. A significant difference was found for child involvement, $F(1,40) = 4.85, p<.05$, and near significance for child responsiveness $F(1,40) = 3.25, p<.10$, with those demonstrating higher levels having higher vocabulary scores. There was also a trend toward less involved children having shorter average phrase lengths, $F(1,40) = 3.29, p<.10$. No significant differences were found for language development assessed using the language survey for secure compared to insecure infants, or organised compared to disorganised infants. However, the secure infants scored higher on both phrase length and vocabulary scores (Table 7.10).
Table 7.9. Estimated marginal means of the Reynell comprehension and expressive language variables, covaried for gender and IQ, for the high and low emotional availability groups

<table>
<thead>
<tr>
<th>EA Scales</th>
<th>n</th>
<th>LDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>20</td>
<td>4.06 (.35) †</td>
</tr>
<tr>
<td>Low</td>
<td>22</td>
<td>3.20 (.35)</td>
</tr>
<tr>
<td>Parental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>25</td>
<td>4.03 (.31) †</td>
</tr>
<tr>
<td>Low</td>
<td>17</td>
<td>3.09 (.38)</td>
</tr>
<tr>
<td>Structuring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>24</td>
<td>3.93 (.36)</td>
</tr>
<tr>
<td>Low</td>
<td>18</td>
<td>3.29 (.36)</td>
</tr>
<tr>
<td>Non-intrusiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>24</td>
<td>4.07 (.30) *</td>
</tr>
<tr>
<td>Low</td>
<td>18</td>
<td>3.09 (.35)</td>
</tr>
<tr>
<td>Non-hostility</td>
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<td></td>
</tr>
<tr>
<td>High</td>
<td>29</td>
<td>3.99 (.27) *</td>
</tr>
<tr>
<td>Low</td>
<td>13</td>
<td>2.89 (.41)</td>
</tr>
<tr>
<td>Child</td>
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</tr>
<tr>
<td>Responsiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>29</td>
<td>3.87 (.29)</td>
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<tr>
<td>Low</td>
<td>13</td>
<td>3.17 (.44)</td>
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<tr>
<td>Involvement</td>
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<td>High</td>
<td>25</td>
<td>4.02 (.30) †</td>
</tr>
<tr>
<td>Low</td>
<td>17</td>
<td>3.11 (.37)</td>
</tr>
</tbody>
</table>

Note: Total N = 42; SE = Standard Error; Language Development Survey (LDS; Achenbach & Rescorla, 2000); EA = Emotional Availability Scales (Biringen, Robinson, Emde, 1998) * = p < .05; † = p < .10
Table 7.10. Estimated marginal means of the Language Development Survey scales, covaried for gender and IQ, for the attachment groups of secure-insecure, secure-avoidant-ambivalent, and organised-disorganised

<table>
<thead>
<tr>
<th>SSP Categories</th>
<th>n</th>
<th>LDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phrase length</td>
</tr>
<tr>
<td>Secure</td>
<td>26</td>
<td>3.83 (.31)</td>
</tr>
<tr>
<td>Insecure</td>
<td>12</td>
<td>3.38 (.46)</td>
</tr>
<tr>
<td>Secure</td>
<td>26</td>
<td>3.83 (.32)</td>
</tr>
<tr>
<td>Avoidant</td>
<td>4</td>
<td>3.67 (.85)</td>
</tr>
<tr>
<td>Ambivalent</td>
<td>8</td>
<td>3.24 (.59)</td>
</tr>
<tr>
<td>Organised</td>
<td>34</td>
<td>3.69 (.28)</td>
</tr>
<tr>
<td>Disorganised</td>
<td>4</td>
<td>3.63 (.82)</td>
</tr>
</tbody>
</table>

Note: Total N = 38; SE = Standard Error; Language Development Survey (LDS; Achenbach & Rescorla, 2000); SSP = Strange Situation Procedure (Ainsworth et al., 1978)

7.2.2.4. Relationship to maternal and infant cortisol

Multivariate analysis with both LDS phrase length and vocabulary as dependent variables, and infant gender and developmental quotient as covariates, was carried out for the median split (low-high) infant and mother morning and evening cortisol groups. A significant group difference with the low infant evening cortisol group demonstrating longer phrase lengths compared to the high cortisol group, $F(1,36) = 6.28, p<.05$, and a near significant difference for larger vocabulary, $F(1,36) = 2.89, p<.10$, (Table 7.11). Conversely the low mother morning cortisol group demonstrated significantly greater vocabulary scores, $F(1,38) = 6.78$, (Table 7.11).
Table 7.11. Estimated marginal means of the Language Developmental Survey, covaried for gender and IQ, for infant and mother high-low groups

<table>
<thead>
<tr>
<th>Cortisol</th>
<th>n</th>
<th>LDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Estimated marginal means (SE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phrase length</td>
</tr>
<tr>
<td><strong>Infant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>Low</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>17</td>
</tr>
<tr>
<td>Evening</td>
<td>Low</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>18</td>
</tr>
<tr>
<td><strong>Mother</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>Low</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>21</td>
</tr>
<tr>
<td>Evening</td>
<td>Low</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Language Development Survey (LDS; Achenbach & Rescorla, 2000); SE = Standard Error; **= p<.01; *= p<.05; †= p<.10

$p=.01$, but not longer phrase length. Significant group differences were also found for mother total and mother difference cortisol measures with the lower cortisol group having a significantly larger vocabulary scores, $F(1,36) = 5.93$, $p<.05$, and $F(1,36) = 6.11$, $p<.05$, respectively (results not shown). Lower mother total also was significantly associated with longer phrase length, $F(1,36) = 9.46$, $p<.05$; results not shown. In addition, low child total cortisol was significantly associated with longer phrase length, $F(1,33) = 4.16$, $p=.05$.

Mothers morning cortisol and infant evening cortisol were significantly correlated (Chapter 5) suggesting that mothers with high morning cortisol had infants with high evening cortisol.
Overall, the results suggest that infants who demonstrate high evening cortisol levels, and/or have mothers who had high cortisol across the day have lower levels of maternally reported language development.

7.2.2.5. Predictors of language development at 24 months of age

The variables found to be associated with the maternal report language development were infant gender and IQ, maternal trauma experience (phrase length only) and dyadic emotional availability, perinatal GHQ (vocabulary only), as well as child evening cortisol (high-low) and mother morning cortisol (high-low). Listwise there were 34 dyads with a complete set of data. Given the strength of the association between cortisol and the LDS scales the continuous cortisol variables were used in the regression analyses. The model predicted 63% of the infants average phrase length at 24 months of age (Table 7.12). The infant gender, IQ and evening cortisol levels demonstrated significant beta coefficients, with maternal trauma experience, dyadic EA, and mother morning cortisol values all demonstrating marginal significance. Approximately 30% of the variance was predicted without infant gender or IQ (analysis not shown). The negative beta coefficient for maternal trauma indicated that trauma experience was related to lower vocabulary scores, whereas the negative beta coefficients for the cortisol measures indicated that lower cortisol was associated with higher vocabulary.

The model accounted for 66.8% of the variance in infant vocabulary size (Table 7.12). Infant gender and IQ, and mother morning cortisol levels demonstrated significant beta coefficients, with maternal perinatal GHQ trending toward significance. Approximately 30% of the vocabulary score variance was accounted for by the model without infant gender and IQ. Analysing the trauma group alone did not find a significant effect with the inclusion of PTSD-no PTSD groups.
Table 7.12. Regression analysis of Language Development Survey variables

<table>
<thead>
<tr>
<th>LDS</th>
<th>Dependant variable</th>
<th>Predictor variables</th>
<th>Statistics</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>R²</td>
<td>F</td>
<td>Sig.</td>
<td></td>
</tr>
<tr>
<td>Phrase length</td>
<td></td>
<td></td>
<td>.630</td>
<td>7.675</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>N=34</td>
<td></td>
<td>Gender</td>
<td>.504</td>
<td>3.923</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IQ</td>
<td>.490</td>
<td>3.510</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No trauma/trauma</td>
<td>-.252</td>
<td>-1.820</td>
<td>.065</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EA total</td>
<td>.268</td>
<td>1.828</td>
<td>.079</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child evening cortisol¹</td>
<td>-.254</td>
<td>-2.116</td>
<td>.044</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mother morning cortisol¹</td>
<td>-.232</td>
<td>-1.850</td>
<td>.075</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td></td>
<td></td>
<td>.668</td>
<td>8.953</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>N=34</td>
<td></td>
<td>Gender</td>
<td>.382</td>
<td>3.135</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IQ</td>
<td>.607</td>
<td>4.647</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EA total</td>
<td>.203</td>
<td>1.546</td>
<td>.134</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child evening cortisol¹</td>
<td>-.107</td>
<td>-.924</td>
<td>.364</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mother morning cortisol¹</td>
<td>-.252</td>
<td>-2.127</td>
<td>.043</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perinatal GHQ</td>
<td>.237</td>
<td>1.993</td>
<td>.056</td>
<td></td>
</tr>
</tbody>
</table>

Note: LDS = Language Development Survey (Achenbach & Rescorla, 2000); IQ = General Developmental Quotients, Griffiths Mental Development Scales (Griffiths & Huntley, 1996); EA = Emotional Availability scales (Biringen, Robinson, Emde, 1998); ¹ = dichotomous 50% median High Low split
7.2.3. Maternal-infant Interactions as Mediators between Maternal Trauma and Language Outcomes

A series of regression analyses were undertaken to determine whether the effect of trauma on language outcomes was mediated through any one specific mother-infant interaction scale (Baron & Kenny, 1986). However maternal trauma experience was not found to be a significant predictor of language development alone, despite being significant in the regression analyses for Reynell comprehension and expressive language scales, as well as demonstrating significant group differences. Another possibility is that maternal-infant interactions moderate the effect of maternal trauma and/or posttraumatic stress on child outcomes. However using 2X2 ANOVAs did not find any significant interactional effects.

7.3. Emotional and Behavioural Development at 24 Months of Age

Forty two mothers completed the Child Behaviour Checklist for Ages 1½-5 (CBCL) (Achenbach & Rescorla, 2000) in relation to their child’s behaviour at 24 months of age. Very few children’s reported level of behaviour reached borderline or clinical significance. Three children reached clinical significance on the total behavioural scale and a further three reached the borderline clinical range. One child reached the ‘clinical’ range and one the borderline range for internalising behavioural problems, while four reached clinical range for externalising behavioural problems with a further three reaching the borderline range. There was a significant negative correlation for IQ and internalising ($r = -.401, p<.01$) and total CBCL scores ($r = -.318, p<.05$), and a trend toward significance for externalising behaviours ($r = -.261, p<.10$). There were no significant gender differences. It was decided not to use IQ as a covariate as behaviour is not expected to be constrained by normal range of intellectual functioning.

There were significant correlations between the temperament dimension of emotionality and CBCL total ($r = .559, p<.001$), externalising ($r = .464, p<.01$) and internalising behaviours ($r$
In addition, activity was associated with Externalising behaviour ($r = .350$, $p < .05$), and Shyness was associated with Total and Internalising summary scores ($r = .349$, $p < .05$; $r = .358$, $p < .05$; respectively). Both the EAS temperament scale and the CBCL were rated by the mothers when their infants were 24 months old. It was therefore expected that there would be significant correlations between the two measures. Infant temperament was not used as a predictor of child emotional and behavioural problems.

7.3.1. Relationship to Maternal Trauma

No significant correlations were found between maternal DSM-IV PTSD symptoms reported posttrauma and CBCL summary scores. The control and trauma groups did not demonstrate any significant differences on the total, internalising, or externalising scores from the CBCL. Both ICD-10 and DSM-IV groups demonstrated similar scores on all CBCL measures and therefore the PTSD groups were combined for further analyses. As can be seen in Table 7.13 the PTSD group consistently scored highest and the trauma control groups lowest on all measures supporting the hypothesis that maternal posttraumatic stress disorder would be associated with poorer infant self regulation. This reached marginal significance for the total CBCL score with post hoc analysis indicating that the PTSD group was significantly different from the trauma control group ($p < .05$). There were no significant correlations between the behavioural checklist summary scores and the number of traumas experienced by the mother or the number of symptoms experienced post trauma. However, chi-square analyses using dichotomous CBCL summary scores (case—top 25%; no case—bottom 75%) and trauma groups found similar levels of cases in the control and PTSD groups for all three behavioural checklist summary scores.
Table 7.13. One-way ANOVA analyses of CBCL summary scores and trauma groups

<table>
<thead>
<tr>
<th>CBCL scale</th>
<th>Control (n=17)</th>
<th>Trauma control (n=14)</th>
<th>PTSD (n=11)</th>
<th>F Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internalising</td>
<td>5.41 (3.39)</td>
<td>3.93 (4.65)</td>
<td>7.36 (3.58)</td>
<td>2.39†</td>
</tr>
<tr>
<td>Externalising</td>
<td>12.59 (6.48)</td>
<td>10.14 (6.84)</td>
<td>15.36 (6.64)</td>
<td>1.91</td>
</tr>
<tr>
<td>Total</td>
<td>29.94 (15.47)</td>
<td>22.36 (16.31)</td>
<td>38.45 (15.80)</td>
<td>3.19*</td>
</tr>
</tbody>
</table>

Note: N = 42; CBCL = Child Behaviour Checklist (Achenbach & Rescorla, 2000); PTSD = combined ICD-10 and DSM-IV; * = p = .05; † = p = .10

In relation to ‘gender’, no interactional effects were found using gender as a fixed factor. No significant differences were found using the dichotomous variables of ‘case’ (top 25%) versus ‘no case’ (bottom 75%) and trauma-no trauma groups. Gender was divided equally for those children who scored in the top 25% of the summary scores. Unexpectedly, the majority of the boys (80%) were in the control group, while 80% of the girls were in the trauma group. However, significance was not reached due to low cell numbers, therefore caution needs to be taken in interpreting this result.

7.3.2. Relationship to Ongoing Maternal Mental Health

Maternal psychological distress and current trauma symptoms from the perinatal period and during the infants second year of life were correlated with the CBCL summary scores (Table 7.14). Significant positive correlations were found between maternal current trauma symptoms (PCL) throughout the study and the behavioural checklist internalising and total scores, indicating the higher current maternal trauma symptoms the greater the maternal reported internalising and total behavioural scores. Perinatal social dysfunction, severe
Table 7.14. Correlations of perinatal and second year summary scores for maternal mental health and CBCL total and subscale scores

<table>
<thead>
<tr>
<th>Mental health measures</th>
<th>Internalising</th>
<th>CBCL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Internalising</td>
</tr>
<tr>
<td>Perinatal PCL</td>
<td>.306*</td>
<td>.274</td>
</tr>
<tr>
<td>2nd Year PCL</td>
<td>.371*</td>
<td>.295</td>
</tr>
<tr>
<td>Perinatal GHQ SS</td>
<td>.249</td>
<td>.244</td>
</tr>
<tr>
<td>GHQ An/Ins</td>
<td>.171</td>
<td>.161</td>
</tr>
<tr>
<td>GHQ SDys</td>
<td>.348*</td>
<td>.339*</td>
</tr>
<tr>
<td>GHQ SDep</td>
<td>.372*</td>
<td>.478**</td>
</tr>
<tr>
<td>GHQ total</td>
<td>.401**</td>
<td>.419**</td>
</tr>
<tr>
<td>2nd Year GHQ SS</td>
<td>.499**</td>
<td>.448**</td>
</tr>
<tr>
<td>GHQ An/Ins</td>
<td>.446**</td>
<td>.331*</td>
</tr>
<tr>
<td>GHQ SDys</td>
<td>.320*</td>
<td>.262</td>
</tr>
<tr>
<td>GHQ SDep</td>
<td>.351*</td>
<td>.419**</td>
</tr>
<tr>
<td>GHQ total</td>
<td>.486**</td>
<td>.413**</td>
</tr>
<tr>
<td>T4 EPDS</td>
<td>.287</td>
<td>.129</td>
</tr>
</tbody>
</table>

Note: \( N = 37; \) CBCL = Child Behaviour Checklist for Ages 1½-5 (CBCL; Achenbach & Rescorla, 2000); PCL = log transformed Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers et al., 1994); GHQ = General Health Questionnaire 28 items (Goldberg, 1978); Perinatal = combined scores for assessment T1, T2, and T3; 2nd Year = combined assessment periods T4, T5, and T6; ** = \( p < .01; \) * = \( p < .05 \)

depression and GHQ total scores were associated with internalising, externalising and total CBCL behaviour scores. Further, all the GHQ subscales and the total score for the second year positively correlated with the CBCL summary scores, with somatic symptoms and total GHQ scores demonstrating the highest correlations. These results are in line with the above
result of greater problem scores in the PTSD group, as this PTSD group also reported the highest level of ongoing mental health over the course of the study (Chapter 4). The postnatal depression specific measure of EPDS did not significantly correlate with CBCL summary scores.

Group comparisons were also conducted for the mother’s ongoing trauma symptoms and general psychological distress for both the perinatal period and the second year of the infant’s life in relation to the dichotomised CBCL summary scores. The CBCL internalising, externalising and total problem scores were dichotomised by dividing each into ‘normal’ and ‘problem’ scores (upper quartile). As shown in Table 7.15 the problem CBCL scores were higher for all mental health measures, reaching significance for perinatal PCL ($t = -2.25; p<.05$) and GHQ ($t = -2.04, p<.05$) scores, as well as second year PCL ($t = -2.30, p<.05$)) and GHQ ($t = -2.21, p<.05$) scores. Externalising problems also demonstrated significant group differences for GHQ in both the perinatal and second year ($t = -2.08, p<.05; t = -2.78, p<.01$; respectively) and a trend toward significance for the PCL during the second year ($t = -1.75, p<.10$). Total CBCL scores were significant for GHQ ($t = -2.45, p<.05$) in the second year only. No significant differences were found in the number of infants in the top quartile for any of the CBCL summary scores for each trauma group.

The work by O’Connor and associates (O’Connor, Heron, & Glover, 2002; O’Connor et al., 2003) and Van den Bergh and Marcoen (2004) have found that maternal anxiety during pregnancy is related to later child emotional and behavioural problems even after controlling for maternal depression during pregnancy and later maternal anxiety and depression. To test whether maternal trauma symptoms present during pregnancy impacted upon later child problems of self regulation the group was divided into high and low antenatal posttraumatic stress symptom (PCL) groups. Multivariate analysis was carried out using CBCL summary scores as the dependent variables and controlling for maternal general psychological distress.
Table 7.15.  Group comparisons for normal and problem CBCL scores and ongoing maternal mental health variables

<table>
<thead>
<tr>
<th></th>
<th>Internalising</th>
<th>Externalising</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>normal</td>
<td>problem</td>
<td>normal</td>
</tr>
<tr>
<td>PCL</td>
<td>2.47 (.99)*</td>
<td>3.17 (.66)</td>
<td>2.51 (.92)</td>
</tr>
<tr>
<td></td>
<td>2.06 (1.07)*</td>
<td>2.87 (.97)</td>
<td>2.08 (1.07)†</td>
</tr>
<tr>
<td>GHQ Total</td>
<td>14.85 (10.12)*</td>
<td>21.48 (98.48)</td>
<td>14.52 (10.00)*</td>
</tr>
<tr>
<td></td>
<td>8.28 (8.19)*</td>
<td>15.17 (12.12)</td>
<td>7.56 (8.18)**</td>
</tr>
<tr>
<td>EPDS</td>
<td>3.97 (4.14)</td>
<td>5.70 (3.33)</td>
<td>4.10 (4.08)</td>
</tr>
</tbody>
</table>

Note: N = 37; N = normal; P = problem; CBCL = Child Behaviour Checklist for Ages 1½-5 (CBCL; Achenbach & Rescorla, 2000); normal = lowest 75%; problem = highest 25%; PCL = log transformed Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers et al., 1994); GHQ = General Health Questionnaire 28 items (Goldberg, 1978); Perinatal = combined scores for assessment T1, T2, and T3; 2nd Year = combined assessment periods T4, T5, and T6; EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987); **= p<.01; *= p<.05; †= p<.1
during pregnancy, 2 weeks, and 3 months postnatally, as well as the combined mother’s GHQ scores for the second year of the child’s life. In addition, PCL scores over the same time frame were also controlled. The overall model was highly significant for CBCL total, $F(2,39) = 3.73, p<.005$, internalising, $F(2,39) = 4.55, p<.005$, and externalising, $F(2,39) = 3.71, p<.005$, summary scores. Significant PCL high-low group differences were also found for each CBCL total, internalising, and externalising scores (Table 7.16). In addition, maternal PCL scores 2 weeks postnatally were significant for CBCL total, $F(2,39) = 7.83, p<.01$, internalising $F(2,39) = 9.539, p<.005$, and externalising $F(2,39) = 10.21, p<.005$ scores, and GHQ scores during the infants second year were significant for CBCL internalising, $F(2,39) = 6.42, p<.005$, and externalising, $F(2,39) = 4.27, p<.05$, and neared significance for total scores, $F(2,39) = 3.34, p<.10$.

7.3.2.1. Mental health as mediator or moderator of child self regulation

Mental health as a mediator of the impact of trauma on child self regulation was assessed using antenatal PCL scores as a proxy for PTSD to enable the whole sample to be used. A series of regressions ($N= 41$) were carried out as described by Baron and Kenny (1986). Firstly, the perinatal GHQ was regressed on antenatal PCL scores, antenatal PCL scores accounting for 36.5% of perinatal GHQ scores $F(1,44) = 25.32, p<.001$. Secondly, CBCL total scores were regressed on antenatal PCL scores accounting for 15.2% of the variance in CBCL total scores, $F(1,39) = 6.99, p<.05$. Thirdly, CBCL total scores were regressed on both antenatal PCL and perinatal GHQ with perinatal GHQ ($t = 2.53, p=.02$) significantly predicting CBCL total scores, whereas antenatal PCL scores were no longer significant ($t = .93, p=.36$). Because PCL no longer is a significant predictor of the CBCL total scores it is assumed that the effect of PTSD is mediated through maternal mental health.
No evidence was found for maternal mental health acting as a moderator between trauma experience and child self regulation as no interaction effects were found for trauma groups and dichotomous mental health variables in 2x2 ANOVAs.

Table 7.16. CBCL marginal means, standard errors and multivariate statistics for high and low antenatal PCL groups controlled for general psychological distress in the antenatal and postnatal periods as well as post traumatic stress symptoms in the postnatal period

<table>
<thead>
<tr>
<th>CBCL scores</th>
<th>PCL groups</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low (n=21)</td>
<td>High (n=21)</td>
</tr>
<tr>
<td>Marginal mean (SE)</td>
<td>Marginal mean (SE)</td>
<td></td>
</tr>
<tr>
<td>Totalª</td>
<td>21.76 (3.67)</td>
<td>38.45 (3.80)</td>
</tr>
<tr>
<td>Internalisingª</td>
<td>2.95 (.85)</td>
<td>8.10 (.88)</td>
</tr>
<tr>
<td>Externalisingª</td>
<td>9.07 (1.50)</td>
<td>16.33 (1.55)</td>
</tr>
</tbody>
</table>

Note: ª = estimated marginal means after controlling for prenatal GHQ, and postnatal GHQ and PCL at 2 weeks, 3 months, and during the second year (combined T4,T5 & T6); CBCL = Child Behaviour Checklist (Achenbach & Rescorla, 2000); PCL = log transformed Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers et al., 1994); GHQ = General Health Questionnaire 28 items (Goldberg, 1978)

7.3.3. Relationship to Measures of Mother-Infant Interaction

No significant differences were found between the continuous consolability variable, nor the dichotomous or continuous variables of infant withdrawal and emotional availability and the dichotomous (top 25%) or continuous Child behavioural Checklist summary scores. However differences were seen for attachment security classifications with secure and organised infants consistently having lower mean internalising, externalising and total CBCL score (Table 7.17). Both avoidant and disorganised children had the highest internalising scores. But only externalising behaviours reached significance for insecure children compared to
Table 7.17. Means and standard deviations of the CBCL summary scores for the attachment groups of secure-insecure, secure-avoidant-ambivalent, and organised-disorganised

<table>
<thead>
<tr>
<th>SSP Categories</th>
<th>n</th>
<th>CBCL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Internalising</td>
<td>Externalising</td>
</tr>
<tr>
<td>Secure</td>
<td>26</td>
<td>5.08 (4.23)</td>
<td>11.08 (6.26)*</td>
</tr>
<tr>
<td>Insecure</td>
<td>12</td>
<td>6.83 (3.88)</td>
<td>16.57 (6.83)</td>
</tr>
<tr>
<td>Secure</td>
<td>26</td>
<td>5.08 (4.23)</td>
<td>11.08 (6.26) †</td>
</tr>
<tr>
<td>Avoidant</td>
<td>4</td>
<td>7.25 (3.30)</td>
<td>17.00 (6.27)</td>
</tr>
<tr>
<td>Ambivalent</td>
<td>8</td>
<td>6.63 (4.34)</td>
<td>16.50 (7.50)</td>
</tr>
<tr>
<td>Organised</td>
<td>34</td>
<td>5.41 (4.13)</td>
<td>12.79 (6.86)</td>
</tr>
<tr>
<td>Disorganised</td>
<td>4</td>
<td>7.50 (4.51)</td>
<td>13.25 (96.87)</td>
</tr>
</tbody>
</table>

Note: Total N = 38; CBCL = Child Behavior Checklist; (Achenbach & Rescorla, 2000); SSP = Strange Situation Procedure (Ainsworth et al., 1978); ** = p<.01, * = p<.05; † = p<.10

secure children, \( F(1,36) = 6.19, p<.05 \), and neared significance for CBCL total score, \( F(1,36) = 3.24, p<.10 \). Using both CBCL dichotomous summary scores and attachment status no significant differences were found. Trauma experience was not associated with attachment security (Chapter 6) and therefore cannot be a mediator between trauma and infant self regulation. In addition no interaction effects were found for attachment security and trauma groups in 2x2 ANOVA (trauma groups only).
7.3.4. Relationship to Maternal and Infant Cortisol

There were no significant correlations between CBCL summary scores and infant or maternal cortisol measures. Although significant high, medium, and low infant cortisol group differences were found. The high and low groups contained the extreme 25% of scores. The means and standard deviations for CBCL internalising, externalising and total behaviour scores are shown in Table 7.18. The most problematic internalising, externalising and total CBCL scores were found for the children with the lowest 25% of morning cortisol levels, highest 25% of evening cortisol levels and the lowest difference across the day. However, significant group differences were only found for the child difference scores and externalising, $F(2,28) = 4.61, p<.05$, and total scores, $F(2,28) = 4.87, p<.05$, and marginal significance for internalising scores, $F(2,28) = 3.10, p=.06$. A trend toward significance was also found for child evening scores and internalising, $F(2,28) = 2.72, p<.10$, and total behavioural scores, $F(2,28) = 2.61, p<.10$.

7.3.5. Predictors of Child Behavioural Outcomes

Given the different patterns found for the individual trauma groups, and the low numbers within several trauma groups, it was difficult to gain an understanding of the full impact of trauma on emotional and behavioural outcomes using regression analysis on the whole sample. It was decided to use the antenatal PCL scores as a proxy for level of trauma and PTSD as those in the PTSD group had the highest of PCL scores. The CBCL scores were not found to be related to infant gender or maternal cortisol levels, but in addition to PTSD, were related to infant IQ, attachment security (19 months) and maternal ongoing mental health (both perinatal and 2nd Year), and infant evening and difference cortisol. The PCL and GHQ maternal mental measures were highly correlated. In the presence of perinatal GHQ the second year GHQ score was not significant suggesting that the variance in the CBCL scores accounted for by the second year GHQ scores had already been accounted for by the perinatal GHQ scores. Infant evening cortisol was selected over difference scores to obtain
Table 7.18. CBCL means and standard deviations for high, median and low cortisol groups

<table>
<thead>
<tr>
<th>Cortisol Group</th>
<th>$n$</th>
<th>CBCL Summary Scores</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Internalising</td>
<td></td>
</tr>
<tr>
<td>Child am</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td>8</td>
<td>4.63 (2.97)</td>
<td>10.88 (6.47)</td>
</tr>
<tr>
<td>medium</td>
<td>25</td>
<td>5.08 (3.38)</td>
<td>11.96 (6.51)</td>
</tr>
<tr>
<td>low</td>
<td>8</td>
<td>7.75 (6.18)</td>
<td>16.25 (7.70)</td>
</tr>
<tr>
<td>Child pm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td>9</td>
<td>8.11 (3.76)$†$</td>
<td>15.33 (7.81)</td>
</tr>
<tr>
<td>medium</td>
<td>23</td>
<td>5.00 (4.00)</td>
<td>12.65 (6.29)</td>
</tr>
<tr>
<td>low</td>
<td>9</td>
<td>4.22 (3.67)</td>
<td>9.67 (6.84)</td>
</tr>
<tr>
<td>Child difference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high</td>
<td>9</td>
<td>4.67 (2.78)</td>
<td>11.00 (6.06)</td>
</tr>
<tr>
<td>medium</td>
<td>23</td>
<td>4.74 (3.33)</td>
<td>11.00 (6.64)</td>
</tr>
<tr>
<td>low</td>
<td>9</td>
<td>8.33 (5.66)$*$</td>
<td>18.22 (5.54)$*$</td>
</tr>
</tbody>
</table>

Note: High = highest 25%; Medium = middle 50%; Low = lowest 25%; CBCL = Child Behavior Checklist; (Achenbach & Rescorla, 2000); * = $p<.05$; $† = p<.10$

the highest sample number possible, as some infants only had a usable morning or an evening cortisol sample. List wise there were 34 dyads with a complete set of data.

The model using infant IQ, attachment security, infant evening cortisol, pre-birth PCL, and perinatal GHQ as predictor variables accounted for 62.8% of the CBCL total behaviour score, $F(5,28) = 9.46, p<.001$, with infant IQ, evening cortisol, attachment security, an maternal perinatal GHQ scores demonstrating significant beta coefficients (Table 7.19). Approximately 35% was accounted for without infant IQ. Posttraumatic symptoms (PCL)
Table 7.19. Regression analyses for CBCL total score for the whole sample and the trauma group only.

<table>
<thead>
<tr>
<th>CBCL summary scores</th>
<th>Predictor variables</th>
<th>Statistics ($N = 34$)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Beta</td>
<td>$t$</td>
<td>Sig.</td>
</tr>
<tr>
<td>Total</td>
<td>IQ</td>
<td>- .322</td>
<td>-2.654</td>
<td>.013</td>
</tr>
<tr>
<td></td>
<td>Child evening cortisol¹</td>
<td>.285</td>
<td>2.541</td>
<td>.021</td>
</tr>
<tr>
<td></td>
<td>Secure/insecure ²</td>
<td>.421</td>
<td>3.594</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>PCL prenatal</td>
<td>.025</td>
<td>.175</td>
<td>.862</td>
</tr>
<tr>
<td></td>
<td>GHQ (T1, 2 &amp; 3)</td>
<td>.507</td>
<td>3.609</td>
<td>.001</td>
</tr>
<tr>
<td>Internalising</td>
<td>IQ</td>
<td>- .430</td>
<td>-2.928</td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td>Child evening cortisol¹</td>
<td>.180</td>
<td>1.281</td>
<td>.211</td>
</tr>
<tr>
<td></td>
<td>Secure/insecure ²</td>
<td>.260</td>
<td>1.833</td>
<td>.077</td>
</tr>
<tr>
<td></td>
<td>PCL prenatal</td>
<td>.051</td>
<td>.291</td>
<td>.773</td>
</tr>
<tr>
<td></td>
<td>GHQ (T1, 2 &amp; 3)</td>
<td>.341</td>
<td>2.006</td>
<td>.055</td>
</tr>
<tr>
<td>Externalising</td>
<td>IQ</td>
<td>- .273</td>
<td>-2.039</td>
<td>.051</td>
</tr>
<tr>
<td></td>
<td>Child evening cortisol¹</td>
<td>.186</td>
<td>1.453</td>
<td>.157</td>
</tr>
<tr>
<td></td>
<td>Secure/insecure ²</td>
<td>.532</td>
<td>4.106</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>PCL prenatal</td>
<td>-.057</td>
<td>-.359</td>
<td>.722</td>
</tr>
<tr>
<td></td>
<td>GHQ (T1, 2 &amp; 3)</td>
<td>.456</td>
<td>2.398</td>
<td>.007</td>
</tr>
</tbody>
</table>

Note: CBCL = Child behaviour Checklist (Achenbach & Rescorla, 2000); IQ = General Developmental Quotients, Griffiths Mental Development Scales (Griffiths & Huntley, 1996);¹ = dichotomous median High-Low split; ² = Strange Situation Procedure (Ainsworth et al., 1978); PCL = log transformed Posttraumatic Stress Disorder Checklist-Civilian Version (Weathers et al., 1994); GHQ = General Health Questionnaire (Goldberg, 1978) accounted for 17.2% of the total CBCL scores alone. As expected from the earlier regression analyses used to determine mediation of PTSD (section 7.3.2.1), it was expected that
antenatal PCL in the presence of GHQ would not be significant. When perinatal GHQ was removed from the equation antenatal PCL neared significance ($t = 1.940, p=.06$). The negative beta coefficient for infant IQ indicated that lower infant IQ scores were related to more problematic behaviour scores. The positive direction of the infant attachment and cortisol, and maternal GHQ beta coefficients indicated that insecure attachment, higher infant evening cortisol and greater maternal distress were associated with more problematic infant behaviour scores. The model predicted 45.5\% of internalising scores, $F(5,28) = 4.68, p<.005$, again with all predictor variables being significant except for antenatal posttrauma symptoms. Antenatal PCL alone predicted 14.2\%, $F(1,39) = 6.46, p<.01$. The model predicted 54.6\% of the variance in externalising scores, with infant cortisol and antenatal PCL not yielding significant beta coefficients. Maternal antenatal PCL predicted 10.1\% of the variance of 24 month old infant externalising scores alone.

7.4. Summary and Discussion

Overall, significant relationships between maternal trauma, mother-infant interactions and child outcomes were found. The hypothesis that poorer child language development would be associated with maternal trauma experience was partially supported, with the trauma control group consistently having the poorest language development at both 19 and 24 months, using examiner tested and maternal report methods. This result was not surprising given the previous unexpected result found in Chapter 6 demonstrating that the trauma control group had the lowest level of emotionally sensitive dyadic interactions. However the hypothesis that the reduced language development associated with trauma experience would be mediated through mother-infant interactions and ongoing maternal mental health was not supported. The hypothesis that maternal lifetime PTSD would be associated with greater emotional and behavioural problems, mediated through maternal mental health was supported. An alternative explanation may be that mothers with PTSD report greater levels of problems in their children compared to mothers without the disorder regardless of the actual problem
level. This proposal will be explored first before sequentially addressing each of the hypotheses.

Throughout the course of this study the PTSD mothers have reported the highest level of ongoing mental health problems and number of ongoing life stressors; have found their children to be the least acceptable (PSI); have reported the lowest level of parenting competence (Parent Stress Index); and reported that having a child has impacted more negatively on their self esteem (Personal Appraisal Inventory). In addition the mothers with PTSD demonstrated a tendency to give their children less autonomy (Parent Child Relationship Inventory) and display a hypervigilance toward their 2 week old infant’s behaviour interpreting normal reflexes as negative. Together these results suggest that these mothers may have greater negative attributions in relation to their children and be more hypervigilant in the assessment of their behaviour that could lead to over reporting of their infant’s behavioural problems. Several studies have found that depressed mothers rate their children as temperamentally more difficult (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005; Najman et al., 2000). In addition the trauma control group reported the lowest levels of child emotional and behavioural problems, which may reflect a general level of detachment as opposed to ‘real’ levels of problem behaviours. As suggested in the previous chapter there are behavioural similarities between the trauma control group and parents who are insecure-dismissive on the Adult Attachment Interview. That is, reduced warmth and responsiveness and a tendency to deny negative affect (Pianta et al., 1996). This could extend to denying or ‘not seeing’ problems in their children. Further, the behaviours of the PTSD group are similar to insecure-preoccupied parents who demonstrated warmth but also reported the highest levels of negative affect (Adam et al., 2004). Again, these behaviours may also extend to reporting the highest levels of problems in their children. In relation to child language development the examiner tested Reynell comprehension and expressive language scales (19 months) did correlate moderately to strongly with the maternal reported Language
Developmental Survey scales (24 months), with the trauma control group scoring the lowest on all measures whether examiner tested or maternal report. This at least suggests that the mothers’ reports on language development were congruent with the examiner assessment. However there is no objective measure of the child’s emotional and behavioural self regulation in the current study. Significant associations were found between high maternal antenatal anxiety and internalising problem behaviours in 8 and 9 year old children when using a composite behaviour score of mother, child, and teacher reports, as well as a direct observation measure (van den Bergh & Marcoen, 2004).

A Finnish study (Mäntymaa, Puura, Luoma, Salmelin, & Tamminen, 2004) assessing parental mental health and child emotional and behavioural outcomes found that a mother’s lifetime psychiatric problems before the pregnancy and the mother’s observed level of hostility and/or intrusiveness were associated with predicted child externalising and total behavioural problems in their 2 year old children. Current and lifetime maternal mental health (case-no case) in this study was measured 4 to 10 weeks postnatally, and the mother-infant interaction was conducted when the infants were 8 to 11 weeks old. The authors suggested that the significant relationship between mother’s lifetime mental health pre-pregnancy and child outcomes indicated a genetic vulnerability in the children. Given the results of the current study this may also reflect an epigenetic transmission of maternal problems. In addition, the Finnish study did not measure symptom level across the course of the study with the results perhaps indicating fluctuations in maternal mental health symptoms or the presence of ongoing subclinical level symptoms as seen in the current study. Of interest this study also found that maternal reported levels of the father’s mental health predicted high internalising, externalising and total problems scores, suggesting that father’s mental health may have a greater impact particularly on the development of children’s internalising problems than the mothers. The authors suggested that the mother’s reports on the father’s mental health may be biased, but concluded that it would be more likely to
underestimate the problems, than overestimate them. The Finnish study, like the current study, only used maternal report of infant emotional and behavioural problems but did not raise the possibility of maternal mental health impacting on maternal perceptions of partner and child emotional and behavioural problems.

Negative maternal perceptions of child behaviour may also reflect distorted attributions regarding the child’s motives which can ultimately negatively impact on the child (Lieberman, 1997; Silverman & Lieberman, 1999). Furthermore, negative beliefs about the child’s behaviour can lead to insensitive parenting which in turn impacts on the child’s behaviour. Lieberman and Silverman suggest that this cycle validates the parent’s attributions and the child internalises the mother’s attributions leading to a self fulfilling prophecy. The current study did not find the PTSD mother’s to be less sensitive, or more hostile and intrusive. However, this may be due to the non-stressful way in which the assessment was carried out (Biringen et al., 2005). Distorted attributions are related to poor parental insightfulness with the parent not able to understand the child’s motives (Oppenheim & Koren-Karie, 2002; Schechter et al., 2006). Oppenheim and Koren-Karie suggest the understanding of a child's behavioural motives is accompanied by an acceptance of these motives. The PTSD group in the current study have demonstrated significantly less acceptance of their children compared to the control group mothers. Oppenheim and Koren-Karie have also found that among other things, worry about the child and lack of acceptance are barriers to insightfulness. These authors view insightfulness as critical to the healthy promotion of child emotional development. Therefore, regardless of whether the mothers with PTSD are reporting ‘real’ problems in their children or they have distorted attributions, the children of this group have the poorest prognosis in this middle class sample. The localisation of disorganised attachment to the PTSD group supports this view.
The trauma control group despite demonstrating the poorest language development also reported the lowest level of emotional and behavioural problems. This may be related to what appears to be a general lower level of emotional interactions associated with trauma experience. The Finnish study by Mäntymaa and associates (2004) found hostile mothers were more likely to be remote in their interactions with their infants than non-hostile mothers. These authors concluded that hostile mothers adjusted their behaviour to protect their child from the harmful effects of their hostility. The current study only found low levels of intrusions and hostility behaviours. At the same time the trauma control and ICD-10 PTSD mothers’ demonstrated significantly greater levels of both these behaviours during their interactions than either the control or PTSD (DSM-IV) mothers. In addition, the Finnish study found that none of the hostile/intrusive mothers suffered from mental health problems over the 2 years of the study suggesting that the hostility-remoteness may have been protective for the mother’s own mental health. The current study supports this finding with the trauma control group reporting less mental health problems despite their trauma experience, being less involved with their infants, and in turn their infants having less maternally reported emotional and behavioural problems. Further to this, the current study would suggest that the infant also plays an active role in this ‘protective’ system with the infants of traumatised mothers being less demanding as seen with the lower levels of intervention required to consol them at 2 weeks postnatally. Robinson and Acevedo (2001) found children who displayed a pattern of low reactivity and low reliance on their mother during an emotional challenge at 6 to 9 months of age had poorer cognitive and language skills at 2 years, compared to infants who were high on both reactivity and reliance. Additionally, infant avoidant behaviour has also been shown to be protective with mothers with bi-polar depression (Radke-Yarrow et al., 1995). This study found that if the infant had developed an avoidant attachment pattern they were less likely to develop emotional and behavioural problems at age 6 years compared to the infant who had a secure attachment and becomes involved in the mothers mental health problems. These findings suggest that care
needs to be taken in relation to intervention programs that they do not disrupt the protective balance of these dyads. Where ‘good enough’ parenting is occurring without being highly sensitive a greater risk may arise if the mother is encouraged to be more involved. As Mäntymaa and colleagues (2004) suggest, a remote but hostile mother encouraged to be more involved may increase her level of intrusiveness that in turn may lead to poorer child outcomes. But this protective system appears to come at a cost.

The lower level of language acquisition in the trauma control group suggests that the resilience these dyads demonstrate comes at a price. Whether the slower language development in the trauma control group infants has long term consequences is unknown. Certainly the lower levels of language development were consistently found at both 19 months and 24 months, although significance was not reached at 24 months, controlling for gender and IQ. Whether over time these infants catch up remains to be seen. However several studies of early language development have found positive associations with later language and executive functioning. A study of Finnish children between 1 and 4 years of age, found that early maternal-infant sensitivity as well as early vocabulary appeared to be associated with later language acquisition and particularly phonological awareness (Silven et al., 2002). Using structural equation modelling this study also found that the acquisition of language was a two-way process driven by both parent and child with the process becoming more child-driven over time. The current study found that the trauma control group children were less involving of their mothers during play interactions. A study by Landry and associates (2002) found that greater maternal verbal scaffolding when the child was 3 years was associated with more advanced language skills at 4 years. Nevertheless, more advanced language skills were associated with more advance emerging executive functioning skills. Therefore the slower language acquisition found with the trauma control group children may lead to less optimal development of other cognitive skills such as problem solving. However this reduced development ultimately would presumably be less detrimental than the
problematic trajectories associated with disorganised attachment (Thompson, 1999) and early emotional and behavioural problems (Hofstra et al., 2000; Keenan et al., 1998).

Dyadic emotional availability and infant consolability were associated with both maternal trauma experience and language development. Yet, the current study did not find that either acted as mediators or moderators between trauma and language development. The lack of ability to demonstrate causal pathways between maternal trauma experience, mother-infant interactions and language development could be due to lack of experimental power (sample size and measurement error) and/or perhaps an unmeasured variable that links trauma, infant consolability, and maternal-infant interactions with language outcomes. A recent study by Milgrom and colleagues (Milgrom et al., 2004) of infants of depressed mothers also found poorer performances on expressive and receptive language skills at 4 years were not mediated through maternal responsiveness. Interestingly, this study did find that IQ scores at 4 years, particularly total IQ and performance subscales of arithmetic and geometric design, were mediated by decreased levels of maternal responsiveness during infancy, suggesting that language is mediated through a different pathway. The current study found cortisol was associated with child language development suggesting a biological link. As speculated in the previous chapter, the epigenetic effect of trauma on both the mother and infant may be to reduce the reactivity of the amygdala and subsequently their emotional reactivity, of which slower initial language development may be a by-product. Other brain structures may also be affected, certainly the hippocampus and the prefrontal cortex have been implicated in changes related to posttraumatic stress disorder (Britton et al., 2005) and maternal stress (Meaney & Szyf, 2005). In addition, the lower level of child acceptability and the maternal reports of less positive reinforcement from their infants suggest that negative attributions, reflective functioning or insightfulness may also play a role separate to maternal sensitivity. Due to the small sample size the current results do not completely rule out either infant consolability or dyadic emotional availability as mediators or moderators of maternal trauma.
on child language outcomes. It would appear though that a more complex model is required to explain the outcomes. Structural equation modelling would be necessary to investigate this level of complexity and would require a much larger sample size than is available at present.

Approximately 65% of the infant’s language development was predicted by infant gender, IQ, consolability, attachment security, and cortisol, as well as maternal trauma experience, and dyadic emotional availability. Infant gender and IQ accounted for approximately 35% of the variance. Poorer child language development was consistently associated with boys, lower IQ, maternal experience of trauma, less sensitive maternal-infant interactions or insecure attachment, as well as low morning or high evening infant cortisol. In relation to gender, boys in the trauma group had a greater reduction in mean summary scores compared to the girls, with the girls in the trauma group resembling the boys in the control group. However, inspecting the summary means for the separate trauma groups suggests that boys in the PTSD group had language levels around the same level as the trauma control group while girls with mothers with PTSD had language levels similar to the control group. Unfortunately the sample size is too small to investigate this difference further and warrants further investigation as this suggests that boys of mothers with the disorder may experience both greater emotional behavioural problems as well as poorer language skills, both of which suggest a poor prognosis for academic achievement. Several studies have found more pronounced cognitive deficits in male infants of depressed mothers suggesting boys are more vulnerable than girls to maternal depression (Milgrom et al., 2004; Murray, Kempton, Woolgar, & Hooper, 1992; Sharp et al., 1995). The current observation may indicate that boys are more vulnerable in general to maternal mental health problems. Gender differences have also been found in relation to maternal frightening behaviour, with girls tending to approach while boys do not, whereas with maternal withdrawing behaviour there were no gender differences with both girls and boys demonstrating increased approach behaviour, particularly in secure dyads (David & Lyons-Ruth, 2005). Boys in general have been found
to develop language skills slower than girls, for example in the standardisation of the Reynell Developmental Language scales it was found that significant differences between girls and boys were evident up to the age of 38 months (Edwards et al., 1997). This slower language development in boys may make them more vulnerable to less optimal environmental circumstances.

Dyadic emotional availability, maternal sensitivity and attachment security all demonstrated positive associations with language development at both 19 and 24 months of age. This is in line with expectations that secure attachment allows for a more regulated interaction with environmental stimuli (Sroufe & Waters, 1977), as well as studies that have demonstrated faster language acquisition for children with mothers who are more sensitive in their play interactions with their children (Silven et al., 2002). A study by Landry and colleagues (2002) also found that maternal verbal structuring was important in language acquisition at 3 and 4 years of age. In the current study maternal structuring did not demonstrate significant differences in language acquisition, although a trend toward significance was seen for vocabulary size when the children were 24 months old, suggesting that the importance of maternal structuring may increase as the child develops. Of interest, at 24 months infant length of utterance acquisition was less for infants whose mothers demonstrated more intrusive and covertly hostile behaviours at 13 months. These mothers were in the trauma control and ICD-10 PTSD groups. This may reflect, as found by Mäntymaa and associates (2004) that hostile/intrusive mothers were more withdrawing in their interactions with their infants. In addition, the study by Silven and colleagues (2002) also found that language development was a two-way process driven by both the mother and the child, with the child becoming the more active partner over time. This view is partially supported by the current study with the child’s level of involving their mother in play interactions at 13 months being significantly associated with vocabulary size at 24 months. Although the numbers were low, disorganised children in this study did not demonstrate any differences in language...
development compared to organised infants. This is congruent with several studies which have found that the disorganised attachment is associated with poorer deductive and abstract reasoning skills but not language skills (Jacobsen et al., 1994; Jacobsen & Hofmann, 1997; Moss et al., 1999).

The hypothesis that low infant cortisol would be associated with poorer language acquisition was partially supported. Low child morning cortisol was a significant predictor of both poorer child comprehension and expressive language skills at 19 months, while high child evening cortisol predicted smaller utterance length but not vocabulary size at 24 months. These results only partially support Gunnar and Vazquez’s (2001) proposal that low morning cortisol may reduce a child’s ability to sustain attention and therefore impact on their learning. The higher child evening cortisol at 24 months may suggest that children who are still aroused in the evening have slower language development. In addition high maternal morning cortisol predicted smaller infant vocabulary size at 24 months. The association with the mothers’ cortisol and infant language development may not be causally linked as the mothers’ morning and children’s evening cortisol were moderately correlated. On the other hand, mothers with heightened basal cortisol production may be directly impacting on their infant’s language development as both mother evening and child morning cortisol appear to be predicting variance in child utterance length independently.

The hypothesis that maternal posttraumatic stress disorder would be associated with less optimal emotional and behavioural outcomes was also supported. Overall, maternal trauma experience, lower infant IQ, insecure attachment, and greater maternal distress during late pregnancy and the first 2 years of life, and infant cortisol were associated with infant greater behavioural problems in the infant. The trauma control group mothers reported the lowest and the PTSD (ICD-10 and DSM-IV) mothers reported the highest internalising, externalising and total problem behaviours. As discussed above this may or may not reflect
‘real’ or objective levels of child behaviours. Because the trauma group as a whole included the lowest and highest subgroups (trauma control and PTSD) when combined the effect would be lost, therefore trauma experience could not be used to predict emotional and behavioural outcomes in the whole sample. To overcome this problem, antenatal posttraumatic stress symptoms were used as a proxy for the disorder. In doing this it was demonstrated that anxiety related trauma symptoms were impacting on infant self regulation measured at 24 months. In addition the results suggest that the effects of PTSD are mediated through maternal mental health. Overall, infant IQ, evening cortisol, and security of attachment, as well as maternal mental health predicted approximately 63% of the total behavioural score, 45% of internalising scores, and 55% of externalising scores.

All maternal mental health measures conducted over the two years of the current study were significantly and positively correlated with poorer child emotional and behavioural outcomes, except for postnatal depression measured at 13 months postnatally. That is the higher self reported mental health problems the higher the infant behavioural scores. Pre-birth current trauma symptoms accounted for approximately 17% of total behavioural scores with higher PCL scores being associated with less optimum behaviours. In addition, multivariate analysis of infant behaviour in relation to whether the mother reported high or low levels of trauma symptoms at 37 weeks gestation showed that infant behaviour was significantly less optimal for infants of high trauma symptom mothers. The difference remained significant even after controlling for concurrent maternal psychological distress (including depressive symptoms), as well as trauma symptoms and psychological distress over the early postnatal period and over the second year of the infants life. This is in line with several longitudinal studies (O'Connor, Heron, & Glover, 2002; O'Connor, Heron, Golding et al., 2002; van den Bergh & Marcoen, 2004; van den Bergh et al., 2005) that have found antenatal anxiety is predictive of internalising and externalising problem behaviour in preschool and primary school children. These studies found that prenatal anxiety (measured as state anxiety) remained significant
even after accounting for postnatal maternal mood. However the majority of the variance in the internalising, externalising and total scores in the current study could be accounted for by perinatal GHQ scores. As reported in Chapter 4 the PTSD group had significantly poorer mental health across all time points.

Poorer maternal psychological distress appears to also impact on behaviour regardless of trauma status. Maternal distress over and above posttraumatic stress symptoms was associated with Child Behavioural Checklist scores. Further, no significant group differences using dichotomous CBCL case-no case by trauma group analyses were found. This may be due to the low number of clinically significant cases of emotional and behavioural problems found in the current sample. The Finnish study by Mäntymaa and colleagues (2004) had similar levels of child problems in their sample of 2-year-olds, but did not find a significant association between maternal mental health in the early postnatal period and child internalising and externalising problem behaviours. They did find however that maternal prenatal mental health was associated with externalising behaviours (measured retrospectively). One difference between the Finnish and the current study was the use of continuous current mental health variables instead of dichotomous case-no case mental health variables. This may be important as subclinical problems could have significant impact, as found by Adam and associates (2004) who demonstrated that low to moderate depressive levels had a moderating effect on maternal sensitivity in ‘insecure-dismissing’ mothers. The current study did not find that impact of maternal mental health on child internalising and externalising behaviours was mediated through maternal sensitivity as few associations were found between mental health and sensitivity. Instead a direct effect of maternal mental health on behaviour was found. This is contrary to a longitudinal study using structural equation modelling by Brody and colleagues (Brody, Kim, Murry, & Brown, 2004) who found maternal psychological functioning significantly impacted on sensitive parenting that in turn significantly impacted on child behavioural problems. Mäntymaa and colleagues (2004)
found that maternal hostility and/or intrusiveness were associated with infant externalising symptoms but maternal insensitivity was not. In addition a recent intervention study did not find improvements in child externalising behaviours were related to improvements in maternal sensitivity (Velderman, Bakermans-Kranenburg, Juffer, & van Ijzendoorn, 2006). Velderman and associates study used the maternal sensitivity scale of the Emotional Availability scales and suggested that this measure of sensitivity was primarily focused on the synchrony between the dyad which may have been too narrow an aspect of maternal sensitivity to yield a great enough power to detect a significant association in their sample of 77 mother-infant dyads.

The current study found that secure children had significantly lower maternally reported levels of internalising, externalising and total behavioural problems compared to insecure infants. This is in line with previous reports (Carlson & Sroufe, 1995; Egeland & Carlson, 2004; Greenberg, 1999). In addition although not reaching significance, disorganised infants had greater mean scores on all three behavioural checklist summary scores compared to organised infants. This result needs to be interpreted with caution due to the small number of disorganised infants. However meta-analysis has shown that disorganised attachment is related to externalising behaviours (van Ijzendoorn et al., 1999).

The hypothesis that low infant morning cortisol will be associated with externalising behaviours was also partially supported with a pattern of flattened child cortisol found to be associated with internalising, externalising and total behavioural scores. The most problematic CBCL summary scores were found for the children with the lowest 25% of morning cortisol, highest evening scores and the lowest difference across the day. But significant group differences were only found for the cortisol variable of child difference scores and externalising and total CBCL scores, and marginal significance for internalising behavioural problems. Child evening cortisol was also a significant predictor of child self
regulation. These results are congruent with the study by Spangler (1995) which found that flattened cortisol patterns on school days were associated with behavioural and attentional problems. As well several studies of clinical populations have found an association between low basal cortisol and externalising behaviour in children (McBurnett et al., 2000; van Goozen et al., 2000). Mothers’ ratings of child temperament also resulted in significant associations between children rated as unsociable and emotional and high evening cortisol. The child behavioural scores and temperament ratings were conducted at the same time. This congruence between the measures suggests that the mothers view their children’s behaviours as stable traits.

Overall, maternal trauma has been found to impact on both child language and self regulation development. The mothers who had experienced a trauma but who had not developed PTSD, were least engaged with their infants, and their infants had the lowest language development. Although poorer language development was not mediated through dyadic emotional availability or maternal sensitivity. Children with low morning and/or high evening cortisol demonstrated lower language development. Posttraumatic stress disorder was found to be related to poorer child emotional and behavioural outcomes which were mediated through maternal mental health. Children with flattened patterns of basal cortisol were found to have higher levels of internalising and externalising behaviour scores. Together with other research studies (Britton et al., 2005; Mäntymaa et al., 2004), these results suggest that maternal trauma experience is associated with a biologically based protective mechanism occurring in both the mother and the infant that is protective for both the mother and the child’s mental health, but comes at a cost of early infant language development. However this mechanism appears to have broken down in the presence of maternal posttraumatic stress disorder for both the mother and the infant and is associated with greater maternal mental health problems and more problematic infant emotional and behavioural problems and disorganised attachment. The following and final chapter aims to summarise and discuss the
limitations of the current study, summarise and discuss the main themes that have emerged from the investigation as a whole, and suggest future research directions and clinical implications.
8. Discussion and Conclusion

This chapter is divided into four main sections. The first section aims to address a range of methodological issues that limit the generalisability of the study results. The second section summarises the study aims and main findings. In the third section a more general discussion including clinical implications is undertaken in relation to the differences in the ICD-10 and DSM-IV diagnostic criteria, and the possible intergenerational transmission of both resilience and vulnerability to trauma. The fourth and final section is a more general discussion in relation to the impact of trauma on mental health and early intervention and prevention.

8.1. Limitations and Methodological Issues

A range of limitations relating to the sample and the measures used have been identified and are discussed below. These include limitations relating to the sample as well as specific issues pertaining to the cortisol, maternal, dyadic interactional and infant measures used. However, off-setting these limitations the study demonstrates many strengths, including its longitudinal design starting in the antenatal period; the use of a community sample; reasonable retention rates; and measures that cover maternal and child physiology, maternal mental health, dyadic interactions, and infant developmental outcomes. In addition the study has not relied any one type of assessment method but has used a range of methods from biological assays, semi-structured clinical assessments, clinical developmental assessments, observational techniques, and self report and maternal-report questionnaires. Further, both lifetime and current maternal mental health was measured, with current mental health being repeatedly measured over the course of 2 years, and a range of observational measures assessing the quality of maternal-infant interactions were implemented at different ages. The range of assessments at different stages has resulted in a convergence of evidence that gives
more weight to the results, particularly where significance may have been marginal, or results were counter to expectations.

8.1.1. Sample
The two main limitations identified in relation to the current study sample are its recruitment and subsequent composition, and the overall and groups sizes.

8.1.1.1. Recruitment and sample composition
As reported in Chapter 4 the majority of the sample was proactive in volunteering for the study which suggests certain personality traits such as being altruistic and novelty seeking. However it also indicates that people with certain types of anxiety disorders and avoidant behaviours would be unlikely to participate. Certainly no mother in the study was diagnosed with a lifetime occurrence of social phobia, agoraphobia, obsessive compulsive disorder, and the only person diagnosed with panic disorder withdrew from the study due to her anxiety. In addition anecdotal accounts suggested that those women with a trauma history felt that they had satisfactorily dealt with any problems. Together with the ongoing mental health measures these results suggest that the current trauma group were not highly symptomatic and that community mothers with more active posttraumatic stress symptoms were not represented in the sample. As well, there was a significantly greater withdrawal, particularly in the first three months, of mothers who were less resourced in terms of personal and financial support, and who had higher trauma related symptoms. The loss of these women impacted significantly on the current study as the PTSD groups were relatively small. This needs to be borne in mind for future studies of low risk populations. Recruiting mothers through staff at antenatal clinics may increase the rate of uptake of these more symptomatic mothers, and early postnatal home visits may be better received if they coincided with the initial visit from the universal home visiting program. Further to this, researchers need to be particularly
sensitive to maternal anxiety and mental health problems in all the study mothers and link them to appropriate services where appropriate.

The homogeneity of the sample reduced variation but can be criticised for also reducing the generalisability of the results. The current sample was culturally homogenous with the majority of participants being of European descent which does not allow the generalisability of the study to more diverse populations. What is more, the middle-class nature of the sample can also be criticized for the same reason. However this decision has led to the reduction in other known risk factors such as low parental education, unemployment, social isolation and unstable family structures. Overall, the results from the current study, although not generalisable to low risk and culturally diverse samples, are applicable to a large proportion of Australian middle class families. This socioeconomic homogeneity of the sample is also beneficial as the results potentially represent true associations between maternal traumas, quality of mother-infant interactions, and child outcomes that are not confounded by associated adversities. The homogeneity of the sample also helps reduce variability in the small sample giving a better chance of significant results.

The current study is also limited by its focus on the mother and infant without taking into account the potential positive or negative impact of fathers. Certainly, fathers may have a protective influence on children whose mothers have mental health problems, and conversely, a recent Scandinavian study (Mäntymaa et al., 2004) has found an influence on child behavioural outcomes in relation to paternal mental health problems. But in Australia women are still predominately the major carers of infants and young children and practical considerations, such as resource availability, meant that the inclusion of fathers was beyond the scope of the current study.
Unfortunately the sample size was too small to systematically and meaningfully investigate the suggestion in literature that boys may be more vulnerable (Milgrom et al., 2004). Yet, there was certainly an indication that boys’ language development may be affected more by maternal trauma than girls. This warrants further investigation, particularly given the Australian government’s concern about boys underachieving in school.

8.1.1.2. Size

Ultimately the sample size for this study was small and therefore the results need to be regarded as tentative until further replication occurs. With small sample size and infrequent phenomena the effect of chance increases. This raises concerns with unexpected findings such as the lower levels of emotional sensitive interactions between the trauma control group mother-infant dyads compared to both the control and the posttraumatic stress disorder group dyads. However because of converging evidence from multiple assessments conducted at different times and performed by different assessors, there is greater confidence that this result is real. In general, it is more likely that a true association fails to emerge as significant in small samples, particularly when a large amount of variability is found for the outcome being measured, such as with morning cortisol levels.

Despite resulting in small group sizes this study found striking differences in outcome measures highlighting the problems of comparing trauma-no trauma or PTSD-no PTSD groups only as is done in many studies. In the current study certain findings would have averaged out the statistical means, resulting in findings being masked, particularly if the trauma control and PTSD groups had been combined. Also ICD-10 and DSM-IV groups at times (such as cortisol) presented strikingly different patterns suggesting that these groups are biologically very different populations and may account for the variable results reported in studies regarding the hypothalamic-pituitary-adrenal (HPA) axis. This has implications for diagnosis that will be discussed below. Overall, the current results indicate the need for future
research to use large sample sizes to enable the investigation of differences between control, trauma control, ICD-10 only, and DSM-IV PTSD groups.

With small samples the effect size needs to be moderately large to achieve a significant result. Larger effect sizes are more likely to be clinically significant, particularly compared to a large sample with small effect sizes (Cohen, 1988). The current study found moderate and large effect sizes in relation to differences in emotional availability and 19 month child language outcomes (respectively) between control and trauma groups. The amount of variance in outcome measures accounted for by maternal trauma experience, mental health and interactional measures varied. Over 33% of the variance in child morning cortisol was accounted for by maternal trauma experience and a further 10% by maternal perinatal anxiety. Approximately 30% of the variance in child language development was account for by maternal trauma experience and measures of mother-infant interactions. In relation to child behaviour approximately 35% accounted for total scores without child IQ, and antenatal trauma related anxiety symptoms accounted for over 14% of the variance in internalising behaviours and 10% of externalising behaviours. How clinically relevant these results are remains to be seen in follow up studies.

Future studies require a significantly larger sample size to allow statistical analyses such as structural equation modelling. This type of analysis would lead to a much better understanding of the interactional and mediating effects of the variables measured over different time points.

8.1.2. Measures

There have been a range of methodological limitations highlighted throughout the study. For this discussion they have been grouped in respect to the construct being measured. These are, cortisol, maternal-infant interactions, child cognitive functioning, and child self regulation.
8.1.2.1. Cortisol

A major limitation of the cortisol section of this study was the collection of only one morning and one evening saliva sample. The high variability between samples and the variability between the ICD-10 mother-infant dyads highlight the need for sampling over several days. Goodyer and associates (Goodyer et al., 2001) propose that cortisol samples be collected over four consecutive days. An additional problem with the current protocol which may have led to higher variability in the morning cortisol samples was in the timing of the morning cortisol. Mothers were instructed to collect saliva from themselves and their infants within 30 minutes of their individual awakening times. Individual wakening time is important as cortisol is linked to the sleep cycle. However, apart from possible problems of compliance, cortisol rises during the first 30 minutes after waking before it starts to decline throughout the day. Therefore greater variability may have occurred depending where in ‘the first 30 minutes’ the morning sample was collected. Mothers were not asked to record awakening or sampling times which in hindsight would have been useful. One study of women with posttraumatic stress disorder found these women were less likely to demonstrate this morning increase post-awakening suggesting that it may be important in studies of this disorder to differentiate between and collect samples at both immediate and 30 minute after awakening (Young et al., 2004). Further, recent studies have demonstrated the importance of collecting sufficient samples across the day to be able to calculate diurnal decline (slope) and average daily levels (area under the curve) in gaining a better understanding of the dysregulation of the HPA axis (Matthews, Schwartz, Cohen, & Seeman, 2006; Yehuda, 2006). These measurements would have been useful in the current study.

Individual differences in basal cortisol may also be due to variables such as body weight, height, metabolism, mood, level of physical activity, substance use such as nicotine, alcohol, current stressors (Yehuda, 2006), and child care (Gunnar, 1998). Mothers were asked to limit their alcohol intake in the 24 hours before collection and to select a quiet day when their
children were not attending child care or other possible stressful activities, but other potential variables were not counted. As well, saliva cortisol samples may be affected by food intake, particularly dairy and acidic foods or drinks, and contamination from blood. These problems were limited through a detailed instruction sheet given to the mothers (Appendix B.11), but as collection was carried out in the home compliance levels are unknown. Yehuda (2006) reports that studies which have multiple collections over a 24 hour period and are conducted in controlled conditions such as clinical research centres using indwelling catheters have generally been the most successful in demonstrating differences between PTSD and non-PTSD samples. But, this sampling protocol is not appropriate for community samples, and particularly not healthy children. In addition the burden of increased levels of home sampling may also lead to lower levels of compliance and loss of samples.

A strength of the current study was the collection of both mother and infant cortisol samples which has not been reported before in relation to basal cortisol levels. Future studies would benefit from repeated sampling of both mother and child but would require a well thought out protocol that would be appropriate to the age of the child and developmental stage without placing to much onus on the mother. Future studies may also consider measuring other biological markers such as several interesting neuropeptides that are discusses in relation to resilience below.

8.1.2.2. Maternal-infant interactions

Given the finding of reduced engagement between the mother and the infant in the trauma control or resilient group, which appears to be present from as early as 2 weeks, the use of an earlier interactional method measuring both the mother and the infant in the early postnatal period may have been more useful than the more specific measure of infant withdrawal used in the current study. The Alarm Distress Baby Scale (Guedeney & Fermanian, 2001) was designed to pick up problematic infant behaviours and may be better suited to a more clinical
sample than the one used in the current study. Measures such as the Global Rating Scale for Mother-Infant Interactions (Murray, Fiori-Cowley, Hooper, & Cooper, 1996) used in several European studies (e.g. Mäntymaa et al., 2004) which measures maternal sensitivity, remoteness, intrusiveness and hostility could be useful. Although, the Emotional Availability scales (EA) used at 13 months of age can also be used in younger infants and could prove to be the most useful as it is a measure of both mother and infant, as well as allowing for analysis using a repeated measures design.

As discussed in Chapter 6 the EA measure would be better conducted under stress conditions and for longer periods of time. This would enable the difference in the behaviours, particularly in relation to frightening behaviours, of the mothers of disorganised infants from non-disorganised to be identified in well educated middle class samples (Biringen et al., 2005). Even then though, this may not identify the frightened and withdrawing behaviours found in mothers of disorganised/secure infants (Lyons-Ruth et al., 2004). These changes would be significant and greatly increase the resources required. Given the current study and other researchers’ (Velderman et al., 2006) findings that maternal sensitivity was not related to child self regulation a measure of reflective functioning or insightfulness may be more useful (Oppenheim & Koren-Karie, 2002) than further investigating maternal behaviour. Alternatively, the mothers own attachment status (AAI; Hesse, 1999), which as been shown to be predictive of infant attachment may be of more value than further focusing on maternal behaviour. This view is supported by findings of Bakerman-Kranenburg and associates (Bakermans-Kranenburg et al., 2006) who found a moderate effect size linking unresolved maternal representations and disorganised attachment but only a small amount of this relationship was mediated through parental behaviours.
8.1.2.3. Cognitive functioning

The use of the Griffiths Mental Developmental scales was useful in relation to global development and as a measure of infant intellectual functioning to use as a covariate in relation to language development. However as an outcome measure is was too global to be effective. In addition, the measures of language were useful but future studies may be more informative if age appropriate marker tasks for frontal lobe functions such as attention, inhibition, planning, problem solving and working memory were implemented, particularly as the prefrontal cortex has been shown to be affected by PTSD, and may be useful in detecting potential differences related to specific alterations in structure-function (van den Bergh et al., 2005). Another interesting marker of neurodevelopment is mixed handedness which has been linked with maternal anxiety, as well as dyslexia, autism, and attentional deficits (van den Bergh et al., 2005).

8.1.2.4. Child self regulation

The sole use of maternal report measures for child emotional and behavioural regulation is a limitation of this study as this in essence reflects maternal perceptions of her child’s behaviour and is not an objective measure. The Child Behavioral Checklist (CBCL, Achenbach & Rescorla, 2000) is a very widely used screening measure of child behavioural problems (Mäntymaa et al., 2004) and has been found to be a valid indicator for the need for treatment and the presence of psychopathology (Achenbach & Rescorla, 2000). The use of DSM-IV or ICD-10 diagnostic criteria would have been of no additional value as most children would not have reached a diagnosis for an Axis 1 diagnosis and these would have relied heavily on maternal report in any case. Further, the continuous variable obtained from the CBCL was of more value in this sample than a dichotomous problem-no problem variable. For a more robust measure of child behaviours the use of multiple informants and observational methods would be useful. A major problem in this area of research is that there is no ‘gold standard’ for measuring child emotional and behavioural problems. Cross-
informant agreement for CBCL (1½ to 5 years) has demonstrated Pearson’s correlations of .65 between parents and .50 between mothers and teachers (Achenbach & Rescorla, 2000). In the current study not all children attended child care therefore the father would be the other useful informant. The addition of an observational method coding for child behaviour could have been incorporated into one of the other methods used. For example the Bayley Scales of Infant Development (Bayley, 1994) has a behavioural scale which is rated via observations of the infant’s performance during the assessment and could have been used instead of the Griffiths Mental Development Scales. Other studies have coded specific components of affect dysregulation such as compliance (Volling, McElwain, Notaro, & Herrera, 2002), negative affect (NICHD, 2004), attention (Schieche & Spangler, 2005), hyperactivity (van den Bergh & Marcoen, 2004), and behavioural inhibition (Sahamir-Essakow, Ungerer, & Rapee, 2005). These components could have been coded during the mother-infant interactions or by simply adding a cleaning up task to the end of the session. Compiling a composite of multiple informants with observational measures may ultimately give the most robust measure of child behaviour problems (van den Bergh & Marcoen, 2004). Although, as discussed in Chapter 7 negative maternal perceptions of child behaviour may well be predictive of later psychopathology whether the behaviours are ‘real’ or represent distorted attributions, as the child internalises the mother’s negative beliefs leading to a self fulfilling prophecy (Lieberman, 1997; Silverman & Lieberman, 1999).

8.2. Summary of Study Findings

This study of middle class mothers and their infants was carried out from the third trimester of pregnancy until the infants were 24 months of age. Overall, caution needs to be used in interpreting the results of the current study due to small sample size. Those women with a diagnosis of posttraumatic stress disorder had greater levels of ongoing distress and were more reactive to stress, but did not report high levels of current trauma specific symptoms. The trauma control group had higher levels of anxiety and stress than the control group but
not as high as the PTSD group. The control infants required the most intervention by the examiner to console and the trauma control the least. Further to this, the mothers’ demonstrated differential patterns of viewing their children and their parenting experience with the control group being more positive, the trauma group less involved and less accepting of their infants, and the PTSD group feeling less competent and appeared to be more likely to perceive negative infant behaviour.

The hypothesis that mother and infant basal cortisol levels would be associated was supported. Infant morning cortisol levels were found to be significantly predicted by the environmental prenatal factors of maternal trauma experience and posttraumatic stress symptoms of hyperarousal. These results support the research of Yehuda (2005) and implicate an epigenetic transmission of environmental experience from the mother to her offspring possibly via in utero programming of the HPA axis. Maternal age and maternal postnatal somatic symptoms (10 months earlier) were the most significant predictors of maternal morning cortisol, while postnatal somatic symptoms and current parenting stress were the most significant predictors of maternal evening cortisol. The hypothesis that maternal PTSD would be associated with flattened patterns of cortisol in both the mother and the infant was only partially supported with infants of mothers with the more stringent DSM-IV diagnosis of PTSD demonstrating a flattened cortisol pattern of lower morning and higher evening cortisol levels. It needs to be reiterated that cortisol levels in the current study, like other studies of this disorder, were within the normal range. Mothers in the DSM-IV PTSD group did demonstrate overall lower morning and evening cortisol however it did not reach statistical significance. Overall the results suggested an epigenetic transmission of trauma experience from the mother to the infant.

The hypothesis that infant withdrawal at 3 months of age would be associated with maternal PTSD was only partially supported. Unexpectedly, infant withdrawal was associated with
ICD-10 but not DSM-IV maternal posttraumatic stress disorder. It was speculated that ICD-10 mothers and/or their infants had basal cortisol levels that were more responsive to daily stress. As predicted associations between early infant withdrawal and later measures of mother-infant interactions were found. Infant withdrawal was related to reduced infant emotional availability and infant distress to novelty at 13 months, and to a lesser degree, avoidant infant attachment patterns and less sociability at 19 months, demonstrating a weak continuity of withdrawal behaviour across the first 2 years of life.

The hypothesis that maternal posttraumatic stress disorder would be associated with reduced emotional availability and maternal sensitivity was not supported. The most surprising finding was that resilient mothers—those who had experienced a trauma but did not develop PTSD-DSM-IV—had the lowest dyadic emotional availability at 13 months. Both resilient mother and infant dyads displayed reduced emotional engagement during interactions and the mothers demonstrated significantly greater intrusive and hostile behaviours. Convergent support for this result was found with the infants of non-traumatised mothers requiring a greater level of rocking and handling to settle at 2 weeks of age than the trauma group as a whole and particularly the resilient group. Together these results suggest that resilience to trauma is associated with reduced emotional interaction from both the mother and the infant. The deactivation of the amygdala in response to emotionally charged material has recently been found in a group of resilient combat veterans. It is proposed that the current results, as seen with animal models, support the occurrence of an epigenetic event related to the maternal trauma which confers resilience to both the mother and infant. For the infant this epigenetic event may occur during pregnancy or very early in the postnatal period. As predicted maternal PTSD was associated with disorganised attachment in the infant. In addition, there was some support for the view that maternal trauma is associated with hypervigilant and over-protective parenting practices.
It was further hypothesised that maternal trauma experience would be associated with poorer infant language and more problematic emotional and behavioural problems, and that these outcomes would be mediated via maternal sensitivity and maternal mental health problems. In addition it was predicted that low child morning cortisol would be associated with poorer developmental outcomes. Overall, maternal trauma experience was found to impact on both child language and self regulation development, as did postnatal variables such as maternal ongoing mental health problems and mother-infant interactions. The resilient mothers who had experienced a trauma but who had not developed the disorder, were least engaged with their infants, and their infants had the lowest language development. However poorer language development was not mediated through dyadic emotional availability or maternal sensitivity. Children with low morning and/or high evening cortisol demonstrated lower language development. Posttraumatic stress disorder was found to be related to poorer child emotional and behavioural outcomes which were mediated through ongoing maternal mental health problems. Although, questions remain about the self report nature of the CBCL with this measure perhaps being more reflective of maternal perceptions than actual child behaviour and the long term clinical significance. However children with flattened patterns of basal cortisol were found to have higher levels of internalising and externalising behaviour scores.

The finding of the current study together with other research studies (Britton et al., 2005; Mäntymaa et al., 2004) suggest that maternal trauma experience is associated with a biologically based protective mechanism occurring in both the mother and the infant, which is protective for both the mother and the child’s emotional health, but comes at a cost of early infant language development. Further, this mechanism appears to have broken down in the presence of maternal PTSD for both the mother and the infant with subsequent associations with greater maternal mental health problems and more problematic infant emotional and behavioural problems and disorganised attachment.
8.3. Discussion and Clinical Implications

The different outcomes found for mothers who met the diagnostic criteria for ICD-10 only or the more stringent DSM-IV criteria are discussed. This is followed by a discussion in relation to the possible intergenerational transmission of resilience and vulnerability following trauma exposure.

8.3.1. PTSD Diagnosis

The differences found between the mothers with ICD-10 only and DSM-IV PTSD have implications for the diagnosis of disorder. Lehmann, Mattiske and McFarlane (manuscript in preparation) found the diagnosis using the DSM-IV criteria identified individuals with greater disability and increased levels of comorbidity compared to those who only met the ICD-10 criteria. However those who only met the ICD-10 criteria also displayed a significant level of symptomatology compared to those people who do not obtain either diagnosis. In the current study mothers who met the ICD-10 category only, compared to mothers who met the more stringent DSM-IV, had different patterns of basal cortisol production. The ICD-10 only mothers and their infants had higher morning and lower evening cortisol levels, while the DSM-IV mothers had lower morning and evening levels and their infants demonstrated a significantly flattened cortisol pattern (lower morning and higher evening). The ICD-10 only group also demonstrated a significantly greater variation between infant and mother cortisol compared to the other groups as well as having a greater number of infants who were rated as withdrawn at 3 months of age suggesting that this group may have greater stress reactivity in relation to daily environmental cues. However these results require replication and cortisol sampling on consecutive days. In relation to ongoing mental health variables the DSM-IV mothers reported significantly more psychological distress across the course of the study, with the ICD-10 mothers reporting greater problems than the trauma control and control groups. Furthermore, in relation to child outcomes the ICD-10 infants at time resembled the trauma control group (reduced emotional availability) and at other times resembled the DSM-
IV group (disorganised attachment and behavioural problems) suggesting that reaching the ICD-10 criteria constitutes a greater risk for more problematic child outcomes compared to the trauma control group. Overall, the ICD-10 women appear to have stress systems that are working at the upper level and that their biological and/or psychological coping mechanisms are perhaps at their limits. The differences in the trauma control, ICD-10 and DSM-IV groups may reflect the different combinations of the level of stress experienced, biological resilience and current level of allostatic load.

A recent study found significant evidence of allostatic load in a group of middle-aged women who had experienced prolonged stress and met the diagnostic criteria for current PTSD (DSM-IV), and to a lesser but still significant extent in those with no or low current trauma symptoms compared to the control group (Glover, 2006). They found allostatic elevations in relation to body mass index, norepinephrine, and cortisol but not cardiovascular, glucose metabolism or atherosclerosis indicators. Prolonged stress appeared to result in cortisol dysregulation in both directions of extreme values. These results suggested a ‘dose-response’ effect in relation to the level of posttraumatic stress symptoms. This effect of allostatic load may also account for the significance of lower morning cortisol with age, which perhaps is a marker of allostatic load in this disorder.

The current results also raise questions about the measurement of posttraumatic stress disorder in research populations with differences between ICD-10 only and DSM-IV study subjects possibly accounting for some of the variation in study results regarding PTSD and the HPA axis, particularly when some studies screen for current PTSD symptoms while other studies used the DSM-IV diagnostic criteria. Many people who reach ICD-10 criteria do not reach DSM-IV criteria due to the ‘F’ criterion (Lehmann et al., manuscript in preparation). The ‘F’ criterion inquires whether the trauma has had a significant impact on the person’s life, and is not assessed using screening tools that only assess current trauma symptoms.
These screening instruments (such as the PCL; Blanchard et al., 1996) are likely to detect people who would reach both the ICD-10 only and DSM-IV criteria as long as their symptoms are current. To further cloud the picture, current symptom level may also be misleading unless the trauma is recent.

The current study and one by Lyons-Ruth and Block (1996) have demonstrated that high current maternal PTSD symptoms are not necessary for problematic outcomes for children. The lack of observable differences in the level of emotional engagement between PTSD mothers and their infants suggest that chronic, oscillating, reactive or residual symptoms may subtly interrupt interpersonal relationships. These problems managing intimate relationships would also likely to be difficult to observe in adult relationships. Unfortunately conducting semi structured interviews for current and lifetime PTSD diagnoses is time consuming and often not practical when screening large populations (for example all mothers with young infants) to identify a smaller group of ‘at risk’ women for targeted interventions. However the screening for trauma experience alone would unnecessarily detect a large set of women, as would the inclusion of questions of sexual molestation and physical attack. Conversely, focusing on the experience of rape only would exclude women with significant posttrauma symptom levels that may impact on parenting and child outcomes. Nemeroff and colleagues (Nemeroff et al., 2006) have suggested a method of mental health assessment and triage to be used following a disaster that could be adapted for screening women in the antenatal period to identify women who may require additional support following the birth of their child. This method assesses for PTSD by initially screening for ‘C’ symptoms (numbing and avoidance), as they have found that 94% of people who met the criteria for ‘C’ symptoms had a diagnosis of PTSD. In the current study the lifetime DSM-IV criteria for ‘C’ symptoms was met by four of the six mothers who met the ICD-10 criteria only and all the mothers who met the DSM-IV criteria. The ‘C’ criteria in the ICD-10 and DSM-IV are significantly different with the ICD-10 only requiring preferred avoidance compared to the DSM-IV of actual avoidance.
as well as the presence of psychological numbing. Group comparisons in relation to DSM-IV criteria ‘C’ criteria as the PTSD group has not been done but would be of interest.

The current study also raises questions about only including primiparous mothers in research studies and intervention programs. In the current study no significant group differences were found in relation to mental health, but there were significant interactions between reported psychological distress for mothers with one or more children and women in the PTSD group. More PTSD (ICD-10 and DSM-IV) multiparous mothers reached caseness for psychological distress compared to both the control groups and primiparous mothers of any group indicating that mothers with a lifetime diagnosis of PTSD may have less personal resources as stress becomes greater. In addition, ongoing maternal mental health was found to mediate child behavioural problems. These results warrant further investigation but suggest that multiparous mothers with a lifetime diagnosis of PTSD are a particularly vulnerable group.

8.3.2. Intergenerational Transmission of Resilience and Vulnerability

One of the main findings in the current study was the significantly reduced emotional availability of the trauma control dyads compared to both the non traumatized mothers and those who had developed PTSD following trauma. This result combined with the significantly reduced need in the infant at 2 weeks postnatally for adult intervention when distressed, the lower maternal mental health problems, and infant emotional behavioural problems, suggests a biologically based mechanism protecting both the mother and the infant from the impact of maternal trauma. But, this resilience appears to come at a cost of delayed language development and it remains to be seen if this slower acquisition of language is evident by the time these children reach school age. On the other hand, the decreased level of infant shyness reported in this resilient group suggests that some emotional blunting may allow the infant to better negotiate novel environments. This is one area where reduced level of engagement may have some benefits, although it is unclear what developmental trajectory
this may set up. One possibility is the reduced development of empathy and social engagement over time.

This protective or resilience mechanism did not demonstrate an association with organised patterns of attachment. Importantly, this mechanism of reduced emotional availability appeared to be absent in the mothers with PTSD and their infants. In addition, the infants demonstrated flattened cortisol patterns and poorer developmental prognosis in relation to greater emotional behavioural problem scores and the potential negative outcomes associated with disorganised attachment. Overall the study results suggest that both a biological resilience and vulnerability to trauma were being transmitted from the mother to the infants.

8.3.2.1. Resilience

A recent article by Yehuda, Florey, Southwick and Charney (2006) has highlighted the need for studies of individual differences between people who demonstrate resilience following trauma compared to those who develop psychopathology. These authors posed the question, ‘are resilient people born or made? (p.380).’ Speculating from the findings of animal studies (Meaney, 2001) and the current study it would seem that the answer is both, where trauma experience perhaps impacts on phenotypic expression at any time postnatally ‘making’ the resilient person, with the resilient phenotype also being passed on in utero to enable a child to be prepared for the more hostile environment they are being ‘born’ into.

The protective nature of certain human genotypes in relation to traumatic events has previously been demonstrated by Capsi and associates (Capsi et al., 2002). Their study was the first to demonstrate this environment-gene interaction in humans. The neurotransmitter-metabolising enzyme monoamine oxidase A (MAOA) is located on the X chromosome and inactivates neurotransmitters such as norepinephrine, serotonin, and dopamine. Maltreated children who had a MAOA genotype that conferred high levels of MAOA expression were
less likely to develop antisocial behavioural problems than children who had low expression of the MAOA gene. Additionally, work by Michael Meaney and colleagues (Meaney, 2001) has demonstrated that natural variations in maternal care during the early postnatal period permanently programs the expression of specific genes in the brain that mediate the rat pup’s response to stress. This variation in maternal care is thought to be a result of environmental demands such as low resources, high predation, aggression and social turmoil. In these situations the mother requires a more external focus to survive in a more hostile world. In addition maternal stress during pregnancy has similar effects. Meaney (2001) proposes that these alterations in the rat pups response to stress conferred by maternal behaviour or via in utero programming give the pup a potent adaptive advantage for the environment in which it will be living. Meaney concludes that different environmental demands require different traits in offspring and as such ‘there is no single ideal form of parenting (p.1182).’ He also proposes that more hostile environments promote a more pessimistic developmental profile where there is an increased level of corticotrophin-releasing factor (CRF) gene expression in the amygdala and hippocampus, a decrease in glucocorticoid receptors (GR) in the hippocampus, a decrease in the gamma-amino butyric acid (GABA) receptor complex specifically in the amygdala, and a decrease in the metabolically expensive synaptic systems of the hippocampus. On the other hand, a more optimistic or favourable environment requires a less reactive stress system and allows for greater synaptogenesis in the hippocampal region. The current study’s findings reflect this type of pattern with infants whose mothers have experienced trauma (trauma control) are demonstrating robust cortisol production and behavioural outcomes (more self reliant, less demanding) that would be suited to a more pessimistic environment. In addition the reduced language development may represent less energy being directed to early cognitive development. It is interesting that several studies of mother-infant interactions have suggested boys may be more vulnerable to alterations in levels of maternal care (e.g. Milgrom et al., 2004).
Yehuda and colleagues (2006) suggest two neurochemicals that may be involved in resilience and recovery to trauma, neuropeptide Y (NPY) and dehydroepiandrosterone (DHEA). Both these compounds have been found to be related to the stress response and interact with components of the HPA-axis and as such may be useful in gaining a better understanding of the mechanism behind the reduced emotional engagement seen between the mother and infants in the trauma control group. Neuropeptide Y has been shown to have an anti-anxiety action and is thought to act on a common core mechanism of emotionality and behavioural stress responses with both the amygdala and the hippocampus thought to be important brain structures in this system (for review Heilig, 2004). Further, behavioural studies in transgenic animal models have demonstrated increased emotionality in response to deactivation of the NPY system and reduced emotionality when the system is over activated suggesting a role in resilience. The current study found less shy infants in the resilient trauma control group and more shy children in the PTSD group compared to the control group, as well as children who were both rated as emotional and unsociable having higher evening cortisol levels. The study by Brand and associates (2006) also found greater distress to novelty in infants of mothers with current PTSD.

The neurochemical DHEA is a steroid hormone produced in the adrenal gland in response to adrenocorticotropic hormone (ACTH) and has been demonstrated to have physiological targets in the brain (Compagnone, & Mellon, 1998; Melchior & Retzmann, 1994). Dehydroepiandrosterone and DHEA/cortisol ratio have been found to be positively correlated with the ability to perform well under stress (Morgan, et al., 2004). This association with cortisol has lead some researchers to suggested that peripheral levels of DHEA are related to the lower basal cortisol levels found in PTSD (Spivak, et al., 2000). The recent finding by Rasmusson and associates (2004) that plasma DHEA levels corresponded to posttraumatic stress symptom improvement but not symptom severity has led to the recent suggestion that
DHEA may be related to recovery from PTSD rather than resilience to trauma (Yehuda, Flory, Southwick, & Charney, 2006).

Brain regions such as the amygdala, hippocampus and the medial prefrontal cortex, including the anterior cingulate cortex, (ACC) have been implicated in resilience to trauma (Britton et al., 2005; Liberzon & Martis, 2006; Yehuda et al., 2006; Meaney, 2001). The prefrontal cortex is thought to be particularly important in the processing of cognitive-emotional interactions and social emotions (Liberzon & Martis, 2006). Neuroimaging comparing the control, trauma control and PTSD mothers while they viewed neutral, positive and negative interactions with their infants would be extremely interesting to see if the amygdala region in particular was deactivating in the trauma control group in relation to negative emotion. Speculating further, spindle cells found in the two small areas of the brain, the ACC and the fronto-insular cortex, in only humans and great apes, have been proposed to have the function of regulating our complex social emotions and interactions (Phillips, 2004). These cells are thought to rapidly adjust behaviour during complex social interactions. These cells have been found to be significantly reduced in the brains of Alzheimer’s patients. Further, these same two brain areas appear to be affected in PTSD patients (Moores, 2004).

Psychological measures of resilience such as positive affect, optimism, positive coping styles, and cognitive flexibility were not addressed in the current study and would be of interest to address in future research. In addition, the measurement of positive growth following trauma (e.g. Tedeschi, Park, & Calhoun, 1998) could also be of interest. The current results would suggest that greater positive growth would be reported in the PTSD groups and may not be a measure of resilience but perhaps one of recovery. However, other measures such as emotional regulation and mastery were addressed directly or indirectly with the PTSD group mothers reporting greater psychological distress and less competence in parenting across the course of the study, compared to both the resilient and control groups.
It is unknown from the current study if the cost of slower language acquisition in the children of the trauma resilient mothers will be a long term consequence or one that will self correct over time, and this warrants further follow up. As well the suggestion that boys may be more vulnerable to maternal trauma and mental health problems, combined with the significant concern within the education system that boys are lagging behind girls particularly in relation to language development, indicates that detailed studies of gender differences in response to maternal trauma and mental health problems are needed.

8.3.2.1.1. Clinical implications
Speculation about the clinical implications of this protective mechanism is premature until these findings are replicated. Nonetheless, there are obvious clinical implications in relation to dyads with maternal lifetime PTSD and these will be addressed further below, and for two other populations which will be addressed here. Firstly, the introduction of universal early intervention programs means that most mothers are being assessed in relation to their interactive style with their infants. Workers in these programs are trained to look for less emotionally engaged mother-infant pairs and intervene to help them become more engaged. In the case of trauma resilient mothers this type of intervention may be detrimental to both the mother and the infant by exacerbating the mother’s intrusive and hostile behaviours and negatively impacting on the mother’s mental health (Mäntymaa et al., 2004). Given that over 50% of women experienced a significant trauma during their lifetime these universal programs could potentially have a negative impact for a large number of mother-infant dyads with long term consequences. This potential outcome goes against the basic ethical tenet of ‘do no harm’ and requires immediate investigation. A key concept to remember in relation to early intervention may be Winnicott’s notion of the ‘good enough mother’ (Winnicott, 1960). Unfortunately, this may be easy to lose site of with the research and intervention focus on maternal sensitivity with description of behaviours that are viewed as optimal or highly sensitive parenting which infers that anything less is, by definition, ‘suboptimal’. For
example, the highest maternal sensitivity rating in the Emotional Availability scales is termed ‘highly sensitive’ and in addition to behaviours that include ‘genuine, authentic, and congruent interest, pleasure, and amusement in the infant’, the mother also is required to be ‘creative and joyful’ in her interactions (Biringen, Robinson, Emde, 1998; p. 26). The results from the current study and those by Mäntymaa and associates (2004), as well as animal studies by Meaney and colleagues (2001) would suggest that ‘good enough’ may be the most optimal depending on the environmental circumstances.

Unnecessary interventions in trauma resilient dyads may also lead to an overall loss of effectiveness when evaluating intervention programs. For example a recently reported intervention study by Velderman and associates (Velderman et al., 2006) found a positive effect on child emotional and behavioural outcomes using a video feed-back intervention focusing on positive parenting. But when they added discussions about the mother’s own attachment experiences and those with her infant the effectiveness of the intervention was lost. The authors suggested that the addition of the attachment component may have taken too much emotional attention resulting in the mother being unable to focus on the positive parenting aspects of the intervention.

Secondly, the current finding of protective behaviours in both the mother and the infant may also be clinically significant for medically high risk infants of traumatised mothers. It is hypothesised that an ill baby’s immediate medical needs would override the protective mechanism of being less demanding of one’s carer, with the infant’s demands exacerbating the mother’s mental health and intrusive and hostile behaviours. This speculation is supported by the fact that medically high risk infants experience higher rates of child maltreatment (Frodi, 1984).
8.3.2.2. Vulnerability

Although the group numbers are small, the presence of a flattened pattern of cortisol in the infants of mothers with a lifetime diagnosis of PTSD (DSM-IV) supports the work of Yehuda and associates (2000; 2005) that suggests that low basal cortisol in the mother with the disorder is passed on to the her infant. Like the results from the World Trade Centre study (Yehuda et al., 2005) the current study is also suggestive of in utero programming of the HPA axis as over 33% of children’s morning cortisol levels were predicted by the number of traumas the mother had experienced as well as the number of posttrauma hyperarousal symptoms the mother had retrospectively reported, and approximately another 10% was predicted by perinatal anxiety. In addition postnatal maternal mental health, including depression, accounted for little unique variance in the child’s cortisol. Further, the results of the current study do not support the alternative position that flattened patterns of basal cortisol in the infants are related to early infant-mother interactions. Child basal cortisol was not associated with dyadic emotional availability or with patterns of organised attachment. However, due to low numbers of disorganised infants the relationship between disorganised attachment and cortisol could not be analysed.

The transmission of flattened cortisol patterns suggested that these infants will be vulnerable to overwhelming trauma experiences with an increased risk of developing PTSD. In addition, it is also possible that flattened basal cortisol patterns may mean that these infants are more vulnerable to stress and may be less able to cope with anomalous maternal behaviours that are thought to be causal in the development of disorganised attachment (David & Lyons-Ruth, 2005; Lyons-Ruth et al., 2004). Disorganised infants have been found to have faster increases in cortisol in response to parental separation and reunion compared with both insecure and secure organised infants (Spangler & Grossman, 1993). In the current study the same infant attachment pattern was found with the trauma resilient group and the controls indicating that the level of dyadic emotional withdrawal found in the trauma control group
did not alter the normal adaptive patterns of organised attachment. However disorganised attachment was associated with both the ICD-10 and DSM-IV PTSD groups suggesting a breakdown in the organisation of attachment in around a quarter of infants whose mothers reached a lifetime diagnosis of PTSD highlighting maternal lifetime occurrence of the disorder as a risk factor for infant disorganisation in middle class samples.

Despite the association between low cortisol responses in the early post trauma period and the subsequent development of PTSD Delahanty and Nugent (2006) suggest that research to date has not demonstrated a causal link between the two. This causal link is important in understanding the underlying biological mechanisms in the development of the disorder. The current view in relation to low cortisol levels suggests that low levels of cortisol are unable to control the sympathetic nervous system response to the traumatic insult which results in prolonged catecholamine levels, which in turn leads to over consolidation of memories and subsequent posttraumatic stress symptoms (Yehuda, McFarlane, & Shalev, 1998). Delahanty and Nugent (2006) suggest a more parsimonious explanation is that low cortisol reflects the risk caused by previous trauma experience and that the HPA axis is not involved in the causal pathway. They further suggest that teasing apart these two competing explanations will be difficult and the most direct approach would be to determine whether exogenously altering cortisol levels post trauma leads to reduced posttraumatic stress symptoms. However the findings of both high and low cortisol posttrauma as well as the presence of low cortisol in 1 year old infants of mothers with PTSD suggests that there is more than one pathway that may lead to vulnerability to later trauma. Certainly there are multiple components to the HPA axis, such as the diurnal rhythm, acute response to stressors and the negative feedback mechanism, which are likely to be controlled by different genes with perhaps different environmental insults impacting on different mechanisms. The level of expression of glucocorticoid receptors in the hippocampus has been demonstrated by Meaney and colleagues (Meaney, 2001; Meaney & Szyf, 2005) to be altered due to both pre and early
postnatal factors in rat pups and is thought to be susceptible to epigenetic alteration via the process of methylation (Seckl & Meaney, 2006).

Gender differences have not been systematically studied in relation to the development of PTSD. Certainly several large scale epidemiology studies have found that women develop the disorder more frequently than men (review Breslau, 2002). However, others have suggested that under extreme trauma gender differences are negligible (Nemeroff et al., 2006; Yehuda, 2002). Nevertheless, Delahanty and associates (2005) found that boys experiencing their first trauma have a different pattern of cortisol posttrauma than girls. Further, the child development literature suggests that boys are more vulnerable to maternal mental health (e.g. Milgrom et al., 2004), and the current study suggested maternal trauma may have had a greater impact on boys language development than girls. In addition the differences in female’s behavioural responses to trauma have been described as ‘tend or befriend’ compared to the male ‘flight or fight’ (Taylor et al., 2000). These behavioural differences have also been demonstrated in response to maternal frightening behaviours that are associated with infant disorganised attachment (David & Lyons-Ruth, 2005). Levels of cortisol have also been implicated in problems such as conduct disorder and attention deficit hyperactive disorder that affect boys at greater rates than girls (e.g. McBurnett et al., 2000). Together, these disparate findings may suggest that an X-linked gene and environmental trauma, like the MAOA gene (Capsi et al., 2002), may interact with the control of the HPA axis resulting in gender specific outcomes.

8.3.2.2.1. Clinical implications

Even though the numbers in the current study are low the finding that posttraumatic stress disorder was associated with disorganised infant attachment in middle class mothers is extremely important as disorganised infants are thought to have the most serious impact on later child psychopathology (van Ijzendoorn et al., 1999). Approximately 10-15% of infants
in middle class families are found to develop a disorganised style of attachment (Gibson et al., 2000; Harrison & Ungerer, 2002; van Ijzendoorn et al., 1992). Assessing for problematic patterns of attachment in both infants and adults are expensive and time consuming and out of the realms of screening programs and most intervention programs. Further, work by Lyons-Ruth and colleagues (2004) have demonstrated how difficult anomalous behaviours, thought to cause disorganisation, can be to observe in middle class mothers. As discussed above, screening for trauma and lifetime presence of ‘C’ criterion may be a cost effective screening method for PTSD in middle class mothers and may be a feasible tool to identify mother-infant dyads in need of assistance in this hard to identify group.

One could hypothesize that treatment in relation to posttraumatic stress disorder would be best addressed before the baby was born to reduce the impact of the mother’s trauma on the critical period while attachments are forming. However trauma related anxiety would be expected, and was found in the current study, to be present during pregnancy with longitudinal studies demonstrating negative affects of prenatal anxiety (O'Connor et al., 2005; O'Connor et al., 2003; van den Bergh et al., 2005). In addition there is no obvious optimal time during pregnancy for therapeutic interventions for PTSD with studies demonstrating negative outcomes for children from the presence of anxiety over multiple stages of pregnancy (van den Bergh et al., 2005). What is more, Oates (2002) highlights the concerns of using psychotropic medication through pregnancy given the evidence from the studies of maternal prenatal anxiety and the sensitivity of the foetal brain. Overall this would suggest that in an ideal world treatment for the disorder should occur before conception and monitored over the early years of the child’s life, with interventions in relation to maternal behaviour and sensitivity being the second choice.
8.4. Concluding Comments

Mental health problems in children, adolescents and adults are thought to have their origins in the interaction of genetic endowment and environmental impact, with early environmental insults having a greater impact (Harrington, 2001a, 2001b). Research demonstrating the importance of the mother-infant relationship to later development has resulted in large scale early child intervention programs being implemented across Australia (e.g. Armstrong et al., 2000), Europe (e.g. Puura et al., 2005) and the U.S. (e.g. Olds, 2006). The results from both large (Gomby, Culross, & Behrman, 1999) and small (Bakermans-Kranenburg et al., 2005) scale intervention programs are mixed and the actual mechanism for change is unknown. A recent study by Velderman and colleagues (2006), did not find that improved levels of behavioural problems in preschool children were related to improvements in maternal sensitivity, but suggested that improved outcomes came from the improvement in broader aspects of parenting, including the mothers increased insightfulness. The carer’s insightfulness and reflective capacity in relation to their child may prove to be the most fruitful targets for interventions (Oppenheim & Koren-Karie, 2002). Furthermore, the research by Mäntymaa and colleagues (2004) has suggested that paternal mental health may have a greater impact on the early development of child self regulation than maternal mental health. Research into this area may find a greater need for interventions that involve both parents, not only the mother.

The focus on maternal behaviour and maternal mental health has prompted researchers such as Oates (2002) to caution the research community about blaming mothers. She also suggests that many of the causes of psychological distress in women are the result of much broader societal issues such as social adversity and violence. Further, research findings that maternal anxiety and psychological distress in both the antenatal and postnatal periods are associated with poorer child outcomes raises the question: When is a good time for therapeutic intervention? If trauma experience does lead to the intergenerational transmission risk and
resilience, as suggested by the current study and by the work of Yehuda and colleagues (2000; 2005), the focus of research should be directed toward the translation of trauma research into early intervention programs following the traumatic experience (Yehuda et al., 2006). In a recent review Yehuda, Flory, Southwick and Charney (2006) concluded that: ‘Despite decades of research into the underpinnings of stress responses and their relationships to mental illness, clinical neuroscience has little to offer during times of national catastrophe, and to those who suffer from personal tragedy, current treatment approaches can sometimes be found lacking.’ (p391). The development of emergency triage methods for assessing the needs of patients posttrauma would be an appropriate first step in early intervention (Nemeroff et al., 2006) in stead of waiting for permanent biological changes and the development of the longitudinal sequelae of trauma symptoms and a vulnerability to psychiatric disorders and additional adverse life events (McFarlane, 1996). Early assessment processes should not only be developed for large scale disasters but effective processes should also be developed for use following known cases of traumatic exposure.

Early intervention is extremely important and prevention preferable to cure. As such, an increased focus on the reduction of societal violence should be a major focus in countries that economically can provide an environment that is optimistic or favourable in relation to human development, rather than allowing traumatic experiences to result in infants entering the world programmed for a pessimistic and hostile world, that may ultimately result in large numbers of children not reaching their full developmental potential. During the current time of escalating world violence it is important for us as human beings to understand that violence not only has a long term negative impact on our current generation, but also has a negative impact for subsequent generations. As a world wide community it is in our interests to reduce war, terrorism, and interpersonal violence, particularly violence directed at women and children. We may be unable to control natural disasters, but it is within the capacity of our governments to reduce the level of violence between and within our communities.
References


*Jacqueline Beall 2006*


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*Jacqueline Beall 2006*


Appendices

A: Participation and Consent Forms

A.1. Participation Information Sheet
PARTICIPATION INFORMATION SHEET
The Development of Mother and Baby Relationships
Phase 2

The Adelaide University together with the Queen Elizabeth Hospital is currently looking at the relationship between mothers and their children. In particular, this ongoing study will explore how the relationship between mothers and their babies develops and how past and present stress affects this relationship and the child's development. In order to do this we wish to examine the mother-baby relationship and child development at three time points, when your child is 12, 18 and 24 months old. In addition, we would like to collect some saliva samples from both the mother and the child to look at a particular stress hormone called cortisol. If you have completed the first phase of the study you are eligible to participate in phase 2.

If you choose to participate Jacqui Beall, a registered psychologist, will contact you. When your child is 12 months of age a developmental assessment of your child will be conducted either at your home or at the Queen Elizabeth Hospital. At this time the equipment and instructions to collect the saliva samples will be given to the mother. Collection of saliva is fast, simple and non-invasive. In addition, several questionnaires relating to stress and personal well-being will be completed. This session will take approximately 1 hour. A further appointment will be made for the following week at the Queen Elizabeth Hospital to look at mother-baby interactions and baby-adult interactions. This session will take approximately 30 to 45 minutes. A brief report of the baby's development will be available upon request.

At 18 months of age, your baby will undergo a brief language developmental assessment at the Queen Elizabeth Hospital as well as a further assessment of the mother-baby relationship. It is anticipated that these assessments will take approximately 45 minutes. Both the 12 and 18-month mother-baby interactions will be videotaped. A brief report of your baby's language development will be available upon request. When your baby has reached 24 months you will be asked to complete a checklist of normal to abnormal childhood behaviors. This will take approximately 20 minutes and can be completed in your home.

We aim to use the information obtained in this research to enhance relationships between mothers and their babies. In addition, this study will be a major part of Ms Jacqui Beall's PhD program.

Your involvement in this study is entirely voluntary. Should you decide to withdraw from the study you may do this freely and without prejudice. Should any issues arise as a result of your participation in this study, we can arrange for you to speak with a health professional. In exceptional circumstances, if it is felt necessary, a case will be discussed with a specialist clinician to determine whether clinical services may be offered. If we find a problem with your child's development you will be informed and offered appropriate care.

The questionnaires, the interviews and assessments of your baby are confidential and will be coded with a number, not a name, to maintain anonymity. No information that could lead to your identification will be released.

For further information or to register to be involved in the study, contact Jacqui Beall or Dr Clara Bookless on 8222 6515.

This study has been approved by the Ethics committees from both the University of Adelaide and the Queen Elizabeth Hospital. Should you wish to discuss the project with someone not directly involved, in particular in relation to matters concerning policies, information about the conduct of the study or your rights as a participant, or should you wish to make a confidential complaint, you may contact the University of Adelaide Ethics Committee on 8222 6841 or call Mr Paul Miller, Executive Officer, Ethics Committee Queen Elizabeth Hospital on 8222 6841.
A.2. Mother Consent Form
CONSENT FORM

I

Hereby consent to my involvement in the research project entitled:
"The Development of Mother and Baby Relationships"
Phase 2

1. The nature and purpose of the research project described on the attached information sheet has been explained to me. I understand it, and agree to taking part.

2. I understand that I may not directly benefit by taking part in this study.

3. I acknowledge that the possible risks, discomforts and inconveniences, as outlined in the Information Sheet, have been explained to me.

4. I understand that while information gained in the study may be published, I will not be identified and information will be confidential.

5. I understand that I can withdraw from the study at any stage and that this will not affect medical care or any aspect of my relationship with the Queen Elizabeth Hospital.

6. I understand that there will be no payment to me for taking part in this study unless specified in the Information Sheet.

7. I have had the opportunity to discuss taking part in this research project with a family member or a friend and/or have the opportunity to have a family member or a friend present whilst the research project was being explained by the researcher.

8. The researchers are legally required to report information if the wellbeing of my infant or myself is considered to be at risk. I understand that all information provided will remain confidential except under these circumstances.

9. I am aware that I should retain a copy of the Consent Form, when completed, and the Information Sheet.

Full Name: -------------------------------

Signed: ------------------------------- Dated: -------------------------------

I certify that I have explained the study to the patient and consider that she understands who is involved.

Signed: ------------------------------- Dated: -------------------------------

Witness States: -------------------------------
A.3. Child Consent Form
CONSENT FORM

I hereby consent to my child's involvement in the research project entitled: "The Development of Mother and Baby Relationships"

Phase 2

1. The nature and purpose of the research project described on the attached information sheet has been explained to me. I understand it, and agree to my child taking part.

2. I understand that my child may not directly benefit by taking part in this study.

3. I acknowledge that the possible risks, discomforts and inconveniences, as outlined in the Information Sheet, have been explained to me.

4. I understand that while information gained in the study may be published, my child will not be identified and information will be confidential.

5. I understand that I can withdraw my child from the study at any stage and that this will not affect medical care or any aspect of my relationship with the Queen Elizabeth Hospital.

6. I understand that there will be no payment to my child for taking part in this study unless specified in the Information Sheet.

7. I have had the opportunity to discuss taking part in this research project with a family member or a friend and/or have the opportunity to have a family member or a friend present whilst the research project was being explained by the researcher.

8. The researchers are legally required to report information if the wellbeing of my infant or myself is considered to be at risk. I understand that all information provided will remain confidential except under these circumstances.

9. I am aware that I should retain a copy of the Consent Form, when completed, and the Information Sheet.

Full Name of Child: ..................................................

Full Name: ...........................................................

Relationship to Child: .............................................

Signed: ............................................................. Dated: ...................................................

I certify that I have explained the study to the patient and consider that she understands what is involved.

Signed: ............................................................. Dated: ...................................................

Witness Status: ...........................................................
A.4. Video Recording Consent Form 1
VIDEO RECORDING CONSENT FORM

1. I _____________________________ (please print) Consent to the video recording of myself and my child as a part of the research project titled “The development of mother and baby relationships”.

2. I give consent for the video-recording to be used for research and training purposes within the Department of Psychiatry, University of Adelaide. My consent is given freely.

3. I have been informed that the video-recording will be kept confidential and that no names or identifying information will be attached to the videos.

4. I have been informed that the video will not be used for any other purpose that has been described above.

5. I understand that the purpose is for research and that my participation may not have any direct benefit to myself or my child.

6. I understand that I am free to withdraw my consent at any time, and free to have the recording erased at any time.

Signed ___________________________ Date ___________________________

I _____________________________ Have described to _____________________________

The nature of the video tape recording process and the uses to which the record will be put. In my opinion she understand the explanation.

Signed ___________________________ Date ___________________________

Witness Status ___________________________
A.S. Video Recording Consent Form 2
VIDEO RECORDING CONSENT FORM 2

1. I, .............................................................. (please print) Consent to the video recording of myself and my child as a part of the research project titled "The development of mother and baby relationships".

2. I give consent for the video-recording to be used for research and training purposes within the Department of Psychiatry, University of Adelaide. My consent is freely given.

3. In addition, I give my consent for the video-recording to be used for educational purposes, such as teaching, seminars and conference presentations. My consent is given freely.

4. I have been informed that the video-recording will be kept confidential and that no names or identifying information will be attached to the videos.

5. I have been informed that the video will not be used for any other purpose than has been described above.

6. I understand that the purpose is for research and that my participation may not have any direct benefit to myself or my child.

7. I understand that I am free to withdraw my consent at any time, and free to have the recording erased at any time.

Signed ........................................... Date ...........................................

I, ..........................................................................................................................

Have described to ........................................................................................................
The nature of the video tape recording process and the uses to which the record will be put. In my opinion she understand the explanation.

Signed ........................................... Date ...........................................

Witness Status: ........................................................................................................
A.6. The University of Adelaide Human Research Ethics

Committee: Document for people who are subjects in a research project
Document for people who are subjects in a research project

CONTACTS FOR INFORMATION ON PROJECT AND INDEPENDENT COMPLAINTS PROCEDURE

The Human Research Ethics Committee is obliged to monitor approved research projects. In conjunction with other forms of monitoring it is necessary to provide an independent and confidential reporting mechanism to assure quality assurance of the institutional ethics committee system. This is done by providing research subjects with an additional avenue for raising concerns regarding the conduct of any research in which they are involved.

The following study has been reviewed and approved by the University of Adelaide Human Research Ethics Committee:

Project title: "The Development of Mother and Baby Relationships"

1. If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult the project co-ordinator:

   **Name:** Dr Clara Bookless

   **telephone:** 82226515

2. If you wish to discuss with an independent person matters related to
   - making a complaint, or
   - raising concerns on the conduct of the project, or
   - the University policy on research involving human subjects, or
   - your rights as a participant

   contact the Human Research Ethics Committee's Secretary on phone (08) 8303 4014
B Appendices: Questionnaires

B.1. Personal Information Questionnaire
ID Number: ..................  Date: .................

Personal Information Questionnaire
Phase 2
18 months

Information about your child:

1. Age: ................. (Months)

2. How would you describe your child's temperament?

3. How would you describe your child's general health over the past 6 months?
   a. [ ] excellent
   b. [ ] very good
   c. [ ] good
   d. [ ] fair
   e. [ ] poor

4. Has your child had any of the following health problems on a regular basis over the past 6 months:
   [ ] Nervousness/anxiety
   [ ] Influenza/common cold
   [ ] Virus infections
   [ ] Bowel/stomach problems
   [ ] Injury
   [ ] Asthma
   [ ] Continual crying
   [ ] Problems sleeping
   [ ] Sleeping too much/fatigue
   [ ] Diarrhea
   [ ] Vomiting
   [ ] Allergies
   [ ] Visual impairments
   [ ] Hearing impairments
   [ ] Croup
   [ ] Skin problems
   [ ] Other (please specify) .................................................................
5. What health services have you accessed in relation to your child’s health over the past 6 months?
   [ ] Child and Youth Health
      If yes
      [ ] health checks
      [ ] immunizations
      [ ] parenting groups
      [ ] day services
      [ ] Torrens House
      [ ] Home visiting service
      [ ] Other (specify).................................................................
   [ ] General Practitioners/Pediatrician
      If yes
      [ ] health checks
      [ ] immunizations
      [ ] illness
   [ ] Community Health Services
      If yes
      [ ] health checks
      [ ] immunizations
      [ ] illness
   [ ] Women’s and Children’s Hospital Pediatric Services
      If yes
      [ ] health checks
      [ ] immunizations
      [ ] illness
   [ ] Parenting Network
   [ ] Nursing Mothers
   [ ] Aged care

Any comments about these services?
 ..............................................................................................................
 ..............................................................................................................

Information about your child’s main care-givers:

7. How would you best describe the household that your child lives in?
   [ ] Two parent family
   [ ] Single parent family
   [ ] Blended family
   [ ] Other (please describe)......................................................

8. Has this changed over the past 6 months?
   [ ] No
   [ ] Yes (please specify)..........................................................
9. Who would you currently describe as your child's main care giver?  
(specify relationship to child)

10. Approximately how many hours per week does your child's father currently  
spend in direct care of your child?

11. Who else currently cares for your child on a regular basis?  
[ ] grandparents ........................................ hours per week  
[ ] other relatives (specify) .................................. hours per week  
[ ] child care worker ........................................ hours per week  
[ ] family day care worker ................................ hours per week  
[ ] others (please specify) .................................. hours per week

12. Have you returned to work since the birth of your child?  
[ ] No  
[ ] Yes

If yes:  
a. How many hours per week do you currently work? ...................... 
   b. At what age was your child when you returned to work? ..........(months)

13. Please indicate if any of the following events have caused you stress over the past  
6 months (tick all relevant boxes).

[ ] Marital conflict  
[ ] Marital separation/Divorce  
[ ] Boy/Girlfriend conflict  
[ ] Problems with child  
[ ] Problems with family  
[ ] Bereavement  
[ ] Financial problems  
[ ] Unemployment  
[ ] Work/study problems  
[ ] Illness/accident/surgery  
[ ] Domestic violence  
[ ] Physical health problems (please specify)

[ ] Other problems or problems with your nerves (please specify)

[ ] Alcohol/drug problems  
[ ] Mental illness  
[ ] Sexual problems  
[ ] Forensic/criminal problems  
[ ] Sexual assault  
[ ] Physical Assault/threat  
[ ] Car problems  
[ ] Problems with the baby’s father  
[ ] Accommodation problems  
[ ] Problems with family of origin  
[ ] Problems with family of the baby’s father

3
Family and Friends:

14. About how many close friendships have you established as a result of having your children?
   [ ] None
   [ ] 1
   [ ] 2
   [ ] 3
   [ ] 4 to 9
   [ ] 10+

15. In the past 3 months, how often did you get together with friends and family with other children?
   [ ] Every day
   [ ] Several days a week
   [ ] About once a week
   [ ] 2 or 3 times a month
   [ ] About once a month
   [ ] Twice in 3 months
   [ ] Once in 3 months
   [ ] Once in 6 months
   [ ] Once in a year
   [ ] Never

16. Do these new friendships serve a different purpose than previous friendships?
   [ ] No
   [ ] Yes (please specify)

17. From time to time, some people discuss important matters with other people. Looking back over the last six months, who is the person you are most likely to discuss important matters with?
   [ ] Spouse/partner
   [ ] Boyfriend/girlfriend
   [ ] Parent
   [ ] Sibling
   [ ] Child
   [ ] Other family member
   [ ] Co-worker
   [ ] Neighbor
   [ ] Friend
   [ ] Adviser
   [ ] Acquaintance
   [ ] No-one
   [ ] Don’t know
   [ ] Other (please specify)
NOTE: Appendices B.2 – B.10 are included in the print copy of the thesis held in the University of Adelaide Library.
B.2. Traumatic Antecedents Questionnaire (TAQ)
B.3. Posttraumatic Checklist-Civilian (PCL-C)
B.4. Dissociation Experiences Scale (DES)
B.5. Impact of Events Scale-Revised (IES-R)
B.6. Edinburgh Postnatal Depression Scale (EPDS)
B.7. Mother and Baby Scale (MABS)
B.8. Personal Appraisal Inventory (PAI)
B.9. The Emotionality, Activity and Sociability (EAS)

temperament survey
B.10. Alarm Distress Baby Scale (ADBB)
B.11. Saliva Collection Instructions
Saliva Collection Instructions

Saliva samples are to be collected within 30-minutes of waking in the morning and 30-minutes prior to going to bed for the evening on the day before you are booked to attend The Queen Elizabeth Hospital.

General Instructions:

1. Do not eat a major meal within 60-minutes before the sample is to be collected.
2. Avoid alcohol consumption 24-hours before sample collection.
3. Avoid eating dairy products during the 30-minutes before sample collection.
4. Avoid acidic or high sugar food and drinks 30-minute before sample collection.
5. Do not brush teeth within 3-hours before sample collection.
6. Rinse mouth out with water 10 minutes prior to collecting sample.
7. Record all prescription and over-the-counter medication taken in past 24-hours.

Child Morning and Evening Samples

After waking give your child a drink of water and 10 minutes later suck up saliva using the plastic pipette supplied. Saliva often collects under the tongue area. Transfer the saliva to the BLUE capped tube marked with the number 1. You need enough saliva to reach the black line marked on the side of the tube. If the pipette is too long you can shorten the tip using a pair of scissors. Throw away the pipette after you have collected the required amount of saliva. Make sure the lid is screwed on tightly so the saliva will not evaporate. Place in the box provided and refrigerate.

When your child is going to bed for the evening give them a drink of water and collect saliva 10 minutes later. Transfer saliva to the BLUE capped tube marked with the number 2. Place tube with the other saliva samples in the refrigerator.

Mother Morning and Evening Samples

In the morning after getting up rinse your mouth out with water and wait for 10-minutes. Do not brush teeth or eat in this time. Collect the spit in your mouth and using the short straw supplied dribble the spit into the RED capped tube marked with the number 1. Collect enough saliva to reach the black mark on the side of the tube. Screw lid on tightly and place in the box provided and refrigerate.

When going to bed for the evening, before brushing teeth, rinse mouth out with water and wait 10-minutes. Collect the spit in your mouth the dribbles down the straw into the RED capped tube labelled with the number 2. Collect enough to reach the black mark on the side of the tube. Screw lid on tightly and place in box with other saliva samples and refrigerate.

Please bring the box and saliva samples to The Queen Elizabeth Hospital when you come for your next appointment.
NOTE: Appendices C.1 – C.2 are included in the print copy of the thesis held in the University of Adelaide Library.
C.1. Accreditation for Griffith Mental Development Scales (GMDS)
C.2. Accreditation for Strange Situation Procedure (SSP)