SHARED AND NON-SHARED INFLUENCES ON THE DEVELOPMENT OF ATTACHMENT IN TWINS

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ABSTRACT

This thesis describes a study of the development of attachment in a sample of infant twins. The aim of the research was to investigate the causes of individual differences in attachment security from a behaviour-genetic perspective. Contemporary attachment research views the development of attachment as being mediated by working models of attachment. An important implication of the contemporary view is that attachment is caused entirely by shared environmental factors. By contrast, behavioural genetics research suggests that the majority of variability in behavioural development is caused by non-shared environmental factors. The current study aimed to test this shared environmental model in families of twins. The study consisted of a sample of 58 pairs of twins and their mothers. Assessments were carried out of maternal sensitivity at 9 months, parental security of attachment (Adult Attachment Interview) at 10 months and infant attachment security in Ainsworth's Strange Situation at 12 months of age. Consistent with the linear model of attachment twins were more likely to receive the same attachment classification than would be expected by chance. Furthermore, concordance for attachment for MZ and DZ twins suggested only environmental influences on attachment. Shared components of variance in maternal sensitivity were also associated with shared outcomes in attachment. In addition, parents who were classified as Secure-Autonomous in the AAI were more likely to be sensitive and responsive to *both* infants – consistent with the internal working models view. There was also strong evidence of non-shared environmental influences on attachment and these differences in outcome were related to differences in maternal sensitivity. Furthermore, significant differences were found between those families concordant for attachment and those who were not for a range of psychosocial factors. The findings are discussed in terms of the importance of the non-shared environment for future models of the development of attachment.

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CHAPTER 1
INTRODUCTION

Bowlby's theory of attachment was revolutionary in its conceptualisation of the processes that shape a child's social and emotional development. Bowlby theorised that the child's view of the self as special, valuable and worthy of love, evolves out of interactions with the primary attachment figure characterised by acceptance, sensitivity and openness to the child's emotional needs. There is now considerable evidence to suggest that individual differences in patterns of attachment assessed in infancy play a powerful role in life-span socio-emotional development. Over two decades of research has consistently shown that a child classified as 'secure' in Ainsworth's Strange Situation (Ainsworth, Blehar, Waters & Wall, 1978) is likely to follow a developmental pathway reflected by high self-esteem and competence (Cassidy, 1988; Matas, Arend & Sroufe, 1978), positive adaptation to the school setting (Erickson, Sroufe & Egeland, 1985), good peer relations (Troy & Sroufe, 1987), effective problem-solving skills Frankel & Bates, 1990), and advantages in belief-desire reasoning (Fonagy, Redfern & Charman, 1997) and I.Q. in middle-childhood (Jacobsen, 1994). The early attachment relationship is thought to provide the child with a safe base from which to explore and learn about the physical and social environment and is considered to provide the child with a model of close social relationships that is brought forward as a pervasive organising influence across the life span.

Given the apparent developmental advantages associated with secure infant-mother attachment and their evident clinical implications (Belsky & Nezworski, 1988; Crowell & Feldmann, 1988; Erickson et al, 1985), the underlying causes of infant-mother attachment have been an important focus of attachment research since its inception. The great majority of recent research work in this area has been dedicated to confirming one of Bowlby's central propositions regarding the development of individual differences in attachment - that it is continuity in representational systems that drives the development and organisation of attachment relationships both across individual lifespan development and between generations from parent to child. According to this view the primary causes of individual differences in attachment security are patterns of parental caregiving behaviour that are themselves determined by the parent's representations of their early attachment experiences. These patterns of parental behaviour are thought in turn to shape the development of the infant's own representations of attachment. These 'internal working models' of attachment

are then thought to control the expression of attachment behaviours in times of stress and separation and come to play a vital role in the child's functioning in later interpersonal relationships.

This 'linear' model of the intergenerational transmission of patterns of attachment stands in sharp contrast to the views of many developmental psychologists who emphasise the importance of differences between siblings (Dunn & Plomin, 1990), of the influence of relationships on relationships (Rutter, 1995; Hinde & Stevenson-Hinde, 1990; Hinde, 1987) and the role of family systems (Marvin & Stewart, 1992). Such a simple linear model leads to predictions about the processes involved in the development of attachment that to many would seem unreasonable, unlikely or quite simply wrong. Specifically, a strong interpretation of this linear model leads to the prediction that all children brought up by the same parent should develop the same pattern of attachment. Such a strong claim is at odds with a large body of evidence that has emerged from behaviour genetic studies of twins, siblings, step children and adoptees which consistently show that once genetic factors are taken into account sibs tend to be no more similar to each other than children reared in entirely different families (Plomin & Daniels, 1987). The importance of environmental factors that are not shared by members of the same family has yet to be determined in the domain of attachment but the presence of such non-shared environmental influences has been a ubiquitous finding in all other areas of development investigated to date.

Of course, these findings would come as no surprise to those who have long urged attachment researchers to consider attachment processes in family systems (Hinde & Stevenson-Hinde, 1990; Marvin & Stewart, 1990; Belsky, 1984). Family systems theory emphasises the complex interplay between relationships within a family, from the influence of one dyadic relationship on another to the role that triadic and higher-order family interactions play in fostering or compromising the development of secure infant-parent attachments. Indeed, the very utility of a family systems approach is predicated upon the notion that relationships cannot be understood in isolation. A strong interpretation of the linear model predicts that the dyadic mother-infant attachment relationship should be encapsulated from the influence of other family relationships except in as much as these relationships might have the potential to lead to maternal representational change. Such a view is not only counterintuitive to many researchers and clinicians but is also broadly inconsistent with evidence that points to the importance of the quality of the marital

relationship for the development of secure infant-mother attachment, the impact of siblings on development and family relationships (e.g. McGuire, Dunn & Plomin, 1994; Perner, Ruffman & Leekam, 1994; Dunn, Stocker & Plomin, 1991) and also to the significance of maternal social support (Belsky & Isabella, 1988; Engfer, 1988; Crnic, Greenberg & Slough, 1986; Crockenberg, 1981).

The aim of this thesis then is to test the linear representational model of the intergenerational transmission of patterns of attachment in families with more than one child. Specifically, key components of the linear model including parental representations of attachment, maternal sensitivity and infant-mother attachment shall be assessed in families with infant twins. The advantage of studying twins in this context is that it allows for simple comparisons to be made between attachment patterns in children raised by the same parent without the potentially confounding influence of intervening discontinuities in maternal attachment status that may occur over time.

This opening chapter shall begin by reviewing Bowlby's original proposals about the causes of attachment behaviour from an ethological perspective. This overview of Bowlby's early work will provide the backdrop from which to understand the links between Bowlby's early thinking and later developments in the field and to evaluate the strengths and limitations of current theory and research into individual differences in attachment. Indeed, this initial focus on Bowlby's early work is partly intended to convey the extent to which current theory and research in attachment has failed in some respects to do justice to the elegance and scientific weight of Bowlby's original insights into the nature of human attachment and that his early work offers a better framework for understanding the effect of relationships on relationships. There will then follow a review of the contemporary theoretical work that forms the basis of this research and particular attention shall be paid to the notion of internal working models and the mechanisms by which patterns of attachment are thought to be transmitted from one generation to the next. The literature addressing the empirical validity of the linear model of attachment shall then be evaluated and this will be followed by a description of the rationale for the present series of investigations and a statement of the hypotheses to be tested in this thesis.

PART I: THEORETICAL OVERVIEW

BOWLBY'S ETHOLOGICAL THEORY OF ATTACHMENT

In the first volume of Bowlby's Attachment trilogy (Bowlby, 1969/82) Bowlby amassed a remarkable body of evidence from diverse scientific disciplines such as ethology, evolutionary biology, neurophysiology and developmental psychology in support of his theory of infant-parent attachment, a theory that was groundbreaking in its treatment of the evolution and development of behaviour. Bowlby's theory of attachment sought to understand the infant's tie to her parent as being of central biological importance and viewed attachment behaviour as having evolved as a primary survival mechanism in the face of environmental threat (Bowlby, 1969/1982).

In order to understand fully the aim and scope of Bowlby's work on attachment it is necessary to cover in some detail its ethological basis. Bowlby's theory was strongly influenced by neo-Darwinian theory and in particular by the work of ethologists such as Robert Hinde and Konrad Lorenz. Indeed much of the early evidence supporting Bowlby's position came from observational and experimental work on primates (e.g. Rajecki, 1978; Harlow, 1960). Ethologists have traditionally approached questions regarding the causation of behaviour by reference to 4 core principles first proposed by Tinbergen (Tinbergen, 1952). Tinbergen's four questions concerned the following aspects of the causes of behaviour:

1. *Phylogeny:* the evolutionary history of a behaviour
2. *Function:* a behaviour's survival value
3. *Causation:* the proximate mechanisms of behaviour
4. *Ontogeny:* development

Bowlby's aim was to outline answers to all four of these questions about the causes of human attachment behaviour. To begin with, Bowlby proposed that the extended period of infancy that is evident in all mammals and especially so in higher primates led to the evolution of behaviours that served to maintain an infant's safety from predation and attacks from conspecifics through proximity to a parent. Bowlby cites many detailed observational studies of rhesus monkeys, baboons, chimps and gorillas as well as human infants. These studies consistently show that attachment behaviours such as clinging, calling and following which

are common across all these species lead to the maintenance of proximity to a parent (usually the mother) and dominate mother-infant interactions in early life. In infancy most primate infants spend a great deal of time near their mother. They actively seek or call her when she moves away or when the infant is threatened - either by predators or by another member of the troop. At the same time, mothers in these species closely monitor their infant's movements. They respond rapidly to alarm-calls and quickly retrieve their infants if they stray too far. In nearly all ground-living primates these behaviours show a relatively consistent form and developmental course. The morphological parallels between human attachment behaviour and that of the lower primates is startling and few now would question the notion that they are functionally equivalent and phylogenetically related. Bowlby thus saw human attachment behaviour as an adaptation that arose early in hominid evolution that is shared via some common ancestor by all ground-living primates. The adaptive function of attachment behaviour in Bowlby's theory is clear and immediate – attachment behaviour probably represents the infant's only effective response to danger and is thus of paramount importance to survival.

1.1 The attachment behavioural system

As well as specifying the evolutionary origins and survival function of attachment behaviour Bowlby proposed a model of the proximate mechanisms involved in the operation of attachment behaviour using concepts derived from ethology and control systems theory. Bowlby proposed that attachment behaviours such as smiling, crying, clinging and proximity-seeking could be understood as elements of a control system whose function is the regulation of threat through the maintenance of proximity to a caregiver.

The idea that biological adaptations can be understood as control systems was central to Bowlby's argument. To Bowlby, the finely-tuned operation of the cardio-vascular system, the stoop of a falcon to catch a moving prey and the maintenance of proximity of an infant to a caregiver all involve organised patterns of behaviour whose ends are achieved by continuous goal-corrected feedback. Goal-corrected feedback, according to Bowlby, is the primary means by which goal-directed, adaptive biological activity has come about through natural selection. As a result of a process of modification and differential survival of better-adapted variants, evolved systems come to have predictable and beneficial consequences when they operate in the environment to which they were adapted. Bowlby referred to this 'design-specified environment' as the *environment of evolutionary adaptedness* and Bowlby

was quick to point out the potentially dysfunctional or pathological consequences of placing an evolved system into circumstances for which it was not designed.

Evolved behavioural systems are thought to be characterised by the following features (from Bowlby, 1969/82):

1. They follow a similar pattern across members of a species
2. They are not simple responses to a single stimulus but represent relatively organised activity or sequences of behaviour that run a predictable course
3. They have obvious survival value at least on average across a population of individuals
4. They have a relatively consistent developmental course and often occur when special learning experiences are absent [1]
5. They achieve their predictable end by monitoring the discrepancy between current circumstances and some internal set-goal (which may be an outcome, a constant or a varying parameter) and making appropriate changes in behaviour based on sensory feedback
6. As a consequence of 5) above, they generally follow a predictable course despite relatively wide differences in initial conditions

The attachment behavioural system consists of various behaviours whose predictable outcome is the proximity of a caregiver. Bowlby categorises these behaviours into two kinds. Some attachment behaviours can be thought of as attachment *signals* whereas others are direct proximity-seeking behaviours. Clearly some attachment behaviours bring about parental proximity by virtue of their effect on the caregiver. Crying, smiling, babbling and calling are all proposed to be attachment behaviours that have a signal function and generally lead to an ameliorating parental response. Early in development such behaviours may not be goal-corrected of course, but as development progresses, they are more likely to be used in a goal-corrected manner - increasing in frequency or intensity as the attachment system becomes more activated and diminishing as a function of parental proximity.

[1] Features 1-4 are also shared by fixed action patterns, see Bowlby, 1969/82 pp. 65-67

Proximity-seeking behaviours on the other hand are almost always goal-corrected. They include behaviours such as approach and clinging. Bowlby notes how proximity-seeking behaviours such as these are organised such that the particular behaviour used at any one time is less important than the outcome itself. Consequently, a baby may crawl, roll, shuffle or walk towards a parent in times of stress to meet the set-goal of proximity. In that sense, these behaviours are organised in terms of a simple goal-corrected plan, an organisational structure discussed further in later sections of this chapter.

Behavioural systems thus generally involve three components. They clearly require sensory systems for monitoring relevant control parameters and action systems for carrying out appropriate changes to ongoing behaviour. More often than not, knowledge of the relevant problem domain is important for the appropriate operation of a behaviour system too - such as the movement and defence patterns of prey or the location of a caregiver. Bowlby notes how many examples of goal-corrected behaviour require the organism to construct some kind of *cognitive map* in order to orient appropriately in space, as in the homing behaviour of pigeons. Of course, a cognitive 'map' need not be a visuo-spatial one. It need only map the relevant dimensions of a problem-space in order to regulate corrective action using sensory feedback. It was this notion that formed the basis of Bowlby's idea of internal working models.

1.2 Internal working models

Bowlby went further in specifying the concept of an internal working model and suggested that what was intrinsic to the idea was that selected parts of a problem-space formed the basis of a working model from which real-world predictions could be made about outcomes under various conditions - as if the organism were able to carry out "little experiments in the head" (Bowlby, 1969/82). Bowlby also pointed out that the organism would often require not just knowledge of the environment but also knowledge of its own capacities in order to effectively regulate goal-corrected action. In addition, these models were thought to be derived from experience of the environment, and of the organism's action within it, through learning processes much like those described by Piaget. Bowlby further suggested that for a working model to be adaptive it would have to be:

a) built with reference to the relevant data
b) generative, in other words applicable to novel situations and

c) continuously checked for consistency.

The idea that working models must be checked for consistency is an important one because it forms part of Bowlby's account of continuity and change in developing behavioural systems and responses to major life events such as loss.

A key component of the attachment behavioural system then is the infant's representation of the environment, especially the current context and the parent's location and availability. The infant is thus thought to generate working representations of his environment that play a primary role in the goal-corrected control of attachment behaviour. Bowlby saw the development of the representational component of the attachment control system as being closely tied to the development of locomotion. It is at this time that the infant is thought to begin to play an active role in monitoring and regulating proximity to a primary caregiver. These representations became arguably the most important aspect of Bowlby's later writing on attachment. As shall been seen in later sections of this chapter this idea provided the link that led to the development of a framework for characterising individual differences in attachment. In this view differences in attachment behaviour result from differences in infants' representations of their parent's availability and likely responsiveness to attachment signals. The bulk of contemporary attachment theory and research has been devoted to elaborating and testing Bowlby's notion of internal working models of attachment.

1.3 Co-ordination of behavioural systems

Bowlby also outlined an account of how the activity of different behavioural systems are co-ordinated. The co-ordination of behaviour systems is important in circumstances when the activity of one system may interfere with that of another or when the prior activity of one system is necessary for another's subsequent success. Bowlby describes three main organisational structures for co-ordinating behaviour systems:

1. Chain-linked systems
2. Causal hierarchies
3. Plan hierarchies

The simplest way in which behaviour systems can be co-ordinated is in simple chains in which the termination of one activates the onset of another. It seems that much of the

elaborate behaviour of lower animals can be explained by reference to linked systems of this sort. The example that Bowlby gives is that of honey-collecting behaviour in bees. The bee's approach to a flower is regulated by a goal-corrected behaviour system that is sensitive to the shape and colour of flowers commonly found in the bee's environment. Once near to the flower, approach behaviour is terminated and olfactory cues initiate landing. Despite the capacity of such systems to co-ordinate complex patterns of behaviour one of the weaknesses of chained behavioural systems of this sort is that any failure in one system can lead to the breakdown of the whole chain. In this example, if specific olfactory cues are absent the bee will not proceed to settle on the flower. Bowlby saw much of early attachment behaviour as being organised along these lines. Causal hierarchies, which do not play a major role in Bowlby's theory of attachment, involve systems that share the same initiating or terminating factors. Hormonal effects and the effects of autonomic arousal are likely to operate in this way.

More important for the purposes of this discussion are plan hierarchies. Plan hierarchies operate as higher-order goal-corrected systems that monitor discrepancies between the activity of lower-order behaviour systems and some more general plan structure. Adjustments are then made to the activity of lower-order systems in order to bring about the overall set-goal. Plan hierarchies obviously represent the most complex patterns of behaviour in which behaviour is flexibly structured into goals and sub-goals which are themselves regulated by an overarching 'long-term' plan. A good example of plan hierarchies in the co-ordination of behaviour systems is spatial learning in rats. Rats who have learned the position of a platform or exit in a maze by running through it are able to navigate their way equally effectively if they are forced to swim. What regulates their behaviour is some higher-order plan - one indeed that clearly depends upon the generation of a cognitive map. What is important here is that Bowlby proposed that the development of behavioural systems tends to progress from simple linked chains towards behaviour governed by plan hierarchies as a result, largely, of maturational changes in the neocortex (Bowlby, 1969/82).

In the case of attachment behaviour Bowlby suggested that in infancy the attachment behaviour system works dynamically in conjunction with several other important behaviour systems that are organised for the most part into simple chains. For example, based on observations made by Anderson (1972), Bowlby proposed the existence of another important behaviour system whose function is the search for and investigation of novel information

through exploration and play. This set of behaviours has become known as the exploratory system. Anderson's observations suggested that exploratory behaviour often leads to the activation of the attachment system, because exploration frequently brings about increases in distance from the parent. Once activated, the attachment system - whose behaviour is incompatible with that of the exploratory system - inhibits exploration and leads to proximity seeking, calling or crying. Once parental proximity is achieved the attachment system is terminated and exploration may commence once again. This balance between attachment and exploration is often referred to as 'secure-base behaviour'. This term is intended to capture the way that infants have been observed to embark on little forays away from the parent but continually check for the parent's presence and return now and then to seek proximity before further exploration.

1.4 Activating causes of attachment behaviour

The activating or inhibitory influence of other behaviour systems is of course one amongst many classes of factors responsible for the onset and termination of systems of behaviour. There are often multiple factors that may lead to the activation of a behaviour system. They range from the very domain general, such as the effects of changes in hormone balance, to the very domain specific, such as a specific environmental stimulus like the rapid looming of a novel object or the departure of a caregiver. Bowlby outlined several possible causal factors involved in the activation of the attachment behaviour system which he referred to as 'natural clues to danger':

1. *Physiological cues*: Fatigue, hunger, cold, illness, pain
2. *Environmental cues*: Novelty, alarming events, approach and rebuff by strangers
3. *Parental cues*: Sheer distance from the parent, parent's departure, parent's discouragement of proximity, parent's inattention or attention to another child (often a sibling)

All the above conditions and no doubt others are capable of eliciting attachment behaviour at greater or lesser degrees of intensity. Once activated, the attachment behaviour system will run its course in a way that is dependent to a large extent on the intensity with which the infant's attachment behaviour is activated. In conditions of relatively low stress looking to the parent may be all that is necessary. In more stressful situations only physical contact is likely to be effective.

To summarise briefly then, the attachment behavioural system is thought to consist of perceptual, cognitive and action systems that are responsible for monitoring the environment for 'natural clues' to danger and co-ordinating goal-appropriate behaviour in order to bring about parental proximity and hence reduce perceived threat.

1.5 The development of attachment

Bowlby also described the processes that he believed to be involved in the development of attachment behaviour. Bowlby's views regarding continuity and change in the organisation of attachment are especially important to this discussion because they forms the basis of the linear model of the intergenerational transmission of patterns of attachment that is the subject of this research. According to Bowlby, behavioural systems develop as a result of three basic processes:

1. Restriction of the range of eliciting conditions: often as a result of improved capacities to discriminate sensory stimuli
2. Incorporation or replacement of primitive behaviour systems by more sophisticated ones
3. Organisation of behaviour systems into functional wholes

Bowlby gives many examples from the ethological literature of behaviour systems whose development are organised along the lines described above. A good example that Bowlby uses is the case of social smiling. Indeed Bowlby saw smiling as an important attachment behaviour that maintains continued interaction and parental proximity. Bowlby describes the following developmental course of the social smile. During the first two weeks or so of life, smiling occurs in a relatively reflex fashion. Smiles may often occur spontaneously without being linked to any specific stimulus or in response to gentle tactile stimulation or soft sounds. Smiling at this age is also incomplete, lacking the typical creasing around the eyes that is characteristic of later smiles. After the second week, the smile begins to be elicited by more specific stimuli - often produced by humans - such as the voice of a parent. At the same time the smile adopts its more complete form with the eyes creasing at the corners. After the first month visual stimuli become to play a more important role and faces become especially powerful elicitors of a smile. It is around this age that mothers and infants often begin to engage in face-to-face play. At around 13 weeks, infants appear to become more selective in their use of smiling and become more likely to smile at a parent than a

stranger on the basis of visual information. As development proceeds the smile becomes incorporated into an organised functional whole in relation to other attachment behaviours that mediate parental proximity. Bowlby suggested that infants learn about the functional consequences of social smiling through trial-and-error learning and hence can modify its use in a goal-appropriate way.

Similarly, Bowlby suggested that the attachment system as a whole passes through a series of transformations across development in response to advances in the child's capacity for discrimination, locomotion, cognition and language. Bowlby identified four main phases in the development of attachment:

1. *Orientation and signals with limited discrimination of figure* (10-12 weeks)
2. *Orientation and signals directed towards one (or more) discriminated figure(s)* (12 weeks – 6 months)
3. *Maintenance of proximity to a discriminated figure by locomotion as well as signals* (6 months – 2-3 years)
4. *Formation of a goal-corrected partnership* (~ 3 years)

In the earliest phase of the development of the attachment system many of the infant's social behaviours appear relatively undirected and do not occur in response to differentiated social stimuli. Bowlby suggested that this lack of discrimination is largely a result of limitations of sensory systems. After the first month of life the infant begins to direct social behaviours such as smiling and babbling specifically towards other people. At the same time the infant is soothed when crying by the sight of a human face or the sound of a human voice - especially that of the infant's mother. At the age of 6 months or so, coinciding roughly with the onset of locomotion, the infant becomes increasingly discriminating in the use of attachment behaviours. Attachment behaviours become restricted in their expression and are directed to one or more specific caregivers. It is at this point that the infant is thought to develop representational models that guide the goal-corrected functioning of the attachment behavioural system. Attachment behaviour at this stage consists of a large variety of social behaviours. Examples include following, proximity seeking, crying, clinging, bids to be picked up, vocal-affective interactions and perhaps social-referencing (Ainsworth, 1992). At this age these behaviours usually occur as an immediate response to threatening situations such as separation, illness, or the approach of an unfamiliar person. This phase is considered

to last until around 3 years of age.

As the infant's representational and linguistic capacities become increasingly sophisticated important changes occur in the conditions that elicit attachment behaviour and in the kinds of behaviours that are recruited in the service of proximity seeking and the maintenance of contact with the attachment figure. As they grow older, infants and toddlers become better able to delay or suppress the expression of attachment behaviour in accordance with longer-term goals and the range of behaviours that mediate attachment expands considerably. Language comes to play a part in signalling distress and maintaining proximity to a parent. Likewise, the child's cognitive capacities allow him to represent increasingly complex aspects of the environment and of the behaviour of others.

At around 3-4 years of age the child is thought to reach a major developmental milestone that has a profound effect on the organisation of attachment. It is generally accepted that at this age children become able to understand the goals and plans of other people and hence are able to include such considerations in their plans and representations regarding attachment. In modern parlance the child is said to have acquired a 'theory of mind' (Wimmer & Perner, 1983). One important result of this cognitive change is that children and parents are able to negotiate attachment issues such as accessibility and proximity by reference to each other's plans and goals. Additionally, the ability to understand the behaviour of others in terms of hidden mental states such as goals, desires and beliefs obviously represents a major breakthrough in the child's capacity to model and predict his social environment.

No doubt further developmental reorganisations occur throughout the lifespan. Bowlby makes no explicit attempt to carry his account of the development of attachment beyond early childhood except to say that despite a waning of the intensity of attachment behaviours with age, attachment processes are likely to be continuously at play throughout an individual's life (Bowlby, 1969/82).

PROCESSES OF DEVELOPMENTAL CONTINUITY AND CHANGE

Having reviewed Bowlby's basic position regarding the nature and development of attachment behaviour it is possible to make some general comments regarding the processes that lead to developmental continuity and change. There are many different ways of thinking about continuity and change and indeed these are perhaps not entirely independent of the way that one views the nature of development itself, a definition of which is surprisingly hard to specify (Rutter & Rutter, 1993). Rutter (Rutter & Rutter, 1993; Rutter, 1988) however suggests the following broad processes that mediate continuity and change in behavioural development:

1. Brain maturation
2. Genetic influences
3. Biological substrate or psychological structures
4. Learned skills or reactions
5. Cognitive sets or models
6. Interpersonal interactions with indirect chain effects
7. Environmental continuity and change

1.6 Brain maturation and genetic influences

Clearly many of the changes that occur in the early organisation of attachment are a result of maturational changes. Examples include improvements in sensory discrimination or locomotion. Genetic influences too almost inevitably play a role in the development of attachment behaviour as Bowlby himself recognised:

> *"So long as the environment is kept within certain limits, it seems likely that much of the variation in the behaviour of different children is attributable to genetic differences"* (Bowlby, 1969/82, pp. 296)

Bowlby also suggested that the gradual waning of attachment behaviour that occurs after childhood may be a result of hormonal changes under genetic control.

1.7 Biological substrate and psychological structures

Perhaps the most important source of continuity however is in the lasting *function* of attachment behaviour. Bowlby suggested that attachment processes are evident in human behaviour throughout the lifespan. Attachment behaviours in adulthood – much like those in childhood - are characterised by the active maintenance of proximity to one or more preferred individuals whose company is sought in times of stress. At the same time, there are obvious changes in the form of attachment behaviours and their organisation at different stages of the lifespan, some of which are described above. What is continuous is the *organisation* of these behaviours according to the set-goal of proximity (see Sroufe & Waters, 1977). This kind of continuity is often referred to as *heterotypic continuity* and is an example of continuity mediated by biological substrates or psychological structures.

Certainly the most important source of continuity for this discussion is the continuity afforded by internal working models. The concept of internal working models of attachment leads naturally to a way of understanding developmental continuity and change. As a result of the interpretative role that working models play in appraising novel situations and guiding action, new information is routinely interpreted with respect to the infant's existing working model. According to Bowlby this information is then integrated into the infant's memory systems and their associated representational structures. As a consequence working models tend to remain stable over time. On the other hand, because internal working models are thought to be continuously checked for consistency new experiences are capable of influencing the development of the higher-level structure of the infant's representational systems. Clearly, the more discrepant an event the greater the likelihood that it will lead to major representational change. For Bowlby another important reason why internal working models lead to considerable continuity over time is that they are thought to be highly automatised procedural structures (Schiffrin & Schneider, 1984) that operate largely outside of awareness (Bowlby, 1988; 1969/82).

Despite the fact that internal working models are capable of mediating change as well as continuity, attachment researchers have tended to emphasise continuity in attachment over processes of change. Indeed Bowlby himself noted that it was with respect to mechanisms of change that his theory was perhaps weakest (Bowlby, 1969/82). Continuity in internal working models of attachment is the primary if not the only way that contemporary attachment researchers have explained stability in individual differences in attachment

behaviour.

Thus, according to Bowlby internal working models though initially flexible and open to adjustment, become increasingly resistant to change. These models then serve to regulate responses to danger and separation and organise the expression of emotions both within current relationships and in relationships with others in the future (Bowlby, 1988).

1.8 Learned skills or reactions

It is not clear what role Bowlby would have attributed to learned skills or reactions in the development of attachment. Certainly Bowlby attributed an important role to learning, especially in the organisation of attachment behaviours into functional wholes. More importantly perhaps, many of the developmental consequences of attachment security may be understood as the result of differences in the opportunity for learning various social skills and behaviours. For example, the attachment behavioural system may affect learning opportunities by way of its influence on exploration.

1.9 Interpersonal interactions with indirect chain effects

These processes refer to situations in which interactions have 'knock-on' developmental consequences. Rutter & Rutter (1993) cite examples from peer relations research - where peer rejection has been shown to lead to truancy which may in turn expose a young person to risk factors for delinquency and crime (Rutter & Rutter, 1993). Again, the most useful application of this kind of developmental model is likely to be in understanding the long-term consequences of individual differences in attachment security. Such interactions and their knock-on effects may of course be driven to some extent by internal working models of attachment. Interpretative biases may bring about experiences that in many cases serve to further reinforce the model. Indeed Bowlby suggested that such effects do indeed contribute to the stability of internal working models (Bowlby, 1988). It is worth noting generally that the developmental processes discussed so far need not operate independently of one another.

1.10 Environmental continuity

The final process that may lead to continuity over time is simply when continuities in behaviour result from continuities in the environment. In the case of attachment some of the stability of attachment behaviour is likely to be dependent on stable patterns of care. Although such environmental sources of stability are not explicitly a part of Bowlby's theory,

they are implicit in several of Bowlby's propositions. Firstly, major changes in the environment are expected to result in the reorganisation of internal working models. These changes would then be expected to lead to changes in the organisation of attachment behaviour. Secondly, many of the activating causes of attachment behaviour may show differential environmental stability. For example, Bowlby noted how attachment behaviour may be activated when a parent fails to attend to the child or rebuffs a child's attachment signals. To the extent that the parent's behaviour is stable with respect to these activating causes one would expect stability in many of the eliciting conditions of attachment behaviour. Consequently there is likely to be stability in the intensity and patterning of the infant's attachment behaviours. This has been the account favoured by most critics of attachment research (e.g. Lamb, 1987). As Rutter (1995) has noted it is difficult to discriminate this kind of stability from that expected from internal working models. The conceptual distinction hangs on the extent of stability in attachment behaviour despite contradictory changes in environmental conditions and in the nature of the specific psychological mechanisms involved. It shall be seen in subsequent sections that it has also been difficult to disentangle these two potential mechanisms of continuity empirically too.

SOURCES OF VARIABILITY IN ATTACHMENT BEHAVIOUR

The above discussion of continuity and change also highlights the processes that could potentially lead to individual differences in attachment behaviour. Some of the most important potential sources of variability in the development of attachment that follow from Bowlby's theory are listed below:

1. *Genetic influences*
2. *Maturational differences* (e.g. in neo-cortical functioning leading to differences in plan hierarchies and delayed action)
3. *Differences in the representation of the environment* (including representations of the parent's responses to attachment behaviours, sib relationships, family interactions, strangers, to name but a few)
4. *Differences in the representation of the self* (representations of one's own capacities, such as efficiency of locomotion and approach)
5. *Differential activity in other behavioural systems* (e.g. increased fearfulness or

exploration, leading to heightened or reduced attachment behaviour respectively)

6. *Differences in learning experiences:* non-representational differences in the organisation of attachment behaviour as a result of learning - organisation of attachment into functional wholes by monitoring the consequences of action i.e. contingency learning
7. *Presence of different causal factors* (context effects – not intrinsic differences in the organisation of the attachment behavioural system per se)

The above potential sources of variability should be relatively self-evident from the preceding discussion. The key point here is that these sources of variability may offer a potential framework for understanding how children brought up in the same family could come to develop different patterns of attachment. For example, it is easy to see from the above sources of variability that sibling relationships and parent-parent interactions would likely impact on the developing attachment relationship. A sibling necessarily constitutes a potential activating cause of attachment behaviour that simply would not exist in a single-child family. On the other hand, genetic and non-shared environmental influences on the activity of the fear-wariness system would inevitably impact upon the developing attachment system. Clearly there is considerable scope in Bowlby's original theory for systematic and idiosyncratic influences that might lead to differences between children in the expression and development of attachment behaviour.

INDIVIDUAL DIFFERENCES, INTERNAL WORKING MODELS AND CONTEMPORARY ATTACHMENT THEORY

In contrast then to Bowlby's early work that emphasised species-typical development later work on attachment has shifted focus to an individual differences perspective. This change of emphasis towards the investigation of differences in the organisation of attachment followed quite naturally from Bowlby's propositions about the role of internal working models in the expression of attachment behaviour. Differences in patterns of attachment behaviour can be easily understood within Bowlby's framework as arising from differences in the infant's representation of the environment. More specifically, contemporary attachment theorists propose that individual differences in attachment behaviour result from

the representation of relatively stable differences in parental behaviour. These aspects of parental response are thought to be incorporated into the infant's internal working model of attachment and come to play a part in controlling attachment behaviour. Individual differences in attachment are seen as adaptive, organised behavioural differences that follow from the normal processes by which aspects of the environment are represented by the infant in order to adaptively regulate the expression of goal-corrected attachment behaviour. The idea that individual differences in attachment behaviour result from differences in the responsiveness of the parent came about largely through the pioneering work of Mary Ainsworth and particularly the development of the Strange Situation procedure.

1.11 Ainsworth's Strange Situation

Ainsworth's striking and now well-known observation of individual differences in infants' responses to brief separations from a caregiver in the Strange Situation Procedure has become the lynch-pin of contemporary attachment theory. Over the last two and a half decades Ainsworth's Strange Situation has been the focus of considerable cross-sectional and longitudinal research. Infants classified as 'secure' in Ainsworth's scheme are easily understood in terms of Bowlby's homeostatic view of attachment. They generally appear relaxed and happy in the presence of the parent and show attachment behaviours such as crying and following when separated. Upon the parent's return the secure infant approaches immediately, is quickly comforted and soon enough returns to play (Ainsworth et al, 1978). By contrast, a subset of infants show considerable anxiety even before separation and are very distressed when the parent leaves. Upon the parent's return these infants do not easily settle and often resist contact by actively struggling, kicking or arching the back. This pattern of response has become known as 'anxious-resistant' and characterises around 12-20% of infants from normative middle-class samples. A third group of infants whose response pattern has become known as 'avoidant' shows almost the opposite pattern of response. Avoidant infants seem unstressed by separation and appear to avoid the parent upon reunion often by shifting attention to other aspects of the environment. These differences in the use of the parent as a secure base are especially remarkable given the evolutionary significance ascribed to attachment behaviour for the infant's safety and survival. Relatively little attention has been paid to the survival function of avoidant and resistant behaviour. However, Main, Kaplan & Casssidy (1985) have suggested that avoidant behaviour may be thought of as a secondary strategy for maintaining proximity to a parent

without invoking parental rejection.

1.12 The role of maternal sensitivity

Attachment researchers have interpreted these differences in patterns of attachment behaviour as emerging as a result of specific patterns of parental responsiveness to an infant's attachment signals. Mary Ainsworth laid the empirical groundwork for current understanding of the kinds of parenting behaviours that might lead to the development of secure and insecure attachment relationships (Ainsworth et al, 1978; Ainsworth & Wittig, 1969). Her intensive home observations of mother-infant interaction consisted of over 70 hours of monthly observations with each family and have been extremely influential in attachment research. Ainsworth's elegant and insightful descriptions of patterns of maternal sensitivity and insensitivity have inspired a considerable body of research that has largely confirmed her findings (see De Wolff & van Ijzendoorn, 1997) . Ainsworth identified four key dimensions of parenting behaviour that are thought to best discriminate secure from insecure relationships:

1. *Acceptance versus rejection:* Ainsworth (Ainsworth et al, 1978) observed how some parents show signs of irritation, exasperation, anger or even dislike of their babies in a way that that might be thought to go beyond what one would expect from the normal frustrations of looking after a young infant. Ainsworth suggested that for mothers characterised as accepting it is not so much that negative feelings are absent but that they are subsumed within a broadly benign approach to their child. Less accepting parents on the other hand tend to demonstrate negative feelings that are not integrated into an otherwise favourable view of the child and tend to criticise, reject or belittle the child's need for proximity.
2. *Accessibility versus ignoring:* Parents of secure infants, according to Ainsworth, also differ in the extent to which they appear to actively monitor their infant's location and activities and in the extent to which they are accessible to the child when needed. Parents of some insecure infants Ainsworth described as appearing to 'tune out' and not notice bids for attention or appear withdrawn and distant. As such, it is assumed that these infant are unlikely to be able to rely on the parent to be available and responsive to attachment signals.

3. *Co-operation versus interference:* A further way in which parents of secure infants are

thought to differ from those of insecure infants is in the manner in which they manage conflicts and changes in activities and in the degree to which they respect and account for the infant's own autonomy of action. In particular, highly 'co-operative' parents time their ministrations to match the child's current state by paying close attention to the infant's ongoing activities and behaviour. Often, co-operative parents use play or social games to encourage their babies to change activities and day-to-day routines are governed by a consideration of the infant's changes in mood, interest and state. As such their interactions appear smooth and harmonious. Mothers who score low on this scale tend not to take account of what the infant is currently doing when carrying out everyday routines but instead interfere with or interrupt the infant's ongoing activities. Play is often characterised as 'teaching' and interactions are generally mechanical, intrusive and inharmonious.

4. *Sensitivity versus insensitivity:* Sensitivity is generally thought to be the critical factor in the development of secure patterns of attachment. Sensitivity actually comprises four separate components involved in the parent's response to an infant's signals.

a) *Awareness* of infant's signals: a sensitive response clearly requires attention to and awareness of the infant's signals
b) *Correct interpretation*: for the parent to respond at all or to respond appropriately the parent must accurately interpret the meaning of the signal
c) *Promptness*: substantially delayed responses are likely to fail to remedy the problem for which the signal was intended and they also reduce the infant's sense of causal efficacy in regulating emotion through signalling to the parent
d) *Appropriateness*: the response should fit the signal and the immediate context in an 'appropriate' manner

It should be immediately evident from the brief definitions given above that Ainsworth's notions of acceptance, accessibility, co-operation and sensitivity refer to a very wide range of parenting characteristics. Some are clearly infant-directed behaviours and some are more like attitudes expressed through language. For the theory to make sense it is implicitly assumed that the infant is capable of perceiving and representing these aspects of parenting behaviour. Similarly, these behaviours ought to be directly relevant, and hence causally related, to the organisation of the infant's attachment behavioural system. Certainly, it is unreasonable to suppose that an infant is capable of understanding rejecting attitudes expressed through

language. More likely, these behaviours may be thought of as correlates or indicators of parental attitudes that also entail directly rejecting behaviour too. Also, it is not always clear in what way these behaviours ought to be relevant to the functioning of the attachment system whose function is the maintenance of proximity to a caregiver in the event of danger. How these behaviours relate to the parent's capacity to make provision for the infant's safety is, in the case of some of the above behaviours, less than obvious. Why parental interference in play for example should be related to the organisation of the infant's attachment behaviours is far from being self-evident. These problems aside, the idea that dimensions of parental sensitivity become represented by the infant and hence mediate individual differences in attachment behaviour has underpinned the vast majority of theoretical and empirical work on attachment.

Main and Solomon (1990) have recently proposed a further category of attachment behaviour that is observed in the strange situation procedure that has become known as disorganised/disoriented behaviour. This new category was developed by Main & Solomon after a review of 55 'difficult to classify' cases where infants failed to fit any of the three traditional classifications. Main and Solomon have suggested that many atypical cases display behaviours that can be thought of as momentary breakdowns in the organisation of otherwise patterned attachment behaviour, such as freezing, stilling, rocking or strong approach followed by immediate avoidance or disorientation. Main and Solomon describe these diverse patterns of behaviour as appearing without "goal, intention or explanation". Furthermore, Main & Hesse (1990) have suggested that these behaviours may represent the conflicting dispositions of mutually incompatible behaviour systems when the parent is both the haven of safety and the source of fear. Main & Hesse propose that the key linking mechanism in disorganised attachment behaviour is parental frightening and/or frightened behaviour. These patterns of behaviour appear to be particularly common amongst maltreated infants (Carlson, Cicchetti, Barnett & Braunwald, 1989) and have also been specifically linked to parental unresolved loss (e.g. Ainsworth & Eichberg, 1991). Several researchers have suggested that disorganised attachment in infancy is likely to be particularly strongly associated with later psychopathology (Main & Morgan, 1996; Liotti, 1992).

1.13 Contemporary approaches to internal working models

In contemporary attachment theory, and in keeping with Bowlby's original proposals, attachment behaviours in infancy are thought to be guided by underlying cognitive structures.

These internal working models are thought to consist of representations of the parent, the self and the attachment relationship that are derived from day-to-day experiences with the caregiver. Through repeated interactions the infant is thought to derive a set of interactional schemas or models of the attachment relationship which include sensorimotor, cognitive and affective components. These representations are seen as a set of expectations regarding the future behaviour of the attachment figure that allow the infant to act rapidly and adaptively in the event of threat in accordance with the demands of the immediate situation and the likely actions of the parent. The Strange Situation procedure is considered a window on the infant's internal working model of the attachment relationship.

Since Bowlby's early work on internal working models several researchers have made efforts to recast his ideas in terms derived from modern theories of infant cognition and event representation. Most notable amongst these attempts has been the work of Inge Bretherton (1995; 1990) who has suggested that Bowlby's view of internal working models of attachment is compatible with Schank & Abelson's notion of scripts (Schank & Ableson, 1988; Schank & Abelson, 1977). In Schank and Abelson's model infants are thought to extract constancies and generalisations from stored memories of repeated events. These invariant aspects of interactions come to form the basis of higher-order representations or schemas of the relational structure of interactions. Through a continual process of integration and cross-referencing of new information with existing schema the infant develops a set of horizontally and vertically integrated representations that encode the spatio-temporal structure of common events. Event-schemas include information that is event-near (specific interaction type) as well as higher-level representations that involve generalisations across many event classes (such as general representations of parental accessibility).

In Bretherton's view, and indeed in Bowlby's original thinking, internal working models of attachment draw upon general cognitive systems involved in the representation of the environment. Despite the many strengths of the idea of an internal working model of attachment one of the weaknesses of this contemporary formulation is that it lacks an explanation of the processes involved in the generation of working models in real-time. It merely describes the organisation of long-term memory systems that are drawn upon when generating a working model in a particular real-time context. In that respect, Bowlby's original definition of working models probably shares as much in common with Johnson-Laird's (1989) mental models theory as it does with Bretherton's schema-based framework.

How 'on-line' attachment behaviour is controlled by cognitive processes remains a relatively unexplored question. A complete account of internal working models of attachment would probably need to make reference to processes such as the generation of representational models in working memory, the organisation of attention, encoding and retrieval processes, and the role of executive/inhibitory systems. These processes are of course central components of Bowlby's view of internal working models and attachment.

1.14 Internal working models across the lifespan

The conceptualisation of attachment behaviour as the functioning of internal working models of attachment has had a major impact on thinking in attachment theory and research and has played a vital role in the understanding of the organisation of attachment behaviour. Internal working models have been especially important in extending attachment theory beyond infancy into later childhood and adulthood (Greenberg, Cicchetti & Cummings, 1990; Main, 1991; Main, et al, 1985). The most important contribution to this movement has been made by Main and her colleagues (Main, 1991; Main & Goldwyn, 1991; Main et al, 1985). One of the key aspects of Main's work has been the reformulation of internal working models as representational systems that control not just behaviour but also thinking, feeling, cognition and language. As Main et al (1985) put it

> " *We define the internal working model of attachment as a set of conscious and/or unconscious rules for the organisation of information relevant to attachment and for obtaining or limiting access to that information, that is, to information regarding attachment-related experiences, feelings and ideations.*" (Main et al, 1985)

This extremely important insight opened up the possibility of investigating the organisation and development of internal working models across the lifespan. This 'move to the level of representation' focuses on narrative patterns as the expression of the organisation and functioning of internal working models of attachment at a cognitive level. Main et al present data, reviewed more thoroughly in the next section, that suggests that 12 month infant-mother attachment security is related to later verbal-affective ('representational') functioning at 6 years of age. These systematic differences in thinking and speech fit well with Main et al's definition of an internal working model - including emotional openness when discussing an imagined separation, verbal responses to a family photo and verbal fluency after a separation from a parent (Main et al, 1985).

This same line of thought suggested that internal working models might be observable in the speech patterns of adults. The development of the Adult Attachment Interview (Main & Goldwyn, 1991) allowed researchers to test Bowlby's (1988) crucial hypothesis that an adult's internal working model of attachment guides parenting behaviour and regulates the expression of affect and sensitivity that is thought to be the key determining variable in the development of patterns of attachment in infancy. The Adult Attachment Interview also made it possible to chart continuities in internal working models from infancy to adulthood.

The adult attachment interview is a 1-hour semi-structured interview regarding a person's memories and evaluations of their childhood experiences. In Main's system what distinguishes the speech patterns - and by extension the thought processes - of parents who are likely to develop secure relationships with their infants from those who are likely to develop insecure relationships is the extent to which the subject is able to present a unified, balanced and ultimately coherent account of their attachment experiences. The interview's relatively complex and cross-referenced structure is designed to 'surprise the unconscious' by allowing the speaker to confirm or contradict statements made earlier in the interview – thereby aiming to uncover the organisational structure of the adult's internal working model.

Main's idea was that the operation of 'secure' working models may be observable in patterns of speech that indicate easy access to memories of attachment experiences and lack of distortion or confusion in thinking and speaking about childhood. This notion actually followed from an earlier suggestion made by Bowlby (1980) that insecure attachment may lead to the development of multiple, contradictory working models. Bowlby's elaboration of internal working models in this way was largely intended to account for disturbances and contradictions in thinking that are a prominent feature of many psychological disorders. These different models are thought to operate largely outside awareness and may lead to disruptions in thinking, feeling and behaviour regarding attachment that in the extreme may underlie certain pathological states.

According to Main the central hallmark of a secure internal working model is thus coherence. In devising the adult attachment interview in line with this idea Main draws upon the work of the philosopher Paul Grice (1975). Grice's work is particularly interesting in this context because of his detailed discussion of the nature of coherent discourse. According to Grice

the core principle of coherent discourse is that the speaker is collaborative. Speech should be open and flexible, changing and adapting to the demands of the current discourse such that the other speaker can understand what is being said. This principle is sometimes referred to as the conversational principle. Grice suggested four maxims that speakers should adhere to in order to maintain coherent discourse:

1. *The maxim of quality*: be truthful and have evidence for what you say
2. *The maxim of quantity*: say as much as is needed without unnecessary detail
3. *The maxim of relevance*: be relevant, presenting what has to be said so that it is plainly understood
4. *The maxim of manner:* be clear and orderly

Main suggests that differences in the underlying organisation of internal working models of attachment lead the speaker to commit various violations of normal discourse. Indeed, there is now considerable evidence to suggest that the speech patterns of parents of resistant and avoidant infants show characteristic violations of coherence during the Adult Attachment Interview. Parents of avoidant infants tend to show a pattern of response to the Adult Attachment Interview that has become known as 'Dismissing' and is characterised by the following features:

1. Very positive idealised view of childhood, without being able to give specific supportive memories – thereby violating the maxim of quantity and quality
2. Insistence on lack of recall of childhood experiences often as a block to further discourse – violating the collaborative principle
3. Normalising and minimising approach to negative experiences, as if the self were unaffected
4. Sometimes actively derogating of attachment, scorning attachment relationships or attachment figures
5. General dismissal of the importance of attachment relationships and experiences

Parents of resistant infants show quite the opposite pattern of response. Rather than dismissing and minimising the discussion of attachment experiences, the transcripts of interviews with parents of resistant infants appear entangled with and/or confused by early attachment relationships. In particular, 'Preoccupied' responses are characterised by the

following features:

1. A mental 'entanglement' with past and present relationships with attachment figures
1. An inability to focus objectively or productively on questions regarding attachment experiences, despite often lengthy discussion
3. A tendency to bring current relationships into the discussion of the past
4. Frequent violations of manner and relevance, often quoting others at length without marking in speech that a quote is about to be made. Extensive use of jargon or 'psychobabble', or the use of nonsense language as if unable to finish a sentence (e.g. and she said "blah, blah, blah and this and that and the other").
5. A tendency to angrily blame others at great length in a way that suggests a moving away from or lack of attention to the discourse context.
6. Subtle confusions between self and others

Both these patterns of speech are thought to indicate distortions in the underlying organisation of thought processes regarding attachment. Main has also described how certain patterns of speech during discussion of a loss or traumatic event may be particularly associated with infant disorganisation. Adults classified as unresolved with respect to loss or trauma show patterns of speech marked by striking lapses in the monitoring of reasoning and discourse surrounding a loss. Main (Main & Goldwyn, in preparation) has suggested that these lapses in normal speech might indicate dissociation or lapses in meta-cognitive processes. Examples include unnoticed slips such as "I was twelve when I died" or radical shifts in speech style when discussing a loss. Lapses in the monitoring of reason include indications of extreme confusion about whether the subject was present at a funeral of a loved one or not. Other indicators of disoriented responses to loss include unusual attention to details of the event or disbelief about whether the lost one is alive or dead (Main & Goldwyn, in preparation).

Evidence shall be presented in the next section that demonstrates that these various patterns of speech are lawfully related to the kind of attachment relationship a parent is likely to develop with their infant. Such a finding represents an exciting demonstration of the internal working models view of the development of attachment across the lifespan. At the same time, there are still many questions regarding the nature of the processes that are captured by the Adult Attachment Interview. The actual underlying cognitive processes that give rise to these patterns of speech are quite unknown and represent an important direction for future

research. Clearly, if the internal working model interpretation is correct these differences in coherence should represent genuine differences in representational aspects of attachment. One might for example expect these patterns of speech to be associated with differences in the organisation of appraisal, memory and attention.

1.15 Summary

This then is the linear model of the intergenerational transmission of patterns of attachment. Early experiences of sensitive or insensitive care are perceived and represented by the infant in the form of a working model of the attachment relationship. This working model then drives the organisation of attachment behaviour in infancy and tends to remain stable over time, organising the patterning of the attachment system as it undergoes transformations across development, and thus shaping patterns of behaviour, feeling and thought regarding attachment throughout the lifespan. Ultimately, internal working models determine the attachment relationship a parent will form with their child as a result of the pervasive influence of early experiences with one's attachment figures on the development of representational models of attachment.

INTERNAL WORKING MODELS: LINEAR CAUSES OVER TIME AND WITHIN FAMILIES

Clearly, the causes of attachment and subsequent patterns of variability underpin any predictions that might be made about differences between members of the same family in the development of attachment security. Despite the many strengths of attachment theory and research the current view seems to imply two rather surprising predictions: That patterns of attachment will be highly stable over time and that children in the same family will develop the same pattern of attachment relationship. Since Rutter's (1972) important critique, contemporary attachment theorists, following Bowlby, have generally recognised the possibility of change but as yet there exists no formal theoretical description of the processes that might be involved. In many cases stressful family events such as divorce or loss are considered to be potential harbingers of change in attachment patterns. However, such propositions are generally underspecified with respect to mediating mechanisms. It is presumed that the quality of care preceding and following major changes in family circumstances is the crucial variable. Nonetheless, little is known about how such family

changes directly affect the nature of developing attachment relationships.

It is pertinent to note that an adult's 'state of mind with respect to attachment' as measured by the Adult Attachment Interview is relatively independent of specific memories of rejecting and neglecting experiences during childhood. The coding system of the AAI does not seem to imply a strict one to one relationship between early attachment experiences and adult attachment security. Adults who report quite harsh upbringings are considered likely to develop a secure relationship with their child if their current evaluation of these experiences indicates balance, forgiveness and ultimately coherence. What is considered to count then in terms of attachment security is the adult's eventual mental 'autonomy' from early relationships and the coherence of an adult's thinking with respect to attachment. It is assumed that insecure attachment in infancy can lead to autonomy in adulthood. Nonetheless, little theoretical work has been done to explain how such processes of continuity and change might operate. The principal theory that we have is one of representational continuity.

Also, under the present reading of contemporary attachment theory, an adult has only one working model of attachment or one broad 'state of mind with respect to attachment'. Given that working models of attachment represent the predominant explanatory framework for understanding the development of attachment, the theory inevitably predicts that children brought up by the same parent should develop the same pattern of attachment. Consequently, from the theory described above, little can be confidently said about non-normative changes over time or differences in attachment within the same family. The strong interpretation of the linear model predicts no change and no differences within families. Even weaker interpretations remain unclear about specific mechanisms and empirical research in this area is still largely lacking. Previous research and theory regarding the development of attachment has downplayed the role of change in attachment patterns over time and has almost entirely neglected the possibility of within-family differences in attachment security. The systematic investigation of patterns of infant-parent interaction in the home, in the context of *multiple family relationships* and their lawful effects on developing attachment relationships thus represents an extremely important direction for future research.

The next section reviews the empirical evidence supporting the linear model of attachment. It makes special reference to evidence that might support the view that parental influences on the development of infant attachment security are of the shared kind. The review shall begin

by evaluating the evidence for stability over time in attachment as measured prospectively by Ainsworth's Strange Situation. There shall then follow a short section describing continuities from infancy to early and middle childhood. Next, the existing data relating to the intergenerational transmission of patterns of attachment is reviewed in detail. Finally research is described that suggests that there may be important non-shared environmental influences on the development of infant-parent attachment.

PART II: EMPIRICAL REVIEW

GENERAL INTRODUCTION

In the first section of this chapter the basic propositions of the linear model of the transmission of patterns of attachment were described in some detail. It was suggested that this model predicts that patterns of attachment will show considerable continuity over time and that children brought up by the same parent should develop the same pattern of attachment. These patterns of similarity - over time and between siblings - are proposed to be mediated by internal working models. In behaviour genetic terms individual differences in attachment are said to be caused by shared environmental influences whose effects are continuous over time. This next section shall evaluate the empirical evidence supporting this view. One of the most remarkable developments in psychology in the last 15 years has been the convincing tide of evidence that suggests that the majority of environmental processes operate to make siblings different from each other not more similar. Behaviour-genetic studies of twins and adoptees have shown that correlations between siblings for cognitive abilities, personality and psychopathology tend to be low. What similarities exist are largely accounted for by what would be expected as a result of genetic influences. The modest correlations generally found between siblings tend to be higher for identical twins than non-identical twins and are generally negligible for adopted and step-siblings - suggesting that shared environmental factors rarely account for any significant proportion of familial resemblance. Behaviour-geneticists (e.g. Plomin, 1994; Plomin & Daniels, 1987) argue that developmental psychologists who ignore within-family variability will miss the vast proportion of the developmental action.

The aim of this empirical review then is to answer two separate but related questions:

1. To what extent are the principal hypotheses of the linear model supported by empirical research?
2. To what extent does the existing empirical evidence suggest that the development of attachment security is influenced primarily by shared environmental factors?

Clearly, not all the predictions of the linear model bear directly on the question of shared influences. For example, it is quite possible that patterns of attachment in infancy are stable over time and yet that the primary influences on the development of attachment are of the

non-shared kind. Empirical evidence that demonstrates continuity in assessments of attachment security alone are therefore silent with regard to the question or shared and non-shared influences. They are merely a necessary condition for the linear model to be a candidate explanation of attachment processes across the lifespan. The same is true for the causal role of parental sensitivity - it is relevant to the broad validity of the linear model but does not in and of itself preclude the influence of the non-shared environment. Measurements of child variables on more than one occasion or assessments of links between child variables and parent variables that could conceivably vary between siblings (such as sensitivity) could thus be mediated by either shared or non-shared pathways of influence.

However, research that demonstrates relations between unitary parent or family variables, such as parental age, SES or Adult Attachment status and child attachment necessarily constitutes evidence for shared influences on attachment security[2]. This is so simply because these variables by definition are the same for all siblings in the same family. Put another way, research that only looks at one child per family will inevitably mistake systematic within-family variation for non-systematic error.

This review shall thus be divided into the following sections:
a) Prospective continuity in individual differences in attachment security across the lifespan
b) The causal role of parental sensitivity
c) The transmission of patterns of attachment across generations
d) Consistency in parental behaviour and concordance in attachment security between siblings.

Sections a) and b) are thus predictions of the linear model that do not imply any specific influence of shared familial causes, whereas sections c) and d) necessarily pertain directly to the question of shared and non-shared influences on the development of attachment security. As a consequence, it is these sections that will be given special emphasis in this review.

[2] It should be noted that shared *genetic* factors could also underlie these kinds of effects

Throughout this review we shall be concerned with the question of whether patterns of attachment are truly mediated by underlying cognitive structures (IWMs) or whether alternative mechanisms might underlie these stable patterns of behaviour between siblings, across generations and over time.

PROSPECTIVE STABILITY IN PATTERNS OF ATTACHMENT

Stability in patterns of attachment is a basic presupposition of attachment theory and is an important prediction of the linear model – internal working models are assumed to underlie attachment patterns across the lifespan and are expected to be relatively resistant to change. In practice, there are two rather different causes of empirical instability: 1) Lawful discontinuity and 2) non-systematic measurement error. In terms of the strong linear view lawful discontinuity must be mediated by parental representational change. Weaker interpretations would predict lawful discontinuity to be associated with wider changes in the family such as divorce and loss. Instability that is truly a result of measurement error is critically important here because the reliability of the Strange situation and other attachment assessments sets the upper limit on the possibility of correlations between them (Kenny, 1972). This is especially important when thinking about shared and non-shared influences on attachment security because when measurement error is not explicitly taken into account, the non-shared environment is confounded with the error term (Plomin, DeFries & Fulker, 1988). As a result, the reliability of the Strange Situation procedure is a limiting factor on the apparent influence of the shared environment. Prospective stability in attachment security is thus important to this discussion firstly because it is a primary prediction of the linear model and secondly because it speaks to the reliability of the Strange Situation procedure.

Generally speaking, early research into the reliability of the Strange Situation in middle-class families between 12 and 18 months has pointed to considerable stability in attachment. The first study of the test-retest reliability of the procedure was carried out by Waters (1978) in which 50 infants were assessed in Ainsworth's Strange Situation at 12 and 18 months. 96% of infants received the same attachment classifications over this 6 month period. Several other studies that followed shortly after Waters' original study were also able to demonstrate considerable test-retest reliability (Owen, Easterbrooks, Chase-Lansdale & Goldberg, 1984;

Main & Weston, 1981). At the same time several studies have shown that instability, when it is apparent, appears to be related to changes in family circumstances or to chronic life-situations such as poverty or depression (e.g. Egeland & Sroufe, 1981; Vaughn, Egeland, Sroufe & Waters, 1979). As such, some of the instability observed in the above studies is likely to represent lawful discontinuity, rather than pure measurement error. It is generally accepted that in relatively stable middle-class families there is considerable stability in attachment classifications between 12 and 18 months and that instability is more likely in high-risk or low income samples (Bretherton, 1985).

However, recent evidence has cast some doubt on this conclusion. In a recent review of 5 low-risk samples in which attachment classifications were available at both 12 and 18 months, Thompson (Thompson, 1996) has shown that estimates of test-retest reliability actually vary considerably from study to study. In Thompson's review test-retest reliability varied from 53% in one sample (Thompson, Lamb & Estes, 1982) to 96% in the Waters study. When the estimates were weighted by sample size the overall rate of stability emerged at 75% across a total sample of 205 infants. A recent study by Belsky, Campbell, Cohn & Moore (1996) raises yet further questions about the assumption - made by the majority of attachment researchers over the past decade - that attachment classifications are stable in low-risk samples. In two independent samples, one low risk (n = 125) and one at risk for maternal depression (n = 90), stability across the three attachment classifications from 12 to 18 months was 52% and 46% respectively (both non-significant). Excluding cases who had received diagnoses of depression did not increase reliability over this period nor did collapsing the categories into secure/insecure groups. The samples reported by Belsky et al represent the largest investigation of the test-retest reliability of the Strange Situation. Indeed, many of the earlier estimates were based on rather small samples (e.g. Main & Weston, 1981, n = 15). Clearly, such low estimates of reliability are some cause for concern and little is known about the reasons for the discrepancies between the higher estimates found by Waters and others and those reported by Belsky. Belsky et al suggest that changes in the coding procedure of the Strange Situation to include the 'D' pattern might account for recent low estimates of reliability. Another possibility suggested by Belsky et al is changes in the ecology of caregiving over the last 15 years. Clearly further work is needed to establish the test-retest reliability of the Strange Situation.

Nonetheless, the consistent finding of developmental links between attachment security in

infancy and later socio-emotional functioning seem to speak to the generally high predictive validity of the Strange Situation procedure. It remains a possibility that the discrepancy between the low test-retest reliability of the Strange Situation and its high *predictive* validity could be explained by assuming that 12 month assessments have better validity than those carried out at 18 months. Such a suggestion is certainly in keeping with the finding that Adult Attachment Status is a better predictor of infant security of attachment at 12 months than it is in older groups (Van Ijzendoorn, 1995a). Test-retest studies of the Strange Situation over shorter periods of time may thus improve the picture somewhat. However, there are obvious practical limits to the time interval over which reliability can be assessed. Ainsworth et al (1978) have shown that repeated assessments over very short time periods (2 weeks) lead to procedural problems resulting from carry-over effects from one session to the next.

The predictive power of the Strange Situation over longer periods of time certainly points to its relatively consistent psychometric properties, despite the difficulties in establishing test-retest reliability described above. A considerable body of evidence has accumulated over the last 25 years that suggests that secure attachment in infancy is predictive of a range of developmental advantages in later childhood. Although an exhaustive review of these data is beyond the scope of this chapter, the most important findings are described below:

1. Peer relations: Sroufe and colleagues (Erikson, Sroufe & Egeland, 1985; Matas, Arend & Sroufe, 1985; Sroufe, 1983) have shown that 5 year-olds classified as secure in infancy show generally better interactions with their peers. Children classified as avoidant in infancy tended to be hostile or distant towards their peers and rarely sought a teacher when distressed. Children classified as resistant tended to be socially inept and were more likely to be bullied. Indeed, avoidant children were more likely to bully than either resistant or secure children.
2. Problem-solving and play: Main (1973) found that 3 year olds classified as secure in infancy have longer attention spans and show more positive affect during play. Matas et al (1983) found that 2 year-olds who were secure in infancy approached difficult problems confidently and enlisted the help of a parent, whereas those classified as insecure were more likely to become whiney (resistant) or would invest relatively little in the task and would not seek a parents' help (avoidant).
3. Mentalising: Fonagy et al (1997) and Meins & Russell (in press) have shown in

independent investigations that children classified as secure in childhood and infancy respectively are more likely to pass standard false-belief tasks.

4. Behaviour-problems:Erickson et al (1985) report greater levels of pre-school behaviour problems in children classified as insecurely attached at 12 months. Similarly Faggot & Kavanagh (1990) found that infants classified as avoidant in the Strange Situation showed greater levels of behavioural problems and difficulties with peers at 4 years of age than those classified as either secure of resistant. Recent evidence also suggests that infant disorganisation may represent a particularly important risk factor for later aggressive behavioural problems (Lyons-Ruth, 1996; See also Atkinson & Zucker, 1997; Greenberg, DeKlyen, Speltz & Endriga, 1997)

These findings generally support Bowlby's suggestion that insecure attachment in infancy has consequences for socio-emotional development that are relatively long-lasting. However this kind of evidence is unable to differentiate continuity resulting from the organisation of a child's internal working model of attachment from continuities in the immediate home environment. Indeed, continuities may also arise as a result of psychological processes other than internal working models. Nonetheless, Sroufe et al's (1985) finding that patterns of peer relations at school - when a parent is not present - are predictable from patterns of attachment in infancy is perhaps suggestive of the influence of underlying mental structures in shaping later interpersonal relationships.

Somewhat more direct evidence of continuity in internal working models has emerged from research programs that have investigated continuities between infancy attachment assessments and later measures that are intended to tap representational processes directly. These studies have focussed on patterns of speech and imaginative play as indices of internal working models. The work of Main et al (1985) described earlier in this chapter is a good example of research that has show long-term links between security of attachment in Ainsworth's Strange Situation and later performance on representational tasks. Firstly, Main et al found considerable stability in attachment between infancy and 6 years ($r = .76$) using a modified version of the Strange Situation for 6 year olds. More importantly, Main and her colleagues found powerful links between early 12 month attachment assessments and several tasks designed to measure patterns of thinking and speech regarding attachment in childhood. The first representational task used by Main focussed on patterns of speech after a period of separation from mother. Specifically, verbatim transcripts of the child's responses to reunion

with the parent were coded for fluidity of speech, balance and content. These parameters of verbal response on reunion with a parent were strongly related to 12 month attachment classification ($r = .64$, $n = 39$). Children who had been classified as secure in infancy were more likely to speak fluently and openly to their mother on reunion and talked directly about the separation experience. Children classified as insecure in infancy tended to speak dysfluently, with stumbles, false starts or long pauses, and tended to steer the conversation towards the discussion of inanimate objects or impersonal issues.

The second task that Main et al report used children's responses to imagined separation experiences illustrated by pictures based on the Klagsbrun-Bowlby Separation Anxiety Test (Klagsbrun & Bowlby, 1976). The pictures depict various attachment-related scenarios, such as going to bed, a first day at school or a parent going away for the weekend. The child's verbal response was scored for emotional openness. An emotionally open response, for example, was scored when the child could talk openly and coherently about feeling sad or lonely while the imagined parent was away. Low scores for emotional openness were given when no response was made or when a child responded angrily or incoherently (Main et al, 1985). Emotional openness was strongly related to infancy attachment classification ($r = .59$).

Finally, the content of the child's response to the question "what would the child do" was used as a measure of a child's internal working model of attachment. Children's responses were scored for the apparent effectiveness of the strategy the child imagined the protagonist using for maintaining proximity to his or her parents. For example, in the strongest story - where the parents leave the child while they go on a 2 week holiday - high scores were given to responses in which the child actively attempted to persuade the parents not to leave. High score were also given if a resolution to the story was reached in which the parents did not leave or the child managed to go with the parents. Lower scores were given to responses to the story that appeared to reflect themes in which the parent is inaccessible. For example, some children finished the story by saying that the parents died or the child locked herself away. The child's approach to these stories, which did not involve actual separation experiences, is assumed to reflect the child's mental representation or working model of attachment relationships. Again, there was a strong relationship between these thematic aspects of the child's response and infancy attachment classification ($r = .59$, $n = 35$). Several other measures were also carried out as part of this investigation that involved

behavioural assessments at 6 years that are not considered here as they are less clearly related to the question of the continuing influence of underlying mental representations of attachment from infancy into later childhood.

The importance and impact of this work cannot be overestimated. Firstly, it represents a revolutionary change of perspective, from measures of overt reunion behaviour to measures that are designed to directly assess mental representations of attachment in patterns of speech and language. Secondly, the relations between early attachment security and later patterns of speech are exactly what one might predict from the internal working models view of attachment. Although it is possible to explain these effects by post hoc reference to continuities in the home environment or enduring genetic influences, these results - if they prove to be robust - clearly represent a non-trivial confirmation of the explanatory power of internal working models. The fact that early separation-reunion behaviours in infancy are related to patterns of speech and thinking about attachment relationships that are not based on actual reunion behaviour lends particularly strong support to the internal working models view. Such a finding is more persuasive than later assessments of behavioural responses to separation where continuities in the *activating causes* of attachment behaviour might provide an alternative explanation. Main et al's work is especially remarkable because of the sheer size of the continuity between 12 months and 6 years – equivalent to correlations of around .60 accounting for around 30-40% of the variability in performance.

The sample size of the Main et al study is of course too small on its own to allow any confident conclusions to be made about links between early attachment patterns and representational measures. However, several studies since have replicated these basic findings. Using a very similar design, Cassidy (1988) presented 50 6 year-olds with a puppet interview and a story completion task aimed at assessing aspects of the child's representation of the self (conducted during a period of separation from a parent). Attachment security in this study was assessed concurrently using a separation-reunion procedure based on the strange situation that was developed by Main et al (1985) for 6 year olds. In the puppet interview, secure infants - paralleling Main et al's findings – were able to openly recognise weaknesses in the self and tended to give positive yet balanced answers. Insecure-avoidant children by contrast tended to portray themselves as nearly perfect whilst maintaining a distanced, impersonal stance. Resistant children showed no clear group pattern of response whereas children classified as disorganised described the self in excessively negative terms.

In the story completion task secure children tended to tell stories that showed the protagonist to be someone worthy of love and with a close supportive family whilst the avoidant children described the protagonist as isolated or rejected. Again, no clear pattern of response emerged from the group of children classified as resistant. The disorganised children's stories were often violent, highly negative or bizarre. Very similar results are reported by Bretherton, Ridgeway & Cassidy (1990) in an independent sample of 37 infants seen in the strange situation at 18 months and by Stevenson-Hinde & Shouldice (1992) in a sample of 4.5 year olds seen at 12 months in the strange situation. It is noteworthy that in the Bretherton et al study considerably stronger relations were found from concurrent assessments of attachment security than early strange situation classifications. This might suggest a degree of instability in this sample and also points to the importance of current relationships on children's responses to these story completion tasks. Bretherton et al were also able to show that story-stem responses were independent of a maternal-report measure of the child's verbal skills. Thus, despite the relatively small sample sizes of each of these studies, taken together they paint a consistent picture – secure infant-mother attachment in infancy appears to be related to open and fluent patterns of speech regarding attachment issues in later childhood.

Of course, it still remains possible that these relatively long-term continuities in attachment processes will be explained by continuities in the home environment. The relevant longitudinal, cross-panel research has yet to be done. There are also alternative explanations of the actual psychological mechanisms involved that may not require a cognitive interpretation. For example, the effects described above could be explained by simply assuming that attachment security in infancy affects the development of interpersonal interaction styles or aspects of emotionality. Children who were secure in infancy may be more likely to approach an interaction with a new person - in this case the experimenter - with an open and relaxed manner when discussing intimate relationships. Insecure children on the other hand may be more uncomfortable with discussing emotionally charged experiences with another person. More generally, emotional responses to the discussion of intimate relationships inevitably impact on patterns of speech. As such, measuring speech rather than overt behaviour does not ultimately guarantee that one will tap representational processes per se.

A more effective strategy would be to describe the specific nature of the key cognitive

processes involved in individual differences in the organisation of internal working models and then measure these processes directly. Unfortunately, as Rutter (1995) and Hinde (1987) have pointed out, the notion of internal working models is too underspecified as yet to allow many predictions to be made about specific cognitive mechanisms. On the other hand, the specification of these mechanisms is extremely important because the long-term credibility of the internal working models idea depends upon direct empirical evidence of this kind.

Kirsh & Cassidy (1997) provide an interesting recent example of an attempt to link security of attachment to specific cognitive processes. Kirsh & Cassidy (1997) investigated the relationship between attachment security and attention and memory processes in a sample of 68 3.5 year olds who had been seen in Ainsworth's Strange Situation at 12 months. Using evidence from research on information processing and cognitive schema (Mandler, 1984; Schank, 1982), Kirsh & Cassidy argue that in the context of attachment children are likely to selectively attend to and remember material that is consistent with their internal working models of attachment. On the basis of this line of thought Kirsh & Casssidy predicted that secure children would selectively attend to and recall information that is consonant with an attachment history characterised by parental openness, warmth and accessibility. Children who had been classified as avoidant in infancy were expected to selectively attend *away* from attachment-related material, in order to maintain the attachment system in a relatively deactivated state, as suggested by Main et al (1985). Kirsh & Cassidy also predicted that avoidant children would show poor recall for information regarding positive attachment experiences but better recall for stories involving rejection. Children who were classified as resistant in infancy were also expected to show poor recall of positive attachment material. However, resistant children were not expected to show poor recall for information involving rejection - based on the assumption that parents of resistant infants are inconsistently available but rarely rejecting (Ainsworth, et al, 1978; Cassidy & Berlin, 1994).

In their first experiment Kirsh & Cassidy presented the children with several sets of drawings– one set depicting a positive mother-child dyad, one neutral and one angry dyad. As predicted avoidant children were found to attend less to these pictures than both secure and resistant children. However, somewhat contrary to predictions, this effect did not appear to depend on the particular picture presented. In a second experiment, the children were presented with two pictures simultaneously, one that was attachment related and one that was

not, with the aim of testing whether insecure children would show an attachment-specific selective bias. The results indicated that both avoidant and resistant children looked at the attachment-related pictures significantly less than the non-attachment pictures whereas the secure children showed no such differential response. Finally, Kirsh & Cassidy presented the children with six stories that reflected different attachment themes – one involved parental responsiveness, one rejection and one involved a parental exaggerated response. Again, the results were not entirely as the authors expected. Secure children showed better recall for the responsive stories than the avoidant children and better recall for the rejecting stories than the resistant children. Avoidant children appeared to show no differential recall for any of the story-types. Although several of these findings appear inconsistent with the authors specific predictions, this early evidence is promising in that it suggests that real differences may exist in the organisation of attention and memory for attachment-related stimuli that may be meaningfully related to patterns of attachment observed in Ainsworth's Strange Situation during infancy. As such, this research represents an important early contribution towards a cognitive account of the notion of internal working models.

Recently, two unpublished studies have investigated the long-term stability of patterns of attachment by following-up young people who were seen in the Strange Situation in infancy. Both of these studies found significant correspondence between infancy attachment classifications and adult attachment classifications derived from the Adult Attachment Interview in late adolescence and early adulthood (Waters, Merrick, Albersheim, Treboux, & Crowell, 1995; Hamilton, 1994). Hamilton also found that the extent of stability varied according to measures of environmental change in the intervening years between assessments, with greater concordance under conditions of greater family stability. Stability in patterns of attachment over such long periods of time seems a remarkable confirmation of the internal working models view of the life-span development of attachment as well as pointing to the importance of environmental continuity in supporting stability in attachment over time.

There is thus a reasonably consistent body of evidence that suggests that patterns of attachment are relatively stable from infancy to adulthood. The quality of early attachment appears to be related to later aspects of social functioning, such as peer relations and social problem-solving. Early attachment patterns also seem to be lawfully related to later aspects of

speech and thinking in a way that is consistent with the view that these continuities over time are mediated by internal working models. There is even some tentative evidence that suggests that internal working models will eventually be understandable in terms of basic cognitive processes of attention and memory. Nonetheless, many questions remain about the specific mechanisms that mediate these continuities from infancy into childhood and adulthood and the available evidence that internal working models are the primary means by which patterns of attachment remain stable over time is largely indirect.

THE CAUSAL ROLE OF PARENTAL SENSITIVITY

The idea that individual differences in attachment security are ultimately caused by differences in parental sensitivity to infant attachment signals is the fundamental cornerstone of attachment theory. Attachment theory is in that respect an environmental theory par excellence. Since Ainsworth's pioneering investigation of the maternal behavioural correlates of attachment security many researchers have sought replicate and extend her findings. Along with an impressive body of evidence that has emerged over the last 25 years this work has also sparked considerable controversy. Researchers have argued both about the size of the link between maternal sensitivity and infant attachment security and about the casual status of this link. In particular, Lamb, Thompson, Gardner, Charnov & Estes (1984) have suggested that Ainsworth's original study of attachment security and maternal sensitivity had over-generalised from a small sample of 26 mother-infant pairs and claimed that the associations that Ainsworth et al (1978) had found might not hold in larger samples. At the same time, biologically-orientated researchers argued that differences in secure-base behaviour observed in the strange situation are in fact constitutionally-based differences in proneness to distress. Associations with maternal sensitivity simply represent the non-causal parental correlates of infant temperament (e.g. Calkins, 1994; Goldsmith & Campos, 1982; Kagan, 1982). This next section reviews the current state of play regarding the role of maternal sensitivity in the development of attachment security.

The sheer volume of research that has accumulated over the last 25 years would be difficult to review were it not for the meta-analytic work of Goldsmith & Alansky (1987) and more recently of De Wolff & van Ijzendoorn (1997). Goldsmith & Alansky's 1987 Meta-analysis consisted of 15 studies of maternal sensitivity and attachment. 13 of theses studies had used

Ainsworth's strange situation, whilst 2 had relied upon the Waters & Deane (1985) attachment Q-Sort as an assessment of attachment security. Overall, the authors found a modest but highly significant relationship between attachment security and maternal sensitivity (d = .68) (as measured by Ainsworth's sensitivity scales or adaptations thereof) when Ainsworth's original study was excluded from the analysis. Goldsmith & Alansky found that two study characteristics were associated with differences in effect size. Firstly they found that objective behavioural count measures produced considerably smaller effect sizes (d = .31). Secondly, the size of the correlation between sensitivity and attachment security was, perhaps unsurprisingly, inversely related to the length of the intervening period between assessments. Goldsmith & Alansky's meta-analysis failed to assuage the controversy surrounding maternal sensitivity and attachment. On the one hand the analysis represents strong grounds for the rejection of the null hypothesis that attachment security and sensitivity are independent. In this respect this meta-analysis could be said to confirm Bowlby and Ainsworth's basic hypotheses. On the other, the size of the association is considerably smaller than some might have expected and certainly suggests that better assessment procedures or additional causes should be sought in the future. Ten years later and now with a total of 66 studies that involved an assessment of maternal sensitivity and attachment security De Wolff & van Ijzendoorn (1997) have recently published an updated meta-analysis that, as well as contributing some additional insights, has generally confirmed Goldsmith & Alansky's findings. To begin with, De Wolff & van Ijzendoorn attempted to summarise the various theoretical and procedural approaches to the parental antecedents of attachment security that have emerged since Ainsworth's original work. Indeed, this was a considerable undertaking given the enormous spectrum of assessment techniques that have been used. Only 16 of the 66 studies in De Wolff and van Ijzendoorn's meta-analysis actually used Ainsworth's sensitivity scales. Initially, the 66 studies were reviewed by judges who were blind to the relevant effect sizes in order to identify various categories of parental interactive behaviours. 55 distinct categories of maternal behaviour emerged – a testimony to the heterogeneity of published work on attachment and sensitivity. Of these 55 categories 15 fell into four relatively self-evident groups: 1) sensitivity (including all of Ainsworth's scales), 2) contiguity of response, 3) physical contact and 4) co-operation. 19 Expert raters were then given the task of sorting the 40 remaining definitions of attachment-relevant parental behaviours into related categories. At the same time, the judges were also asked to rate each definition according to how similar each was to Ainsworth's sensitivity construct.

These groupings were then subjected to a hierarchical cluster analysis, which yielded 5 different clusters of concepts:

1) *Synchrony*, reflecting mutually rewarding and reciprocal interactions
2) *Mutuality*, interactions involving shared activities and state
3) *Support*, the extent to which the parent appears attentive, available and supportive of the infant's activities
4) *Positive attitude*, the mother's expression of positive feelings towards her baby
5) *Stimulation*, the extent of maternal involvement with the child

9 conceptual groups were thus formed and separate meta-analyses were carried out for each group. The authors also considered various aspects of study design and sampling that might moderate the size of the relationships between maternal interactive behaviours and attachment security. These included sample size, year of publication, age of assessment, birth order, lab-based assessments versus home visits and socio-economic status. Broadly speaking, the results of De Wolff & van Ijzendoorn's meta-analysis confirmed Goldsmith & Alansky's earlier work. Firstly, the size of the association between Sensitivity and attachment was equivalent to a correlation of .22 which, based on a sample of 1,666 mother-infant pairs is highly significant. When only the 16 studies that used Ainsworth's scales were analysed the effect size increased somewhat to .24. Using Rosenthal's criteria (Rosenthal, 1991) De Wolff and van Ijzendoorn note that it would take 862 studies with null findings to reduce this effect to insignificance. Perhaps surprisingly, the largest effect sizes were found amongst the group of studies using the Synchrony definition of maternal sensitivity ($r = .32$, $n = 168$). The remaining measures produced considerably weaker associations between .18 and .09 (all of which, it should be noted were significantly greater than zero at $p < .05$). It was also found that smaller samples were associated with larger effect sizes. Low SES was also associated with smaller effects. The age of the infant at the time of assessment of sensitivity was found to play a role with greater effect sizes for older groups of infants. At the same time, the older the infant was seen for the attachment assessment (SSP or Q-Sort) and the shorter the period between assessments the stronger the effect.

There is thus strong reason to believe that measures of maternal sensitivity, broadly defined, are associated with later patterns of attachment. There can be little doubt that Bowlby and

Ainsworth's theory receives substantial support from this work. Nonetheless, as the authors point out, there is considerable room for improvement – either in the quality of the assessment procedures or in the theory itself. De Wolff & Ijzendoorn, as well as several commentators of the article, suggest that improvements might be made if researchers paid more attention to group effects, age-specific influences, the role of the family system and the non-shared environment (Belsky, 1997; Cowan, 1997; De Wolff & van Ijzendoorn, 1997; Van Den Boom, 1997). Of course, it is not clear whether the effects of these 9 domains of maternal sensitivity are independent of each other or not. If they were, the additive effect could be considerable and these univariate effect sizes would underestimate the multivariate influence of these various dimensions of maternal behaviour on attachment security. Nonetheless, it is likely that the majority of the variability in attachment security remains to be explained. New ways of thinking about the interactive causes of attachment security are clearly needed, although as yet there are no serious candidate explanations of the processes that might be involved.

There is thus a robust albeit modest association between patterns of caregiving behaviour and infant attachment security. Of course, correlations permit only limited inferences about causation and the question of whether the association is truly a causal one can probably only be resolved satisfactorily with direct experimental evidence.

Some intervention work focussed on prevention or modification of insecure infant-parent attachment has indeed been undertaken in recent years. Van Ijzendoorn, Juffer & Duyvesteyn (1995b) have provided a narrative and meta-analytic review of these experimental studies. Van Ijzendoorn et al reviewed 12 studies in which the aim was to alter patterns of attachment via maternal sensitivity or maternal representations of attachment. The design of these studies varied considerably, with some involving focussed interventions and others providing a whole range of supportive services (such as financial, housing, home help). There was also considerable variation in the length of the intervention programme and degree of contact between families and intervention workers. What all these studies shared in common however was some kind of randomised control-group design. Van Ijzendoorn et al's meta-analysis indicated significant but modest change in attachment security but more substantial changes in maternal sensitivity. Although the results of these studies imply that intervention can change attachment status, it is clear that the extent of change is both small and highly variable across studies (from none to an effect size of d = .97, Jacobsen & Frye, 1991).

Furthermore, although some studies were able to show an improvement in sensitivity and attachment —which might support a causal relationship between the two – given the multi-dimensional nature of many of these interventions it is simply not possible to say whether experimentally induced changes in maternal sensitivity led to subsequent changes in attachment. Van Ijzendoorn et al point out that in several cases the extent of change may have been constrained by ceiling effects and differential attrition. Overall then there is some evidence that interventions broadly directed at improving maternal sensitivity can lead to change – in sensitivity and, in some cases, infant attachment security. Though consistent with environmental explanations of sensitivity and attachment, the evidence for a causal link between the two remains somewhat indirect.

THE INTERGENERATIONAL TRANSMISSION OF PATTERNS OF ATTACHMENT

Evidence was described earlier in this section that generally supports the idea that patterns of attachment are relatively stable from infancy into childhood and adulthood. These stable patterns of action, emotion and cognition are thought to be mediated by representational models or relationship-schemas known as internal working models of attachment. At the same time, evidence was described that is consistent with the view that at least one of the causal agents involved in the development of these working models is the responsiveness and sensitivity of a parent to an infant's attachment signals. If, as Bowlby and others have suggested, internal working models also carry patterns of attachment from one generation to the next then parental sensitivity and infant attachment security should be predictable from knowledge of a parent's representations of attachment. With the development of the Adult Attachment Interview direct empirical tests of this crucial hypothesis of the linear model of attachment have become possible. Even more importantly, if the predicted links between parental representations and infant attachment security can be demonstrated we have specific evidence for shared causation. The logic behind this suggestion is simple: if a parent has *only one fixed representation* or 'state of mind with respect to attachment' and the research in question measures the attachment security of one child *chosen at random from a population of siblings* then truly robust correlations between parent and child must represent family-wide associations. Whether these associations are mediated by genes or by the environment, they are by definition shared.

As with the strange situation, the demonstration of these kinds of links depends critically upon the psychometric properties of the AAI. The longitudinal research from infancy to adolescence carried out by Waters, Merrick, Albersheim, Treboux & Crowell (1995) and Hamilton (1994) points quite strongly to the stability of the AAI and several studies have also assessed the test-retest reliability of the AAI directly – all generally confirming the good test-retest properties of the AAI over periods from 2 months to 1.5 years (Benoit & Parker, 1994; Sagi et al, 1994a; Bakermans-Kranenburg & van Ijzendoorn, 1993). As well as demonstrating good test-retest reliability several studies have shown the AAI to be independent of measures of personality, I.Q. and autobiographical memory (Crowell et al, 1997; Steele & Steele, 1994; Bakermans-Kranenburg & van Ijzendoorn, 1993; Ward, Botyanski, Plunket & Carlson, 1991). Waters et al also found no association between coherence of discourse during the AAI and coherence during an interview that did not relate to early attachment experiences (Waters et al, 1993). Rates of inter-rater reliability are also consistently high (e.g. Benoit & Parker, 1994; Zeanah et al, 1993; Dozier & Kobak, 1992; Fonagy et al, 1991; Main et al, 1985;). There is thus good evidence that the AAI is a reliable instrument and also that the AAI measures attachment-specific processes rather than more mundane aspects of psychological functioning such as I.Q., general (non-attachment related) autobiographical memory or speech style.

A considerable number of studies have investigated the hypothesised links between adult attachment status and infant security of attachment and again we can look to the meta-analytic work of van Ijzendoorn for a summary of these findings (van Ijzendoorn, 1995a). Van Ijzendoorn's meta-analysis consists of 18 studies that involved assessments of both parental AAI (either mother or father) and infant security of attachment measured either by Ainsworth's Strange Situation or the Water's & Deane Attachment Q-Sort (Waters & Deane, 1985). As well as arriving at estimates of the effects of parental attachment status on infant attachment security van Ijzendoorn also considered various aspects of study design and sampling that might explain some of the variability in effects across studies. These included age of child, year of publication, rater expertise, nationality and SES. To begin with, van Ijzendoorn found a substantial association across the 18 studies between parental autonomy and infant security of attachment based on 854 pairs of infant-parent dyads. The effect size was 1.06 - equivalent to a correlation of .47 - which by Cohen's standards represents a very large effect size (Cohen, 1988). Using Rosenthal's criteria (Rosenthal, 1991) it would take

1,087 studies with null findings to reduce this effect to zero, suggesting that under-reporting of null findings is unlikely to seriously bias these estimates. The only significant moderator of this effect was the child's age at the time of the attachment assessment, with smaller effect sizes for groups of older children. The effect of Dismissing adult attachment status on infant avoidance was also substantial with an effect size of 1.02 (r = .45). Cluster analysis revealed two outlying studies, one showing no effect (van Ijzendoorn, 1991 – with fathers) and one with an exceptionally large effect (Zeanah et al, 1993). Analyses of potential moderators also revealed some interesting differences between studies. Generally speaking maternal Dismissing status was more strongly related to infant avoidance than was the paternal Dismissing classification and as before samples of older children produced smaller effect sizes. Nationality also appeared to play a role, with larger effect sizes in American samples than in non-American ones. Finally, random samples were associated with larger effects than selected samples. For parental Preoccupation, a somewhat smaller although nonetheless highly significant association emerged with infant resistance (d = .91, r = .42). There appeared to be considerably greater heterogeneity in effect sizes across studies in the link between preoccupation and resistance. Two study characteristics appeared to explain some of this between-study variability - samples of older adults generated smaller effect sizes, as did samples from non-American populations. 16 of the 18 studies reported 3 way cross-tabulations of adult attachment status and infant attachment classification in the Strange Situation revealing a 3-way match of 70% (n= 661). Finally, a significant match emerged between parental lack of resolution of mourning and infant disorganised/disoriented status with a combined effect size of .65, equivalent to a correlation of .31. An analysis based on 4-way classifications of the AAI showed similar results as the above 3-way results with the notable exception of the association between parental preoccupation and infant resistance, which was considerably weaker once parental U status and infant disorganisation were taken into account (d = .39, r = .19). It was also notable that when U status was taken into account smaller effect sizes for parental Dismissing classification and infant avoidance were found for more recent studies and samples of older adults. Similarly, smaller effects were found for samples from non-American populations, selected samples and studies using less trained raters.

Overall then it is clear that a strong association exists between adult attachment representations as measured by the Adult Attachment Interview and infant attachment security. Remarkably, this effect is not significantly attenuated when the AAI is conducted

before the birth of the child in question (Ward & Carlson, 1995; Benoit & Parker, 1994; Fonagy, Steele & Steele, 1991). At the same time, the range of effect sizes is considerable - from near zero in one study (DeKlyen, 1992) to a 90% match in another (Ainsworth & Eichberg, 1991). It should also be noted that some of the samples included in this meta-analysis were not independent of each other – four studies included both mothers and fathers seen in the strange situation with the same child. Given that there tends to be a small association between attachment with mother and with father (Fox, Kimmerly & Shaffer, 1991) these non-independent data points are likely to bias significance levels somewhat. It is also worth noting that 5 of the studies used in this meta-analysis were not published in peer reviewed journals. Although it is important to include unpublished work in a meta-analysis to avoid the 'file-drawer' problem (Rosenthal, 1991), this practice nevertheless raises questions about the methodological rigour of these studies which were either never submitted or never accepted for publication in a reputable journal. Also, given that there is an indication in van Ijzendoorn's meta-analysis that earlier studies are associated with larger effect sizes it seems likely that the effect size will further diminish with time. Nonetheless, despite the fact that the estimates provided by this meta-analysis are likely to overestimate the size of the association to some degree, the fact that an association exists and that it is a relatively substantial one is difficult to deny.

Providing that the infants sampled in these studies were truly chosen at random from a population of siblings the implication of this work is clearly that children from the same family should develop the same pattern of attachment to any one parent. Indeed this shared pattern of attachment should be predictable from the parent's AAI. It is worth noting that some of the studies included in van Ijzendoorn's meta-analysis selected only first-born infants-raising the possibility that non-random sampling might be obscuring non-shared influences (Ward & Carlson, 1995; Fonagy, Steele & Steele, 1991). Indeed, it is unfortunate that birth order was not included as a moderator in van Ijzendoorn's meta-analysis. It could be argued that one might expect more linear relations in a one-child family - which is obviously the most simple of family systems. However, the studies conducted by Main & Goldwyn (in press), Grossmann, Fremmer-Bombik, Rudolph & Grossmann (1988), Bus & van Ijzendoorn (1992) and Zeanah et al (1993) did include children with siblings and these studies do not appear to be consistently associated with smaller effect sizes. Indeed, Zeanah et al (1993) included birth order as an interaction term in the prediction of attachment status from maternal AAI and found no difference in the size of the association between infants

who were first children and those who were not.

Thus attachment research could be said to have come full circle, predicting with considerable accuracy an infant's attachment status from the parents' internal working model of attachment, and predicting child and adult attachment representations from behavioural assessments of attachment in infancy. Remarkable degrees of stability have been demonstrated in attachment representations from infancy to adulthood and across generations from parent to child. All these findings are consistent with the linear representational model of attachment. In contrast to the views of many behaviour-geneticists, attachment researchers have amassed considerable, albeit indirect evidence that suggests that to some significant degree patterns of attachment in infancy are caused by shared familial factors.

Nonetheless, many questions remained to be fully answered about the causes of attachment security and insecurity. There is still much that is poorly understood about the nature of the existing associations between adult attachment and infant attachment status. Questions regarding causality remain and little if anything is known about the unexplained variability in attachment security. Few convincing explanations are currently forthcoming. It has been noted by van Ijzendoorn (1995a) and others that the predictive power of the AAI greatly outstrips that of maternal sensitivity and further meta-analytic work by van Ijzendoorn has shown that the relationship between adult attachment security and maternal sensitivity is also somewhat less than might be expected. These moderate associations lead to a marked discrepancy between the strong association from the AAI to the Strange situation on the one hand and the weak evidence for the putative mediating causal processes on the other. Van Ijzendoorn refers to this as the 'transmission gap'. Fig. 1.1 shows a path model taken from van Ijzendoorn (1995a) that shows the strengths of the links between the AAI, maternal sensitivity and infant attachment security based on the Goldsmith & Alansky (1987) and van Ijzendoorn (1995a) meta-analyses.

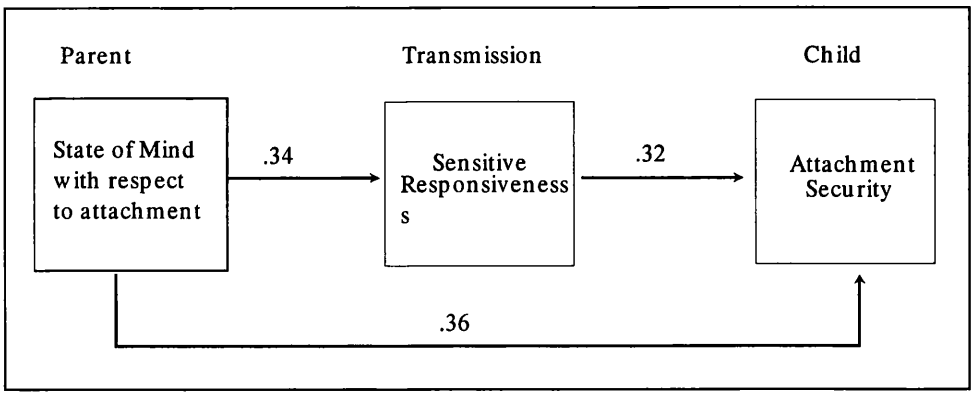


Figure 1.1: Path diagram of the intergenerational transmission of patterns of attachment and the transmission gap from van Ijzendoorn (1995a).

Clearly there is much work that needs to be done in further specifying the interactive causes of patterns of attachment. Van Ijzendoorn has suggested that alternative ways of thinking about the specific causal parental variables may need to be developed, including a consideration of the role of facial emotion expressions and affect attunement (Haft & Slade, 1989). On the other hand, it is equally likely that the transmission gap reflects a measurement problem. At the very least this possibility needs to be ruled out before the basic theoretical framework is called into serious question. As pointed out earlier in this chapter, the research that has investigated parental antecedents of attachment security has relied upon generally unvalidated and idiosyncratic measurement instruments. This inevitably leads to considerable between-study error - a problem not suffered by the AAI which is manualised and very well validated. Indeed the inter-rater consistency of the AAI is continually maintained by reliability tests carried out by M. Main and E. Hesse for all researchers who use the instrument. Between study variability in the coding of the AAI is likely to be considerably less than that suffered by the various assessments of parental sensitivity.

Finally, because of the ill-defined nature of the notion of internal working models it is still very unclear how attachment representations come to influence parenting behaviour even if the basic empirical links were to be established. For many researchers and clinicians, it seems unreasonable to suppose that early parenting experiences or even the representational 'reconstruction' of these experiences in adulthood could be the sole determinant of attachment – biology, the family ecology and later life experiences must surely play a role. It is to these aspects of development that we turn to in the next three sections.

It has been argued by some researchers that differences in the organisation of attachment behaviour represent the influence of biologically-based reactions to stress and that links between attachment and parental behaviour are non-causal, spurious associations (e.g. Chess & Thomas, 1982; Kagan, 1982). It has been argued, for example, that avoidant infants are temperamentally less prone to stress than ambivalent or secure infants. What is the evidence for this view? Goldsmith and Alansky (1987) carried out a meta-analysis of 18 studies that had assessed infant temperament and infant-parent attachment and found that temperament predicted resistant behaviour in the Strange Situation. However, the effect size was small and no association was found for overall attachment classification. Kagan (1994) has shown that resistant infants are over-represented in groups of infants who show high levels of behavioural inhibition in early infancy. Van den Boom (1990) followed the development of a sample of 50 infants who were classified as highly irritable as neonates. It was found that those infants who were highly irritable in early infancy were likely to be classified as avoidant at 12 months. Belsky et al (1996) on the other hand reported that only one association out of eight comparisons showed a relationship between temperament and attachment with father and none for attachment with mother. Mengesldorf et al (1990) found no direct links with temperament but one out of four possible interactions between temperament and maternal personality. Difficult infant temperament, in conjunction with high maternal constraint, seemed to lead to insecure infant-mother attachment at 12 months. In fact there is some suggestion that difficult temperament may represent a risk factor for the development of insecure attachments. Crockenberg (1981), for example, found that temperament was associated with attachment classification only in the context of low maternal social support. The data regarding temperamental influences on attachment are mixed and indeed, it seems likely that part of the reason for these contradictory findings lies in the range of definitions of temperament itself. It is possible that only certain restricted definitions of temperament, such as those that emphasise fearfulness (e.g. Kagan, 1994) will show robust associations with attachment security. As yet there are too few studies that have used the same measures to permit satisfactory comparisons.

Belsky & Rovine (1987) have proposed an alternative approach to the temperament/ attachment debate suggesting that temperament may influence the sub-category of attachment an infant receives in Ainsworth's Strange Situation. They found that although overall

attachment security was unrelated to measures of temperament a relationship did exist between temperament and certain sub-classifications of the Strange Situation. Specifically, those infants classified as A1-B2 differed in temperament from those who were classified B3-C2 – categories broadly reflecting proneness to distress. Belsky & Rovine also found significant overlap between infant-mother and infant-father attachment in terms of this distinction lending further support to a temperamental origin to these differences in response to the Strange Situation. However, Manglesdorf et al (1990) failed to replicate this finding. In a small sample of twins Riccutti (1995) found that identical twins were more similar than non-identical twins in terms of this distinction. Such a difference was not found for attachment security.

It is also possible that other biologically-based influences – not covered by the many definitions of temperament - could explain individual differences in attachment security. In a meta-analysis of 11 studies that had assessed attachment with both parents, Fox et al (1991) found a small but significant association between a child's attachment status with one parent and attachment status with the other. This finding has been interpreted as evidence that individual characteristics of the child influence attachment classification. Others have argued however that assortative mating could account for such a concordance. For example, in a recent study Steele, Steele and Fonagy (1996) reasoned that concordances between infant-mother and infant-father attachment might be explained by parallel concordances in parental adult attachment status. However concordances in infant-parent attachment were still found to remain after controlling for both parents' attachment status. On the other hand the data could be equally well accounted for by a model that allowed the attachment status of the mother to influence the infant's attachment with father. Steele et al argued that it is reasonable to expect some 'spill-over' from attachment with mother to attachment with father because of the primary caregiving role of the mother in normative samples.

There is thus still great uncertainty about the role of biological factors in the development of attachment. There is good evidence that attachment is related to different patterns of physiological response to separation but not whether these differences are constitutionally based (Hertsgaard, Gunnar, Erickson & Martha-Farrell, 1995; Spangler & Schieche, 1994). Indeed, without large-scale behavioural genetic studies the debate is likely to continue.

ECOLOGICAL APPOROACHES TO ATTACHMENT

Ecological approaches to attachment, inspired by the work of Bronfenbrenner (1979), have looked for the antecedents of attachment security in the broader social context of the developing infant-mother attachment relationship. Research in this tradition has focussed on areas such as the marital relationship and the quality of maternal social support (e.g. Isabella, 1993; Belsky, 1984). This alternative approach to the development of attachment is exemplified by the work of Belsky and his colleagues. Belsky (e.g. 1988, 1984) has proposed a model of the processes that determine infant security of attachment that illustrates the emphasis placed on contextual influences upon parenting in the development of attachment. Belsky's 'process model' is depicted below in Fig 1.2.

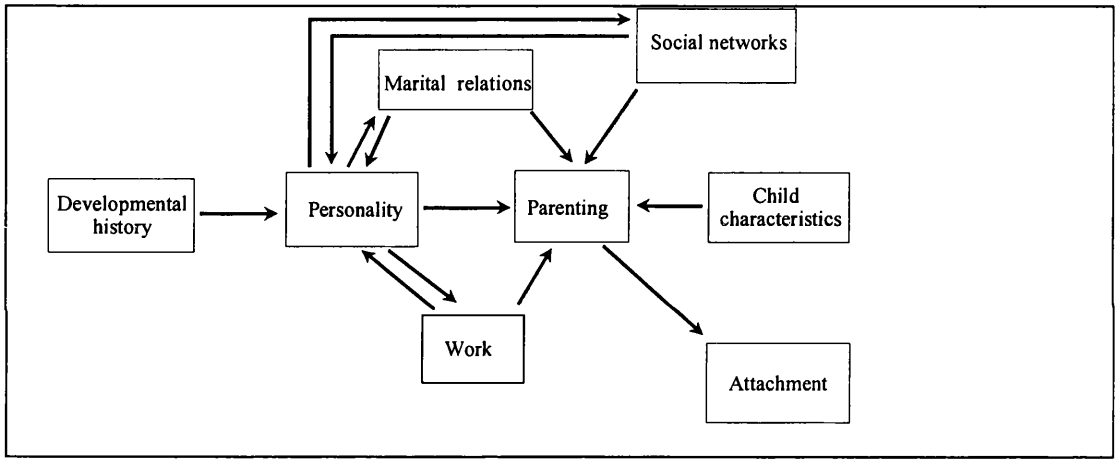


Figure 1.2. Belsky's (1984) process model of the determinants of parenting

In Belsky's model there are many pathways of influence upon parenting, including effects from the parent (such as the parent's security of attachment as assessed by the AAI), from the child (such as temperament) and from the wider social context (e.g. the marital relationship, social networks and work).

The influence of the marital relationship on the developing mother-child relationship has received considerable attention from both clinicians and researchers interested in the development of attachment security. There is certainly good reason to believe that marital quality could have an important influence on the development of attachment. Numerous studies have shown significant associations between marital quality and infant-parent

interaction (Belsky & Volling, 1987). Indeed, several studies have found links between attachment and marital quality across a host of different socio-economic and cultural groups (Durrett, Otaki & Richards, 1985; Goldberg & Easterbrooks, 1984; Crnic, Greenberg & Slough, 1989; Howes & Markman, 1990; Jackobsen & Frye, 1992). For example, Howes and Markman, (1990) found that measures of marital quality taken before the birth of the child predict attachment security at preschool-age as assessed by the Waters and Deane (1985) attachment Q-sort. Spieker (1986) also found marital quality to be associated with infant disorganisation in a high-risk sample of mother-infant dyads. A longitudinal study by Belsky et al (1989) also found that parents of insecure infants were more likely to experience a drop in marital satisfaction and self-esteem after the birth of a child than parents of secure infants. This might suggest that families of insecure infants react badly to the arrival of a new child and the changes and challenges this can represent. It also underlines the potential complexity of the relations between marital harmony, the family situation, the individual's appraisal and response to such circumstances and the development of the infant-parent attachment relationship. Of course, this is in keeping with Belsky's emphasis on multiple inter-related social causes of attachment. Indeed, Isabella (1994) has shown how influences of the marital relationship may be understood more fully by taking into account indirect associations that mediate between attachment, parental personality and the marital relationship. Isabella found that the marital relationship, measured prenatally, did not independently predict attachment security at 12 months. However, the quality of the marital relationship was found to be linked to maternal 'role satisfaction' at 4 months, itself a predictor of maternal sensitivity and infant-mother attachment.

There is thus fairly good evidence that relations exist between aspects of marital quality and attachment security. On the other hand, these relations may form part of a constellation of mediating and interacting influences from diverse aspects of the family's ecological context. As ever, these findings are somewhat limited by their correlational design and as yet no experimental interventions have been carried out that have focussed specifically on the marital relationship.

More powerful experimental evidence does exist for social network factors. Two studies have carried out interventions aimed at improving social support and access to social resources. Lyons-Roth , Connell & Grunebaum (1990) carried out a home-support intervention in a sample of disadvantaged at-risk families. Over a period of six months from 9 to 18 months of

age mothers were visited at home on a weekly basis. The aims of the intervention were broad. The weekly visits were designed to provide mothers with an accepting and trustworthy friendship, improve access to basic resources and encourage sensitive caregiving. At 18 months of age the treatment group were significantly more likely to have secure infants than control dyads. Correlational research has also documented relatively consistent associations between social support and security of attachment. For example, Crittenden (1985) investigated the role of social support networks in the development of attachment in a sample of high-risk mother-infant dyads. Low social support was found to be associated with insecurity of attachment. Interestingly, this association did not remain after controlling for parental sensitivity, indicating that social support and maternal sensitivity form part of the same causal, or at least correlational path. Crnic et al (1986) found that high social support from a spouse, friends and the wider community predicted security of attachment. Crockenberg (1981) found that low social support was associated with insecure infant-parent attachment only for temperamentally irritable infants. Crockenberg (1981) suggested that irritability might represent a 'stressor' that, in the context of low social support, can compromise the parent's capacity to attend to the infant's needs and respond in a sensitive and contingent manner.

The implication of these studies and the theories that have inspired them is that a full understanding of the causes of attachment security will have to recognise the complex patterns of mediating and interacting influences that may impinge upon the infant-parent relationship. However, it is important to note that none of the research that has investigated the wider social influences on attachment has taken into account the role of adult attachment status - a factor that is known to account for a large proportion of the variance in infant attachment. It would seem very likely that adult attachment security would be linked to wider domains of social functioning such as marital harmony and social support. Indeed, recent research has begun to document the social correlates of adult attachment security. For example, Treboux, Crowell and Colon-Downs (1992) found that college students who were classified as secure scored higher on measures of self-esteem. Kobak and Sceery (1988) also found that secure adults were rated as less hostile, less anxious and more ego-resilient by their peers than those classified as insecure. It may well be that secure adults are better able to foster supportive social relationships and harmonious marriages than insecurely attached adults. At this stage, the relevant research that might disentangle associations between adult attachment status, marital quality, social support and infant security of attachment has yet to

be done.

What is clear from this work is that there are serious alternative sources of causal influence on the developing attachment relationship that may not require reference to internal working models. Little is known about the relations between these social-contextual influences and adult attachment processes. At the same time, in its present incarnation Belsky's process model and the research that follows its line of reasoning, is still a shared environmental theory. Belsky's model does not predict differences between members of the same family, except in as much as these various influences might change over time and hence impact differentially on siblings spaced apart in age. Despite its focus on the ecology of parenting, nowhere in this model is there a treatment of systematic, intra-familial aspects of the family ecology that might lead to differences between siblings in the development of attachment.

CONCORDANCE IN ATTACHMENT PATTERNS, DIFFERENTIAL PARENTAL TREATMENT AND THE NON-SHARED ENVIRONMENT

The most striking finding from nearly every study that has investigated psychological development in siblings - be they twins, normal siblings, step-siblings or adopted siblings - is that differences are ubiquitous. Over 25 years of behaviour genetics research has shown that environmental processes tend to operate in such a way that, once genetic factors are taken into account, siblings are rarely more similar to each other than children reared in entirely different families (Plomin & Daniels, 1987; Plomin, Chipuer & Neiderhiser, 1994). This startling finding appears wherever you look amongst the domains of developmental psychology, from the development of personality, cognitive abilities and academic achievement, to peer relations and psychopathology. Although the universal influence of the non-shared environment is almost beyond doubt it is only in the last few years that researchers have moved beyond simply estimating non-shared components of variance in development to directly measuring and developing models of the way in which specific environmental processes are experienced differently by members of the same family. This new research is beginning to document how these differential experiences may lead to different developmental outcomes (Hetherington, Reiss & Plomin, 1994).

This final section reviews the existing evidence - both direct and indirect - that suggests that non-shared environmental processes are likely to play an important role in the development of attachment. We shall begin by looking to the few studies that have assessed attachment security in twins and siblings for direct evidence of non-shared sources of influence. Secondly, evidence shall be described that points to the salience of siblings in family relationships and suggests that there are considerable non-shared influences on the way parents treat their children. Finally, it is argued that parental *differential* treatment may represent a powerful source of non-shared experiences in the family that may be critical to the development of infant-parent attachment.

1.14 Concordance in attachment among twins and siblings

Perhaps surprisingly, there have only been two published studies of patterns of attachment in siblings so direct evidence of concordance rates is to say the least scant. Ward et al (1988) investigated concordances in attachment in 65 pairs of siblings seen in the strange situation at 12 months of age. The second sibling was observed between 11 months and 4.5 years after the first sibling's attachment assessment (mean = 30 months). The 3-way concordance between siblings was 57% which was significant at $p < .05$. Although, Ward et al do not discuss the concordance rate over the secure/insecure distinction, collapsing across insecure classifications does not improve the concordance rate observed by Ward et al. Indeed, if anything the concordance is worse - 37% of sibling pairs were not concordant for attachment security (Del PRE (Hildebrand, Laing & Rosenthal, 1977), the statistic used by Ward et al is .17 and non-significant). Ward et al also carried out observations of parent-infant interaction at 24 months of age during a joint problem-solving task. Ward et al found that correlations in maternal behaviour towards each sibling were evident for siblings whose attachment classification were concordant at 12 months but not for those who were not. This finding suggests that similarities or dissimilarities in maternal treatment may underlie these patterns of concordance. Indeed, it is also very notable that although Ward et al emphasise that their research suggests greater concordance in sibling behaviour than behaviour-geneticists might expect, the correlation between sibling behaviour in the problem -solving task was very low - around .20 and indeed only one correlation out of 8 was significant. Maternal behaviour on the other hand was considerably more consistent between siblings - correlating .49. Nonetheless, only 25% of the variability in maternal behaviour towards one sibling was predictable from that of the other. So although Ward et al find some evidence for

similarities in attachment classifications with mother for siblings spaced apart in age, the degree of overlap is small and there appears to be a substantial amount of variability in maternal behaviour that is not shared. More recently, van Ijzendoorn, Belsky, Pederson & Fisher (unpublished manuscript) have reported attachment concordances in a sample of siblings pooled from three small-scale investigations of attachment. Van Ijzendoorn et al find a remarkably consistent level of concordance across these three studies in the region of 62% (secure versus insecure), consistent with Ward's estimate (Ward et al, 1988). Of course, one of the obvious problems with this kind of design is that the intervening time raises all kinds of questions about changing circumstances between attachment assessments. Changes may have occurred in parental state of mind, in the organisation of the family system or as a result of major life events over this period. Such changes may well reduce the concordance rates from what one might expect if siblings could be observed concurrently. This, of course, is the major methodological advantage of studying twins. The second reported study of patterns of attachment in siblings took a somewhat different approach to the Ward study in an attempt to limit the effect of changes over time between assessments of security in siblings. Teti & Ablard (1989) carried out strange situation assessments of attachment security with a group of 50 infants aged between 1 and 2 years who had older siblings between 2 and 7 years. Instead of obtaining strange situation classifications at 12 months for both members of a sibling pair spaced apart over several years, Teti & Ablard (1989) asked mothers to carry out the Water's & Deane attachment Q-Sort concurrently for the older sibling. After splitting the older siblings into secure and insecure groups on the basis of their Q-Sort scores concordance for attachment between siblings was 64% - a figure not far off that of Ward et al (1987). The use of the Waters & Deane attachment Q-Sort thus neatly side-steps the problem of intervening changes in attachment status between assessments. On the other hand, there are some doubts about the validity of maternal reports of the Waters & Deane AQS (Pederson et al, 1995) and given that the concordance rate is critical, the use of arbitrary cut-off scores for assignment to secure and insecure groups seems questionable. What are needed to really confirm the findings of Ward et al (1988) and Teti & Ablard (1989) are concurrent assessments of attachment security in Ainsworth's Strange situation in infancy - for which samples of twins seem the only choice.

There are several sources of data on concordance rates for attachment in twins, although the investigations carried out to date have involved extremely small or heterogeneous samples. The first reported study using the strange situation in a sample of twins was carried out by

Goldberg, Perrota & Minde (1986). Goldberg et al's primary interest was in the effect of very low birth weight on attachment security. Consequently, their sample included only 17 twins and a further 20 single babies who were born prematurely. Goldberg et al found comparable rates of security and insecurity in this sample to the distributions found in typical populations but unfortunately concordance rates between twins were not reported. It should also be noted that 17 pairs of twins does not even come close to having adequate power to detect even relatively large differences in the distribution of attachment classifications between twins and singletons. Indeed, even with this small sample size Goldberg et al note that there appeared to be an excess of B1 and B4 infants compared to that found in typical populations. Many attachment researchers (e.g. Main et al, 1985) consider the B1 and B4 categories to be at the borderline between security and insecurity. A second study of patterns of attachment in twins that followed shortly after the Goldberg et al one was carried out by Vandell, Owen, Wilson & Henderson. Vandell (1990) has reported attachment distributions for a sample from the original Vandell et al (1988) study and a further 8 cases from another unreported sample leading to a total sample size of 33 pairs of twins. The concordance rate across 3 categories was 71%. The concordance was largely a result of concordances in security with 19 pairs of twins both classified as secure. Only 3 twin pairs were concordant for resistance and one pair for avoidance. Indeed, one of the limitations of this work – other than the small sample size – was the preponderance of secure infants (73%). The overall kappa calculated for this sample is .35 (p =.001). When the data are collapsed into secure versus insecure groups the concordance remains significant (kappa = .315, p = .013). Recently, Riccutti has reported a further pooled sample of 55 pairs of twins for which the overall rate of concordance was 50%. Unfortunately, raw frequencies are not reported so further analyses of these data are not possible. Riccutti's primary interest in this unpublished report was differential rates of concordance between monozygotic (MZ) and dizygotic (DZ) twins. No difference in concordances between MZ and DZ twins were found, supporting the view that individual differences in attachment are not genetically mediated. Nonetheless, it is important to note that the Riccutti sample is extremely heterogeneous with infants ranging in age from 12 to 22 months of age. This heterogeneity in age – and no doubt in procedures between the different source studies – may well obscure real differences between MZ and DZ twins and may underestimate rates of concordance generally. A recent study by Finkel, Wille & Matheny (1998) paints a rather different picture. Finkel et al carried out a twin study of infant-parent attachment using a modified version of Ainsworth's Strange Situation. To begin with, Finkel et al carried out a small-scale validation of their modified version of the strange situation.

Finkel et al tested a sample of 16 pairs of twins seen in both the modified strange situation between 18 and 24 months and in the standard Ainsworth procedure approximately one month later. Overall, there was a 78% 3-way match between the standard Strange Situation and Finkel et al's modified procedure (kappa = .52, $p < .001$). Following this validation work, Finkel et al proceeded to assess the concordance in attachment classifications in a sample of 60 pairs of same-sex twins aged between 18 and 24 months. Finkel et al found a 67.6% match across ABC classifications for MZ twins but only a 38.5% match for DZ twins suggesting a heritable component to attachment security. The overall cross-sibling match (ignoring zygosity) was 55% (kappa = .087, p = .386, calculated from the raw counts reported by Finkel et al). Thus, from these data it seems that what small similarities exist for attachment security between siblings – in this case twins – may be explained by shared genes not shared environments. Indeed, it is quite feasible that concordance between a parent's AAI classification and his or her infant's attachment security could also be mediated by the genes that they share. Of course, without AAI data one can only speculate about the role that genetics might play in intergenerational patterns of transmission. What Finkel et al's study also suggests strongly is that – again - non-shared environmental processes are likely to be critical in the development of attachment. Only around 1 in 3 pairs of twins who were not genetically identical were concordant in their attachment classifications. Having said that there are obvious problems with Finkel et al's study and as such these results should be considered merely suggestive. Firstly, the validation of their modified separation-reunion procedure leaves a great deal to be desired and further validating work clearly needs to be done. As a result of this lack of validity data little can be said about how much common variance this procedure is likely to share with the traditional Strange Situation paradigm. Relatedly, little is known about the test-retest properties of this procedure and given the lack of firm validity data regarding it's relation to the strange situation it gains little from the established evidence regarding the psychometric properties of Ainsworth's procedure. Finkel et al's findings for DZ twins also clearly diverge from research on attachment in non-twin siblings (van Ijzendoorn et al, unpublished manuscript; Teti & Ablard, 1989; Ward et al, 1988). Finally, it was suggested earlier in this chapter that 12-month Strange Situation assessments may be more valid than later ones and as such it would be highly desirable to carry out twin research of this kind with 12 month-olds.

The data regarding rates of concordance in attachment in samples of twins is thus rather equivocal –largely due to meagre sample sizes, heterogeneous populations and non-standard

research tools. Nonetheless, what is fairly clear is that a large proportion of twins are non-concordant for attachment and indeed the data described above fit fairly well the Ward et al's (1988) finding of a 3-way match of 57%. If these data say anything conclusive it is that the non-shared environment is likely to be important for attachment, as it is in virtually every other domain of development studied so far. There is even suggestive evidence that some of the modest similarity between siblings in patterns of attachment may result from their shared genes rather than their shared family environments.

1.15 Non-shared experiences of siblings and differential parental treatment

Since Plomin & Daniels' (1987) target article entitled " Why are children from the same family so different from one another" the race has been on to locate specific environmental processes that might lead to these remarkable differences between siblings in psychological development. One key area – among many – that researchers have identified as a potentially powerful source of non-shared influence is the different experiences that siblings may have of their parents and especially the importance of parental differential treatment (e.g. Brody & Stoneman, 1994).

Young siblings certainly report that there are differences in the way parents behave with different siblings in the same family (Daniels & Plomin, 1985) and it is clear that siblings consider these differences in parental treatment to be extremely important (e.g. Dunn & Kendrick, 1982). Dunn & McGuire (1994) have described how the children in their observational studies of siblings were acutely aware of differences in parental attention and that sibling rivalry for a parent's affections was extremely common. Dunn has also shown that older siblings tend to receive less parental affection than younger ones, despite the fact that parents seem to behave quite consistently to each child at comparable ages (Dunn & Plomin, 1986). It appears that to some degree parents pitch their parenting to the current developmental levels of their children and show generally greater involvement and affection to younger siblings – inevitably leading to differences in parental treatment at any one point in time (Dunn, Plomin & Daniels, 1986). These differences in parental behaviour do not go unnoticed (Dunn & McGuire, 1994; Dunn & Stocker, 1989; Bryant & Crockenberg, 1980). A recent study by Hart, Field, Letourneau & Del Valle (1998) is a particularly nice illustration of the salience of maternal attention and affection even for quite young infants. Hart et al conducted an experimental study of infant jealousy in which the infant's mother

was instructed to attend in counterbalanced order either to a realistic baby doll or a book. Hart et al found that infants were more likely to protest, look at mother and seek the mother's proximity when the mother was attending to the toy than when she was attending to the book. What is remarkable about this is firstly that signs of jealousy are evident in infants so young (1 year) and more importantly that infants appear able to discriminate between maternal attention to another child (or in this case doll) from maternal attention to other objects. In other words, it is not changes in the absolute level of infant-directed attention that the infant responds to but the specific nature of the object that is the focus of the mother's attention. What is especially important is that other-child directed maternal attention has the capacity to elicit attachment behaviour. Clearly in naturalistic settings the parallel of the baby doll is very likely to be the infant's older or younger siblings - fitting neatly with the observational findings of Dunn & Kendrick (1982). Indeed, in Bowlby's first volume of Attachment, Separation & Loss (1969/82) Bowlby included maternal attention to another child as a primary activating cause of attachment behaviour. It seems highly probable then that differences between siblings' relationships to the same parent are likely to be closely monitored by even quite young infants and may well play a role in the development of infant-parent attachment. Indeed, two studies have found security of attachment to be related to the quality of siblings' relationships and level of sibling rivalry. The study described earlier by Teti & Ablard included assessments of the quality of sibling relationships and in particular focussed on protest behaviour as a result of maternal attention to the other sibling. Teti & Ablard (1989) found that insecure infants (although not older siblings) were more likely to protest when the mother played with the older sibling than were secure infants. Of course without longitudinal data it is not possible to say whether security of attachment causes less protest behaviour or whether competition for maternal attention is in fact a cause of security of attachment itself. Nonetheless, these data certainly suggest that sibling competition for parental resources may have an important part to play in the development of attachment security. Vandell et al (1988) found much the same result - with more harmonious sibling relationships - in this case twins - in secure dyads than insecure ones.

Most parents also report that they do not feel equally affectionate towards each of their children and only a third of parents report that they give each child equal amounts of attention (Dunn, Stocker & Plomin, 1990). Differences in parental behaviour have also been found to be associated with important domains of socio-emotional development (Conger &

Conger, 1994; Dunn, Stocker & Plomin, 1990). Dunn, Stocker & Plomin (1990) found that differential maternal control and affection was associated with worrying, anxiety and depression at 7 years. In particular, the sibling who reported experiencing more control and less affection was more likely to feel anxious or depressed. Differences in self- reported maternal differential behaviour has also been linked to sibling self-esteem (Beardsall & Dunn, 1992). Differential parental behaviour appears to be linked to the quality of the relationship that siblings have with each other (Brody & Stoneman, 1994). A recent study by Mekos, Hetherington & Reiss (1996) underlines the considerable differences in adolescent's and parent's reports of parental warmth, control, conflict/negativity as well as in sibling's exposure to parental discord. Exposure to parental discord is a particularly interesting variable because it is known to be associated with - and thought to be a risk factor for - conduct disorder in adolescence (Rutter, 1994). As well as finding substantial differences between siblings in their experience of parenting and in their problem behaviours Mekos et al also found that differences in adolescent's exposure to marital conflict were associated with differences in siblings' overall levels of problem behaviours. Clearly, sibling research of this kind will come to play an important role in developmental psychiatry in the future.

At present very little direct empirical work has addressed the question of differences in parental behaviour in infancy for variables that might be considered to be directly relevant to the development of attachment. However, in a recent study of infant twins DiLalla and Bishop (1996) examined dimensions of parenting behaviour that certainly appear to overlap with many operationalisations of parental sensitivity and found strong evidence for non-shared influences. DiLalla & Bishop observed 168 pairs of twins in their homes in play interactions with their mothers at 7 and 9 months of age. 2.5 minutes of mother-infant interaction were recorded for each baby individually and the video recordings were then coded for microanalytic and global aspects of maternal and infant behaviours. The microanalytic coding recorded instances of infant vocalisations, affect states and attention to mother as well as maternal behaviours such as showing a toy, acknowledging the child and verbalisation. Global rating scales assessed the infant's enthusiasm for interaction, affection, negativity and task orientation and the mother's respect for her infant's autonomy, her quality of instruction, sensitivity to her infant's cues and overall warmth. Generally speaking, the infant variables showed only modest correlations between DZ twins ranging from .09 for negativity to .53 for attention to mother. The global scales of maternal behaviour – which correspond most closely to definitions of sensitivity – showed somewhat larger correlations

ranging from .20 for respect for autonomy to .55 for warmth. There was little evidence of genetic influences on maternal behaviour except in the case of mother's sensitivity to her infant's cues, which showed significant heritability – suggesting that sensitivity is influenced to some degree by characteristics of the child as many temperament researchers have suggested. At the same time, few of the globally rated maternal behaviours showed correlations greater .50 with most around the .30 - .40 mark - indicating that the majority of maternal behaviours as measured in this study are non-shared. There are clearly limitations of the DiLalla & Bishop study – in the short period of interaction observed, the use of non-standard measures and the lack of outcome data that might support the idea that these differences in maternal behaviour have important developmental implications. Nonetheless, there is obvious surface overlap between the measures of maternal behaviour used by DiLalla & Bishop and those routinely used by attachment researchers.

CONCLUSIONS, HYPOTHESES AND THE CURRENT STUDY

Evidence has been presented in this chapter that is consistent with the general idea that attachment behaviours in infancy are organised in such a way that it is useful to describe them as being driven by internal working models of attachment. This model or relationship schema is thought to be derived from repeated day-to-day experiences of caregiving and evidence was reviewed that to some degree supports this view. Similarly, evidence was described that fits broadly with the idea that internal working models also play a role in parenting behaviour and shape the kind of attachment relationship a parent will form with his or her baby. On the other hand, further evidence was described that suggests that shared influences on the development of attachment are likely to be limited and it was argued that non-shared influences on the development of attachment represent an important class of causes of attachment behaviour that have yet to receive consideration from attachment researchers.

In sum, it is suggested that there is good reason to believe that there will be non-shared influences on the proximal causes of attachment security as a result of differences between siblings in the kinds of relationships that each has with his or her parent. Furthermore, these differences in children's relationships with their parents will be observable – at least to some extent - in differential patterns of mother-infant interaction. These differences in a child's experience of parenting will then lead to non-shared patterns of concordance in infant-parent

attachment between siblings. What modest similarities are observed will be predictable from assessments of parents' representations of attachment evident during the Adult Attachment Interview and such shared aspects of attachment will be observable in related patterns of mother-infant interaction. Finally, it is suggested that relative maternal sensitivity and insensitivity will constitute an independent source of influence on attachment because of the impact of one's sibling's relationship on that of the other.

The present study is an investigation of shared and non-shared influences on the development of attachment in a sample of infant twins. As noted previously, there are some powerful methodological advantages in using twins. Assessments of twins are uncontaminated by changes in family circumstances, by changes in parental representations of attachment and indeed by changes in unmeasured causes that would otherwise lead to inflated error and an exaggeration of the influence of the non-shared environment. At the same time, it should be noted that these specific advantages do not come for free – they are bought at the cost of generalisability. It is of course possible that the rearing experiences of twins are different from those of singletons to an extent that might compromise their usefulness in exploring developmental mechanisms that are at play in wider populations. For our current purposes the advantages outweigh the disadvantages and future studies will need to assess the generalisability of the findings presented in this thesis. As one way of assessing the generalisability of the findings presented in this thesis the prevalence of secure and insecure attachments will be compared with that of a matched control group of singletons collected in the same lab in a previous investigation. Furthermore, singleton matched data is also available regarding the association between parental representations and infant attachment security as an additional check on the comparability of twin and singleton populations.

The current study will be organised as follows:

Chapter 2: Concordances in patterns of attachment and attachment behaviour in twins
Chapter 3: Distal influences on shared and non-shared patterns of attachment: Maternal, social-contextual and child factors
Chapter 4: shared and non-shared influences on the development of attachment: the role of maternal sensitivity
Chapter 5: Adult attachment representations and shared environmental influences on

attachment in twins

Chapter 6: The origins of shared and non-shared patterns of attachment: an exploratory analysis of predictors of concordance

Chapter 7: General discussion

CHAPTER TWO

CONCORDANCE IN PATTERNS OF ATTACHMENT AND ATTACHMENT BEHAVIOUR IN INFANT TWINS

INTRODUCTION

Traditionally developmental psychology has tackled questions regarding the causes of socio-emotional development by treating the primary domains of interest as between-family variables. The vast bulk of research in developmental psychology has proceeded by measuring two sets of variables – one set representing causes and the other effects – once for each family and inferring causation – albeit with the usual qualifications - from the resulting correlation between the two.

Research into the development of infant-parent attachment represents perhaps one of the most successful and productive research programs inspired by this traditional outlook. Bowlby's theory of attachment and the research and theorising that followed it views the development of individual differences in attachment as emerging from differences in the sensitivity and responsiveness of a parent to an infant's attachment signals over the first year of life. Differences in security of attachment are then thought to play an important organising role in later socio-emotional development. A child whose parent is accessible and sensitive to the child's attachment needs is thought to develop a working representation of the self as valuable and worthy of love which guides later behaviour in close interpersonal relationships and serves as a protective factor in the face of future environmental hazards. These 'internal working models' are also thought to play a powerful role in the relationships that a person will eventually form with their own children. An adult's state of mind with respect to attachment is believed to play a primary regulating role in a parent's capacity to respond sensitively and contingently to an infant's attachment signals. As such contemporary attachment theory draws a continuous developmental line from the development of early sensori-motor representations of the attachment relationship in response to specific patterns of parental caregiving behaviour through to the increasingly sophisticated cognitive/ representational systems in childhood and adulthood that are ultimately believed to guide parental caregiving and consequently shape the development of early working models of attachment in the next generation.

This view of the development of attachment has received considerable support from cross-sectional and longitudinal research. Infancy assessments of attachment in Ainsworth's Strange Situation have been found to be predictive of a range of developmental advantages in later childhood and adulthood and assessments of internal working models of attachment in adulthood using the Adult Attachment Interview have been found to be strongly predictive of the attachment relationship a parent will form with his or her child even when the AAI is conducted prenatally. Bowlby's theory of attachment and the research that it has inspired has proved to be a powerful way of looking at the causes of individual differences in emotional development.

This focus on between-family effects has recently come under fire from behavioural genetic researchers who have criticised this traditional approach for missing two important facts about development that are only revealed by investigating more than one child per family. Firstly, behaviour genetics research has shown that a substantial proportion of the variability in behaviour and development is attributable – at least indirectly - to the action of genes (e.g. Plomin, 1994). At the same time behaviour geneticists have also shown that in many cases measures of the environment are themselves influenced by genes. Consequently, supposed environmental causes, developmental outcomes and the links between them may in fact be caused by the genes that parents share with their children or from environmental responses to constitutional differences in children's behaviour. Secondly, behaviour geneticists have shown that the majority of variability in individual differences in cognitive abilities, personality and psychopathology is to be found *within* families and not between them. In other words, once genetic effects are taken into account systematic between family variability is negligible and siblings are rarely more similar to each other than children brought up in entirely different families. The majority of variability in behavioural development does appear to be attributable to the environment, but not the environment as normally conceived by traditional developmental psychology. Instead, environmental effects appear not to be shared by members of the same family and serve to direct siblings along different developmental pathways. The revelation of the non-shared environment has had a dramatic impact on the way that psychologists think about development and on the research methods they use to study it.

Strong claims have been made about the role of the shared environment in behavioural

development – or the lack thereof - leading some researchers to discount it altogether (e.g. Scarr, 1992). However, it would be fair to say that many areas of developmental psychology have yet to subject to behaviour-genetic analysis and indeed much of this research has been somewhat atheoretical and has relied heavily upon rather blunt research instruments such as parent-report questionnaires. Attachment research and behavioural genetics research thus stand rather at odds with each other. Attachment research is theory-rich and involves intensive observational measurement techniques, generally small sample sizes and an emphasis on the shared environment. Behavioural genetics research on the other hand is generally atheoretical and measurement-oriented, using expedient pencil and paper self-report instruments, large samples and emphasising genetics and the non-shared environment. There is clearly a need to bring together these two perspectives for their mutual benefit.

The aim of the present study is to investigate the extent of sibling concordance in patterns of attachment in infancy as assessed in Ainsworth's Strange Situation procedure in a sample of infant twins and thus to test a critical prediction of the linear model of the development of individual differences in attachment. This strong reading of contemporary attachment theory predicts that children in the same family will develop the same pattern of attachment to their mother because the primary causal factors are presumed to be the same for each child - patterns of maternal caregiving behaviour that are ultimately determined by the parent's state of mind with respect to attachment. At the same time the present study aims to assess just how prevalent intra-familial differences in attachment might be.

2.1 Shared influences on the developing attachment relationship

The key evidence that suggests that patterns of attachment in infancy may be caused by shared familial influences is the finding that Strange Situation classifications are predictable to some considerable degree from patterns of parental response to the Adult Attachment Interview. A sizeable body of research has shown that the three primary categories of response to the AAI are associated with infant security of attachment in predictable ways - the Autonomous classification is associated with security of attachment, the Dismissing classification with infant avoidance and the Preoccupied category with resistance. A recent meta-analysis by Van Ijzendoorn (1995a) found a 70% three-way match between the AAI and the Strange Situation across a sample of 661 infant-parent dyads - a highly significant and by conventional standards large effect. If

each child is considered to be chosen at random from a sample of siblings then the correlation between parental AAI and infant security of attachment must be one that is shared between siblings and ought to lead to cross-sibling concordance. Of course this match is by no means perfect leaving around 30% of infants with a different classification to that of their parent. It is not clear at this stage whether or not these intergenerational mismatches will be explained by further shared familial factors such as maternal social support or marital harmony. Certainly there is evidence that both these variables play a role in the development of attachment. If so, the degree of concordance between siblings may be even greater than that suggested by the AAI findings. As far as current thinking goes, the causes of attachment – whatever they are – are of the kind that vary between families and not within them. According to this traditional view discordances in attachment security between siblings should not be observed except within the limits of measurement error.

There is evidence that siblings do tend to be similar to some degree in terms of their attachment security. Both Ward et al (1988) and Teti & Ablard (1989) found that concordance between siblings for attachment security was around 60%. On the other hand the association appears modest to say the least and certainly raises questions about the causes of these substantial sibling differences. On the other hand, the obvious problem with sibling research of this kind is that attachment assessments for each sibling are either spaced apart over long periods of time (Ward et al) or entirely different assessment procedures are needed for the older sibling (Teti & Ablard). The value of using twins to answer questions about the concurrent determinants of attachment security is obvious and is the approach taken in this study. Determining the extent of concordance between siblings in attachment security is clearly an important task for attachment researchers because the outcome is likely to have important implications for both theory and methodology.

The few studies that have investigated patterns of attachment in twins seem to point in a similar direction to the evidence from siblings - concordance between 50% and 60% (Finkel et al, 1998; Vandell et al, 1988; Riccutti, 1992) suggesting that the differences between siblings observed by Ward et al (1988) may not have merely resulted from changes over time between assessments. On the other hand, the twin studies that have been carried out to date must be considered preliminary because they involved either very small or highly heterogeneous samples or non-standard research instruments.

With a few notable exceptions (e.g. Stevenson-Hinde, 1992; Stevenson-Hinde & Byng-Hall, 1992) there has been little if any theoretical or empirical work that might provide a framework for understanding how children in the same family could develop different patterns of attachment to the same parent. If the non-shared environment proves to account for a substantial proportion of the variability in attachment security researchers will have to rethink how they understand and investigate the causes of infant-parent attachment. Indeed, there are good reasons for expecting non-shared environmental influences to play a role in the development of attachment. Bowlby himself suggested that a mother's attention to another child might be an important primary activating cause of attachment behaviour (Bowlby, 1969/82) and Dunn and her colleagues (e.g. Dunn & Kendrick, 1982) have shown how acutely aware children are of their sibling's relationships with their parents and how important differences in parental treatment may be for emotional development. Hart et al (1998) and Teti & Ablard (1989) have also shown that 12 month old infants protest and seek a parent's proximity when the parent's attention is given to another child and that sibling rivalry of this kind is associated with insecure patterns of attachment. Indeed, a substantial and rapidly growing body of evidence suggests that parental differential treatment may play a powerful role in lifespan socio-emotional development (Brody & Stoneman, 1992, 1994). It seems likely that aspects of the family system such as these would influence the development of infant-parent attachment.

It is thus predicted that infant twins will show a modest but significant degree of concordance for attachment security and that a substantial number of twins will have different attachment classifications to the same parent, supporting the idea that attachment is influenced by non-shared factors.

2.2 Temperament and genetic factors in the development of attachment

There are of course potential non-environmental causes that would be expected to contribute to similarities between siblings in attachment. The debate over whether individual differences in attachment are caused by constitutionally-based differences in infant's responses to stress is a longstanding one that has never be satisfactorily resolved. Some researchers (e.g. Main & Morgan, 1996) have argued that only studies that employ genetic designs will truly resolve the issue. The evidence that attachment is associated with measures of temperament is scattered with contradictory findings and conclusions,

although it would be fair to say that the failures to find associations outweigh the successes (see for example Fox, 1995; Steele & Steele, 1994; Calkins & Fox, 1991; Belsky & Rovine, 1987). Nonetheless, there have been some positive findings that might suggest a small influence of temperament on the development of attachment (e.g. Kagan, 1992; Calkins & Fox, 1991; Frodi, Bridges & Shonk, 1989). Indeed one of the problems with the temperament debate is the poorly defined nature of temperament itself. Because the term temperament refers broadly to an idiosyncratic collection of rather disparate behaviours the opportunities for replication failures or apparently contradictory findings are considerable. Certainly, there is evidence that attachment classifications to mother and to father are associated (Steele, et al, 1996; Goldsmith & Alansky, 1987) – a finding that some have interpreted as an indication of the influence of temperament (Fox, 1995). Attachment is also clearly linked to differences in physiological responses to separation (Hertsgaard et al, 1995; Spangler et al, 1994). Belsky & Rovine (1987) have suggested that temperament may influence attachment indirectly by influencing the attachment sub-category an infant receives. Specifically, Belsky & Rovine suggest that there may be temperamental influences on the A1 – B2 versus B3-C2 dimension of attachment with infants who are temperamentally prone to distress being more likely to be classified B3, B4 or C. Belsky & Rovine were able to demonstrate considerable support for this view. In particular they found significant correspondence between infant-mother and infant-father attachment for the A1-B2/B3-C2 categories and associations with newborn autonomic reactivity, alertness and positive responding. Temperament should certainly be considered as a potential cause of sibling similarity in attachment security and dimensions of attachment behaviour. In the present study twin concordances in attachment will be assessed both for attachment security and Belsky & Rovine's temperamental distinction between A1-B2 and B3-C2 infants.

Regardless of the specific role of temperament in the development of attachment, twin and adoption studies offer a unique insight into the possible influence of genetic factors considered as a whole. Riccutti's (1992) study of infant twins observed in Ainsworth's Strange Situation between 12 and 22 months found no evidence of genetic influences on attachment. However, methodological problems and lack of statistical power preclude any strong conclusions to be drawn from this study. A larger scale twin study by Finkel et al (1998) did find evidence of substantial genetic influence on attachment security. Nevertheless, as was pointed out in the Introduction to this thesis, the Finkel et al study also suffers from methodological limitations that make this finding difficult to interpret.

The current study, though lacking in statistical power, will examine the possible role of genetic factors in the development of attachment in an exploratory fashion.

2.3 The unique ecology of twins and issues of generalizability

Twin children represent an intensively studied population in developmental psychology, principally because of the insights they can provide for understanding the influence of genes on behaviour. Concordances or correlations between identical twins and non-identical twins have become the most widely used and effective method for disentangling genetic and environmental influences on physical and behavioural development. The twin paradigm, of course, assumes that twins are representative of the wider population and for the present purposes it is important to consider whether findings from samples of twins are likely to generalise to wider populations. The generalizability of twin data has received surprisingly little attention in genetic research and the possibility of so-called 'twin effects' in social development has only very recently been recognised (Rutter & Redshaw, 1991). Methodological and statistical techniques for assessing the generalizability of twin findings are beginning to play a part in behavioural genetic research (e.g. O'Connor, Hetherington, Reiss, & Plomin. 1995) but a great deal still needs to be done terms of documenting the differences and similarities between the development of twins and singletons.

There can be little doubt that the life of a twin is in many ways very different to that of a singleton. Twins tend to be born prematurely, to have more perinatal problems, higher mortality rates and tend to come from a lower socio-economic group than singletons (Bryan, 1992). Of course, twins also have to share the parent's time and attention with the other same-aged child and will usually spend a great deal of time in the company of the other twin. It is also possible that parents of twins may be different from parents of singletons. It is known for example that mothers of twins tend to be older, to have had more marriages, to have a shorter menstrual cycle, an earlier menopause and more failed pregnancies (Bryan, 1992). Parents of twins have also been reported to score higher on measures of anxiety and depression than parents of singletons (Hay, Gleeson, Davies, & Lorden, 1990) and also experience higher levels of marital stress and divorce (Hay et al, 1990). The presence of twins in the family is also likely to have a profound impact on the functioning and patterning of the family system and the wider involvement of family, friends and professionals.

Because of the relatively scarce data regarding attachment in twin populations it is difficult to say whether levels of rates of insecurity are likely to be comparable to singleton samples. Goldberg et al (1986) carried out a study of the socio-emotional consequences of prematurity including a sample of 17 pairs of twins. Several studies have indicated that early parent-infant interactional styles are different for full- and preterm infants (Brachfeld, Goldberg & Sloman, 1980; Brown & Bakeman, 1980). Some researchers have suggested that the stress associated with prematurity may cause maladaptive patterns of parent-child interaction. It was found however, that their sample did not differ in the distribution of the 3 attachment classifications from that found in normative samples and that twins were no more likely to be insecurely attached than singletons. It should be noted however that given the small size of this sample only very gross differences in the prevalence of insecurity would be detected. Indeed, it was found that within the secure group B_1 and B_4 infants were significantly over-represented amongst pre-term twins and singletons. Goldberg et al (1986) suggest that these sub-classifications can be thought of as 'marginally secure,' showing signs of insecurity such as angry or resistant behaviour or moderate avoidance. The majority of the infants in this group were twins, although this difference in distribution was non-significant. Home observations indicated that mothers of B_1/B_4 infants were significantly less responsive and sensitive to the infant's signals and indeed were indistinguishable from sensitivity ratings of mothers of insecurely attached dyads. Given the very low numbers of B_1/B_4 infants in normative samples little is known about the antecedents and developmental consequences of this pattern of infant-parent attachment. This subgroup may or may not constitute an insecure pattern of attachment, but further research into the status of this category and it's incidence in populations of twins and pre-term infants is clearly needed.

A later study by Vandell et al (1988) of 28 pairs of infant twins found no significant differences between the distribution of secure and insecure patterns of attachment between twins and normative singleton samples - 70% were classified as secure, 9% as avoidant and 20% as resistant. Despite lack of significant differences in the distribution between this sample and normative singleton data it is notable that - perhaps surprisingly –the number of securely attached twins was rather high in this study as was the number of resistant twins and the number of avoidant twins was low. No doubt, if the authors had included disorganisation in their coding the proportion of secure infants would have dropped somewhat. A further study by Finkel et al (1998) involving 60 pairs of twins

also revealed no significant differences between normative samples and twins using a modified version of Ainsworth's Strange Situation with 24-month old twins, although the use of this unvalidated procedure precludes any strong statements about the validity of this finding.

There is thus some modest evidence that suggests that twins are equally likely to develop secure relationships with their parents as singletons although replication of these findings in larger samples of twins is clearly needed. Also, it should be noted that these data say nothing about whether the patterns of covariance between twins is representative of that found in singletons or that the developmental processes that lead to individual differences in attachment are the same as those in samples of singletons.

2.4 Measurement issues

Despite its many strengths one of the greatest weaknesses of Ainsworth's Strange Situation is its division of individual differences in attachment behaviour into 3 nominal categories. Although there is considerable evidence to support the general contrast between secure and insecure patterns of attachment there is no direct evidence to support the idea that attachment is a categorical phenomenon. As Lamb et al (1985) have also pointed out that when the dimensional scales of proximity seeking, contact maintenance, resistance and avoidance are analysed for categorical structure using cluster analysis the categories that emerge do not conform to the standard ABC classifications. There are obvious problems with this categorical approach, the most important of which is statistical power. It is well known that categorical data in most situations is less powerful than continuously distributed data (e.g. Neale & Cardon, 1992). The categorical nature of the classification system severely limits statistical analysis both in terms of statistical power and in the range of statistical techniques available to the analyst. It is also noteworthy that few studies report separate effects for the two insecure categories – ordinarily they are pooled to form a general 'insecure group'. Doing so implicitly recognises that the key contrast as far as developmental outcome is concerned is between security and insecurity – a contrast that might easily be translated into a continuum.

Several researchers have attempted to do just that. For example, Cummings (1990) has devised a coding scheme for a modified version of the Strange Situation for 3 year olds based on the idea of a continuum of 'felt security'. Main et al (1985) also used a continuous scheme based on the sub-classifications of Ainsworth's coding scheme in

which the B_3 sub-classification is considered most secure and is assigned a score of 3. B_4, B_2 and B_1 classifications are considered the next most secure scoring 2, followed by the A, C and D categories which all score 1. Main et al were able to demonstrate considerable validity for this rank ordering scheme. Richters, Waters & Vaughn (1988) took a statistical approach to the problem. Richters et al carried out a discriminant analysis to generate a continuous function that would optimally discriminate between secure an insecure infants on the basis of their interactive scales scores – the discriminant function scores were then used in further subsequent analyses. The rank ordering approach and the discriminant function procedure are both attractive alternatives to the dichotomous classification scheme and will be used in conjunction with the traditional ABCD system in this study. Although this represents something of a departure from standard practice in attachment research it is not without its precedents and the statistical benefits are potentially significant.

2.5 A final note regarding concordance

It is important to note that the degree of overlap between twins or siblings that one might expect on the basis of current thinking in attachment research depends heavily on how current thinking is interpreted. The issue can be neatly summarised in a path diagram. Fig. 1 illustrates a plausible model of the causes of attachment security that includes shared influences from a parent's IWM as well as additional distal influences from the social context. These shared influences converge upon patterns of mother-infant interaction which according to this model are experienced similarly by siblings in the same family.

If a strong reading of the linear model is used to make predictions about sibling concordance then a very substantial degree of overlap would be expected and indeed the mediated pathway between the AAI and infant attachment security ought to approach 1 (or within the limits of measurement error). Indeed a very substantial degree of overlap would be expected from any or all accounts of the development of attachment that adopt the traditional between-family approach. These shared aspects of the model are illustrated in Fig. 2.1 as the series of paths converging on sib 1 and sib 2 attachment from the left.

On the other hand, if one adopts a more empirical approach the concordance might be expected to be considerably less. For example, Van Ijzendoorn (1995a) estimates the

correlation between parental AAI and infant attachment security to be approximately .50. If this estimate is broadly correct and no other independent between-family effects exist (e.g. if social support and the AAI were to correlate very highly) then from standard path analytic rules the between-sibling correlation ought to be approximately .25 ($.50^2$). Between these two extremes is the situation in which various other independent shared proximal influences exist and contribute additively to the between-sib correlation in proportion to the square of their effect sizes (although correlations between these additional factors would effect the specific implied correlations to some extent). Thus measurement of the between sib correlation allows the estimation of the maximum potential influence of the whole range of known and unknown shared causes of attachment security.[1]

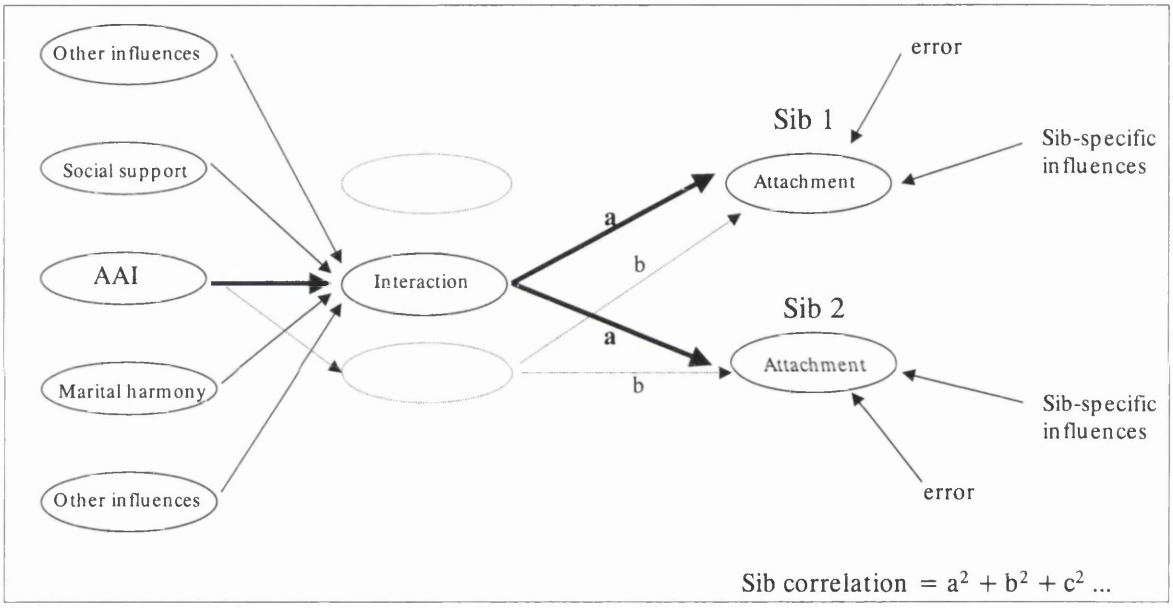


Fig. 2.1 A model of the shared and non-shared influences on attachment security

Of course, the second set of components of the model in Fig. 2.1 that is of interest here is the sib-specific effects which set the upper limit on the shared causes on the left. In reality little is known about the overlap between the AAI and other social causes of attachment security or indeed about the mediating links between the AAI and Ainsworth's Strange Situation (van Ijzendoorn, 1995a). Consequently, specific predictions based on empirical considerations are difficult to make. On the other hand, it is clear that theoretically speaking attachment researchers have largely assumed that the

[1] This discussion ignores the complicating influence of shared and non-shared genes

causes of attachment security are of the shared kind and hence that evidence of non-shared influence is direct evidence to the contrary.

The aim of this study is thus to assess the degree of concordance in patterns of attachment in a sample of 12 month old infant twins in Ainsworth's Strange Situation. It is predicted that there will be a significant association between the security of attachment of one twin and that of another as predicted by the linear representational model of attachment. On the other hand, the match is expected to be by no means perfect and a substantial number of twins are expected to have different attachment classifications to the same parent. The distribution of attachment classifications in this sample of twins will also be compared to normative data and a matched control group of singletons to assess the degree to which twins are representative of wider populations. Finally, because data are available regarding twin zygosity a preliminary exploration of genetic influences on attachment security will be made.

METHODS

Participants

The participants in this study consisted of 58 families with infant twins living in and around London, UK. The families were recruited through the Multiple Births Foundation (MBF) of Queen Charlotte's and Chelsea Hospital in south west London, during the MBF's weekly 'twins clinics'. Ethical approval for the study was given by the Joint UCL/UCH Research Ethics Committee and the Joint Hammersmith Medical School, Queen Charlotte's and Chelsea and Ealing Hospitals Ethics Committee. Only intact families whose baby twins were younger than 9 months of age (corrected for prematurity) and did not suffer from any serious motoric or mental impairments (for example, as a result of Cerebral Palsy) were approached to take part in this study. Participants were initially approached by a member of staff at the MBF who explained what the study would involve and gave out information letters which covered the aims and practical details of the study and contact telephone numbers. A week or so later the parents were followed-up with a telephone call from a member of staff at the MBF who answered any questions that parents had about the study. Verbal consent was given by telephone by those families who wished to take part. Final written consent was given at the start of the initial home visit when the babies were 9 months CA. 60% of the families approached agreed to take part in the study. Once the study had begun only 3 families subsequently dropped out - 2 due to constraints of time and one because of a serious illness.

The families were largely middle-class and well educated with 40% of the mothers holding university degrees, 13% had higher degrees, 27% had 'A' levels or their equivalent and 20% had only 'O' levels, CSEs or their equivalents . On the basis of the father's occupation 36 % were from social class I (professional and managerial), 30% were from social class II (intermediate occupations), 21% from social class III (partly skilled occupations) and 13% from social class IV (unskilled) using a modified version of the *Classification of occupations coding index* (1980). Fathers worked for an average of 45.5 per week ranging from 0 (unemployed) to 70. Maternal age was fairly high (Mean = 35, S.D. 5.4) which is not unusual in samples of twins because of the increased incidence of twinning with age and as a result of fertility treatment programs - for which parents may wait 5 years or more for a successful pregnancy (Bryan, 1992). 24% of the twins in this sample were born with the help of fertility treatments - by far the most common being In Vitro Fertilisation (IVF). Most of the parents in this study had been together for

five years or more (mean = 7.1 years, S.D. = 4.7).

On the whole, few of the infants in this study went to full term, which is typical of samples of twins. In normative samples the average gestation of baby twins is 36 weeks and in this sample it was 35.9. (range 27 – 40, S.D. = 2.7). The average birth weight of the infants taking part in this study was 3.4 kg with a range of 1.2 to 5.0 kg. 21 (36.2%) of the twins were monozygotic (MZ) and 37 (63.8%) were dizygotic (DZ) again reflecting the proportions found in the general population (Bryan, 1992). 15 (64.3%) of the DZ twins were opposite sex twins. 56% of the whole group were boys and 44% were girls. At the time of assessment in Ainsworth's Strange Situation the mean age of the infants was 54.7 months (S.D. = 3.6).

Design

When the infants were between 9 and 10 months of age after correcting for length of gestation, two researchers visited the family home to obtain written consent and to carry out naturalistic observations of mother-infant interaction. A month later the family was visited again in the evening by the same two researchers who carried out the Adult Attachment Interview with both mothers and fathers. At 12 months corrected age, the families were asked to come to the observational labs at University College London for assessment of mother-infant attachment in Ainsworth's Strange Situation. A further two months later the families were asked to return for assessments of father-infant attachment. The mothers were also given questionnaires regarding infant temperament, social support, anxiety, depression and stress. Only data from the mothers are reported in this thesis and only the 12-month Strange Situation data is reported in this chapter.

Procedures

When the baby twins were between 12 and 13 months of age after correction the families were invited to visit the observational labs at UCL. On arrival they were taken to a comfortable playroom and the family were given around 10 -15 minutes to settle in and for the babies to get to know the room and the two experimenters. When the parents felt that the babies were relaxed and comfortable the father was asked to look after one of the twins while mother carried out 3 very brief (2 minute) assessments of play, social referencing and emotion-recognition. These experiments are not reported in this thesis. The mother then took the other twin through the same procedures while father looked after the first. Occasionally older sibs were present too (with father).

Once these brief non-stressful procedures were completed for each twin the family took a break - parents were offered a drink and often the babies had a feed or a snack. After this period - which lasted between 10 and 15 minutes the mother and one of the infants were taken to a second observation room which they had not seen before for the Strange Situation. The second twin stayed with father in the familiar room. The order in which each twin was seen in the Strange Situation was chosen by a coin toss. After the first twin's Strange Situation was complete mother and infant returned to the original playroom where father and the other twin were waiting. A further break was taken again lasting 10-15 minutes to minimise the impact of the second twin's separation from mother during the Strange Situation. Whether this separation from mother - although always in the presence of father - had an effect on the infants response to the Strange Situation procedure was examined empirically by contrasting those twins who went first with those twins who went second. No significant differences emerged (details of this finding are presented in the results section).

The Strange Situation - The Strange Situation is a widely used and well-validated procedure for assessing the security of the infant-parent attachment relationship (Ainsworth et al, 1978). The procedure involves two brief episodes in which the infant is separated form the parent in an unfamiliar room. In the first separation the infant is left in the presence of the stranger and in the second the infant is left alone in the room. These separation episodes last up to 3 minutes and are curtailed if the infant shows signs of considerable distress. The procedure lasts approximately 20 minutes although it is often less if the separation episodes are curtailed.

Infants classified as secure in Ainsworth's coding scheme appear relaxed in mother's presence prior to separation and upon reunion immediately greet the parent and usually actively seek proximity. Secure babies are easily comforted when upset and are able to return to play fairly quickly. An avoidant classification is given to babies who appear unstressed by separation and appear to actively avoid or more specifically shift attention away from the parent upon her return. When the parent attempts to pick up the baby he or she will often signal to be put down. Resistant infant by contrast often show signs of anxiety even before the parent leaves the room - sometimes in response to the strangers entrance - and upon reunion show considerable levels of protest and distress but do not easily settle. Often resistant infants kick, wriggle or arch their back when picked up as if

signalling to be put down, but when put down cry to be picked up. Finally, disorganised responses to separation and reunion are coded when infants show signs of an apparent breakdown in an otherwise coherent behavioural strategy - such as sudden stilling, rocking, rapid approach followed by strong avoidance or direct indices of fear or disorientation (Main & Solomon, 1990).

All infants were assigned one of the four categories described above as well as a best-fitting ABC classification. Each reunion episode was also scored for Ainsworth's scales of proximity seeking, contact maintenance, resistance and avoidance which form the basis of the ABC classification. The infants were also assigned a score for disorganisation on a 7 point scale, following Main & Solomon (1990). Each twin of a pair was coded independently by one of four raters, 3 from the University of Washington, USA (Bonnie Connely, Susan Paris and Joyce Moon) and one from the University of Haifa, Israel (Tirtsa Joels) all of whom have been trained to code the ABC and D classification systems and have passed the reliability tests for the ABC system administered by Alan Sroufe at Minnesota University, USA and the D system administered by Mary Main and Erick Hesse at the University of California at Berkely, USA. No rater scored both members of a twin pair and 29 cases were scored by a third rater to assess inter-rater reliability. Disagreements or low confidence cases were agreed by conferencing between two raters. Inter-rater reliability for the 3-way attachment classifications for a sample of 29 double-rated cases was .73 (kappa) and the 4-way reliability was .70. Correlations between raters for the proximity seeking, contact maintenance, resistance and avoidance range between .90 and .70 (median correlation = .83). All four raters were blind to any other information regarding the twins and their families.

Zygosity determination - Zygosity determination was carried out for all same sex twins in one of two ways. Firstly, for a substantial number of the twins in this sample information was available regarding placentation. Specifically, MZ status could easily be identified for those twins who were monochorionic/mono-amniotic (MC/MA - shared the same placenta). 47% of the twins in this sample were identified as MZ twins in this way. For the remaining same sex twins for whom placentation data were not available or who were not MCMA - and thus could be either MZ or DZ - zygosity was determined using a genetic test developed by Freeman, Powell, Ball, Craig & Plomin (1997) using DNA extracted from samples of cheek cells. Families for which zygosity was unknown were

given a test kit upon leaving the first Strange Situation session at 12 months. Each kit contained 10 cotton buds and a separate test tube for each twin containing a preservative solution. A set of instructions for the collection of cheek cells was also included in the kit with a telephone number in case of problems. The parents were asked to swab the inside of each twin's mouth ten times for about 20 seconds in different areas of the mouth across the course of a day whilst immediately placing each cotton bud into their respective test tubes. Prepaid envelopes were included in the test kit and the test tubes containing the cheek cells were sent by the parents directly to Bernard Freeman at the Institute of Psychiatry, London for zygosity determination. This procedure has been established as a highly accurate test of zygosity with miss-hits for monozygosity in the order of one in 1500 (Freeman, personal communication, 1998). 39% of the twins in this sample were tested using this procedure.

Case-matched control group of singletons

A control group of singletons was identified from a previous study of attachment in this lab conducted by Fonagy et al (1991). From a database of 100 mother-infant pairs who had been in observed in the Strange Situation at 12 – 13 months 56 control cases were selected for comparison with the 56 pairs of twins who had complete attachment and adult attachment interview data (the results of the AAI data are presented in Chapter 5). The Fonagy et al sample as a whole was largely middle-class and well educated. The mean age of the mothers was 31, with 70% holding university degrees. Mothers were interviewed during the third trimester of pregnancy. All infants reached full-term. Strange Situation assessments were carried out in accordance with the procedures described above for the twin sample and in Ainsworth et al (1978) and were coded blind (inter-rater reliability was high: median $r = .88$). For more details of this study see Fonagy et al (1991).

Individual case matching was carried out by sequential selection of a singleton case that most closely matched each twin case in terms of maternal age and father's occupation (in that order of priority). This procedure was carried out iteratively until all twin families had a matched singleton case. Matching was carried out blind with respect to attachment classifications and other attachment data. After matching there were no significant differences between the twins and singletons on maternal age ($t(55) = 1.07$, $p = .30$). However, despite best-case matching there remained a significant difference in paternal occupation between the two samples (Wilcoxon signed ranks test $Z = 2.49$, $p =$

.013). Overall the fathers from the singleton group came from a higher class of occupation with the majority in class II (professional/management). It was simply not possible given the social class distributions of the singleton and twin samples to find fully adequate matches. This difference in socio-economic backgrounds of the two samples should be borne in mind when interpreting the results of between-group analyses of these twins and singletons.

The results of this study are divided into three sections. The first is concerned with the prevalence of attachment security and insecurity in this sample of twins and comparisons are presented between this sample and normative data. This section will also include a description of the analytic steps taken to generate the continuous attachment measures.

The second section describes the extent of concordances in major attachment classifications between members of a twin pair. This section also presents analyses of cross-twin associations in attachment security using the continuous measure of attachment security derived from the discriminant function analyses and Ainsworth's interactive scales.

The final section describes an exploratory analysis of differences in concordance rates and correlations for attachment variables between identical and non-identical twins. For the purposes of these correlational/concordance analyses the sample of 116 twins was divided into two arbitrary groups at random (hereafter referred to as twin 1 and twin 2) with one member of each pair in each group.

2.6 Rates of attachment security in twins, comparisons with singleton data and continuous measures of attachment

A total of 116 infants are included in these analyses from 58 pairs of twins. In total, 61 out the 116 (53%) twins given a three-way attachment classification were classified as secure which fits broadly with what is expected from normative low-risk samples. Estimates of security in low-risk middle-class samples range from around 50 to 60%. However, rates of resistance were considerably higher than expected with 36 infants classified as resistant (31%) and a parallel reduction in the frequency of avoidance. Only 19 infants were classified as avoidant (16.4%) which is considerably less than frequencies expected on the basis of British and American normative data from singletons which put estimates of avoidance at around 25-30%.

Inclusion of the Disorganised category reduced the proportion of secure infants only marginally (50% or 58 infants were classified as secure). 14 infants were classified as D (one of which was CC or A/C) of which 8 were given best-fitting three-way classifications of resistance, 3 secure and 3 avoidant. Thus when D was taken into

account 50% were classified secure, 24% resistant, 13% avoidant and 13% disorganised.

For the 56 infants with singleton comparison cases a series of McMenar's χ^2 tests were carried out in order to identify significant differences in the rates security, avoidance, resistance and disorganisation between twins and singletons. The four-way attachment classifications were thus broken down into four dichotomous variables: secure versus not secure, avoidant versus not avoidant, resistant versus not resistant and disorganised versus not. Each test was carried out twice – once for the twin1 sample and once for twin2 sample. In the singleton sample, 17 infants (31%) were classified as avoidant, 27 as secure (49%), 3 as resistant (5%) and 8 as disorganised. These figures match quite closely with normative data and clearly diverge from the distributions found in the twin sample. The McMenar tests suggested that there were significantly more resistant infants in the twin group (singletons vs. twin1 sample: McNemar p = .035, singletons vs. twin2 p = .004) and significantly more avoidant infants in the singleton group – although the effect was only statistically significant for the twin2 sample (singletons vs. twin1 McNemar p = .13; singletons vs. twin2 McNemar p = .035). There were no significant differences between the two samples in security or disorganisation that even approached significance (all p values > .50). Clearly, given the number of tests carried out here, these significance levels are likely to be biased somewhat. Nevertheless, the increased levels of resistance observed in this sample of twins is striking and seems unlikely to have arisen by chance.

In order to see whether the experimental procedure itself was responsible for the increased numbers of resistant infants the attachment classifications of those infants who entered the Strange Situation first were compared with those who went second (and had hence been separated from mother for up to 20 minutes in the company of father). There was no significant difference in the overall rate of security between those who went first and those who went second (Binomial test, p = .27), although the raw frequencies suggest the possibility of some impact of prior separation. For those who went first 55% were classified secure, whereas of those who went second only 45% were secure. Similarly, the twin who went second was not significantly more likely to be classified as resistant than the one who went first (Binomial test, p = .80).

However, there was a trend that suggested a difference in the proportion of infants classified as disorganised - with more of the twins who went second being given a D

classification (Binomial test, $p = .083$). As such the D classifications and scores reported here should be treated with some caution. Also, those infants who were previously separated from mother scored higher in terms of resistance and contact maintenance after the first reunion episode ($t(57) = 2.4$, $p = .019$; $t(57) = 2.0$, $p = .049$, respectively). There was also a trend for the twin who went second to score higher on the 7 point scale for disorganisation ($t(57) = 1.8$, $p = .079$). There were no other significant differences amongst the interactive scales between those twins who went first and those who did not. As such, these analyses seem to suggest that the prior separation may have increased stress levels somewhat at the start of the procedure but no differences were evident for the second reunion. As such, from the analyses reported above it seems unlikely that procedural factors could account for the inflation in the numbers of resistant infants alone and indeed it seems that the prior separation if anything lead to some misclassification of disorganisation rather than resistance.

Two continuous measures of attachment security were considered for this study. The first is a system used by Main et al (1985) in which 'very secure' (B3) infants are given a higher score (3) than less secure ones (B2, B2, B4 scoring 2) who in turn score higher than avoidant, resistant and disorganised infants (scoring 1). An additional approach has been suggested by Richters et al (1988). In Richters et al's approach the interactive scales are entered into a discriminant function analysis with security of attachment as a dichotomous dependent variable. The discriminant function analysis finds a linear combination of the interactive scales that best differentiates between those classified as secure and those classified as insecure. This linear combination (or discriminant function) is then used to generate 'security' scores for each case on the basis of a linear weighted combination of their scores for avoidance, resistance, contact maintenance and proximity seeking.

Two discriminant function analyses were carried out - one for twin 1 and one for twin 2 - using the interactive scales for both reunion episodes. In each case the discriminant function was highly significant (twin 1: Wilks' Lambda = .478, χ^2 (8) = 37.65, $p < .0001$, Canonical R = .72; twin2: Wilks' Lambda = .434, χ^2 (8) = 43.35, $p < .0001$, Canonical R = .75). Overall the two discriminant functions correctly classified 87% of cases (15 miss hits out of 116). The distribution of the discriminant function scores in both cases closely approximated normality. Thus in later analyses Main's system and the discriminant scores are used as continuous measures of attachment security in conjunction with the

traditional ABCD and secure versus insecure categorical measures.

2.7 Concordances and correlations between measures of security of attachment

The primary aim of this study was to assess cross-twin concordance in patterns of attachment as a means of testing the hypothesis that siblings will develop the same pattern of attachment to their mother as a result of shared experiences of parenting. The second aim of this study was to assess the extent of sibling discordance in attachment as a way of estimating the importance of non-shared influences on attachment. Table 2.1 presents a cross-tabulation of 4-way attachment classifications for the 58 pairs of twins in this sample.

Table 2.1 Patterns of concordance and discordance in 4-way attachment classifications

	Twin 1 Attachment classification			
Twin 2	Avoidant	Resistant	Secure	Disorganised
Avoidant	3	1	4	2
Resistant	0	6	6	3
Secure	2	5	18	3
Disorganised	1	1	2	1

As can be seen from the above table discordances in attachment between twins were common. At the same time the degree of concordance was moderate but significant. In total 48.3% of twin pairs were concordant for 4-way attachment classification (Kappa = .22 p = .007). When the 3-way classifications were cross-tabulated (i.e. ignoring disorganisation) the concordance did not change by any substantial degree. Overall, 55.2% of twin pairs were concordant when best-fitting ABC classifications were used (Kappa = .25, p = .009). Table 2.2 shows the 3-way correspondence between attachment classifications.

Table 2.2 Patterns of concordance and discordance in 3-way attachment classifications

	Twin 1 Attachment classification		
Twin 2	Avoidant	Resistant	Secure
Avoidant	4	1	6
Resistant	0	10	7
Secure	4	8	18

The attachment classifications were then collapsed into the traditional secure versus insecure dichotomy. The correspondence across twins was only marginally significant (Kappa = .24, p = .06; ϕ=.24). Overall 62.1% of twin pairs were concordant for attachment security. The discriminant scores and Main's continuous security scores also suggested correspondence in terms of attachment security. The twin correlation for the continuous discriminant function security scores was .28 (p = .035) and that for the Main security score was .27 (p = .042) showing as before a moderate but significant association between members of a twin pair for attachment security.

To further explore the possibility of shared influences on attachment, a series of correlations were carried out between Ainsworth's scales of proximity seeking, contact maintenance, resistance and avoidance. Of the eight correlations carried out between the interactive scale scores for each reunion episode only the correlations for proximity seeking and contact maintenance were significant for the first reunion episode (proximity seeking: r = .28, p = .033; contact maintenance: r = .36, p = .005). For the second reunion significant twin correlations were found for contact maintenance and resistance (contact maintenance: r = .33, p = .012; resistance: r = .28, p = .014).

There is thus some evidence of shared patterns of attachment behaviour for contact maintenance and resistance. Of course, a low level of resistant behaviour is often seen in B4 infants and similarly resistant infants often show fairly high levels of contact maintenance. Indeed, this finding is consistent with Belsky's & Rovine's (1987) division of the attachment sub-classifications into categories representing temperamental proneness to distress and may indicate a genetic influence on attachment behaviour. In fact when the attachment sub-classifications were collapsed into Belsky & Rovine's temperamental categories ($A_1 - B_2$ versus $B_3 - C_2$) significant concordance emerged with

69% of twin pairs concordant (Kappa = .39, p = .002).

2.8 A preliminary exploration of genetic influences on attachment and attachment behaviour

As a way of exploring the possibility of genetic influences on attachment concordance rates were calculated separately for MZ and DZ twins. These analyses of course must be considered highly exploratory in nature because the sample size in this study is too small – by an order of magnitude – to permit adequate tests of genetic influence (Neale & Cardon, 1992). Four and three-way concordances in attachment security are presented in tables 2.3 and 2.4.

Table 2.3 Correspondence in 4-way attachment classification for MZ and DZ twins

	Twin 1 Attachment classification			
Twin 2	Avoidant	Resistant	Secure	Disorganised
DZ Twins				
Avoidant	1	1	2	2
Resistant	0	5	5	1
Secure	0	4	12	1
Disorganised	0	0	2	1
MZ Twins				
Avoidant	2	0	2	0
Resistant	0	1	1	2
Secure	2	1	6	2
Disorganised	1	1	0	0

As can be seen in the above table there was certainly no evidence of any dramatic differences in the concordance in attachment classification for MZ and DZ twins. Indeed, if anything DZ concordances were marginally higher than that for MZ twins (51.4% Kappa = .24, p = .019 and 42.9% Kappa = .17, p = .20 respectively). An inspection of Table 2.4 shows that classifying each case by its best-fitting three-way classification did not yield any further evidence for greater concordance in MZ twins.

Table 2.4 Correspondence in 3-way attachment classification for MZ and DZ twins

	Twin 1 Attachment classification		
Twin 2	Avoidant	Resistant	Secure
DZ Twins			
Avoidant	2	1	4
Resistant	0	7	6
Secure	0	5	12
MZ Twins			
Avoidant	2	0	2
Resistant	0	3	1
Secure	4	3	6

For DZ twins concordance for three-way attachment classification was 57% and for MZ twins it was 52%. When MZ and DZ twins were compared for security/insecurity concordance was 62.0% for MZ twins and 62.2% for DZ twins (Kappa for MZ twins = .24; for DZ twins = .25). Main's continuous security scores revealed rather larger correlations for DZ twins (.34, $p = .04$) than for MZ twins ($r = .12$, $p = .59$). This difference in the size of the MZ and DZ correlations is likely to reflect sample error. The possibility of genetic influence was suggested however by the discriminant function scores. The twin correlations for the discriminant security scores were .23 ($p = .17$) for DZ twins and .39 ($p = .09$) for MZ twins.

Finally, a series of twin correlations were computed for Ainsworth's scales for proximity seeking, contact maintenance, resistance and avoidance. The resulting correlations are presented below in Table 2.5 (significance levels are in brackets).

Table 2.5 Twin correlations for Ainsworth's interactive scales for MZ and DZ twins

	Zygosity	
Ainsworth Scale	MZ	DZ
Reunion 1		
Proximity seeking	.26 (25)	.29 (.08)
Contact Maintenance	.46 (.05)	.27 (.11)
Resistance	.33 (.14)	-.07 (.66)
Avoidance	.01 (.98)	-.14 (.40)
Reunion 2		
Proximity seeking	.12 (62)	.31 (.06)
Contact Maintenance	.38 (.10)	.24 (.14)
Resistance	.50 (.02)	.16 (.47)
Avoidance	.27 (.25)	-.05 (.79)

From table 2.5 it can be seen that somewhat larger correlations for MZ than DZ twins were found for Contact Maintenance and Resistance for both the first and second reunions and Avoidance during the second reunion (highlighted in grey). It should be noted however that none of these correlations are significantly different from each other using Fisher's z transformation. Nonetheless, these data hint at the intriguing possibility of genetic influences on attachment security and attachment behaviour. Indeed, further suggestive evidence of genetic influence was found when concordance rates for MZ and DZ twins were calculated for Belsky & Rovine's (1987) temperamental categories representing high and low proneness to distress. For DZ twins concordance was 65% (Kappa = .26, p = .103) whereas for MZ twins concordance was 76% (Kappa = .49, p = .018).

2.9 Behaviour-genetic model fitting of genetic and environmental influences on attachment

Despite the lack of statistical power for resolving genetic and environmental effects, a series of standard behaviour genetic model-fitting analyses were carried out in order to obtain preliminary estimates of additive genetic effects and shared environmental and non-shared environmental factors for these attachment data. Rather than analyse all the attachment variables presented above, these analyses focussed on the primary measures

of attachment security (secure vs. insecure, Main's security scores and the discriminant function scores) and those attachment behaviours that suggested the possibility of genetic effects in Table 2.5. Furthermore, behaviour-genetic analyses were carried out for Belsky & Rovine's temperamental measure.

Behaviour genetic analysis of twin data is most commonly carried out using structural equation modelling (SEM) procedures with software packages such as LISREL (Joreskog & Sorbom, 1985) and EQS (Bentler, 1989). Structural equation modelling is a very general set of procedures that encompasses more familiar statistical methods such as regression, factor analysis and MANOVA. The technique uses the rules of path analysis or covariance algebra to derive the covariance matrix that would be expected under a particular causal model. This expected covariance matrix is then compared to observed data to test the plausibility of the model. The advantage of structural equation models for genetic data is that they provide explicit mathematical representations of genetic hypotheses and allow for the estimation of models with variables that are not directly observed but are inferred from patterns of covariance (latent variables). In the case of twin data, SEM procedures make it possible to estimate genetic, shared environmental and non-shared environmental influences as well as providing estimates of overall model fit.

Parameter estimates are found by minimising some function of the differences between the observed and predicted covariance matrices (examples of fit functions include Least Squares, Maximum Likelihood and Generalised Least Squares). The significance of model fit is assessed by reference to the remaining discrepancies between the covariance matrix predicted by the model after minimisation and that actually observed in the data. This remaining discrepancy can then be translated into a χ^2 statistic. A non-significant χ^2 indicates a good fit – in that the observed discrepancies between model and data do not exceed that expected by chance. Because the significance of the χ^2 statistic depends quite heavily on power - and hence sample size - a variety of other indices of fit are routinely used that give broad measures of fit that are sample size-independent. Hypothesis testing proceeds by comparing the fit of alternative competing models. For example, the significance of genetic effects can be tested by comparing the fit of a model that includes all genetic and environmental parameters with one in which the genetic term has been removed. If this leads to a significant deterioration in fit one can conclude that there is a significant genetic effect. The significance of the change in fit is assessed

from the difference in χ^2 between the two models which itself is distributed as χ^2.

The standard genetic analysis is based on a comparison of models between MZ and DZ twins. Before embarking on such a between-group analysis some authors suggest that a test should be carried out to see whether the population covariance matrices of the two groups are actually significantly different (Dunn, Everritt & Pickles, 1993). If there are no differences in the covariance matrices between the two groups the implication is that each group estimates the same population covariance matrix and hence there would seem to be little reason for further multi-group model testing and the groups could be pooled in later analyses.

The test involves constraining all covariances between observed variables and their factor loadings to be equal across groups. The significance of this multi-group model gives a multivariate test of the equality of the group covariance matrices. This analysis was carried out using Bentler's EQS Structural Equation Modelling program (Bentler, 1989). For the two categorical measures – secure vs. insecure and Belsky & Rovine's temperament measure – estimates of covariances were obtained from tetrachoric correlations according to methods developed by Lee, Poon & Bentler (1992) for these analyses and the genetic models that follow. An example of an EQS script for these analyses is given in Appendix A.1. The results of these analyses for the attachment variables are shown below in Table 2.6.

Table 2.6 Results of Equality of Covariance Matrices Tests for attachment variables

	Model Test Statistics	
Attachment variable	Model χ^2 (df = 3)	p-value
Secure vs. insecure	.142	.986
Main continuous scores	1.376	.711
Discriminant function scores	2.042	.564
Contact Maintenance Episode 1	.882	.830
Resistance Episode 1	2.475	.480
Contact Maintenance Episode 2	.543	.909
Resistance Episode 2	2.015	.569
Avoidance Episode 2	2.410	.492
Belsky & Rovine Temperament groups	1.459	.692

There was very little evidence that the covariance matrices differed for MZ and DZ twins. From Table 2.6 it can be seen that in no case did the test of equality of covariance matrices even approach significance. However, it should be borne in mind that the small sample sizes of these groups greatly reduce the power to show even substantial differences in covariance structure. Also, Byrne (1997) has suggested that the test of the equality of covariance matrices is probably too stringent and that non-significant test results should not necessarily be taken as evidence that no meaningful between-group differences will be found when nested model testing is carried out.

The above analyses suggested that it was unlikely that significant genetic effects would be found. Nevetheless, given Byrne's recommendations, behaviour-genetic analyses were carried out in order to obtain rough estimates of genetic, shared environmental and non-shared environmental parameters using univariate genetic analyses as described by Neale & Cardon (1992). The standard ACE model for univariate genetic analysis is presented below in Figure 2.2. The model estimates three parameters representing genetic effects, shared environmental effects and uncorrelated variance in each twin's attachment score which includes systematic non-shared environmental effects and measurement error (Neale & Cardon, 1992).

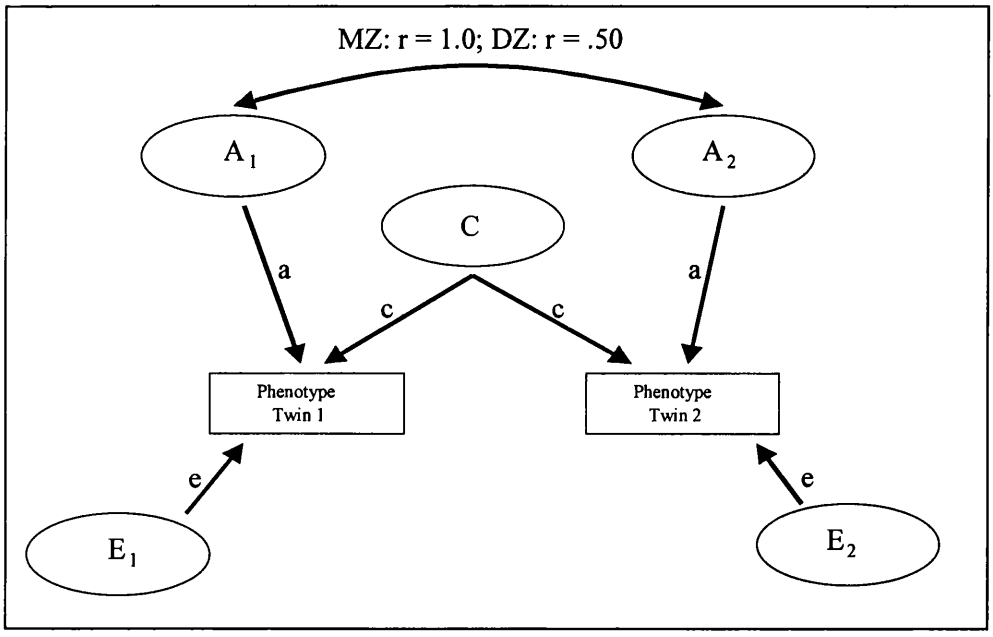


Figure 2.2 ACE model of genetic and environmental influences on twin resemblance

Each twin's score is thus assumed to be caused by three factors and can be represented by the following equation:

$P_i = aA + cC + eE$

where A = additive genetic variance, C = shared environmental variance, E = non-shared environmental variance and a, c and e their respective parameter estimates.

The variances of the latent factors were constrained to be 1.0 such that the effects are estimated by a, c and e. The variance of the phenotypes attributable to genetic and environmental factors is found by squaring the relevant parameter estimate. The only difference between the models for MZ and DZ twins is the size of the correlation between genetic factors – which is assumed to be perfect for identical twins and .50 for non-identical twins. Following standard procedures, all the models assumed that the error terms and parameter estimates were equal for both twins.

For each of the attachment variables the full ACE model was tested and compared with a model with the genetic parameter removed (CE model) to test for the significance of genetic effects. To test for the significance of shared environmental effects a second comparison model was estimated in which only genetic and non-shared environmental effects were included (EA model). Table 2.7 shows the χ^2 and associated p-values for each of the three models. Table 2.8 shows the estimates of a, c and e for the full ACE model for the nine attachment variables. χ^2 and parameter estimates in Tables 2.7 and 2.8 are based on the Maximum Likelihood function for the continuous measures and Lee et al's (1992) Generalised Least Squares estimates for categorical data.

It should be noted that parameter estimates should ordinarily be based on the best-fitting model and hence the estimates based on the ACE model shown in Table 2.8 may not, strictly speaking, be the most appropriate. These estimates are presented only to give a broad overview of genetic and environmental components of variance in attachment.

Table 2.9 presents parameter estimates based on best-fitting models derived from the model comparisons shown in Table 2.7. The disadvantage of the best-fitting model estimates is that in most cases lack of statistical power leads to the genetic parameter being dropped and so nothing can be said about potential (though in this sample non-

significant) genetic effects. For this reason both best-fitting and overall ACE estimates are given for the sake of completeness. The advantages and disadvantages of the two sets of estimates should be carefully borne in mind when interpreting them.

When the full ACE model was estimated for the standard secure-insecure categorical variable the genetic parameter was constrained at its lowest permissible value (zero). This means that the estimate actually arrived at was negative and hence uninterpretable. This is likely to be a result of the large sampling fluctuations expectable in this small sample and indeed this negative estimate clearly derived from the fact that the twin correlation was marginally smaller for MZ twins than DZ twins in this sample. Under the behaviour genetic model this is clearly an impossible result and lead to problems of estimation.

Table 2.7 Results of EQS model comparisons for genetic and environmental influences on attachment security and attachment behaviour

	Model					
	ACE (df = 3)		AE (df = 4)		CE (df = 4)	
	χ^2	p-value	χ^2	p-value	χ^2	p-value
Secure vs. insecure	--[a]	--	1.197	.880	.143	.99
Main continuous scores	--[a]	--	3.259	.515	1.747	.782
Discriminant function scores	1.782	.619	1.907	.753	2.065	.724
Contact Maintenance Episode 1	.242	.970	5.229	.265	.896	.925
Resistance Episode 1	--[b]	--	3.259	.515	3.571	.467
Contact Maintenance Episode 2	.183	.980	4.779	.311	.605	.962
Resistance Episode 2	--[b]	--	1.783	.776	3.276	.513
Avoidance Episode 2	5.239	.155	5.378	.251	5.282	.260
Belsky & Rovine Temperament groups	0	1.00	.413	.981	1.462	.833

[a] genetic parameter constrained at lower bound (zero)

[b] shared environmental parameter constrained at lower bound (zero)

Dropping the shared environmental parameter from the CE model lead to a significant decrease in model fit ($\chi^2(1) = 24.80$, $p < .001$), suggesting significant shared environmental effects. However, it should be noted that the AE model also represented a reasonable fit (χ^2 (4) = 1.197) and dropping the genetic parameter from this model also resulted in a significant deterioration in fit ($\chi^2(1) = 23.75$, $p < .001$). It is assumed that the best-fitting model in this case is the CE model because the full ACE model constrained the genetic parameter to be zero and the χ^2 for the CE model was – albeit marginally- smaller than that for the AE model. Table 2.9 shows that under the CE model approximately 34% of the variance in attachment security could be explained by shared environmental factors. The remaining 66% of the variance in attachment security was accounted for by non-shared environmental effects.

When the ACE model was estimated for Main's security scores the genetic parameter was similarly constrained at its lower bound. In this case, however, removing the shared environmental parameter from the CE model lead to a significant deterioration in fit ($\chi^2(1) = 4.15$, $p = .04$) but removing the genetic parameter from the AE model did not ($\chi^2(1) = 2.68$, $p = .10$). In this case it would seem reasonable to suppose that the best-fitting model is one in which only shared and non-shared environmental effects influence attachment security. Table 2.9 shows that under this best-fitting model around 27% of the variance in attachment security could be explained by shared environmental factors and 73% by the non-shared environment.

When genetic and environmental effects were estimated for the discriminant function scores of attachment security the ACE model suggested that around 25% of the variance in attachment security could be explained by genetic factors – according with the impression gained from the twin correlations in the previous section. A further 13% of the variance in attachment security was accounted for by shared environmental factors and the remaining 62% by the non-shared environment. However, these estimates should be treated with caution. Deletion of either the genetic parameter or the shared environmental parameter lead to a non-significant change in overall model fit (ACE vs. CE: $\chi^2(1) = .23$, $p = .72$; ACE vs. AE: $\chi^2(1) = .59$). Despite this, deletion of *both* terms lead to significant deterioration in fit, indicating that a model assuming no family resemblance did not adequately fit the data (ACE vs. E: $\chi^2(2) = 5.90$, $p = .05$).

As such it was not possible to say with any confidence which model (AE or CE) represented the best fit for the discriminant function measure of attachment security. Furthermore, examination of goodness of fit indices did not provide any additional evidence regarding the best-fitting model. For the EA model the Goodness of Fit Index (GFI) was .968 and the Adjusted Goodness of Fit Index (AGFI) was .976. For the CE model the GFI was .966 and the AGFI was .974. This difficulty with identifying the best-fitting model is perhaps unsurprising given the extremely low power of these analyses.

The results of model-fitting for contact maintenance for the first reunion were more clear cut. The CE model was not a significantly worse fit than the full ACE model ($\chi^2(1) = .744$, $p = .39$) but the AE model was ($\chi^2(1) = 4.987$, $p = .03$). Under the CE model approximately 32% of the variance in contact maintenance was attributable to shared environmental factors. It should again be noted that low power for the estimation of genetic effects should preclude any strong conclusions about the non-significant influence of genetic factors. Indeed, under the full ACE model approximately 39% of the variance in contact maintenance was accounted for by additive genetic effects. A similar picture emerged for contact maintenance during the second reunion. Dropping the shared environmental parameter lead to a significant reduction in model fit ($\chi^2(1) = 4.60$, $p = .03$) but dropping the genetic parameter did not ($\chi^2(1) = .42$, $p = .52$). Under the CE model 29% of the variance in contact maintenance was accounted for by shared environmental factors.

Table 2.8 Standardised genetic and environmental parameter estimates under ACE model for attachment variables

	ACE model parameter estimates		
	a^2	c^2	e^2
Secure vs. insecure[a]	0	.34	.66
Main continuous scores	0	.27	.73
Discriminant function scores	.25	.13	.62
Contact Maintenance Episode 1	.39	.07	.54
Resistance Episode 1	.12	0	.88
Contact Maintenance Episode 2	.32	.07	.61
Resistance Episode 2	.44	0	.56
Avoidance Episode 2	.10	.14	.76
Belsky & Rovine Temperament groups	.49	.22	.29

Table 2.9 Standardised genetic and environmental parameter estimates under best-fitting models for attachment variables

	Best-fitting model parameter estimates		
	a^2	c^2	e^2
Secure vs. insecure	0	.34	.66
Main continuous scores	0	.27	.73
Discriminant function scores	-- [a]	--	--
Contact Maintenance Episode 1	0	.32	.68
Resistance Episode 1	0	0	1.00
Contact Maintenance Episode 2	0	.29	.71
Resistance Episode 2	.44	0	.56
Avoidance Episode 2	0	0	1.00
Belsky & Rovine Temperament groups	-- [a]	--	--

[a] no clear best-fitting model emerged

For resistance in the first and second reunion episodes estimation of the full ACE model lead to the shared environmental parameter being constrained at its lower bound – in line with the near zero correlations between DZ twins for resistance found in the previous section. For the first reunion, when the AE and CE models were tested against the baseline E model (no family resemblance) neither was a significantly better fit, suggesting that all of the variance in resistance could be attributable to non-shared environmental effects.

However, resistance in the second reunion did show evidence of significant genetic effects (AE vs. E: $\chi^2(1) = 6.21$, $p = .01$). However, to complicate matters, deletion of the shared environmental term from the CE model also lead to a deterioration in fit ($\chi^2(1) = 4.71$, $p = .03$). Following the line of logic used in the context of the dichotomous attachment classification, it was assumed in Table 2.9 that the AE model was a better fit. The ACE model forced the shared environmental parameter to be zero and the χ^2 for the CE model was greater than that of the AE model. Under the AE model approximately 44% of the variance in resistance during the second reunion was attributable to genetic factors. It is notable however that the GFI and AGFI for the AE model were .970 and .977 respectively and that for the CE models the GFI and AGFI were .947 and .960 - clearly not indicating substantial differences in fit between these two models. As before, these results should thus be treated with caution because the decision regarding the best fitting model has substantial implications for the magnitude of parameter estimates. For example, in this case the CE model (which ignores genetic effects) estimated the shared environmental parameter to be .53 (thus accounting for around 28% of the variance in resistance).

For avoidance in the second reunion there was little evidence of genetic or shared environmental effects. Deletion of either term from the full ACE model lead to a non-significant decrease in model fit ($\chi^2(1)$ less than 1 in both cases). Furthermore, deletion of both terms – and hence comparing ACE with E – did not significantly reduced model fit ($\chi^2(2) = 2.73$, $p = .10$).

In the case of Belsky & Rovine's temperament measure the overall ACE model suggested substantial genetic effects – accounting for nearly half of the variance. However, deletion of the genetic term from the ACE model did not lead to a significant change in $\chi^2(\chi^2(1) =$

1.46, p = .23). Similarly, removing the shared-environmental term did not appreciable reduce model fit ($\chi^2(1) = .41$, p = .52). However, deletion of both terms lead to a substantial deterioration in fit suggesting that a simple 'no family resemblance' model was not adequate to explain the data ($\chi^2(2) = 43.22$, $p < .001$). Certainly, the AE model appeared to be a marginally better fit to the data ($\chi^2(3) = .41$) than the CE model ($\chi^2(3) =$ 1.46). However, the fit indices again did not show evidence of substantial differences between the two models (AE: GFI = .994, AGFI = .996; CE: GFI = .984, AGFI = 988). One can only conclude from these data that although they suggest the possibility of genetic effects ($a^2 = .49$ under ACE) the lack of statistical power in this sample means that it is simply not possible to disentangle genetic effects from the shared environment.

DISCUSSION

The aim of this study was to find evidence for a primary prediction of the linear intergenerational model of the development of attachment - that siblings brought up in the same family should develop the same pattern of attachment to a given parent. Indeed, the idea that individual differences in attachment are caused by shared familial factors is implicit in virtually all contemporary research and thinking on the determinants of infant-parent attachment. This study chose to investigate patterns of attachment in families with infant twins because they offer the possibility of comparing patterns of infant-mother attachment in siblings at the same time and using the same measures.

This study found concordance rates in attachment security roughly comparable to those found in previous studies of siblings and twins (Ward et al, 1988; Teti & Ablard, 1989; Vandell et al, 1988; Finkel et al, 1998; Riccutti, 1995) with 55% of twins in this sample sharing the same 3-way attachment classification - a degree of overlap very close to that found by Ward et al (1988) with non-twin siblings (57%). Significant correspondence between the attachment classification of one twin with that of the other was found but the degree of association was modest – representing correlations of around .26. Evidence was also found for shared patterns of attachment from a continuous measure of attachment security derived from a discriminant function analysis based on Ainsworth's scales of proximity seeking, contact maintenance, resistance and avoidance. Nonetheless, the twin correlation for this continuous measure of attachment was only .28 again suggesting a modest shared influence on attachment. Similarly, the interactive scales themselves provided some evidence of similarities between twins in attachment behaviour, particularly for resistance and contact maintenance. There was even some evidence for a degree of genetic influence on attachment security and dimensions of attachment behaviour. Specifically, larger correlations for MZ twins compared to DZ twins were found for resistance, contact maintenance and avoidance as well as for the discriminant function measure of attachment security. Given the extremely small size of the MZ group in this study nothing definite can be said about these differences between MZ and DZ twins – it is quite possible that they resulted from sampling error. However, consistent with the findings of Riccutti (1992), this study found evidence for Belsky and Rovine's (1987) suggestion that temperamental influences on attachment distinguish those infants who will be resistant from those who will be avoidant rather than on attachment security per se. This study found higher levels of concordance for Belsky &

Rovine's temperamental categories for MZ than DZ twins replicating the finding of Riccutti (1992). As such, some of the associations between twins in attachment behaviour found in this study may in fact be explained by shared genetic influences on temperamental dimensions of attachment. Preliminary genetic analyses suggested that shared environmental factors accounted for a significant proportion of variance in attachment security (around 30%) and little evidence was found for genetic factors. More importantly, there was strong evidence of non-shared environmental factors, which appeared to account for around 65% of the variance in attachment security. However, some modest evidence of genetic effects was found for infant resistance and for Belsky & Rovine's temperament measure, although lack of statistical power makes the interpretation of all these genetic analyses tentative at best.

Of course, the only way to satisfactorily separate shared environmental from shared genetic influence is to conduct large-scale behavioural genetic studies. Several labs are currently undertaking large-sample studies of attachment in twins. Later chapters of this thesis will report on investigations of associations between measures of temperament and measures of parenting and their associations with similarities and dissimilarities in twin attachment security.

Overall, this study found evidence to support the general claim that the development of infant-mother attachment is influenced by shared factors. The 4- and 3-way concordances for attachment between twins were highly significant although modest in size. Indeed, the correlation of .28 for the continuous discriminant measure of attachment is roughly what would be expected if the influence of the AAI on attachment security (amounting to an effect size of around .50) was the only independent shared causal influence on attachment. It may also suggest that the relatively consistent finding of social support and marital harmony on attachment security may overlap with that of adult attachment status. As yet little data is available on the concurrent associations between aspects of social context, adult attachment status and infant attachment security that might provide independent corroboration for this suggestion. Certainly the current study might suggest that the well-documented effect of a parent's state of mind with respect to attachment on infant attachment security might be approaching the ceiling of shared influences on attachment. The finding that shared environmental factors account for around 30% of the variance in attachment security seems to fit well with van Ijzendoorn's (1995a) conclusion that the AAI accounts for around 25% of the variation in infant attachment.

This could be considered indirect evidence that the relation between the AAI and infant attachment security is environmentally mediated. Certainly, it suggests that it is *possible* that the link is environmentally mediated. If no evidence of shared environmental influence had been found the assumption of the environmental mediation of adult attachment processes on infant attachment security would certainly be called into question.

These data - as well as evidence from previous studies involving twins and siblings - clearly point to the importance of differences in attachment security for siblings in the same family. At the same time an examination of concordance rates in attachment on their own says little if anything about the meaning of these differences and their likely developmental implications. One of the concerns about this study and indeed other studies that aim to assess shared and non-shared influences on development by simply investigating patterns or concordance or correlation in measures of outcome is that discordances may occur as a result of error and may not represent important developmental processes. Of course, this is ultimately a question of validity. As yet few studies have investigated the systematic processes involved in the development of differential patterns of infant parent attachment. The study of siblings by Ward et al (1988) represents one of the few attempts to map differences in infant-parent attachment to systematic differences in infant-parent interaction. Ward et al were able to show that differences in the way each mother-infant dyad behaves with each other was related to differences between siblings in mother-infant attachment security - thereby lending considerable support to the idea that differences between siblings in attachment are related to real differences in attachment-related causal processes. A great deal of work still needs to be done in terms of documenting the nature of the underlying developmental mechanisms involved in sibling differences in attachment security. Indeed, little is also known about the nature of the processes that lead to sibling concordance either.

Contemporary thinking in attachment research would of course predict that these similarities in siblings' relationships with their parents would be related to the organisation of the parent's internal working model of attachment. More biologically orientated researchers however might be inclined to think of these concordances in attachment security as representing evidence for biological influences on infant parent relationships. Without data regarding temperament and adult attachment status these two

different views of the causes of sibling concordance are difficult to distinguish. The tentative evidence from this research - of *some* differences between MZ and DZ twins - might to some degree seem to favour the biological view. On the other hand the extremely small numbers of identical twins in this sample strongly cautions against commitment to such an interpretation.

One of the difficulties of course with doing attachment research with twins is that unless strange situation assessments of each twin are carried out on different days (introducing potential logistical problems and increased travel-time for the families) one twin inevitably experiences a separation from his or her mother before entering the strange situation. A very important question in this respect is whether this methodological difference might lead to increased levels of measurement error and an over-estimation of the non-shared environment. Statistical comparisons of the levels of attachment security and insecurity in this study did not suggest an important impact of this prior separation (in which the infant is left with his or her father). On the other hand if prior separation were to act in a way that simply introduced more random error and not simply increases in attachment insecurity these analyses would be inadequate. As a result it will be important in future research that uses this kind of design to assess the psychometric properties of the strange situation under these conditions and to establish the validity of attachment classifications carried out in this way. Certainly there was evidence that twins who had experienced a separation from their mother prior to the strange situation were more likely to show somewhat higher levels of resistance and contact maintenance at the start of the procedure suggesting slightly increased levels of distress in these circumstances. However it is difficult to argue from these data that the over-representation of resistant infants in this sample could be entirely a result of this procedural difference in the administration of strange situation. Firstly, the rates of concordance found in this study do not differ substantially from earlier studies of attachment in twins and siblings. Secondly, the data suggest that increased levels of distress lead to a small but specific increase in the incidence of disorganisation and not resistance – the category over-represented in this sample. Comparisons with a group of singletons suggested that this increased level of resistance is more than would be expected by chance and raise the possibility that there is something distinct about the twin situation that gives rise to greater incidences of resistance.

For many who work with baby twins it may come as no surprise that increased levels of

resistance were found. There can be little doubt that the early life of infant twins is different to that experienced by baby singletons. Research by Lytton (1980; 1977) for example has shown that compared to matched samples of singletons baby twins experience significantly less affection and significantly more control from their parents as well as considerably less overall mother-infant interaction than same aged singletons. Mothers of baby twins are also more likely to suffer from exhaustion, depression and anxiety than mothers of singletons (Hay et al, 1990).

From an attachment theory perspective it seems very reasonable to suppose that twins would be more likely to experience less sensitive and responsive care. The twin situation - in which a parent's attention is inevitably divided between two babies more often than not at the same time - seems likely to reduce a parent's capacity to attend to a baby's moment to moment individual needs which is presumed to be essential for the development of secure infant-parent attachment. Furthermore family stress resulting from the frequent medical difficulties experienced by baby twins may also lead to difficulties in infant parent interaction and an increased level of insecure attachment. Also direct competition between infant twins for parental resources may lead to heightened attention to the parent and increased levels of uncertainty regarding parental availability - factors thought to be associated with resistance. At the same time all of these factors may also effect patterns of covariance between twins for attachment security. For example, competition between twins for a parent's attention may lead to increased variability in attachment classifications because one twin - for whatever reason - may succeed in gaining the parents attention more than the other. Thus, it will be important for future research into the development of attachment in siblings and twins to establish the generalisability of twin data from a better understanding of developmental processes in samples of twins and control singletons and in convergent evidence from samples of siblings, step siblings and adoptees. The current study represents the largest single study of infant parent attachment using Ainsworth's standard strange situation procedure at 12 months of age.

This study thus provides some supportive evidence for the contemporary view of the development of infant-parent attachment. This study indicates that children in the same family are more similar in terms of their attachment security than children from entirely different families and assuming genetic effects are not operating this suggests that attachment is caused to some extent by shared environmental factors. On the other hand,

if the non-shared environment proves to be as significant in the development of attachment as this study and others like it suggest researchers will need to find new ways of thinking about developmental processes that take into account intra--familial environments. Several researchers and clinicians have argued persuasively for the need to develop family systems models of attachment but a great deal of work needs to be done in terms of specifying the mechanisms and dynamics of family interaction as they relate to the development of attachment. Indeed if attachment research is to provide an adequate account of the relationship between normal emotional development and the development of psychopathology it will need to formulate new models of the way in which shared and non-shared influences impact upon developing attachment relationships and of the way in which unique environmental processes - both inside the family and out - may set a child on a pathway to adaptation or to psychological difficulties and distress. Next to nothing is known about the causes of differences in sibling's attachments to their parents or about the consequences of such differences for later socio-emotional development.

In subsequent chapters of this thesis similarities between twins in overall attachment security will be assumed to be environmental in origin and – largely in the interests of statistical power – MZ and DZ groups will be pooled. At all times this assumption should be borne in mind given that there is limited power to detect even quite substantial genetic influences in this sample.

CHAPTER 3

DISTAL INFLUENCES ON SHARED AND NON-SHARED PATTERNS OF ATTACHMENT: MATERNAL, SOCIAL-CONTEXTUAL AND CHILD FACTORS

The significance of the non-shared environment in the development of infant-parent attachment seems to argue persuasively for an ecological account of the antecedents of individual differences in emotional development (Bronfenbrenner, 1979; for evidence regarding the non-shared environment see Chapters 2 and van Ijzendoorn et al, unpublished manuscript). If it is true that children within the same family can develop quite different attachment relationships with their parent it is likely that the causes of these differences will be found in the details of how parents and infants interact with each other during the course of everyday family life (see chapter 4). The family context in which interactions between parents and their children take place would seem to be more important than ever for models of socio-emotional development.

Researchers inspired by Bronfenbrenner's ecological approach to human development (Bronfenbrenner, 1979) have looked to the immediate social context of infant-parent relationships in an attempt to understand the more distal causes of individual differences in attachment (e.g. Belsky, 1996; Belsky et al, 1995; Crockenberg, 1981). In Bronfenbrenner's view development is seen as embedded in a family context which itself is subject to influences from wider social systems such as the extended family, friends, the work place and society. In most ecological formulations of development parenting is seen as the central proximal process by which wider social influences come to play a role in children's socio-emotional development. Belsky (1996) for example has suggested that child characteristics, maternal personality and social support all impinge upon the parent's capacity to deliver sensitive and responsive care and hence come to influence the infant-parent relationship and attachment security. In searching for the causes of non-shared patterns of attachment, characteristics of the child may play an especially important part in understanding how children in the same family come to develop quite different attachment relationships with their parents. At the same time, wider social factors may influence shared patterns of attachment through their effects on parental psychological wellbeing and coping. Indeed it is also possible that these factors may impact differentially on children in the same family and may lead to differing

developmental outcomes. The present study aims to investigate the importance of these distal factors in the development of shared and non-shared patterns of attachment in 12-month-old twins. In particular, this study examines the influence of socio-economic factors, social support, anxiety, depression and stress as sources of shared influence on the development of infant-parent attachment. Furthermore, child-specific factors will also be examined. This study will investigate the role of biological factors, infant temperament and significant health-related life events as direct non-shared influences on patterns of attachment.

3.1 Ecological approaches to the development of attachment

The ecological approach to the development of attachment is exemplified by the work of Belsky and his colleagues (Belsky, 1996; Belsky et al, 1995; Belsky & Rovine, 1987; Belsky & Isabella, 1988). Belsky's process model of parenting and attachment recognises the multiple and inter-dependent factors that jointly determine a parent's capacity to provide optimal care for an infant and to foster secure attachment. Belsky's model was described in the introduction to this thesis but for convenience it is reproduced below in Fig. 3.1.

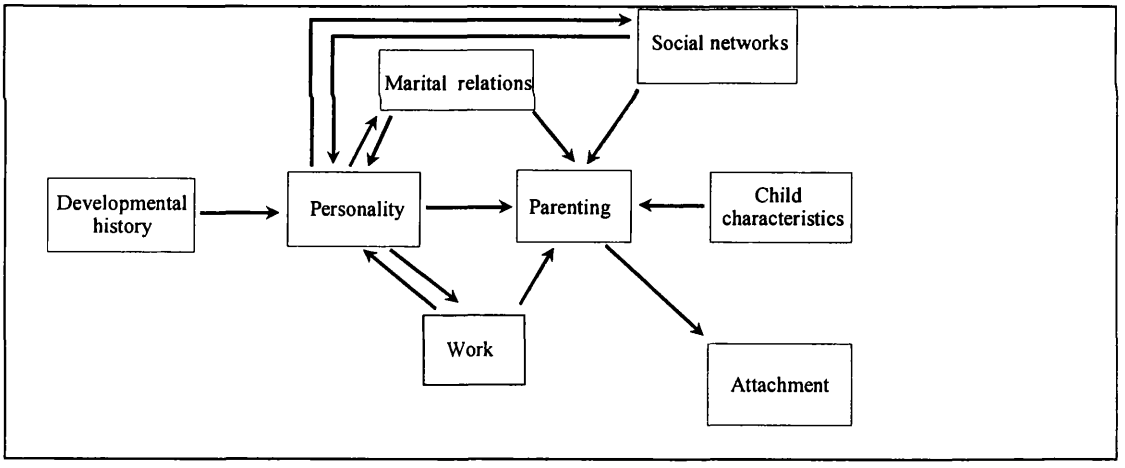


Figure 3.1 Belsky's (1984) process model of the determinants of parenting

Belsky's model shares much in common with contemporary thinking in attachment research in which a parent's internal working model is thought to play a primary role in the caregiving he or she may provide for a child. Nonetheless, Belsky's model includes several other potential influences – such as personality factors not associated with the adult attachment security (e.g. extroversion-introversion, anxiety and depression),

temperamental characteristics of the child and social support networks. Another important feature of Belsky's thinking regarding contextual influences on attachment is the interdependent nature of the various distal influences on parenting. According to Belsky, the parenting system is a 'well buffered' system because shortcomings in one domain may be ameliorated by compensatory changes in another. Consequently, what counts in terms of outcome is the number of simultaneous stressors at any given point. Belsky's view is similar in that respect to contemporary thinking in developmental psychopathology which emphasises the importance of risk and protective factors (Cicchetti, 1984; Sroufe & Rutter, 1984). The model is essentially an interactive one - in the statistical sense - in that the effect of one stressor may depend upon the level of another.

3.2 Maternal Characteristics

There is some positive evidence that maternal personality characteristics are related to infant-mother attachment security. For example, Bates, Maslin & Frankel (1985) found positive personality traits such as nurturance, autonomy and low aggression to predict secure infant-mother attachment. Del Carmen et al (1993) found that prenatal maternal anxiety predicted security of attachment at 12 months. However, links between parental personality and security of attachment have been relatively inconsistent. Several studies have found no associations between attachment and standardised measures of personality (e.g. Belsky, et al, 1995; Zeanah et al, 1993; Mengelsdorf et al, 1990; Levitt, Weber, & Clarke, 1986).

One aspect of personality that has received considerable attention in the research literature is parental depression. There are good reasons for expecting depressive symptoms to have an adverse effect on the development of infant-parent attachment. The symptoms of clinical depression include behaviours and states of mind that would be expected to compromise the parent's capacity to attend to the infant's attachment signals. For example, depressive symptoms include feelings of worthlessness, depressed affect, and unresponsiveness. It is fairly well established that maternal depression affects psychological development (e.g. Murray & Cooper, 1996; Murray, Kempton, Woolgar & Hooper, 1993; Lyons-Ruth, Zoll, Connell & Grunebaum, 1986). For example, research has shown parental depression to be associated with negative physiological states in the infant (Field et al, 1988) and poor early cognitive outcome (Murray et al, 1993). Indeed, there is considerable evidence to suggest that parental depression represents a risk factor

for the development of later psychological problems (Cicchetti et al, 1998). Several studies have found a relationship between parental depression and elevated levels of insecure attachment (e.g. Murray, Fiori-Cowley, Hooper & Cooper, 1996; Radke-Yarrow et al, 1985; Lyons-Roth, 1988; Campbell et al, 1993). However, by no means all studies that have investigated parental depression and attachment have discerned an association (e.g. Radke-Yarrow et al, 1995; Sameroff, Seifer and Zax, 1982). Belsky et al, (1996) have noted that studies that have found significant associations have tended to look at older infants (15-18 months), suggesting, perhaps, that length of exposure to depressed parental symptomatology may moderate the influence of depression on attachment. It is also possible that links between attachment and depression might be stronger for bipolar depression than unipolar depression (Radke-Yarrow, 1991). The present study examines the influence of maternal symptoms of depression and anxiety on infant attachment security in the non-clinical range in a low-risk sample of infant twins.

There is very good evidence of course that parental state of mind with respect to attachment is associated with infant attachment security (van Ijzendoorn, 1995a). Adult attachment classifications derived from Main & George's Adult Attachment Interview (Main & Goldwyn, 1991) appear to overlap with infant attachment security in Ainsworth's Strange Situation (Ainsworth et al, 1978) in around 75% of cases (van Ijzendoorn, 1995a). The role of adult attachment status will not be considered in this chapter but is treated separately in Chapter 5.

3.3 Adversity, social support and marital harmony

There is also evidence that suggests that life events and family difficulties are associated with poorer outcome in terms of parenting quality and attachment security. Certainly, studies that have investigated patterns of infant-mother attachment in samples experiencing difficult social circumstances have found increased levels of insecurity (e.g. Murray et al, 1996; Belsky & Isabella, 1988; Spieker, 1986; Crockenberg, 1981). Furthermore, correlational and intervention research has found marital harmony and good social support to be positive predictors of infant attachment security (Jackobsen & Frye, 1991; Lyons-Roth, Connell and Grunebaum, 1990; Crittenden, 1985; Crockenberg, 1981). For example, Lyons-Ruth , Connell and Grunebaum (1990) carried out an intervention program with a sample of disadvantaged families aimed at providing families with social support, and advice and help with access to social resources between 9 and 18 months of age. At 18 months infants in the treatment group were significantly more

likely to be classified as secure in Ainsworth's Strange Situation than a sample of matched-controls. However, it should also be noted that there have been some failures to find associations between attachment security and these social-contextual variables (Zeanah et al, 1993; Spieker & Booth, 1988; Levitt et al, 1986).

Some authors have suggested that the reason for these inconsistencies is that the effects of social support and marital harmony on attachment security are mediated or moderated by other factors. For example, Belsky et al (1995) have suggested that insecure attachment will be observed only in the context of multiple social stressors. Belsky et al found no direct effects of marital quality, social support or difficult infant temperament, but the sheer number of stressors was highly predictive of infant attachment security. When no stressors were reported 80% of infants were classified as secure. When difficulties were reported in all three domains the rate of security dropped to 32% (Belsky et al, 1995). Similarly, Crockenberg (1981) found evidence that suggests that social risk factors may interact with each other in their effect on attachment security. Crockenberg (1981) found that low social support was associated with attachment insecurity only for those infants who were highly irritable 5-10 days after birth. Crockenberg suggests that social support may be particularly critical when the family is experiencing other difficulties – in this case the stress associated with rearing an irritable infant. Crockenberg's findings are consistent with Belsky's process model in which different domains may moderate or compensate for difficulties experienced in other areas of family life. This study includes measures of social support and maternal caregiving stress.

3.4 Infant Characteristics

The role of characteristics of the child has been a focus of research in attachment for two rather different reasons. One the one hand, some researchers have suggested that constitutional differences in infants' emotionality might explain individual differences in secure-base behaviour observed in Ainsworth's Strange Situation. On the other hand, others have pointed to the impact that child characteristics may have upon the parent's capacity to cope with the strains of child rearing and the challenges that an irritable or unresponsive infant may present to a parent in providing sensitive and responsive care. These researchers have argued that difficult infant temperament may be better understood as a risk factor for the development of attachment insecurity rather than as a direct cause (e.g. Crockenberg, 1981; van Den Boom, 1990).

The evidence for direct effects of temperament on infant attachment security is generally mixed. Negative finds are common (e.g. Mangelsdorf et al, 1990; Vaughn, Lefever, Seifer & Barglow, 1989; Belsky & Rovine, 1987; Bates, Maslin & Frankel, 1985). On the other hand some studies have found associations between attachment security and measures of temperament (Calkins & Fox, 1992; Izard, Haynes, Chisholm & Baak, 1991; Weber, Levitt & Clarke, 1986; Miyake, Campos & Kagan, 1984). Given the wealth of assessment procedures and theoretical formulations of temperament these inconsistencies may not be surprising. At the same time, temperamental ratings appear to be more consistently associated with individual differences in attachment behaviours (proximity seeking, contact maintenance, resistance and avoidance) than they are with major attachment classifications (Belsky & Rovine, 1987; Goldsmith & Alansky, 1987). It is possible that the marked differences in these behaviours between the two insecure categories of attachment (A versus C) have in some cases obscured real temperamental influences on attachment security. Nonetheless, perhaps the most satisfactory explanation of the inconsistencies in links between attachment security and child characteristics is the failure to take into account moderating or mediating third variables. If Belsky's process model is right, temperament is one component among many potentially interacting factors such as social support, maternal personality and adverse life-circumstances that may place a child at risk for developing insecure patterns of attachment. Several studies have found temperament to interact with third variables in predicting attachment security. Crockenberg's study of social support described previously is a good example. Manglesdorf et al (1990) also found that infant difficultness was associated with insecure attachment for those mothers who scored highly on a personality measure of maternal constraint. Susman-Stillman, Kalkose, Egeland & Waldman (1996) found temperament to be associated with insecurity only for those mothers rated low on maternal sensitivity. The present study includes a well-validated measure of infant temperament (Buss & Plomin's EAS) and will test the direct and interacting influence of infant-temperament on attachment security.

3.5 The current study

The aim of the present study is to investigate the development of shared and non-shared patterns of attachment from an ecological perspective. In order to assess the influence of shared distal influences on attachment security measures of maternal social support, anxiety and depression will be examined in relation to infant attachment security in Ainsworth's Strange Situation. Furthermore, socio-economic factors such as social class

and maternal age will be considered. Several infant-specific measures will be also be examined in order to investigate the ecological origins of non-shared influences on attachment security. Specifically, several biological variables will be used as direct predictors of non-shared components of patterns of attachment between twins, including birth-weight, medical status and gender. In addition, maternal–report measures of dimensions of infant temperament will be examined as specific non-shared influences on attachment security. Finally, this study will test the hypothesis that the impact of infant temperament on attachment security is moderated by family SES, social support and maternal psychological state and hence that these variables may serve to mediate non-shared environmental influences on attachment in families with twins. In this way the study aims to explore the possibility that family-wide influences may impact differentially upon children in the same family.

METHODS

Participants

The participants in this study were described in detail in Chapter 2. They consisted of 58 mothers and their baby twins recruited from the Multiple Births Foundation of Queen Charlotte's and Chelsea Hospital, London, UK. Of the 58 families involved in the study, 6 did not have complete data for the measures used in this Chapter. In four cases, parents failed to return questionnaires by post. In a further two, the questionnaires had been filled out incorrectly and hence the data were uninterpretable. As such, the present study consists of 52 families of infant twins and their mothers.

Procedure

Ainsworth's Strange Situation – The procedure for the assessment of infant-parent attachment security used in this study was described thoroughly in Chapter 2 and is not repeated here. See Chapter 2 for details.

Questionnaire Administration – During the initial home visit at 9 months parents were asked a series of questions about significant health problems experienced by each of the twins at the time of birth and over the subsequent months. These health problems were coded as 0 for none or only very minor illnesses (such a mild colds or eczema), 1 for moderate illness (such as asthma or more severe flu) 2 for serious illness not requiring hospitalisation and 3 for serious illness involving hospitalisation. Mothers were also asked to provide each infant's birth weight. At the end of the 12-month Strange Situation assessment mothers were given two sets of questionnaires to fill out. Parents were given a stamped addressed envelop and asked to return the questionnaires as soon as possible. Parents were given instructions regarding the procedure for filling out the questionnaires and were given an opportunity to ask questions. The questionnaires given at this stage were the EAS (Buss & Plomin, 1984) and the Parenting Stress Index Short Form (Abidin, 1991) and are described below. Parents were also asked to record their highest level of education, their working hours (if they were not working a zero was recorded), the length of time that they had been living with their partner and their age. At the second visit to the University at 14 months mothers were again asked to fill out two sets of questionnaires. Most mothers completed these questionnaires before the end of the session, but for those who did not stamped addressed envelopes were given and again returned by post. This second set of questionnaires consisted of the SCL90-R and the Social Support Questionnaire (both described below).

Buss & Plomin's EAS – The EAS is a twenty-item questionnaire measure based on Buss & Plomin's theory of temperament (Buss & Plomin, 1984). The questionnaire consists of various items designed to assess three core dimensions of temperament: Emotionality, Activity and Sociability. Items relating to emotionality include "Child reacts intensely when upset" and "Child often fusses and cries". Items aimed at the Activity dimension include "Child is always on the go" and "Child is off and running as soon as he/she wakes up in the morning". Finally, examples of items relating to the Sociability dimension include "Child is friendly with strangers" and "Child finds people more stimulating than anything else". Each item is rated on a 5-point scale from 1 - "very unlike my child" to 5 - "very like my child". All items within a domain are summed (with the appropriate directionality taken into account) to form three composite scales of Emotionality, Activity and Sociability. Internal consistencies (Cronbach's α) of these scales from a random sample of 52 infants (only one from each pair) were .87 for emotionality, .83 for Activity and .75 for Sociability. The EAS has been extensively validated and has been shown to been influenced by genetic and non-shared environmental factors (Buss & Plomin, 1984).

The Parenting Stress Index – The Parenting Stress Index Short Form (PSI) (Abidin, 1991) is a 36-item questionnaire regarding adults' experiences of stress associated with the role of being a parent. The questionnaire assesses feelings of stress associated with three core areas of parenting. Firstly, it includes items associated with depression and feelings of self-competence in the role of parent (e.g. "I feel trapped by my responsibilities as a parent"). A second set of items aims to capture stresses associated with difficulties that parents may experience in their interactions with their children (e.g. "My child rarely does things that make me feel good"). The last set of items consists of child-characteristics that may be causes of stress to parents (e.g. "My child makes more demands on me than most children"). Each item is rated on a 5-point scale from "Strongly agree" to "Strongly disagree". For each set the items are summed to form a global scale reflecting Parent Stress, Parent-Child Interaction and Difficult Child dimensions of parenting stress. In this sample the parents were asked to fill out the Parent Stress section once but to complete the Parent-Child Interaction and Difficult Child items separately for each twin. These scales of the PSI have been shown to have good test-retest reliability over a 6 month period as well as good internal consistency (α range between .80 and .85 – Abidin, 1991). In the current sample the internal consistencies of

each scale were .73, .83 and .81 respectively. Several studies have found the PSI Short Form to have good concurrent and predictive validity (Abidin, 1997).

The Revised Symptom Checklist (SCL90-R) (Derogatis, 1983) – The SCL90-R is a 90 item inventory of common psychiatric symptoms. Each item is scored according to the frequency with which the symptom has been experienced as a problem in the last 6 months on a 5 point scale from 0 ("Not at all") to 4 ("Extremely"). In this sample items relating to Paranoid Ideation and Psychoticism were removed because they were not felt to be meaningful to parents in a low-risk population. The 75 remaining items fell into 7 broad categories: Somatization (e.g. head aches, chest pain, dizziness), Obsessive-Compulsive ("having to double-check things", "repetitive washing", "unpleasant thoughts that won't leave your mind"), Interpersonal (e.g. "feelings easily hurt", "feeling that others are critical of you" or "feeling that others are unsympathetic"), Depression (e.g. "Thoughts of ending your life", "feeling hopeless about the future"), Anxiety (e.g. "Suddenly scared for no reason", "Heart pounding or racing"), Hostility (e.g. "Feeling easily annoyed or irritated", "Shouting or throwing things") and Phobic Anxiety (e.g. "Feeling afraid to go out of the house", feeling afraid you will faint in public"). The scales can be used independently and are also summed to form a Global Severity Index (GSI). The symptom dimensions of the SCL90-R have been shown to have good internal consistency (α range between .82 – 90 – Derogatis, 1983) and good test-retest reliability over a 10 week period (r range between .70 and .86). In the current sample the internal consistencies ranged between .65 (Somatization) to .83 (Anxiety), (median α = .79). The SCL90-R has been shown to have good convergent and discriminant validity (see Derogatis, 1983).

The Social Support Questionnaire – (Sarason, Levine, Basham & Sarason, 1983). The Social Support Questionnaire consists of 6 questions regarding various aspects of support provided by people in the respondent's life. For example, "Who can you rely upon to cheer you up when you are down in the dumps?". For each question the respondent is required to list the initials of all people in their life who can be relied upon in that respect (up to a maximum of nine) and to rate their overall satisfaction regarding that area of support on a 6-point scale. The number of support figures is then summed across all six domains to provide a total. This total score may include several instances of the same figure (for example, if "husband" is included in all six domains). Similarly, the rated satisfaction scores for each domain are summed to form a total (maximum score of 36).

In the present data set item 1 ("Whom can you really count on to be dependable when you need help?") was found to substantially reduce the internal consistency of the total scores for both the number of support figures and satisfaction with support. Consequently, this item was excluded from the scale. As a result the internal consistencies of the two total scores were .84 and .86. The Social Support Questionnaire has been used extensively in clinical and developmental research and has been established as a valid measure of social support (Sarason, Sarason & Shearin, 1986; Sarason et al, 1983).

The results of this study are divided into five sections that broadly reflect the domains of the family context that were investigated in this study. Section I begins by assessing the impact of distal demographic factors on the development of infant attachment security. Section II then assesses the role of maternal symptomatology and stress using the scales of the SCL90-R and the parent scales of the Parenting Stress Index. Section III focuses on the impact of maternal social support on the development of attachment and section IV investigates the role of child-characteristics on the development of infant-mother attachment security. Finally, section V describes a series of analyses using interaction terms from the previous sections in line with Belsky's process model of the determinants of parenting.

The data analytic approach adopted in these sections uses the General Linear Model (GLM) procedure of SPSS for Windows version 7.5. The General Linear Model is a generalisation of multiple regression, the analysis of covariance and Multivariate Analysis of Variance (MANOVA). The procedure allows for categorical and continuous independent variables and multiple dependent variables. Main effects of independent variables are tested against a linear combination of the dependent variables. The procedure allows significance tests of the individual main effects of each independent variable on the combination of dependent variables. The advantage of this technique is that it allows tests of the effects of the independent variables of interest on both twins' attachment security considered simultaneously and avoids carrying out two separate (and non-independent) tests for each twin. The interpretation of such effects would be regarding mean differences in overall family-wide attachment security. Additionally, overall omnibus tests of all the independent variables on each DV are also available (equivalent to the omnibus F test of multiple regression) as are individual regression coefficients. Because of the requirement for continuous dependent variables Main's (Main et al, 1985) continuous attachment scoring system was used in these analyses.

3.6 Section I: Demographic factors

Four demographic factors were considered as potential predictors of attachment security in this sample of twins. Maternal age, education, working hours and the length of co-residence of the parents were entered as independent covariates in a GLM MANOVA. Interaction terms were not included in this analysis. The means and standard deviations

for these demographic variables for secure and insecure infants for each set of twins are presented in table 3.1. Secure/insecure groups are used here simply for ease of interpretation.

Table 3.1 Means and standard deviations for demographic variables and infant attachment security

	Twin1 sample means (S.D.)		Twin2 sample means (S.D.)	
Demographic factor	Insecure	Secure	Insecure	Secure
Age	34.69 (7.0)	35.12 (2.8)	34.23 (5.5)	35.49 (4.9)
Education	2.28 (1.2)	2.78 (0.9)	2.29 (1.1)	2.75 (.9)
Working hours	13.60 (18.0)	15.52 (16.1)	12.96 (17.3)	16.0 (16.7)
Co-residence	6.66 (4.21)	8.41 (5.1)	7.40 (5.2)	7.71 (4.4)

There was a significant association between maternal education and family-wide levels of infant-mother attachment security (Wilks' Lambda: .877, Exact $F(2, 46) = 3.21$, $p = .049$). None of the other variables was significantly associated with this linear combination of the twins' attachment security scores (Age: Wilks' Lambda = .998, Exact $F(2, 46) = .04$, $p = .96$; Working hours: Wilks' Lambda = .988, Exact $F(2, 46) = .27$, $p = .77$; Co-residence: Wilks' Lambda = .960, Exact $F(2, 46) = .95$, $p = .39$). Univariate contrasts revealed a significant effect of maternal education for the twin1 sample but not the twin2 sample (twin1: $F(1, 47) = 4.97$, $p = .03$; twin2: $F(1, 47) = 2.53$, $p = .12$). The correlation between maternal education and infant attachment security was .34 ($p = .03$) in the twin1 sample and .23 ($p = .10$) in the twin2 sample with higher levels of education associated with greater infant attachment security in each case. Although the effect of maternal education was not significant in the twin2 sample the difference in the size of these correlations was clearly modest. Given the overall significance of the multivariate test this finding should clearly be taken seriously.

3.7 Section 2: Maternal symptomatology and parenting stress

In order to examine the role of parental psychological distress and self-reported difficulties with parenting two separate GLM analyses were carried out - one for maternal psychological symptomatology and another for parenting stress. In the first analysis all seven symptoms scales were entered as independent covariates. As in the previous analysis interaction terms were not included. The mean scores for maternal symptomatology for secure and insecure infants are presented in Table 3.2.

Table 3.2 Mean maternal psychological symptoms for secure and insecure infants

	Twin1 sample means (S.D.)		Twin2 sample means (S.D.)	
Symptom scale	Insecure	Secure	Insecure	Secure
Somatic	.393 (.29)	.488 (.36)	.508 (.35)	.386 (.30)
Obsessive-compulsive	.724 (.53)	.942 (.52)	.977 (.58)	.838 (.46)
Interpersonal	.515 (.55)	.528 (.34)	.719 (.50)	.353 (.32)
Depression	.689 (.60)	.704 (.41)	.798 (.48)	.610 (.51)
Anxiety	.304 (.41)	.278 (.24)	.367 (.40)	.225 (.24)
Hostility	.693 (.56)	.624 (.45)	.750 (.53)	.577 (.46)
Phobic	.251 (.35)	.243 (.27)	.291 (.28)	.209 (.32)

The results of the GLM analysis indicated no significant effects of the symptom scales on the combined infant attachment security scores (Somatic: Wilks' Lambda = .984, Exact $F(2, 43) = .36$, $p = .70$; OCD; Wilks' Lambda = .930, Exact $F(2, 43) = 1.61$, $p = .21$; Interpersonal: Wilks' Lambda = .899, Exact $F(2, 43) = 2.40$, $p = .10$; Depression: Wilks' Lambda = .993, Exact $F(2, 43) = .16$, $p = .86$; Anxiety: Wilks' Lambda = .968, Exact $F(2, 43) = .70$, $p = .50$; Hostility: Wilks' Lambda = .947, Exact $F(2, 43) = 1.21$, $p = .31$; Phobic: Wilks' Lambda = .972, Exact $F(2, 43) = .62$, $p = .54$). Given the trend ($p = .10$) for interpersonal problems to be associated with infant attachment security follow-up contrasts were carried out. Univariate contrasts indicated that mothers of insecure infants reported significantly greater levels of interpersonal symptoms than did mothers of secure infants in the twin2 sample only (twin1 sample: $F(1, 44) = .04$ $p = .83$; twin2 sample: $F(1, 44) = 4.75$, $p = .03$). There was thus some tentative evidence that maternal reports of greater levels of interpersonal problems were associated with infant attachment insecurity but the inconsistency between samples of twins and the non-significant multivariate effect suggests considerable sampling error and consequently this result should be treated with caution.

The second GLM analysis of this section assessed the effect of maternal ratings of parenting stress and difficulties in interactions with her infants. As such three covariates were entered into the analysis – the maternal parenting stress variable and the ratings for difficulties with interactions for each infant. Given the arbitrary scales of the Parenting Stress Index, means are not presented. None of the Parenting Stress Index scales were

significantly associated with the linear combination of infant attachment scores (Parenting Stress: Wilks' Lambda = .977, Exact F(2, 47) = .55, p = .58; twin1 difficulties in interactions: Wilks' Lambda = .992, Exact F(2, 47) = .18, p = .84; twin2 difficulties in interactions: Wilks' Lambda = .985, Exact F(2, 47) = .35, p = .71).

3.8 Section 3 Social Support

The Social Support Questionnaire consists of 6 items related to various areas of support provided by figures in the parent's life. The total number of support figures and the summed total of the parent's reported satisfaction with each domain of support were entered as independent variables in a GLM MANOVA. The main effect of the total number of support figures was not significant (Wilks' Lambda = .916, Exact F(2, 48) = 2.20, p = .12). However, there was a significant multivariate effect of rated satisfaction with social support (Wilks' Lambda = .860, Exact F(2, 48) = 3.90, p = .03). Univariate contrasts revealed a significant effect of satisfaction with social support in the twin1 sample only (twin1: F(1, 49) = 6.70, p = .013; twin2: F(1, 49) = .16, p = .69). However, the direction of effect was not as anticipated: For parents of insecure infants in the twin1 sample the mean score for satisfaction with social support was 28.1 (S.D. 2.0) whereas for parents of secure infants it was 26.4 (S.D. 3.4). Thus, parents of insecure infants reported generally greater satisfaction with social support than did parents of secure infants. As before however, given the inconsistency of this finding across both sets of twins this result should be treated with caution.

3.9 Section 4 The role of temperament and infant characteristics

The aim of the next section is to assess the contribution of infant characteristics to individual differences in attachment security in this sample of infant twins. Infant characteristics are especially important in this context because they are child-specific variables and consequently may offer a way of understanding non-shared pathways of influence on the development of attachment. The correlations between twins for emotionality, activity and sociability are presented in Table 3.3.

Table 3.3 Twin correlations for EAS Emotionality, Sociability and Reactivity

		Twin 2	
Twin 1	Emotionality	Activity	Sociability
Emotionality	.376**	-.118	-.008
Activity	-.012	.079	.191
Sociability	-.170	.387**	.340**

** $p < .01$

From the above table it can be seen that the correlations between twins were significant for emotionality and sociability but were small and non-significant for activity. Twin1 sociability also correlated with twin2 activity, but the reverse was not true – twin2 sociability did not correlate with twin1 activity. As before in these circumstances the only reasonable explanation for such a finding is sampling error.

The infant specific temperamental variables were then examined with respect to the continuous attachment security scores using simple correlations. These correlations are presented in Table 3.4. Only those correlations between each twin's attachment security and their own temperament score were carried out.

Table 3.4 Correlations between EAS temperament ratings and infant attachment security

	Attachment variables	
EAS Scale	Twin1 attachment security	Twin2 attachment security
Emotionality	-.190	-.002
Activity	.001	.127
Sociability	.159	.321*

* $p < .05$

As can be seen from the above table only one correlation out of six was significant. There was a significant positive correlation between sociability and attachment security in the twin2 sample but not in the twin1 sample ($r = .321$, $p = .019$). After Larzelere & Mulaik (1977) correction for multiple tests this correlation is not significant at $p < .05$. Two multiple regressions were then carried out for each twin's attachment security score with the three scales of the EAS as predictors to assess the simultaneous association between these predictors and infant attachment security. Neither regression was significant (twin1: $R = .25$, $F(3, 51) = 1.02$, $p = .39$; twin2: $R = .31$, $F(3, 51) = 1.66$, $p = .19$). There was

thus no strong evidence from these data of temperamental influences on infant attachment security. The relation between infant attachment and sociability in the twin2 sample may suggest a modest effect of temperament that might emerge as consistently significant in both groups of twins in a larger sample.

Finally, three further infant-specific variables were examined in relation to attachment. Correlations were carried out between infant attachment security and birth weight, the extent of significant health problems and the 'difficult child' dimension of the Parenting Stress Index. These correlations are presented in Table 3.5.

Table 3.5 Correlations between birth weight, health problems and the Difficult Child scale of the Parenting Stress Index

	Attachment variables	
Infant domain	Twin1 attachment security	Twin2 attachment security
Birth weight	-.033	.150
Health problems	-.081	-.068
Difficult child	.137	-.003

There was no evidence of any associations between these infant-specific variables and attachment security in either sample of twins. Furthermore, infant attachment security appeared to be independent of gender in both samples of twins ($\chi^2(1) = .02$; $p = .88$; twin2: $\chi^2(1) = .27$, $p = .60$). Multiple regression analyses also revealed no evidence of any multivariate associations between these variables and attachment security (twin1: $R = .19$, $F(3, 49) = .42$, $p = .80$; twin2: $R = .16$, $F(3, 49) = .30$, $p = .88$).

3.10 Section 5 Interactive risk factors and the development of attachment

Following Belsky's model of parenting and the development of attachment this final section examines the possibility that ecological factors may impact on development only when they occur in conjunction. Another way describing this model is that one risk variable may only influence outcome at one level of another risk factor. Consequently, Belsky's model suggests that risk factors interact in their influence on infant development. This section thus consists of a series of analyses in which the main ecological variables from earlier analyses were allowed to interact in the prediction of attachment security.

A GLM analysis was carried out with both twins' continuous attachment scores as dependent variables. The General Severity Index (GSI) score of SCL-90-R, maternal education and the parent-report score for total satisfaction with social support were entered as continuous covariates. All three two-way interactions and the three-way interaction between these independent variables were included in the analysis. None of the main effects was significant (GSI: Wilks' Lambda = .978, Exact $F(2, 44) = .49$, $p = .62$; Education: Wilks' Lambda = .974, Exact $F(2, 44) = .57$, $p = .57$; PSI Satisfaction: Wilks' Lambda = .967, Exact $F(2, 44) = .69$, $p = .51$). More importantly, none of the interaction terms were significant either (GSI x Education: Wilks' Lambda = .993, Exact $F(2,44) = .14$, $p = .87$; GSI x Satisfaction: Wilks' Lambda = .983, Exact $F(2, 44) = .37$, $p = .70$; Education x Satisfaction: Wilks' Lambda = .978, Exact $F(2, 44) = .49$, $p = .62$; three-way interaction: Wilks' Lambda = .995, Exact $F(2, 44) = .10$, $p = .90$). Furthermore, following Belsky et al (1995) each of these family variables were median-split and summed to form a 'risk index'. Thus, those scoring a maximum of three were in the lower half of the sample in terms of education and social support and the upper half in terms of maternal symptomatology. A further GLM analysis was thus carried out with both twins' security scores as dependent variables and Belsky's risk index as the predictor. There was little evidence of greater family-wide insecurity in those families experiencing greater levels of apparent social 'risk' (Wilks' Lambda = .987, Exact $F(2, 48) = .31$, $p = .73$).

Finally, in order to test for infant-specific interactions between temperament and these family demographic-contextual factors, six univariate GLM analyses were carried out – three for each twin's security score each corresponding with each of the three scales of the EAS. In each case, maternal education, GSI and social support ratings were entered as independent continuous covariates and were allowed to interact with one scale of the EAS. To control for type I error, statistically significant effects were evaluated at $p < .01$. Only two-way interactions involving each family demographic-contextual variable were tested to protect against excessive type I error and because of the difficulties of interpreting three-way interactions. The results of these analyses are presented in Table 3.6.

Table 3.6 Interactions between twin temperament and family demographic-contextual factors (n=52)

	Multivariate test statistics					
Temperament	Beta		Exact F		p-value	
Interaction	Twin1	Twin2	Twin1	Twin2	Twin1	Twin2
Emotionality						
x Education	-.742	1.41	1.50	2.79	.23	.10
x Social support	-.514	-2.16	.29	2.00	.59	.17
x GSI	-.228	-.509	.31	.25	.58	.62
Activity						
x Education	-.110	.579	.06	1.06	.81	.31
x Social support	-1.17	-1.33	.46	.98	.50	.33
x GSI	-.234	.094	.08	.02	.78	.90
Sociability						
x Education	.176	.574	.01	.95	.93	.34
x Social support	-1.71	-.386	.93	.04	.34	.85
x GSI	-.141	-.506	.01	.57	.99	.46

None of the scales of the EAS interacted with the family demographic-contextual variables in the prediction of infant attachment security. These data thus provide little support for the notion that temperament - at least as operationalised by Buss & Plomin's EAS - is related to attachment security either directly or in interaction with aspects of the family context.

DISCUSSION

The aim of the present study was to identify family-context factors associated with infant-parent attachment security. In particular this study aimed to assess the role of between-family variables in the development of shared patterns of attachment. Furthermore, several infant-specific variables were examined in order to explore the possibility of specific non-shared processes involved in within-family variability in attachment security. Assessments of family-level factors included several variables considered by previous research and theory to be important causes of individual differences in attachment security: socio-economic status, education, parental depression, anxiety, stress and social support. Infant temperament was considered as an especially important factor in the development of non-shared aspects of attachment security. Finally, analyses were carried out that aimed to explore the possibility that family-wide stressors may impact differentially on the attachment security of children in the same family.

Overall there was remarkably little evidence to suggest that family-context factors are significant determinants of shared dimensions of infant-parent attachment. No differences were found between infants classified as secure and insecure in terms of maternal age, working hours and length of co-residence. Furthermore, there were no significant associations between infant attachment security and maternal psychological symptoms of anxiety, depression, interpersonal problems, hostility or somatic symptoms. Parents of insecure infants also reported no differences in the number of supportive figures in their life than those parents with secure infants. Surprisingly, mothers of insecure infants reported significantly greater levels of satisfaction with social support than did mothers of insecure infants. At the same time, significantly greater levels of infant security were found for mothers with higher levels of formal education.

The finding of an association between infant attachment security and higher levels of education is perhaps not surprising as maternal education is likely to be directly related to family economic status. It is likely that a greater family income and consequently better access to social resources place a mother under less stress and facilitate a parent's capacity to respond sensitively to an infant's attachment signals. Previous studies have shown maternal sensitivity and infant attachment security to be associated with family socio-economic status and social class (Belsky et al, 1995). Nonetheless, given the presumed mediating role of parenting stress it was surprising that parenting stress was not associated with infant attachment security, indeed the relationship did not even approach

significance. The failure of measures of stress and psychological difficulties to be consistently associated with infant attachment security raises important questions regarding mediating mechanisms. Certainly, one possibility that needs serious consideration is the validity of questionnaire-based self-report measures of stress and psychological dysfunction. Parents' interpretation of questions regarding these aspects of family life is likely to vary widely and social-desirability bias may also further attenuate empirical links between social stress and observational measures of attachment security. The finding in this study that mothers of insecure infants on average report greater satisfaction with social support than parents of secure infants seems to lend support to the view that social desirability influences parental reports of this kind. The other possibility, of course, is that social class effects are not mediated by stress and difficulties in parenting but are related to attachment via other factors such as child-rearing practices or beliefs about the socialisation of emotional behaviour.

Regardless of the question of the mediating pathways between family economic factors and infant attachment security, these data call into question the idea that attachment security is related to family context factors such as social support, anxiety, depression and parenting stress. This study of course is not the first to fail to find significant associations between these family-wide variables and infant attachment security. This study, taken together with null findings from previous research, raises important questions regarding the robustness of associations between family-context and attachment. Belsky et al (1995) have noted that direct relations between social support, marital harmony and parental personality factors have been generally inconsistent and the current study further underlines this view. Nonetheless, Belsky et al found that the total number of family risk factors was a strong predictor of infant-mother attachment security – a find that this study failed to replicate. Such replication failures clearly warrant further investigation. It is possible that inconsistencies between studies result from differences in the composition of samples, such as between-study differences in socio-economic factors. Certainly, the present study consisted of largely middle-class low-risk families, which may have served to reduce the impact of family-context effects. Another potential explanation of the considerable inconsistencies between studies in this area is that social-class factors and family stress are associated with greater levels of instability in attachment classifications (e.g. Thompson, 1982; Lamb et al, 1985; Vaughn et al, 1979). As such, systematic reductions in security associated with social stress may be obscured by the lower reliability of assessments and substantial changes over time under high stress conditions.

A further possibility that is worthy of consideration is that developmental processes that are evident in singleton samples simply do not operate in the same way in populations of twins. Only further replications with twin and non-twin samples will be able to address such a possibility.

Perhaps the most convincing reason why direct effects of family-wide social context variables have limited or inconsistent effects on infant attachment is the degree of within-family variability in attachment security. In Chapter 2 of this thesis it was found that only a small proportion of the variability in attachment security could be attributed to shared factors and this finding is consistent with research on attachment in non-twin siblings as well as a sizeable body of evidence from behaviour-genetic research beyond the attachment domain (van Ijzendoorn et al, unpublished manuscript; Plomin, 1994; Ward et al, 1987). Given the limited scope of influence of shared factors it is perhaps not surprising that there have been difficulties in establishing consistent associations between family-wide aspects of the social context and infant attachment security. This research suggests that in order to understand the antecedents of infant-parent attachment security it will be necessary to take into account developmental processes that are unique to each child in a family.

Following that line of inquiry, a further aim of the current study was to identify child-specific factors associated with infant-parent attachment security as a way of accounting for within-family variability in attachment security. It was suggested that temperamental differences between siblings in the same family might offer an important source of non-shared influence on the development of attachment. To begin with, direct correlations were assessed between infant-specific maternal-report measures of temperament and attachment security using Buss & Plomin's infancy version of the EAS (Buss & Plomin, 1984). The EAS was chosen because of it emphasis on emotional and social aspects of temperament and hence was considered to be especially likely to discriminate between attachment classifications. The EAS is also known to be determined to a considerable extent by non-shared environmental influences (Buss & Plomin, 1984). However, there was little evidence to suggest that infant-specific attachment security is associated with dimensions of temperamental emotionality, activity or sociability, at least within the limits of the statistical power of this study. There was a modest suggestion that infant sociability might be linked with attachment security - with a correlation of .32 in one sample of twins and .16 in the other. Evidently, this finding deserves further

investigation in larger samples. It is clear from the difference in size (and statistical significance) of the correlations between sociability and attachment in each group of twins that sampling error was an important factor. If this finding could be replicated in larger samples it would be an extremely important demonstration of the role of temperamental factors in the development of attachment security – a view for which only inconsistent or indirect evidence has been found in the past (Steele et al, 1996; Calkins & Fox, 1992; Belsky & Rovine, 1987). More importantly for the present purposes, such a finding may offer an important insight into the causes of within-family differences in infant attachment security. Nonetheless, as things stand the present study finds only weak evidence for such a possibility. It is of course conceivable that other child characteristics not covered by traditional definitions of temperament may be responsible for non-shared aspects of infant attachment security. Examples might include individual differences in emotion-regulation and vagal tone (Calkins & Fox, 1992), attention (Derryberry & Rothbart, 1988) or fearfulness and behavioural inhibition (Kagan, 1994).

As well as investigating direct associations between temperament and attachment, the present study investigated the possibility that family-wide factors may impact differentially upon children in the same family as a function of infant temperament. On the basis of previous research (e.g. Crockenberg, 1981) it was suggested that social stressors (such as low social support) may interact with temperamental characteristics that are specific to one child in a family and hence may lead to non-shared patterns of infant-parent attachment. Despite the attractiveness of this idea, no evidence was found for statistical interactions between dimensions of temperament and social support, maternal symptomatology or levels of maternal education. Future research again may need to consider the validity of self-report measures of family stressors (and indeed temperament) if such interaction effects are to be found.

A further area that deserves attention is the role of fathers. A considerable weakness of the current study is the omission of fathers' contributions to the family ecology which may play a very significant role in moderating the effects social stressors and in the extent to which mothers are able to respond sensitively and contingently to their infant's attachment signals during the course of everyday family life. Little research has investigated the role of fathers in the development of attachment (although see Belsky, 1996, Steele et al, 1996; Lewis, 1980; Owen et al, 1984) and much of the research that has been done has focussed on dyadic assessments of infant-father attachment security

rather than on the contribution that fathers make to wider family interactions. The non-shared environment seems to point to the importance of the family system for the development of attachment and if this is indeed the case future research in this area will need to examine the family considered as a whole.

From an attachment theory perspective, perhaps the most plausible candidate causal factor in the development of attachment (both shared and non-shared) is parental sensitivity. There are good reasons to expect variability in maternal sensitivity within families with more then one child (e.g. DiLalla & Bishop, 1996; Dunn & McGuire, 1994) and it seems likely that these differences in maternal behaviour will result in unique outcomes in infant-parent attachment. This hypothesis is explored empirically in Chapter 4 of this thesis.

The significance of the non-shared environment in the development of attachment presents considerable challenges to researchers of socio-emotional development. Non-shared patterns of attachment bring within-family aspects of infant's lives to the forefront of developmental research into the environmental determinants of attachment security and insecurity. Future research will need to respond to these challenges with new theoretical and methodological approaches if we are to fully understand the causes of early emotional development. It seems likely that simple-minded models that only consider linear relations between broad aspects of family life will need to replaced by more elegant methods and measurement instruments that take into account the subtle interplay between biological and relationship factors and wider social influences in the development of shared and non-shared patterns of attachment.

CHAPTER 4

SHARED AND NON-SHARED INFLUENCES ON THE DEVELOPMENT OF ATTACHMENT: THE ROLE OF MATERNAL SENSITIVITY

Since Mary Ainsworth's original pioneering work on the naturalistic patterns of mother-infant interaction associated with the development of secure and insecure attachment relationships (Ainsworth et al, 1978) the role of maternal sensitivity has been central to contemporary attachment theory (Bretherton, 1985). Many hours of intensive home observations of mothers and their babies seemed to suggest the exciting possibility that differences in secure base behaviour observed in Ainsworth's Strange Situation procedure might be understood as being caused by differences in the extent to which mothers responded contingently and sensitively to their infants attachment signals. Mary Ainsworth's observational research laid the groundwork for all future thinking on the interactive causes of attachment security and insecurity. Since this early work a considerable body of research has attempted to confirm and extend Ainsworth's basic findings. As a result much is known about the role of maternal sensitivity in the development of attachment. In particular, there is good evidence that mothers who respond sensitively and contingently to their infants attachment needs are more likely to develop a secure attachment relationship with that child than mothers who are rejecting, inconsistently available or insensitive (De Wolff & van Ijzendoorn, 1997). Indeed, this quasi-experimental research has even received corroboration from experimental interventions which suggest that improvements in the level of parental sensitivity and responsiveness lead to increased levels of infant attachment security (Van den Boom, 1990).

Paradoxically, the same body of research also strongly suggests that maternal sensitivity at least as currently defined is not the exclusive causal influence on the development of infant parent attachment. A large number of studies have consistently shown that the size of the relationship between measures of maternal sensitivity and infant attachment security is generally small to moderate -raising many questions for both theory and methodology in attachment research (Seifer, Schiller, Sameroff, Resnick & Riordan, 1996; Goldsmith & Alansky, 1987). Many researchers have responded to the challenge of finding alternative

models of the development of attachment in recent years and several new directions have begun to emerge in attachment research. Firstly, some researchers have suggested that some of the variability in attachment security might be attributable to characteristics of the child (Seifer et al, 1996; Fox & Calkins, 1989). In line with the commonly held view that attachment security in the strange situation reflects the transactional nature of the dyadic attachment relationship, researchers have begun to explore the contribution that the child makes to this developing relationship. At the same time some researchers have suggested that the determinants of attachment security will only be fully understood in the light of a thorough explanation of the influence of relationships upon relationships and of the dynamics of the family system (Cowan, 1998; Stevenson-Hinde & Byng-Hall, 1992). In this view one of the reasons why maternal sensitivity is only a moderate predictor of infant parent attachment security is that the infant mother dyadic relationship cannot be understood in isolation and must be seen as embedded in the context of other family relationships. Similarly, perhaps the most promising avenue has emerged from outside attachment research. Behaviours geneticists and those inspired by their findings have suggested that more attention should be paid to the role of the non-shared environment (De Wolff & van Ijzendoorn, 1997; van Ijzendoorn, 1995a; Plomin & Daniels, 1987). Finally, attempts have been made to resolve the difficulties with identifying the causes of attachment security by looking to new ways of conceptualising the specific parental influences on attachment and to new and better measurement techniques (Meins & Russell, 1997; Fonagy et al, 1991; Pederson et al, 1990).

4.1 Definitions of sensitivity

Ainsworth's original definition identified four broad components of maternal sensitivity - acceptance, accessibility, co-operation and sensitivity. These dimensions of maternal behaviour variously refer to the extent to which a mother is aware of her infant's signals and states, takes into account her infant's need for autonomy of action, and responds promptly and appropriately to attachment signals, particularly in times of distress. Many of the definitions of maternal sensitivity that followed after Ainsworth's original descriptions share these basic features in common. In a recent review of the definitions of maternal sensitivity used by attachment researchers Nicholls & Kirkland (1996) identify 11 different dimensions of sensitivity that have been used to investigate attachment related maternal behaviours.

Firstly, Nicholls & Kirkland (1996) note that most definitions of maternal sensitivity include a dimension related to maternal *awareness,* such as a mothers awareness of her infant's affective state (Crawley & Spiker, 1983), of her infant's moods and fluctuations in state (Pederson et al, 1990) or her awareness of her infant's current activity (Crawley & Spiker, 1983). At the heart of these definitions is the idea that a mother who is likely to develop a secure relationship with her infant pays very close attention to her infant's cues (e.g. Pederson et al, 1990; Marfo, 1992; Crawley & Spiker, 1983; Isabella, 1993).

Secondly, most definitions of maternal sensitivity include aspects of maternal behavioural response, such as the promptness of a mother's response to an infant's cries, responses to an infant's initiation of contact and joint activity as well as responses to an infant's cues defined more generally (Robinson, Little & Beringen, 1993; Crockenberg, 1981; Isabella & Belsky, 1991; Vondra, Shaw & Kevenides, 1995). A further key component of many definitions of sensitivity is the appropriateness of a mother's response to her infant's attachment signals. Appropriateness, though difficult to define exactly, generally refers to the matching of a mothers response to her infant's signals that is developmentally appropriate and leads to smooth and harmonious interactions or a reduction in infant distress (Pederson, et al, 1990; Pianta, 1989). Nicholls & Kirkland (1996) also point out that researchers often see mutually rewarding or stimulating joint activity as being an important part of secure mother-infant interaction (Kochanska, 1998; Marfo, 1992; Robinson et al, 1994; Pederson et al, 1990). Some definitions of maternal sensitivity also explicitly refer to attitudes held by the mother regarding her child's feelings, activities and goals (Goldberg et al, 1986; Pederson et al, 1990; Ainsworth et al, 1978). For example, in Ainsworth's original definition of acceptance a mother who is likely to develop a secure relationship with a child is thought to have few conflicting or angry feelings towards her infant and accepts her infant's needs and goals even if they conflict with her own. Some researchers have included behaviours that diverge more significantly from Ainsworth's original definition. For example Pianta et al (1989) include instructional support as a component of sensitivity and others (e.g. Crittenden, 1984) have emphasised the importance of maternal consistency.

A recent meta-analysis by De Wolff & van Ijzendoorn (1997) listed 55 different definitions of maternal sensitivity from a review of existing literature. De Wolff & van Ijzendoorn

(1997) compiled these definitions into a small a set of 15 broadly similar categories on the basis of expert similarity judgements and found that there was significant heterogeneity among these categories in the extent to which they predicted attachment security. In particular, definitions that closely resembled Ainsworth's original scales of maternal sensitivity and definitions related to mother-infant synchrony yielded the largest effect sizes.

4.2 Empirical associations between maternal sensitivity and attachment security - new directions for attachment research

There is strong evidence that patterns of maternal caregiving behaviour are related prospectively and concurrently to infant attachment security. De Wolff & van Ijzendoorn (1997) and Goldsmith & Alansky (1987) have shown in two partially overlapping meta-analyses that maternal sensitivity - broadly speaking - is associated with infant-attachment security measured using Ainsworth's Strange Situation or Waters & Deane Attachment Q-Sort (Waters & Deane, 1985) with an effect size equivalent to a correlation of around .20 - .30 which though highly significant is by conventional standards small to moderate (Rosenthal, 1991). De Wolff & van Ijzendoorn (1997) and Goldsmith & Alansky (1987) have also shown that various methodological factors play a role in moderating the size of this relationship. In particular, global rating scales appear to be more effective than event-coding techniques, assessments with older infants show generally stronger effect sizes and studies using middle-class samples reveal stronger relationships than those using low SES samples. Nonetheless, even taking into account these study characteristics the meta-analyses by De Wolff & van Ijzendoorn and Goldsmith & Alansky seem to suggest that the relationship between attachment and sensitivity is considerably smaller than Ainsworth's original study might have indicated. As Belsky (1997) has pointed out there is little reason to doubt that the null hypothesis that security of attachment is independent of maternal sensitivity can be confidently rejected but conversely there is clearly much more that needs to be understood about the determinants of attachment security.

One possible explanation of the mixed findings regarding the role of maternal sensitivity and of the low overall effect size may be the sheer diversity of measurement instruments that have emerged from research into the determinants of attachment over the last 15 years. Very little psychometric and validity data have been collected for the various measures of

maternal sensitivity other than the minimal prerequisite of inter-rater reliability. Indeed, because the same measure is rarely used twice few if any strict replications have actually been carried out. The present study uses Pederson & Moran's Maternal Behaviour Q-Set (Pederson et al, 1990) as a measure of maternal sensitivity because it has been demonstrated in several replications to be an excellent predictor of infant attachment security. Indeed, in the meta-analysis of De Wolff & van Ijzendoorn (1997) the study of Smith and Pederson (1988) using the maternal behaviour Q-Set was among the set of studies with the largest effect sizes and Pederson & Moran's lab has replicated this substantial effect in several independent investigations (Pederson et al, 1990; Pederson, Gleason, Moran & Bento, in press; Pederson & Moran, 1995; Pederson & Moran, 1996). The Maternal Behaviour Q-Set also appears to show good test-retest reliability (Pederson & Moran, 1996). A further advantage of Pederson & Moran's (1990) maternal behaviour Q-Set is that as well as providing a global summary of the infant-mother attachment relationship it consists of 90 concrete items with detailed descriptions of specific maternal behaviours thought to be of particular importance for the development of attachment. The present study thus forms part of a growing body of research demonstrating the usefulness of this procedure for investigating interactive correlates of developing attachment relationships.

Various suggestions have been made about how to re-conceptualise maternal sensitivity in light of the modest findings using earlier definitions. For example, van Ijzendoorn (1995a) has suggested that in order to bridge the transmission gap researchers may need to take into account more subtle aspects of infant-parent interaction than are covered by current definitions of maternal sensitivity. Van Ijzendoorn suggests that Haft & Slade's (1988) notion of affect attunement may be a useful way of thinking about these more subtle components of infant-parent interaction. Fonagy, Steele, Steele, Higgit & Target (1993) have proposed that the key mechanism in the development of infant parent attachment security is the extent to which the parent is able to think about the infant as a psychological entity with thoughts, feelings and intentions. According to Fonagy et al (1993) it is the parent's capacity to mentalize in this way that underlies the capacity for sensitive responsiveness. In support of this idea Fonagy et al have shown that parents who are likely to develop secure relationships with their child show greater and more sophisticated use of mental state terms and belief-desire reasoning when discussing early family relationships during the Adult Attachment

interview. At the same time Fonagy et al have shown that children who were secure in infancy show precocious development of mentalizing skills ('Theory of Mind') in childhood. Nonetheless, Fonagy et al's notion of mentalizing has yet to be translated into a unique measure of maternal sensitivity. Meins (1997) has proposed a very similar re-definition of maternal sensitivity which she refers to as 'mind-mindedness'. Meins (1997) has also developed a measure of maternal behaviour based on this idea which assesses a mother's use of mental state language when talking to her infant which appears to be predictive of infant attachment security. Nonetheless, maternal language use can only be considered at best a distal cause or correlate of the specific causal factors underlying attachment security since it is unreasonable to suppose that an infant would be sensitive to these sophisticated differences in the use of mental-state language. Thus, although promising, the idea of parental mentalizing capacity has yet to shed direct light upon the interactive causes of infant-mother attachment security. A further advantage of the Pederson and Moran Maternal Behaviour Q-Set is its emphasis on observable infant-directed maternal behaviours.

Pederson & Moran (1998) have suggested that rather than further refining the definition of maternal sensitivity it may be more productive to broaden the concept to include other aspects of mother-infant interaction, such as teaching interactions or cognitive and affective 'scaffolding'. As yet there has been no empirical work that might support this position. Perhaps the most important new direction that has been suggested by several researchers (e.g. Pederson & Moran, 1998; van Ijzendoorn, 1995a; Cowan, 1997; De Wolff & van Ijzendoorn, 1997) is the consideration of the impact of relationships on relationships and of the importance of family systems and the non-shared environment in the development of attachment. Several authors have urged researchers to take a family systems view on the development of attachment (e.g. Marvin & Stewart, 1992; Stevenson-Hinde, 1992; Stevenson-Hinde & Byng-Hall, 1992; Cowan, 1997). However, although there are good clinical reasons for thinking that attachment relationships need to be understood in the context of the other family relationships (see Byng-Hall, 1987; Byng-Hall, 1990; Byng-Hall, 1995) the family systems perspective has been difficult to translate directly into developmental research and the majority of work in this area has focussed on the marital relationship as a predictor of infant-mother attachment security (see Belsky & Nezworski, 1988). Although this research represents an important step towards understanding how

relationships influence each other this perspective has generally maintained a shared-causes view of the development of infant-parent attachment and virtually no infancy research has investigated the effect of children's differing relationships with their parents. Of course, in terms of research methodology the investigation of children's different relationships with their parents and the effects these relationships have on each other presents a special challenge. In the absence of self-reports of relationship quality family systems research in infancy must rely upon direct observations of infant-parent interactions. Of course, the relevant interactions may be complex – including infant-parent interactions, infant-infant interactions and triadic interactions between siblings and a parent at the very least. As Emde (1994) has noted the number and complexity of permutations of family relationships increases exponentially with the number of interactants. As a result of these difficulties little research has explored siblings' relationships in infancy, so we have to look to research in older children for direct evidence of the importance of differences in family relationships for socio-emotional development. Dunn & Plomin's recent book (Dunn & Plomin, 1990) entitled "Separate Lives: Why siblings are so different" provides a wealth of examples from research on twins and siblings that show that for a very wide range of behaviours differences between siblings predominate. Research into the origins of these differences is just beginning but already there is evidence that suggests that differential parental treatment might play an important part. For example, parents often feel quite differently about each of their children and few parents report that they give equal amounts of attention or feel as affectionate to each of their children. Furthermore, there is evidence that the child who experiences relatively less parental affection or control shows higher levels of anxiety, depression and externalising problems than the other sibling (Dunn, Stocker & Plomin, 1990; McGuire, Dunn & Plomin, 1995; Daniels, Dunn, Furstenberg & Plomin, 1985). Differential parental treatment also appears to be quite stable over time (McGuire et al, 1995). It is also clear that siblings are very aware of differences between their relationships with their parents and that they feel very strongly about parental differential treatment (Dunn, 1994). It seems reasonable to suppose that processes such as these might have a significant impact on the nature of developing attachment relationships in families with more than one child and that differential parental treatment might lead to differences within families in attachment security.

That there are differences between siblings in significant areas of socio-emotional development is beyond doubt (see Plomin, Chipuer & Neiderhiser, 1994). Evidence is also accumulating that suggests that siblings may have quite different experiences with their parents during infancy. Moore, Cohn & Campbell (1997) for example carried out observations of mother-infant face-to-face interaction with 2 month olds and found that although maternal positive affect was relatively stable between siblings ($r = .52$) after controlling for mother's behaviour with one sib her behaviour with the other significantly predicted that infant's positive affect. In other words, maternal positive affect that was child-specific (non-shared) predicted infant-specific emotionality - unique experiences result in unique behavioural outcomes. The degree of consistency in maternal behaviour fits well with Bishop & DiLalla's (1996) findings with infant twins again indicating both a degree of maternal similarity and considerable differences. It is interesting to note that Moore et al (1997) found no correlation between siblings in emotionality. What is particularly important about the Moore et al study and the study by Bishop & DiLalla (1996) is that they indicate that variables thought to be important in the development of attachment may to a significant degree be experienced differently by siblings in the same family and that these differences may relate in a meaningful way to developmental processes.

The aim of the present study is thus to measure maternal sensitivity and infant-parent attachment security in infant twins and to test the following hypotheses:

1. That the shared component of maternal sensitivity will predict shared patterns of attachment
2. That unique (non-shared) experiences of maternal sensitivity and insensitivity will predict non-shared patterns of attachment.
3. That maternal differential treatment will predict attachment security or more specifically that *relative* maternal insensitivity will be directly related to attachment insecurity.

Hypotheses 1 and 2 follow directly from the proposition that maternal sensitivity is both a shared and a non-shared proximal cause of infant-attachment security. Hypothesis 3 assumes that one twin's relationship with his or her mother influences the kind of infant-mother relationship his or her co-twin will have. This is an important difference - hypotheses 1 and 2 focus on shared and independent sources of covariance whereas hypothesis 3 focuses on

contingencies between one relationship and another and hence on the effect of relationships on relationships.

4.3 Statistical models of non-shared environment: regression approaches and difference scores

Rather than simply estimating the extent of the non-shared contribution to variability in development researchers have recently begun the process of identifying specific environmental factors responsible for within family differences in behavioural development (Hetherington, Reiss & Plomin, 1994). The search for the specifics of non-shared environmental processes has forced researchers to think about the most appropriate methods for investigating the causes of siblings differences and the statistical and methodological issues raised by this change of tack are still being developed. This next section thus briefly introduces some of the methods used in this study to estimate the effects of differences between siblings in their experience of maternal sensitivity.

Rovine (1994) has pointed out that there are two basic approaches to the question of differences and their association with outcomes. The first approach, which Rovine (1994) refers to as the regression approach, is based on patterns of covariance - the study of Moore et al (1997) mentioned above being an example. Another common example is the Cholesky decomposition method used by behaviour-geneticists (Neale & Cardon, 1992). In this approach 'differences' are inferred from independent pathways between each sibling's score on a predictor and an individual outcome. In this study, regression and latent variable modelling procedures will be used to investigate shared and non-shared pathways as well as contrast effects. Contrast effects are particularly interesting in this context because they represent the influence of one infant's interactions with his or her mother on the security of attachment of the other sibling.

However, some researchers have noted that this approach does not directly measure sibling differences per se (Rovine, 1994; Tejerina-Allen, Wagner & Cohen, 1994). Sibling difference, they argue, is a dyadic-level concept whereas regression-based analyses focus on group-level summaries of similarity (correlations or covariances). Thus, the second approach discussed by Rovine (1994) is the use of the simple difference score. Rovine

suggests that the simple difference score has many conceptual advantages over the regression approach, largely because it conforms more closely to what researchers mean when they say *differences* between siblings. However, the difference score has had a chequered history in measurement theory and has come under considerable criticism from psychometricians (e.g. Cronbach & Furby, 1970) who point out that under many circumstances the difference score is highly unreliable and that when test measures are parallel on both occasions of measurement the correlation between a difference score and a criterion is necessarily zero (Zimmerman & Williams, 1982). Difference scores have also been criticised for being correlated with the initial level - raising questions about what a difference score really measures (Cronbach & Furby, 1970). There is now some consensus regarding the use of difference scores and it is clear that many of the concerns about the reliability and validity of difference scores were unfounded (Rovine, 1994; Willetts, 1987; Zimmerman & Williams, 1982). Willetts (1987) for example has shown that under realistic conditions the difference score can be highly reliable and show strong associations with a criterion variable. Willetts (1987) also notes that unlike many of the other measures of change put forwards as replacements of the difference score - such as the residualised gain score - the difference score is an unbiased estimate of the true difference between two variables.

There are two different methods for calculating difference scores (Rovine, 1994). The first is known as the relative difference score and is used when there is a natural or theoretically significant ordering of siblings, such as birth order or clinical status. The relative difference is then the simple difference between sibling 1 (younger or non-clinical) and sibling 2 (older or clinical). The second difference score is known as the absolute difference score and is simply the unsigned difference between siblings for each pair (i.e. ignoring negative of positive signs). According to Rovine (1994) the absolute difference score should be used when there is no apparent ordering between siblings. Rovine (1994) notes that the choice of strategy is a non-trivial issue and should be dictated by theoretical considerations.

Rovine (1994) thus recommends the use of difference scores for measuring non-shared environmental processes. However, there are some further concerns about difference scores that Rovine does not raise. The principal problem is described by Zimmerman & Williams

(1982) and is illustrated by the formula for the correlation between a difference score (D) derived from two variables x and y and a criterion (z) shown below:

$$\rho(y - x, z) = \frac{\lambda^{-1/2}\rho yz - \lambda^{1/2}\rho xz}{(\lambda + \lambda^{-1} - 2\rho xy)^{1/2}}$$

where $\lambda = \sigma_x/\sigma_y$ the ratio of the standard deviations of x and y and ρ represents the population correlation between two variables

The above formula shows that if λ is 1 and $\rho xz = \rho yz$ then the correlation between a difference score and a criterion must be zero. However, if $\lambda < 1.0$ and/or $\rho xz \neq \rho yz$ then the difference score can show a non-zero correlation with a validity criterion. Indeed, Williams & Zimmerman show that the correlation between a difference score and a criterion can be quite high under the above conditions. Zimmerman & Williams (1982) argue that it is exactly in situations where one is interested in change that the conditions for a valid difference score are likely to hold, because changes over time are likely to result in a moderate correlation between x and y, differences in the variance of x and y and differences in the size of the correlation between the criterion and x and y.

However, the important point for researchers investigating the non-shared environment is this: when measures of behavioural development are carried out contemporaneously and – as in the case of twins – there is no strong theoretical reason for expecting systematic differences between the group of children making up one half of a pair (x) and those making up the other (y) then the above conditions are not likely to hold true. For example, in the current study each member of a twin pair is assigned at random to one of two groups – referred to as twin 1 and twin 2. – and because of this random allocation the expectation of the variances of the two groups and their correlation with a shared criterion is the same. As such, a difference score based on non-systematic groups is unlikely to reveal significant relationships for reasons described above.

In cases where relative difference scores are appropriate – for example if birth order is thought to play an important role – the conditions for a valid change score are more likely to hold. On the other hand, it is important to note that the use of birth order should only really

be undertaken if it is considered to be of real theoretical value to do so. With twins there seems no reason to assign groups on the basis of birth order. Instead, in the present study difference scores are calculated by simply ordering the groups according to which twin scored lower – in line with the simple but reasonable expectation that differences in maternal sensitivity are likely to have a negative effect on the security of the twin who experiences relatively less sensitive interactions with his or her parent. It should be noted that the difference score calculated in this way is equivalent to the absolute difference score but that the groups thus formed are likely to have different variances and different correlations with a criterion. By ordering the groups of twins in this way it is hoped that the difference scores will show greater predictive validity than those based on random assignment. This approach is likely to be of very general applicability and is more likely in many circumstances to produce valid difference scores over a very broad range of circumstances.

The present study will thus investigate the influence of shared, non-shared and contrasting pathways of influence between maternal sensitivity and security of attachment as well as testing the hypothesis that relative differences in maternal sensitivity between twins represent an additional influence on the development of attachment.

METHODS

Participants

The participants in this study consisted of 58 families with infant twins recruited as part of the semi-longitudinal UCL Attachment and Twins Study carried out by the author. The demographic profile of this sample is described in Chapter 2. Two of the 58 families were not observed at home because the twins were too old at the time of recruitment (> 10 months corrected age) These cases are not included in the present investigation. Consequently, 56 families of twins form the basis of the present study of maternal sensitivity and attachment. All the infants came from intact families except one. For this family a full-time nanny accompanied the mother and babies during the laboratory visit to UCL. All the families were initially seen between 9 and 10 months after correction for gestation period.

Procedure

Home observations - Home observations of maternal sensitivity were conducted by two trained researchers when the infants were between 9 and 10 months. The visits were scheduled at a time that the mother expected the babies to be lively and when a feeding could be observed. Upon arrival written consent for participation in the study was obtained from the mother and a video camera was set up in a fixed and unobtrusive position in the room. A wide angle lens was fitted so that most of the room was captured by the video camera. Experience revealed that a fixed camera was quickly forgotten about and was far less intrusive than if held by an observer. The researchers endeavoured to maintain a relaxed and conversational atmosphere. Mothers were told that the researchers were interested in observing twins at home in as natural a way as possible and that they should feel free to interact with their babies as they normally would. After a period of initial introductions and discussion of the study the mother was given a questionnaire to fill out (Bates' Infant Characteristics Questionnaire – Bates, Freeland & Lounsbury, 1980). During the observation the babies were also filmed during feeding and mothers were asked to play with each infant separately. Towards the end of the visit the mother was interviewed briefly about the babies' medical background and about how much help and support the mother received during which the infants were free to interact with the observers and their mother or to play independently. As such, the observations consisted of both semi-structured interactions and periods in which

the infants were observed with their mother free from constraints imposed by the researchers. Each session lasted approximately two hours of which 1.5 hours were videotaped. Occasionally the father or a nanny were present during the observation.

After the home visit one trained researcher reviewed the videotapes twice - each time focussing on one twin whilst taking detailed written notes of interactions relevant to the Q-Sort procedure. Video tape reviewing and Q-Sort Ratings were carried out either immediately after the observation or the following day.

Strange Situation visit - Between 12 and 13 months the families visited University College London's Parent-Child Project observational playrooms for assessments of mother-infant attachment security. This procedure is described in detail in Chapter 2.

Maternal Behaviour Q-Set (Pederson et al, 1990) – Pederson & Moran's Maternal Behaviour Q-Set (MBQ) consists of 90 items describing specific kinds of maternal behaviour considered important in the development of attachment. They include descriptions of behaviours thought to foster security and behaviours thought to be indicative of insecurity. The items themselves cover a wide range of categories of maternal behaviour. Positive items include behaviours relating to emotion-regulation, signs of physical affection, synchrony of interactions, and maternal accessibility. Negative items include descriptions relating to rejection, lack of involvement, inattention, pushing away of bids for attention, rough physical handling of the baby and intrusiveness. Each item is sorted into one of 9 piles with the constraint that each pile must include 10 items. All the items that characterise the observed interactions are place in piles 1-3 in order of priority and all the items that are uncharacteristic are place in piles 7-9. Piles 4-6 are used for items that are either not particularly relevant to the description of the dyad or were not observed at all. The distribution of items across the 9 piles is then correlated with a criterion sort of a prototypically secure dyad developed by Pederson et al (1990) from expert ratings.

Thus, positive scores represent a distribution of items that closely resembles a secure dyad. The resulting correlations (Fisher's z-transformed) are then used as data. Pederson & Moran have shown the security scores of the MBQ to be remarkably effective in differentiating dyads who will be secure in Ainsworth's Strange Situation from those who will not (Pederson et al, in press; Pederson & Moran, 1996; Pederson & Moran, 1995). Inter-rater reliability from 18 cases rated by a trained independent judge was .84 (Pearson's r)[1].

Ainsworth's Strange Situation - At 12 months corrected age each twin was seen in Ainsworth's Strange Situation (Ainsworth et al, 1978). This procedure is described in detail in chapter 2. Each twin was seen on the same day with their mother whilst one twin waited in a different room with the father (or in one case a full-time nanny). Both the traditional 3-way ABC classifications as well as the more recent D classification were assigned by 4 trained raters. Inter-rater reliability was kappa good (Kappa= .70). Low confidence cases were agreed by conference with a second rater.

[1] Many thanks to Federica Melandri for ratings these cases

RESULTS

The results of this study are divided into three sections. The first summarises the extent to which observations of maternal sensitivity were associated with infant attachment security across the whole sample of 112 infants. The second section presents regression analyses aimed at estimating shared and non-shared pathways of influence between sensitivity and attachment security and explores the possibility of contrast effects between twins. The final section describes analyses based on difference scores in order to assess the extent to which relative differences in sensitivity are associated with security and insecurity of attachment.

4.4 Section 1: Prediction of attachment security at 12 months from observations of maternal sensitivity at 9 months

The first primary objective of this research was simply to replicate the basic finding that differences in maternal sensitivity are associated with differences in attachment security assessed in Ainsworth's Strange Situation (Ainsworth et al, 1978). In order to arrive at group means for maternal sensitivity for secure and insecure infants across the sample as a whole maternal sensitivity scores were double-entered into two one-way ANOVAs (reflecting ABC and ABCD groupings) with each infant of a twin pair treated as a separate case. In each analysis each case was weighted .5 such that the degrees of freedom for error for the F test was 53 (the number of *pairs* minus the number of groups). This resulting F test can be considered a lower bound estimate of the significance of between group differences.

For these analyses and indeed for analyses presented in section 2 each member of a pair was assigned at random to one of two groups (referred to, as in previous chapters, by the labels twin1 and twin2). The means and standard deviations of maternal sensitivity for 3 and 4-way attachment classifications are presented in Tables 4.1 below.

Table 4.1 Double-entered means and standard deviations of MBQ maternal sensitivity scores for ABC and D attachment classifications (n = 112)

	Attachment classification				
	Secure (n = 56/59)[a]	Avoidant (n= 16/19)[a]	Resistant (n = 26/34)[a]	Disorganised (n = 14)	F-value df=52/53[a]
4-way classification					
MBQ Sensitivity score	.33 (.42)	-.21 (.48)	-.07 (.52)	-.06 (.52)	4.23*
3-way classification					
MBQ Sensitivity score	.32 (.42)	-.21 (.47)	-.06 (.53)	--	6.13**

Notes: [a] Numbers and degrees of freedom refer to 4-way and 3-way classifications respectively.

* p = .01

** p = .004

There were substantial differences in observed maternal sensitivity between attachment classifications. From Table 4.1 it is evident that mothers of avoidant infants scored lowest for maternal sensitivity and mothers of secure infants highest. Resistant and disorganised infants fell between these two extremes. Bonferroni post hoc comparisons confirmed this general picture. For the 3-way analyses secure infant-mother dyads scored significantly higher than resistant and avoidant ones. Resistant and avoidant dyads did not differ significantly from each other. For the 4-way analysis, only the difference between secure and avoidant dyads was significant.

Overall, the correlation between security of attachment and maternal sensitivity was .43 (p = .001). When the twin1 and twin2 samples where analysed separately the 3 and 4-way group differences remained significant (4-way: twin1 – $F(3, 52) = 4.7$, p = .006; twin2 - $F(3, 52) = 4.5$, p = .007; 3-way: twin1 – $F(2, 53) = 6.4$, p = .003; twin2 – $F(2, 53) = 6.3$, p = .003). Similarly, the correlation between attachment security and maternal sensitivity was significant in both samples (twin1 r = .44; twin2 r = .43).

There was a considerable degree of consistency in maternal sensitivity between twins with a cross-twin correlation for MBQ security scores of .75 ($p<.001$). Thus, nearly half the variability in maternal sensitivity towards one twin is predictable from that of the other - consistent with the idea that maternal sensitivity is to some degree a trait-like characteristic.

4.5 Section 2: Shared and non-shared pathways between maternal sensitivity and infant-parent attachment security

The second primary objective of this study was to test for shared and non-shared links between maternal sensitivity and attachment security. It was also suggested that contrast effects might play a role in the development of attachment security because one twin's interaction with his or her mother might influence the attachment security of the other twin directly as a result of competition for parental attention. These hypotheses can be broken down into three basic predictions:

1. To a significant extent shared variance in patterns of attachment between twins will overlap with shared variance in maternal sensitivity
2. After controlling for shared influences on attachment, child-specific variance in maternal sensitivity will predict child-specific variance in attachment security
3. After controlling for shared influences on attachment security and child-specific effects of maternal sensitivity, one twin's maternal sensitivity score will predict *insecurity* in the other.

For these analyses the continuous security scores derived from discriminant function analyses shall be used in conjunction with the traditional dichotomous secure-insecure variable.

There are several ways that the above hypotheses could be tested. We shall begin with univariate analyses that provide simple tests of the role of shared and non-shared influences on attachment security. Following these univariate analyses a series of regression and structural equation models will be tested that provide a more parsimonious description of the data.

To test the hypothesis that shared variance in maternal sensitivity is associated with attachment security, correlations were carried out between attachment security and the average of each twin's maternal sensitivity scores. For the continuous scores both correlations were significant and positive (twin1: $r = .33$, $p = .012$; twin2: $r = .29$, $p = .029$) in line with the hypothesis that shared patterns of maternal sensitivity predict attachment security. When the dichotomous security variable was used the correlation between security and the cross-twin average of maternal sensitivity was significant for the twin1 sample but only marginally significant for the twin2 sample (twin1: $r = .36$, $p = .006$; twin2: $r = ..25$, $p = .06$). These differences can only be a result of sampling error. When a partial correlation was computed between each twin's attachment security scores whilst controlling for average maternal sensitivity the cross-twin correlation was non-significant (partial $r = .17$, $p = .22$; zero-order correlation $r = .27$, $p = .04$). These findings fit well the proposition that the correlation between twins in attachment security results to some extent from correlations between twins' experiences of maternal sensitivity and insensitivity.

Conversely, when partial correlations were computed between each twin's maternal sensitivity score and attachment security - controlling for the other twin's sensitivity score and attachment security - there was clear evidence of direct (non-shared) pathways between maternal sensitivity and attachment. For both samples the partial correlation between maternal sensitivity and attachment security was .59 ($p < .001$). The security scores revealed broadly the same picture with a partial correlation of .52 for the twin1 sample and .42 for twin2. Finally, to test for contrast effects two further partial correlations were carried out this time computing the cross-twin correlation between attachment security of one twin and maternal sensitivity of the other after controlling for the maternal sensitivity score of the target infant. In both cases the correlation was significant and negative (twin1 sample: $r = -.29$, $p = .031$; twin2 sample: $r = -.32$, $p = .07$). When the security scores were used negative correlations emerged again but only the twin1 sample was significant.

To summarise, these data appear to support all three hypotheses: Some evidence was found for shared pathways between maternal sensitivity and attachment security, for environmental influences that are unique to each child and for influences of one child's security on that of the other.

In order to test the presence of shared, non-shared and contrast effects simultaneously, two logistic regression analyses were carried out – one for each sample (twin1 and twin2). In the first regression twin1 MBQ score, twin2 MBQ score and twin2 attachment security were used as predictors of twin1 attachment security and in the second regression the same analysis was carried out with twin2 attachment security as the DV. The logic of this analysis was that the effect of twin1 MBQ score after controlling for the other twin's maternal sensitivity score and attachment security would represent the truly non-shared component of the effect of maternal sensitivity on attachment. At the same time the independent effect of twin2's MBQ score would indicate contrasts effects after controlling for direct effects between maternal sensitivity and attachment security. Finally the direct path between each twin's attachment security after controlling for unique effects and contrast effects represents the remaining influence of shared factors in the development of attachment security in this sample of twins.

For both samples the logistic regression was highly significant (twin1: $\chi^2(3) = 25.6$, $p < .0001$; twin2: $\chi^2(3) = 28.6$, $p < .0001$). In both cases the logistic regression model also appeared to be a good fit to the data (Goodness of fit twin1: $\chi^2(52) = 51.99$, $p = .47$; twin2: $\chi^2(52) = 48.96$, $p = .59$). Indeed the analyses were remarkably consistent across samples. In both samples all three predictors were significant and in the same direction. For the unique effect of maternal sensitivity on attachment the Beta value was 5.75 for twin1 (Wald = 11.78, $p = .0006$) and 7.24 for twin2 (Wald = 11.19, $p = .0008$). Both contrast effects were also significant and negative – for twin1 Beta was –4.90 (Wald = 7.31, $p = .0068$) and –5.90 for twin2 (Wald = 8.88, $p = .0029$). Finally, after controlling for both sets of sensitivity scores the attachment security of one twin remained a significant predictor of the attachment security of the other. The Beta value was 2.40 for twin1 (Wald = 7.35, $p = .0067$) and 2.44 for twin2 (Wald = 7.66, $p = .0057$).

Discriminant function analyses suggested that approximately 43% of the variance in twin1 attachment security and 39% of the variance in twin2 attachment security was explained by these three predictors. These results thus appear to indicate quite strongly that non-shared influences and contrast effects play a powerful part in the development of attachment

security in infant twins. At the same time these analyses show that once these contrast and non-shared effects are taken into account there is quite strong evidence of shared patterns of attachment too. Indeed, the fact that, after controlling for sensitivity, each twin's attachment security remained a predictor of the other's might suggest that the shared association between them is not mediated by maternal sensitivity. It should be noted of course that, strictly speaking, these analyses show that non-shared components of maternal sensitivity influence infant attachment security. They do not directly address the question of whether maternal behaviour is associated with non-shared *outcomes* for attachment security. It should be noted that these contrast effects represent *suppressor* effects in that the zero-order correlation between one twin's sensitivity score and the other twin's attachment security was positive whilst the same effect in the regression was negative. As such these findings should be treated with caution (the interpretation of suppressor effects is discussed in detail in the Discussion).

The weakness of these univariate and regression analyses is that although they indicate shared and non-shared pathways of influence between maternal sensitivity and attachment security they do not directly test the notion that shared effects on attachment are *mediated* by shared components of maternal sensitivity. Similarly, they do not directly test the effect of non-shared patterns of maternal behaviour on non-shared, *uncorrelated* outcomes in attachment security. Structural equation modelling allows for more direct tests of these ideas. Structural equation modelling has the advantage of allowing explicit causal models to be tested with all effects simultaneously and gives an overall indication of how well the model fits the data (Bollen, 1989).

Thus to test the hypotheses proposed in this study, latent variable modelling was used to capture the shared dimension of maternal sensitivity that might underlie correlations between twins in attachment security. Separate pathways of non-shared factors were also included so that the contribution of each could be estimated simultaneously. The analysis is based on a series of models described by Loehlin (1996) known as common and specific factor models. The model is presented as a path diagram in figure 4.1.

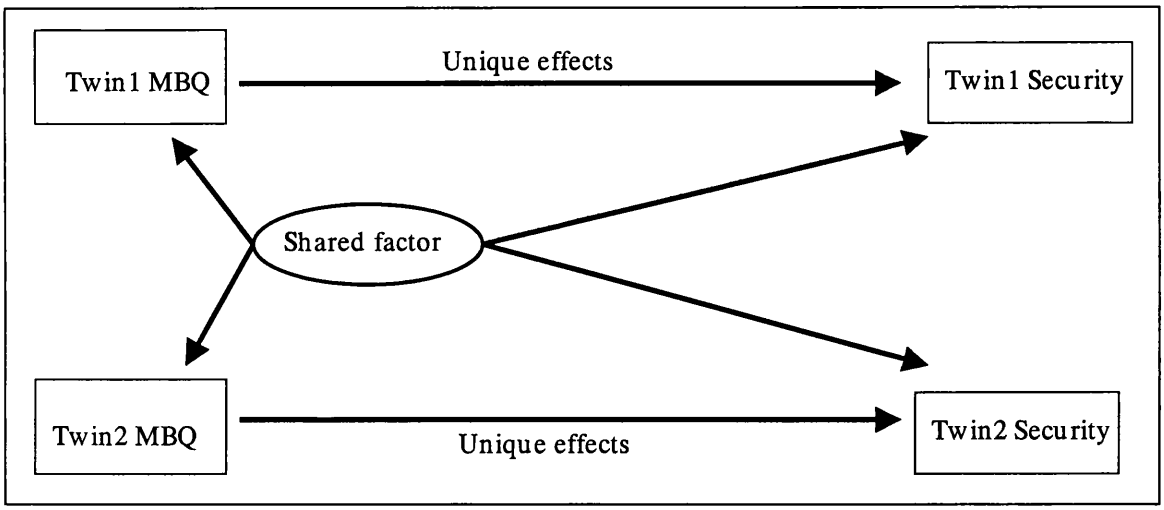


Fig. 4.1 Path diagram of latent variable model of shared and non-shared influences effects on infant attachment security

As Loehlin (1996) notes, these models are generally not identified unless certain constraints are imposed. In this model four constraints were applied that are reasonable in this case because there should be no systematic differences between the effects for twin1 and twin2 because they are assigned to these two groups arbitrarily. In other words, the model should be symmetrical about the horizontal midline in the above diagram. As a result there is no reason to expect differences in the size of the error terms for twin1 and twin2 attachment security or in the size of the loadings between maternal sensitivity, attachment security and the shared latent variable. Therefore, following Loehlin (1996) these terms were constrained to be equal. After applying these constraints the model shown above in Fig. 1 is identified.

Bentler's (1989) EQS structural equation modelling software was used to fit the model using the Generalised Least Squares discrepancy function from the variance-covariance matrix in Table 4.2. Because of the non-normal (dichotomous) distribution of the attachment variable tetrachoric correlations used to estimate the model according to procedures developed by Poon & Lee (1987) and Lee et al (1992).

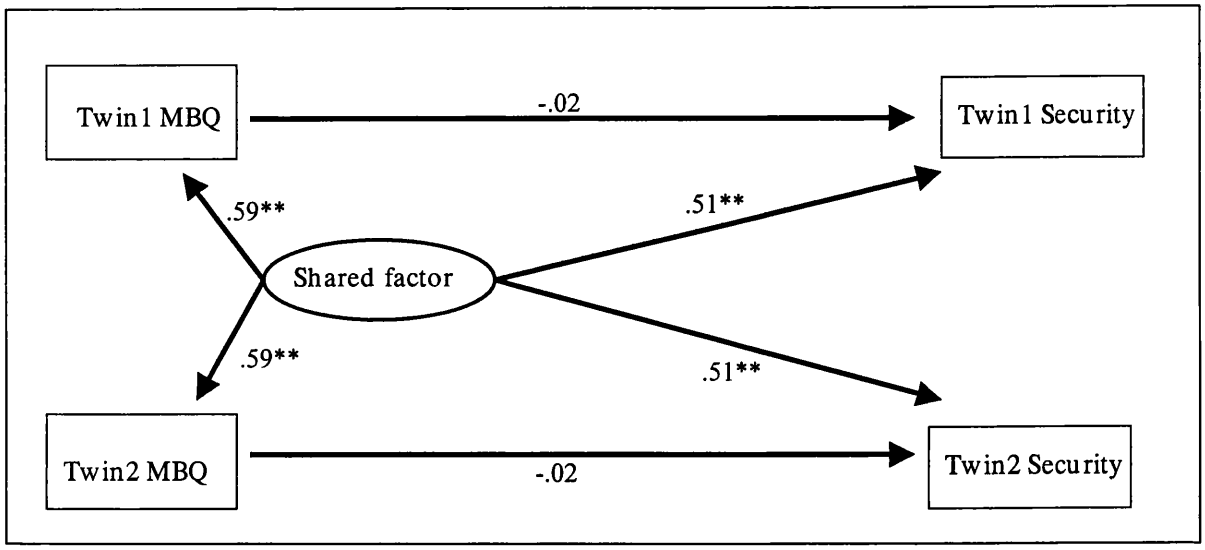
Table 4.2 Variance-covariance matrix of maternal sensitivity and attachment security

	Covariance (correlation)			
	Twin1 Security	Twin2 Security	Twin1 MBQ	Twin2 MBQ
Attachment variable				
Twin1 Security	.328 (1.0)			
Twin2 Security	.085 (.32[a])	.393 (1.0)		
Twin1 MBQ	.120 (.41)	.06 (.17)	.258 (1.0)	
Twin2 MBQ	.02 (.07)	.135 (.47)	.192 (.74)	.260 (1.0)

[a] Derived from Tetrachoric correlation

Overall, the model appeared to be a reasonably good fit to the data ($\chi^2(4) = 6.40$, $p = .17$). Examination of fit indices also suggested a good fit. The Bentler-Bonett Normed Fit Index was .981 and LISREL's (Joreskog & Sorbom, 1988) Goodness of Fit Index (GFI) was .900. Bollen (1989) suggests that in practice a fit index of less than .90 indicates that a model does not provide a good explanation of the observed covariance matrix. The GFI of .900 may suggest that improvements in fit could be made. Four Lagrange Multiplier Tests were carried out to check the adequacy of the assumptions underlying the constraints imposed on the model and none were significant - suggesting that relaxing these constraints would not produce an improvement in overall fit.

Z tests of the individual regression coefficients indicated that the shared pathways were highly significant but that the direct non-shared effects were not. The model is reproduced in Fig. 4.2 with the standardised regression coefficients (error terms are omitted for the sake of clarity). The latent variable representing shared variance in attachment and maternal sensitivity accounted for around 25% of the variance in each twin's attachment security. An analysis based on the continuous security scores produced goodness-of-fit indices and parameter estimates that were not substantially different from those using the categorical attachment variables.



** $p < .01$

Fig. 4.2 Standardised solution of latent variable model of maternal sensitivity and attachment

The results of this model were thus somewhat surprising in the light of earlier analyses, which seemed to indicate significant non-shared pathways between maternal sensitivity and attachment security. Nonetheless, these results certainly support the hypothesis that shared dimensions of parenting mediate the development of shared patterns of attachment security in twins. Such a finding fits well with predictions derived from contemporary attachment theory in which a parent's internal working model of attachment is the primary influence on sensitivity.

Traditionally, behaviour-genetic data of this sort would be analysed using bivariate genetic analysis. This analysis proceeds via a statistical technique known as Cholesky decomposition (Neale & Cardon, 1992), and, by way of a series of transformations, the results can be used to find parameter estimates for a range of bivariate models, including the correlated factors model shown below in Figure 4.3. A simplified example of a Cholesky decomposition for the two-variable case is also given in Figure 4.3. Of the several bivariate models, the model that the analyst should choose depends on theoretical considerations, such as the causal priority between the two variables of interest, because these related models lead to the same predicted covariance matrix (Loehlin, 1996). In this particular case, the simplest model to interpret is the correlated factors model in which the shared causes of sensitivity correlate with the shared causes of attachment. This model makes the fewest assumptions about

causal priorities between sensitivity and attachment. An example of the EQS script for this model is given in Appendix A.2.

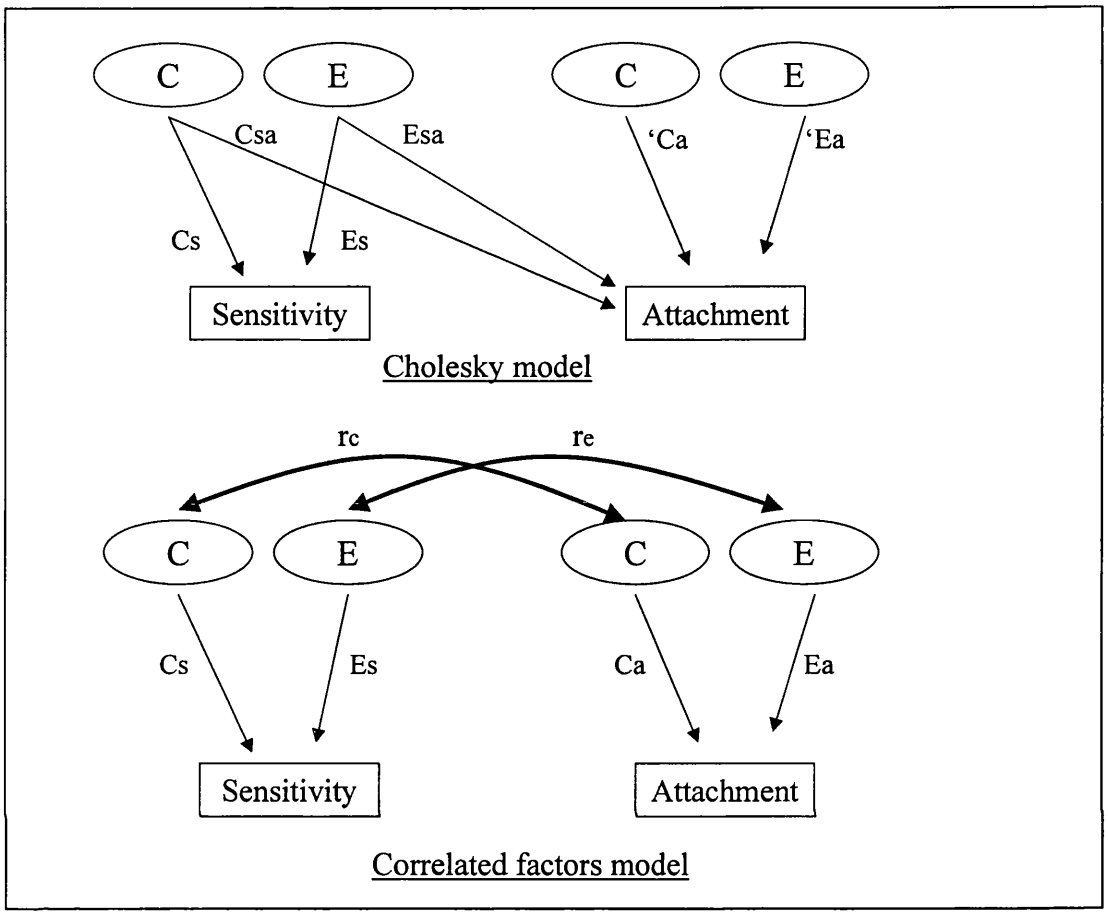


Figure 4.3 Cholesky and correlated factor models for bivariate data (only shared and non-shared factors are shown)

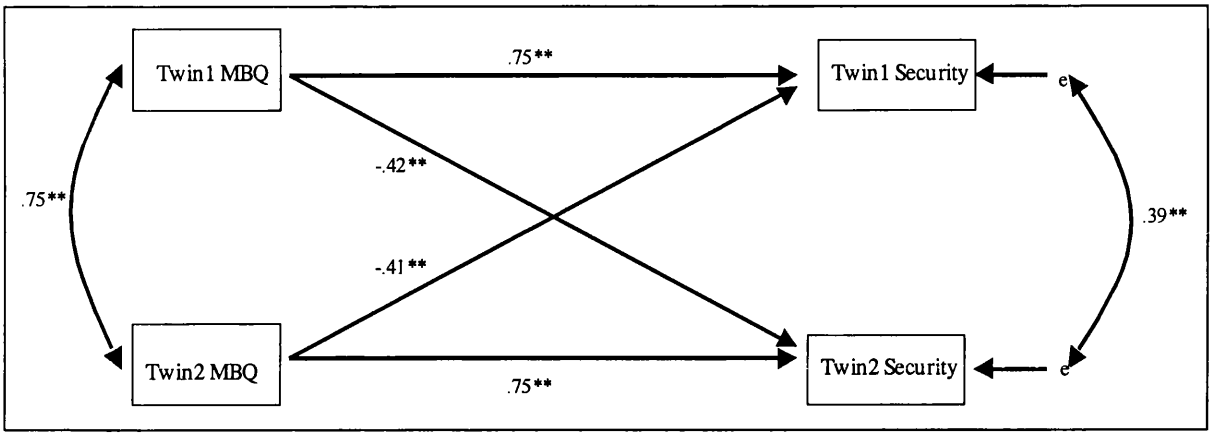
When the bivariate Cholesky model was estimated for the dichotomous attachment classifications (using the categorical methods of Lee et al, 1992) the model lead to a negative estimate of the variance of the non-shared term for sensitivity, presumably as a result of the high correlation between twins for sensitivity and the large standard error of estimates based on categorical data and small sample sizes (Neale & Cardon, 1992). These kinds of problems (known as 'Heywood Cases', see Bollen 1989) have been found from Monte Carlo studies to be particularly common in cases where there are few indicators per factor and when sample sizes are small (see Anderson & Gerbing, 1985; Boomsma, 1987). Of course, the current

study suffers from both these limitations. Parameter estimates from this analysis are unlikely to be meaningful and are not reported here.

However, when Main's continuous scores were analysed (again using polychoric correlations) estimation problems were not encountered. Overall, this Cholesky model provided a good fit to the data (Yuan-Bentler Corrected $\chi^2(4) = 3.0$, $p = .557$; BBNFI = .99, LISREL GFI = .99). All paths in this model were significant in univariate z tests and multivariate χ^2 difference tests ($p < .05$), suggesting significant shared and non-shared pathways. The terms Ca and Ea are the same as those from the univariate genetic analyses presented in Chapter 2 (.27 and .73 respectively). For the sensitivity ratings there were clearly strong shared environmental influences, as expected from the high correlation between twins. The term Cs in Figure 4.3 was .76, suggesting that around 58% of the variance in sensitivity was accounted for by shared environmental factors. More importantly, the shared environmental correlation (r_c) between sensitivity and attachment security was .39 whilst the non-shared correlation (r_e) was .49. These analyses thus suggested that the association between sensitivity and attachment (r approximately .40) is mediated by both shared and non-shared pathways. Indeed, fitting with the logistic regression analyses earlier, the bivariate model suggested greater overlap between non-shared components of sensitivity and non-shared components of attachment security than it did for overlapping shared influences. Nevertheless, the fact that a single factor model provided an adequate fit to the data suggests that these results should be treated with caution, especially in the light of the suppressor effects described earlier and the estimation problems associated with the secure-insecure attachment classification in the bivariate analysis.

Of course, neither the single-factor model nor the bivariate model is capable of taking into account contrast effects. Rather than include an underlying shared dimension to both maternal sensitivity and attachment security (which, with contrast effects would not be identified), a final model was estimated that attempted to test whether the unique and contrast effects identified in the logistic regression analyses could account for the correlation between twins in attachment security. This model was then compared to a second model in which the error terms for twin1 and twin2 attachment security were allowed to correlate – thereby testing whether there was residual shared variance in attachment security that could

not be accounted by unique and contrast effects[2]. In order to ensure parameter identification of the second model the unique and contrast effects were constrained to be equal for twin1 and twin1. As before Lagrange Multiplier tests indicated that these constraints would not lead to significant deterioration in fit. The second model is shown in Fig. 4.3 (the resulting regression coefficients from the analysis are included). The first model is the same as that shown in the path diagram with the correlation between the error terms deleted.



** $p < .01$

Fig. 4.4 Correlated errors model of unique and contrast effects of maternal sensitivity on infant attachment security

Allowing the errors between each twin's attachment security to correlate, as shown in the above diagram, resulted in a significant improvement in model fit ($\chi^2(1) = 7.27$, $p < .01$). Indeed, this second model was a very good fit to the data ($\chi^2(2) = .018$, $p = .990$; BBNFI = 1.00, LISREL AGFI = .999). As can be seen from the path diagram, all effects in the model were significant, suggesting unique, contrast and shared effects in the development of attachment security. However, as noted before, this model does not really capture the *mediational* role of shared experiences of maternal sensitivity on shared patterns of attachment. Thus, taken together these model-fitting analyses seem to generally support all three pathways of influence between maternal sensitivity and attachment. However, results

[2] It should be noted that in its basic form this model closely parallels the logistic regression analyses carried out earlier in this Chapter. However, this model provides a better formulation of the relationship between twins' attachment securities (correlated, rather than one being a predictor of the other in two separate, non-independent analyses) as well as providing measures of overall model fit.

were not entirely unequivocal in this respect because of difficulties in fitting the most appropriate model, concerns regarding suppressor relations and the goodness of fit of competing models (single-factor versus bivariate Cholesky model). The next section deals with shared and non-shared effects from a different angle, using the simple difference score as a measure of the shared and non-shared environment.

4.8 Section 3: Differences score measures of the non-shared environment

In many ways the simple difference between siblings' scores on an environmental variable is a more intuitively appealing way of investigating the role of the non-shared environment in the development if infant-parent attachment than methods based on correlations between members of a dyad (Rovine, 1994). In the introduction to this chapter some statistical issues were raised about the properties of difference scores that should be taken into account when considering their associations with outcome. In particular it was argued that difference scores should be calculated on the basis of clear groupings such that there is a systematic difference between twin1 and twin2. In this study the primary hypothesis of interest was that the sibling who experiences relatively less maternal sensitivity will be particularly prone to developing an insecure attachment relationship with his or her parent. Consequently the most reasonable ordering of the twin groups is to assign the twin with the highest MBQ score to one group and the twin with the lower score to the other. The first part of this section shall simply present some of the characteristics of the difference scores formed in this way. This shall then be followed by analyses of the association between relative differences in maternal sensitivity and infant-attachment security.

4.9 Characteristics of the difference score

To begin with the distribution of the difference score was examined graphically and, unlike the raw MBQ scores, the difference score was highly skewed with the majority of cases at the zero-end of the distribution. This is an almost inevitable consequence of the high correlation between twins for maternal sensitivity coupled with the fact that negative scores were impossible because of the way the groups were assigned. However, after a square-root transformation the distribution of the difference scores approximated normality quite well. Not surprisingly there was a significant difference between the maternal sensitivity scores for those twins who scored lower compared to those who scored higher ($t(55) = 6.8$, $p < .001$).

The mean (untransformed) MBQ score for the lower group was -.10 whereas for the higher group it was .23. Somewhat disappointingly the standard deviations of the two group were virtually identical (lower group S.D. = .50, higher group S.D. = .49). Correlations were then computed between the difference score and each twin's raw MBQ score because in previous discussions of difference scores concerns have been raised about the difference score's correlation with initial level (Cronbach & Furby, 1979). For the lower group the correlation was -.32 ($p = .016$) but for the higher group it was .20 ($p = .14$). However, as Willetts (1987) has noted overlap between a difference and the scores that make up that difference are almost inevitable but this does not preclude the potential meaningfulness of an association between a difference and an outcome.

4.10 Associations between maternal differential treatment and infant attachment security

The first step in these analyses was to ask the simple question: Are twins who experience similar levels of maternal sensitivity more likely to develop the same attachment relationship with their mother? An independent samples t-test revealed significant mean differences in the MBQ difference score between those twins who were concordant for attachment classification (secure vs. insecure) and those who were not ($t(32.62) = 2.86$, $p = .007$). It was also notable that Levene's test indicated significant differences in the variance of difference scores for concordant and non-concordant pairs ($F(54) = 14.63$, $p = .002$). The untransformed standard deviation of the difference score for the concordant group was .16 but for the discordant group it was .35.

Next, within-group correlations were computed between the difference score and attachment security. For the group who experienced lower maternal sensitivity the correlation was -.40 ($p = .002$) and for the group who experienced greater sensitivity the correlation was .37 ($p = .004$)[3]. These correlations generally confirmed the predictions of this study in that differential maternal sensitivity appeared to have a negative effect on the twin who experiences less sensitive interactions with his or her parent and a positive effect on the twin who experiences more. Nonetheless, the positive correlation between raw MBQ score

[3] In view of the technical discussion of the difference score in the introduction to this chapter it is interesting to note that correlations between difference scores and attachment security on the basis of two randomly assigned groups (twin1 and twin2 in previous analyses) were small and non-significant (twin1: $r = -.024$, $p = .86$; twin2: $r = -.19$, $p = .12$).

shown above left some questions about the nature of these effects. Is it really the relative difference that counts or is this merely re-stating the finding that maternal sensitivity predicts attachment security? As yet there is no entirely satisfactory way of answering this question (Rovine, 1994). As a check, two logistic regressions were carried out for each group, testing the association between the difference score and attachment security whilst controlling for the raw MBQ score. For the group who experienced less maternal sensitivity the independent effect of the difference score after controlling for that twin's raw sensitivity rating was significant (B = -3.98, Wald = 4.54, p = .03). However, for the group who experienced relatively greater maternal sensitivity the independent effect of the difference score was not significant (B = 1.28, Wald = .82, p = .36). One interpretation of this finding is that relative discrepancies in maternal sensitivity only matter to the sibling who comes off worse. Certainly these results and the results of the previous section are consistent with the idea that one child's interactions with a primary caregiver affect the kind of relationship that a sibling or in this case co-twin will have with that same adult.

DISCUSSION

Attachment researchers have long speculated about the causes of individual differences in patterns of infant-parent attachment. Contemporary thinking in attachment research views the primary causes of attachment security and insecurity as being located in dimensions of parental caregiving behaviour and research has focussed on maternal sensitivity as the key component of maternal behaviour in the development of attachment. Furthermore, recent developments in attachment research suggest that these patterns of maternal behaviour are likely to be shared by children in the same family because they are guided by a parent's internal working model of attachment. On the other hand, behaviour-genetic studies of twins and siblings point to the importance of non-shared influences on behavioural development and several authors have argued that shared influences are negligible (e.g. Scarr, 1992). The finding of pervasive differences between siblings in cognitive abilities, personality and psychopathology has set in motion a series of research programs aimed at understanding the within-family processes that lead to differences between siblings in developmental outcome (see Hetherington et al, 1994). The current study thus aimed to test the hypothesis that shared dimensions of observed maternal sensitivity underlie the development of attachment in a sample of 12 month-old twins. As well as testing this important prediction of attachment theory this study also aimed to investigate the role of systematic non-shared aspects of maternal behaviour in the development of within-family differences in attachment security.

Despite the obvious challenges involved in observations of maternal sensitivity in families with twins this study found quite strong associations between maternal sensitivity observed at 9 months and infant attachment security at 1 year. This research thus contributes positive findings to the growing body of work attesting to the value of Pederson & Moran's Maternal Behaviour Q-Set (Pederson et al, 1990). In each sample of 56 infants the correlation between maternal sensitivity and attachment security was around .40 which is considerably greater than the mean effect size reported by De Wolff & van Ijzendoorn (1997) and is comparable to correlations reported by Pederson & Moran (1990; 1996). In Pederson & Moran's system the Q-Set is sorted from running notes collected during the observation. The experience of this research suggests that without complete videotaped records of the home

visits a meaningful description of each mother-infant dyad would have been impossible. The other advantage of videotaped records is that note-taking can be intimidating for the family and can hinder the establishment of a relaxed and informal atmosphere that is essential for naturalistic observation. It is likely that this procedural detail was critical to the finding of relatively strong associations between maternal sensitivity and attachment.

A further finding of this study was of considerable consistency in maternal behaviour towards her infant twins, consistent with the internal working models view of attachment and maternal sensitivity (Steele & Steele, 1994; Van Ijzendoorn, 1995a; Bowlby, 1988). This degree of stability between twins suggests that to some degree maternal sensitivity can be considered a trait-like characteristic – a view also consistent with trait theories of emotion (Lykken & Tellegen, 1966; Larsen & Diener, 1987). Consistency in maternal behaviour towards infants and young children has been found in several other investigations of twins and siblings (DiLalla & Bishop, 1996; Moore et al, 1997; Dunn & Plomin, 1986; Ward et al, 1988). Attachment theory would of course predict that this consistent pattern of response would be associated with a parent's state of mind with respect to attachment as measured by the Adult Attachment Interview. Data that speak to this issue will be reported in subsequent chapters of this thesis. It should be pointed out however that some proportion of the consistency in maternal behaviour might have arisen as an artefact of the coding procedure used in this study because only one coder rated both twins of a pair. Independent ratings of maternal sensitivity in future investigations would allow a bias-free estimate of consistencies in maternal sensitivity towards infant twins and siblings.

Not only did this study find considerable consistency in maternal behaviour but this shared dimension of maternal behaviour was found to be associated with shared patterns of attachment – fitting neatly with predictions derived from attachment theory. Latent variable analysis indicated that a shared dimension underlying maternal sensitivity and attachment security could explain the observed degree of concordance for attachment in infant twins. Attachment researchers' emphasis upon the shared environment may not be as misguided as some had thought – twin siblings are similar in terms of attachment security in a way that is unlikely to be explained by genetic factors (see Chapter 2) and these similarities are

associated with shared dimensions of parenting. Taken together these findings clearly represent a non-trivial confirmation of contemporary attachment theory.

On the other hand, this study also found fairly strong evidence for non-shared influences on attachment that cannot easily be explained by the internal working models view of attachment. Nonetheless, one of the exciting findings of this research is that a significant proportion of the non-shared variability in attachment security was associated with maternal sensitivity – *non-shared* maternal sensitivity. The logistic regression analyses indicated that unique variance in one twin's experience of maternal sensitivity that was not shared with the other twin's maternal sensitivity scores or attachment security was predictive of that twin's attachment security. Bivariate analyses also suggested overlap between unique patterns of maternal behaviour and unique outcomes for attachment security. Similarly, twins who had similar experiences of sensitive care were likely to develop the same pattern of attachment but those who experienced quite different caregiving were not. These findings are consistent with the simple idea that to some extent twin's have different interactions and relationships with their mother and that these differences lead to differences in attachment security observed in Ainsworth's Strange Situation. This finding, if it proves to be robust, is important because it demonstrates that there is likely to be more to non-shared patterns of attachment than just measurement error and that the non-shared environment can be understood in terms of Ainsworth's original propositions regarding the proximal causes of attachment security.

This research is thus relatively consistent with traditional attachment theory in its finding of shared pathways between maternal sensitivity and attachment, but also shows how the theory might be extended to take into account within-family variability. Maternal sensitivity provides an elegant link between the linear model of attachment - in which caregiving behaviour is determined by internal working models of attachment - and a non-shared model of attachment in which independent influences on sensitivity come to be experienced differently by different members of the same family.

An even more remarkable finding of this research – and one that needs urgent replication- was the significance of contrast effects on the development of attachment in twins. After

controlling for other influences, the sensitivity that one twin experienced had a negative impact on the security of the other. One explanation of these contrast effects is that infants are sensitive to the kinds of interactions that their siblings have with their parent. This of course is what Bowlby expected (1969/82) and what the observational work of Dunn and her colleagues (Dunn & Kendrick, 1982) has shown. The implication of this is that infants play an active role in shaping their attachment relationships – a view held by many attachment researchers (e.g. Sroufe & Waters, 1977) but one that has not been demonstrated empirically before. The research of Hart et al (1998) on infant jealousy provides strong support for the idea that infants as young as 1 year are able to discern the focus of a parent's attention and that attention to another child is a powerful activator of attachment behaviour. Informally, it was not uncommon during these home observations of mothers and their baby twins to observe active competition between twins for maternal attention and indeed the presence of a sibling in the mother's lap was often a cause of fussiness or proximity seeking. Similarly, rivalrous interactions between twins for toys or food were very common and were a cause of concern to many parents. It is interesting to note that in this study analyses of difference scores seemed to suggest that relative discrepancies in maternal sensitivity were more important in predicting attachment security or insecurity for the infant who lost out rather than the infant who was relatively better off. It is possible that this might be because a sibling receiving relatively more attention is an activating stimulus of the attachment system but when an infant is not losing out the attachment system is not especially activated and less attention is paid to the activities of the other sibling. Only experimental research is likely to answer this question. There are strong reasons to believe that important gains will be made in our understanding of the processes involved in non-shared influences on emotional development if research begins to move in this direction. Indeed, one of the weaknesses of the present study is that it can only *infer* real developmental processes on the basis of difference scores and patterns of covariance. Future research should attempt to measure these processes directly. Pilot work in this lab is currently under way to measure sibling rivalry for parental resources and 'winners and losers' in triadic sibling-parent interactions as components of non-shared influences on attachment.

As a general note, it must be pointed out that the issue of non-shared pathways of influence between sensitivity and attachment, and indeed the role of contrast effects, was by no means

straightforward. One major concern regarding the current findings is that the contrast effects were clearly a result of suppressor relations between measures of sensitivity and attachment. Darlington (1968) cautions against the strong interpretation of suppressor effects in the absence of clear theory. In the current case, a plausible account of these suppressor relations can be made, but the possibility that they arose from measurement problems associated with the non-independent ratings of sensitivity for the two twins should be considered seriously. A suppressor variable can be defined as a variable that, when added to a regression equation, receives a negative weight when the zero-order correlation is positive or zero (Darlington, 1968). This is clearly the case here: The zero-order correlation between twin1 attachment and twin2 sensitivity is small and positive, but when twin2 sensitivity is added to the regression of twin1 attachment on twin1 sensitivity, the β weight becomes negative. Interpretation of suppressor relations is relatively complex and several authors caution against making strong interpretations of them (e.g. Howell, 1989; Gulliksen, 1950). Darlington (1968) has provided an excellent account of suppressor relations and suggests that the appropriate interpretation of a suppressor variable is that the suppressor is a better predictor of the residual term in the regression equation than it is of the criterion per se. In other words, twin2 sensitivity correlates more with the reasons why twin1 sensitivity does not always predict twin1 attachment than it does with twin1 attachment security per se. Darlington shows that suppressor relations will always arise when the following inequality holds:

$\rho_{02} - \rho_{01}\rho_{12} < 0$

where ρ_{02} is the population correlation between the second predictor (twin2 sensitivity, say) and the criterion (twin1 attachment)

ρ_{01} is the population correlation between the first predictor (twin1 sensitivity) and the criterion and

ρ_{12} is the population correlation between the two predictors

In the current case, the correlation between twin2 sensitivity and twin1 attachment is remarkably low and non-significant (ρ_{02}) whilst the direct correlation between twin1 sensitivity and twin1 attachment is .41(ρ_{01}). Given that the correlation between each twin's sensitivity was very high (.74 - ρ_{12}), the inequality shown above clearly holds and suppressor

effects are the result. The major concern regarding the meaning of these effects is that they may have resulted from shared method variance between measures of sensitivity – because the same rater assessed both twins from each pair. Certainly, the above formula suggests that this is possible – the higher the correlation between twins for sensitivity the greater the likelihood that the right side of the above formula is greater than the left. Of course, for suppression to occur the cross-twin correlation must also be low – as it is in this case. This particular effect is unlikely to be a result of shared method variance and would seem to be interpretable as a child-specific pathway between sensitivity and attachment. Indeed, it should be noted that in any situation in which there is a highly child-specific relation between a predictor and a criterion (i.e. the cross-twin correlation approaches zero) but some positive correlation between children for the predictors, suppressor relations will result. It seems rather likely then that suppressor relations will be common if strong non-shared environmental pathways exist. The issue of suppressor relations would thus seem to be an important one for all those interested in the non-shared environment. Suppressor relations have received limited treatment in structural equation modelling (although see Bollen, 1992) and their presence cautions against strong interpretation of the single factor and bivariate analyses presented in this Chapter. Furthermore, the fact that both the bivariate model and the single-factor model both provided adequate accounts of the data suggests that caution should be exercised in making conclusions regarding the independent effects of shared and non-shared pathways of influence. The findings should be considered, at best, preliminary and await replication.

Furthermore, given the similarity of the interpretations given to the difference score analyses and those based on regression, one might wonder whether or not these different approaches actually represent two sides of the same coin. A moment's reflection shows that broadly this is indeed the case. For the regression analyses when there are suppressor effects we are estimating the following model:

$$P_1 = \alpha + \beta_1 X_1 - \beta_2 X_2 + e$$

Where P_1 is twin 1's attachment security

α is the intercept term

X_1 and X_2 are twin1 and twin2'sensitivity scores respectively

And e is an error term

For the difference score we correlate the difference between X_1 and X_2 with twin1 and twin2's attachment security separately. Each regression is thus implicitly testing the following model:

$P_1 = \alpha + \beta_3(X_1 - X_2) + e$

Or alternatively,

$P_1 = \alpha + \beta_3X_1 - \beta_3X_2 + e$

The similarity between the two models should be evident. In particular, the primary difference between the two models is that the difference score model assumes that the regression coefficients are the same for the two predictors. Thus, when suppressor relations are at work the two models are likely to be very similar except in the magnitude of the regression coefficients. At a more general level, regression approaches and differences scores are both essentially *independence* models in that each twin's score is assumed to have an independent, additive effect on the outcome. The difference score model simply makes more restrictive assumptions about the form of the associations – that one twin's score is positively associated with outcome, the other negatively and both roughly to the same degree. Thus, the same cautions would seem to apply when interpreting the difference score analyses as those raised earlier when discussing contrast effects – these associations between differential parental treatment and infant attachment security may themselves have resulted from suppressor effects.

Nevertheless, broadly speaking the question that this research clearly raises is this: What are the origins of non-shared influences on attachment? To some extent this study indicated that differences in maternal sensitivity could account for sibling differences in attachment. Nonetheless, the question of why this might be still remains. If it is true, why is it that parents treat their infants differently and why would one infant experience consistently less maternal sensitivity than another? Of course, it is possible that temperamental differences

could be responsible and that the direction of causation between maternal sensitivity and attachment runs the other way. Certainly, it is easier to feel affectionate to an affectionate baby, irritated with a difficult baby and it is easier to ignore an easy-going, independent one. These, perhaps small, differences in infants' personalities may well ultimately explain why parents might behave differently towards their children. Nonetheless, the results of Chapter 2 do not suggest strong genetic influences on attachment. On the other hand, early temperamental differences may arise out of environmental influences on biological development. Longitudinal genetic research into very early sibling-parent relationships would be invaluable in this regard. Of course, it is also possible that parents behave differently for idiosyncratic reasons but that these idiosyncrasies become self-perpetuating as the relationship develops.

Research into the specific causes of shared and non-shared influences on development is only just beginning and clearly there is a long way to go. Nonetheless, the current study found intriguing evidence that suggests that looking to similarities and differences in within-family relationships will be a fruitful avenue for future research in attachment and socio-emotional development.

CHAPTER 5

ADULT ATTACHMENT REPRESENTATIONS AND SHARED ENVIRONMENTAL INFLUENCES ON ATTACHMENT IN TWINS

The development of the Adult Attachment Interview (AAI) and the research that it has led to has had a profound effect on the way that researchers think about the nature of the underlying causal processes involved in the development of infant-parent attachment. This important breakthrough in both instrumentation and theory has given attachment researchers an empirical language with which to describe and investigate one of Bowlby's key ideas about the development of attachment. Bowlby suggested that attachment behaviour is controlled by representations or 'internal working models' of attachment that mediate continuities in attachment over time and ultimately lead to the transmission of patterns of attachment across generations. There is now considerable evidence to support Bowlby's view. In particular, parents' representations of their own attachment experiences assessed using the AAI appear to be strongly associated with their infants' attachment security in Ainsworth's Strange Situation even if the AAI is conducted before the birth of the child (Fonagy et al, 1991; Ward & Carlson, 1995).

The contemporary view of the causal processes involved in the development of individual differences in attachment was described in detail in the introduction to this thesis and is only summarised briefly here. According to current thinking internal working models of attachment underlie individual differences in infants' responses to separation in Ainsworth's Strange Situation procedure. These internal working models are believed to be derived from actual caregiving interactions between infants and their parents over the first year of life. Internal working models are then expected to be relatively stable over time and are thought to organise behaviour, thinking and feeling in times of separation, anxiety and loss across the lifespan. Ultimately, an adult's internal working model is thought to play a powerful role in a parent's capacity to respond sensitively and contingently to an infant's attachment signals and hence shapes the development of the infant's own representations of attachment. This model was referred to in the introduction as the linear model of attachment because it describes a single, continuous causal line that runs from early infancy to adulthood and across generations from parent to child. Current formulations of the development of attachment thus suggest that individual differences in attachment are caused entirely by shared environmental factors. Consequently, the linear

model makes the perhaps surprising prediction that children reared in the same family will develop the same pattern of attachment to any one parent. Twins represent a unique opportunity to test this key prediction of the linear model of attachment.

The aim of the present study is thus to test this important prediction of contemporary attachment theory in a sample of infant twins and their mothers. In chapter 2 of this thesis a significant albeit modest concordance was found in patterns of attachment in twins - consistent with the view that attachment is caused by shared familial factors. At the same time, little evidence was found for strong genetic influences on attachment security. Together these findings suggest that to some extent the shared environmental model of attachment may be broadly correct. On the other hand they also suggest that the linear model can only be one part of the story – strong evidence was also found for non-shared environmental influences on attachment that would not be predicted by the linear model. According to the linear model of attachment the origin of shared patterns of attachment ought to lie in shared patterns of maternal behaviour that are themselves determined by a parent's internal working model of attachment. Contemporary attachment theory thus predicts that the shared component of attachment between twins would be associated with a parent's 'state of mind with respect to attachment' (Main et al, 1985) and that this shared pathway will be mediated – at least to some extent – by shared patterns of maternal sensitivity. It is this prediction that the current study sets out to test – that concordances in attachment security in twins will be associated with congruent states of mind in the parent as assessed by the Adult Attachment Interview and that these associations will be linked by consistencies in maternal sensitivity.

5.1 The AAI and representational processes in adulthood

As van Ijzendoorn & Bakermans-Kranenburg (1997) have pointed out, the AAI represents a simple but revolutionary change of world-view for researchers investigating the processes involved in the intergenerational transmission of relationship patterns. Rather than focusing on the apparent 'facts' of a person's early life retrospectively, the AAI concentrates on a person's representation – or more strictly, presentation – of their attachment experiences during the course of the interview itself. As such the AAI aims to assess an adult's current thinking regarding attachment relationships. Van Ijzendoorn & Bakermans-Kranenburg (1997) note that earlier autobiographical approaches relied on an overly optimistic view of a subject's autobiographical memory capacities and failed to take into account systematic distortions in thinking such as repression, idealisation or

dissociation. Instead, the AAI assumes that autobiographical memory represents a subject's ongoing construction of the past in the light of new experiences. The AAI focuses exclusively on the subject's current working model of early family relationships and pays special attention to processes of idealisation and distortions of thinking that are evident in patterns of speech during the interview.

The AAI coding scheme is designed to assess the extent to which a person's thinking about early family relationships appears ultimately to be coherent. Transcripts of autonomous subjects are easy to follow, open to negative experiences and weaknesses in the self but are contained in their discussion of early family life. Autonomous adults are able to give supportive examples of their generalised descriptions of childhood and present a unified picture that is free-flowing and believable. This coherence in thinking regarding attachment relationships is thought then to underlie a parent's capacity for sensitive responsiveness. Observations of maternal sensitivity in relation to maternal AAI status seem to support this idea (van Ijzendoorn, 1995a).

Over 2000 AAIs have now been administered and coded and a good deal is known about normative distributions of AAI classifications. In non-clinical populations around 58% of transcripts are coded as autonomous, 24% as Dismissing and 18% as Preoccupied (Van Ijzendoorn & Bakermans-Kranenburg, 1996). Around 19% of cases are also classified as Unresolved with respect to loss or trauma of which the majority are given a secondary classification or either Dismissing or Preoccupied. There is also evidence that supports the clinical validity of the AAI. Rates of insecurity in clinical groups tend to high with only around 12% of cases classified as autonomous (Van Ijzendoorn & Bakermans-Kranenburg, 1996). On the other hand it is unclear whether the AAI has a great deal of clinical specificity although there is suggestive evidence that the U and CC classifications may be especially common in severely disturbed populations (Van Ijzendoorn et al, in press).

The AAI also appears to have good psychometric properties and has been shown to be independent of social desirability, general speech coherence, personality and autobiographical memory (Van Ijzendoorn & Bakermans-Kranenburg, 1997). Several studies have assessed the contribution of IQ to adult attachment classifications with somewhat equivocal results. Four studies have found no association between the AAI and measures of logical reasoning and verbal intelligence (Bakermans-Kranenburg & van

Ijzendoorn, 1993; Sagi, et al. 1994a; Rosenstein & Horowitz, 1996; Ward, Botyanski, Plunket & Carlson, 1991). However, Crowell et al (1993) found that Preoccupied subjects scored lower on the Henmon-Nelson Test of Mental Ability than did autonomous subjects. The weight of evidence seems to favour the view that the AAI is independent of general intellectual abilities or at least that the contribution of IQ to AAI classifications is likely to be small.

The fact that the AAI is predictive of infant attachment security has been reviewed thoroughly in earlier sections of this thesis and the findings are not repeated here in detail. There can be little doubt however that in normal Western samples there is strong evidence of a link between the AAI and infant attachment classifications in Ainsworth's Strange Situation with around a 75% match between the two (van Ijzendoorn, 1995a). Only one study in van Ijzendoorn's (1995a) meta-analysis failed to find cross-generational correspondence between the AAI and the Strange Situation (DeKlyn, 1992). Certainly in normative samples which are likely to involve stable middle-class families adult attachment representations appear to play an important role in the development of infant attachment security.

However, there is also emerging evidence that suggests that the strength of the association may depend to some degree on ecological factors. Aviezer, van Ijzendoorn, Sagi & Schuengel (1994b) carried out a study of the AAI and infant attachment security with families in Israeli Kibuttzim. The Kibuttzim represent an interesting context in which to study cross-generational transmission of attachment patterns because caregiving practices differ significantly from those found in most Western families. In particular, children in Kibuttzim spend a large part of the day in communal 'crèches' under the supervision of professional caregivers. Some families also have communal sleeping arrangements for their infants. As a result these infants only spend around three to four hours a day at home.

Aviezer et al (1994) only found significant cross-generational concordance in attachment for those families whose infants slept at home. Consequently, it seems that the influence of a parent's representations of attachment is to some extent context-dependent and may depend on the child-rearing practices of a particular family or society. Whether these ecological effects hold true for less extreme differences in caregiving practices is not

known. A further aim of this study is to assess whether the processes that appear to operate in singleton families also take place in the special caregiving context of twins.

The current study will this test the shared linear model of attachment in a sample of infant twins and will investigate the role of maternal sensitivity in mediating shared pathways of influence between infant attachment security and maternal state of mind with respect to attachment.

METHODS

Participants

The participants in this study were described in detail in the methods section of chapter 2. The current study includes 55 parents and their infant twins. For two parents from the total sample of 58 families involved in this research three did not have AAI data. In one case the mother did not speak English fluently enough to allow the AAI to be conducted. In the second case the twins' maternal grandmother died very shortly before the AAI was to be conducted and the mother elected not to do the interview because of this recent loss. A third family went abroad for the period during which AAIs were conducted. Two further families were not observed in the home because their infants were too old at the time of recruitment. Thus, for the purposes of the present study, 55 families had AAI and Strange Situation data and 53 had a complete set maternal sensitivity, AAI and Strange Situation assessments. The singleton cases identified for case-matching in Chapter 2 from the study by Fonagy et al (1991) were also used in this Chapter to explore differences in intergenerational correspondence between the AAI and the Strange Situation. Details of case-matching and the sample characteristics of these singleton mother-infant dyads are presented in Chapter 2.

Procedures

Adult Attachment Interviews were carried out between 10 and 11 months corrected age. Both mothers and fathers were interviewed although only data from mothers are reported in this study. The families were visited in their homes by two researchers whom they had met previously. Interviews were conducted in the early evening immediately after the babies had been put down to sleep. Interviews with mother and father were conducted in separate rooms. A male researcher interviewed the father while a female researcher interviewed mother. Parents were reminded of the broad content of the Adult Attachment Interview and that their responses would be kept strictly confidential. Parents were also reminded that they were not obliged to answer questions they did not want to. Each interview was tape recorded for later transcription. Following the Adult Attachment Interview parents were asked a further series of brief questions about their infants' personalities and the strains and difficulties of caring for infant twins. This second interview lasted approximately 20-30 minutes. Data from this interview are not reported here.

The Adult Attachment Interview – The AAI is a one-hour semi-structured interview about memories and evaluations of early family relationships. The interview consists of 21 questions covering many facets of adults' memories of childhood such as memories of being hurt, illnesses, and feelings of rejection and punishment. The interviewee is also asked to think of five adjectives that they feel describes the relationship that they had with each of their parents. The interviewee is asked to provide specific supportive memories of each generalised description. The interview also includes a section on loss and trauma and a series of questions about current relationships with parents. The speaker is also asked about the impact that these early experiences may have had on their current personalities and the reasons why their parents behaved the way they did. Verbatim transcripts of the interview are then coded according to the scheme developed by Main & Goldwyn (in press). Main & Goldwyn's coding scheme consists of two sets of 9-point rating scales. The first set relates to the rater's best judgement regarding the subject's actual experiences during childhood. Each of the subject's parents are rated for loving, rejecting, involving/role-reversing behaviour and the extent to which the parent in question pressured the subject to achieve.

The transcript is then rated for the speaker's apparent state of mind with respect to attachment as evidenced in speech during the interview. Main & Goldwyn's coding scheme consists of several 'state of mind' scales that assess idealisation, preoccupying anger, derogation, insistence on lack of recall of childhood and passivity of speech. Sections of the transcript relating to loss and trauma are also rated for disorganised/ disoriented responses. Finally the transcript is given two global ratings for coherence – one that relates directly to the surface coherence of the transcript and another that relates specifically to the rater's estimate of the coherence of the speaker's thinking regarding attachment issues. The second coherence scale takes into account factors that go beyond the internal consistency of the transcript and include judgements of the extent to which thinking expressed during the interview conforms to external criteria (such as normative views regarding causation).

Once these rating scales are completed the judge assigns a classification on the basis of the transcript's fit to four broad categories described by Main & Goldywn as Secure-Autonomous (F), Preoccuppied/Enmeshed (E), Dismissing (D) and Unresolved with respect to loss or trauma (U). Secure-Autonomous transcripts are characterised by free-flowing, open and coherent speech that is easy to understand and presents a balanced

view of early relationships and their effects on later development. Enmeshed transcripts are often excessively long and confusing and are marked by a pervasive inability to move beyond early family relationships. There are two principal sub-categories of Enmeshed response labelled E1 and E2. E1 transcripts are characterised by extreme passivity of speech in which the speaker makes excessive use of non-sense language (e.g. " and he said "blah, blah, blah and this that and the other") or fails to complete fully started sentences (e.g. "and that was when she .. we went on holiday for two weeks""). E2 transcripts on the other hand are marked by unmitigated, over-involving anger towards an attachment figure, often blaming them at great length without setting the offender's actions in context. E2 transcripts also often feature unmarked and unnecessarily long quotations of the offending parent in a manner that suggests that the speaker has failed to attend to the discourse context. Dismissing responses are generally characterised by a minimising approach to the discussion of early family relationships. Dismissing subjects often describe their relationships with their parents as having been perfect, wonderful or normal but are unable to give specific examples that might corroborate such positive descriptions. Thus, some dismissing transcripts are marked by substantial idealisation of parents and a strong insistence of lack of recall of childhood (Ds1). Others demonstrate some acknowledgement of negative incidents during childhood but nonetheless maintain that the self was unaffected by these experiences (Ds3). A minimising approach is also evident in subjects who actively derogate an attachment figure (Ds2) as if the person in question is not worthy of further discussion (e.g. "my father was an idiot, end of story"). Finally, disorganised/ disoriented responses (U) to loss or trauma are scored when the subject demonstrates lapses in the monitoring of reasoning or discourse during the discussion of a loss or traumatic experience. Examples include confusion about whether the lost one is alive or dead, substantial slips in reasoning about causality (e.g. "funny how you can kill someone with a word" – from Main & Goldwyn, in press), sudden changes in speech style often into eulogistic speech and repeated denial or confusion about whether a parent was abusive or not. If a primary classification of U is given the judge also gives a best-fitting classification of F, E or Ds.

Four judges assigned ratings and classifications to the 55 transcripts (Mary Target – University College London; Sergio Muscetta – University of Rome; Christine Tyrrell – University of Delaware; Nina Koren-Karie - University of Haifa). All four raters have demonstrated 80% reliability on 30 independent test cases provided by Mary Main and Erick Hesse at Berkeley, University of California.

Strange Situation and maternal sensitivity– The assessment of infant–mother attachment security using Ainsworth's Strange Situation procedure and the Maternal Behaviour Q-Set measure of maternal sensitivity were described in detail in chapters 2 and 4. Infants were given best-fitting ABC classifications and D scores and classifications when appropriate.

The results of this study are presented in three sections. The first simply describes the frequencies of adult attachment classifications in this sample of 55 mothers. Comparisons will be made with expected frequencies derived from normative data as a way of assessing the representativeness of the sample. Following this descriptive overview two, three and four way correspondence between adult attachment classification and infant-mother attachment security shall be described. Following early chapters, the infants were divided into two groups (twin1 and twin2) at random. Associations between the AAI and infant attachment security will be analysed separately for each of these groups. This section will also examine associations between the AAI, maternal sensitivity and infant attachment classification. Finally multivariate analyses will test the hypothesis that maternal attachment security and maternal sensitivity are associated with infant attachment classification in both samples of twins simultaneously. These analyses directly test the hypothesis that maternal attachment representations might underlie the association between infant attachment classifications found in chapter 2.

5.2 Section 1: Distribution of attachment classifications

In this sample of 55 mothers of infant twins 63.6% were given a primary classification of Secure-Autonomous (F). Of the 36.4% given an insecure classification, 16.4 were classified Dismissing, 9.1% Preoccupied and 10.9% were Unresolved with respect loss or trauma. These frequencies closely match those observed in the control sample of singletons and that of normative data (see van Ijzendoorn & Bakermans-Kranenburg, 1997.). Of the six mothers given a primary classification of U, five were given a best-fitting three-way classification of Secure-Autonomous and one was Dismissing. All U classifications were given for unresolved loss – none with respect to trauma or abuse. The mean score for coherence of mind across the entire sample was 5.4 (S.D. = 1.8) which again closely matches normative data (Main & Goldwyn, in press).

5.3 Section 2: Univariate and multivariate associations between adult attachment status, maternal sensitivity and infant attachment security

In order to examine the correspondence between maternal attachment security in the AAI and infant attachment classification in Ainsworth's Strange Situation three- and four-way AAI classifications were cross-tabulated with infant ABCD and ABC classifications for

twin1 and twin2 samples separately. These two cross-tabulations are presented in tables 5.1 and 5.2 below. Cell standardised residuals are also presented in parentheses.

Table 5.1 Four-way correspondence between maternal AAI and infant attachment security (standardised residuals in parentheses)

	Infant attachment classification			
AAI Classification	Avoidant	Resistant	Secure	Disorganised
Twin1 sample				
Dismissing	2 (.4)	2 (-.3)	4 (-.1)	1 (.2)
Preoccupied	0 (-.9)	4 (2.3)	1 (-.9)	0 (-.7)
Secure	7 (.5)	8 (-.5)	17 (.1)	3 (-.1)
Unresolved	0 (-1)	1 (-.5)	4 (.7)	1 (.6)
Twin2 sample				
Dismissing	2 (1)	2 (0)	4 (-.3)	1 (-.4)
Preoccupied	0 (-.7)	2 (.9)	2 (-.3)	1 (.2)
Secure	4 (.1)	5 (-1)	19 (.3)	7 (.5)
Unresolved	0 (-.8)	3 (1.5)	3 (0)	0 (-1)

Inspection of the above table reveals little evidence of a match between maternal AAI classification and infant attachment security. Overall the match was not significant in either sample (twin1: $\kappa = .12$, $p = .14$; twin2: $\kappa = .06$, $p = .44$). Three-way correspondence was marginally greater, as shown in table 2 below.

Table 5.2 Three-way correspondence between maternal attachment status and infant attachment security (standardised residuals in parentheses)

	Infant attachment classification		
AAI Classification	Avoidant	Resistant	Secure
Twin1 sample			
Dismissing	3 (.9)	2 (-.6)	5 (0)
Preoccupied	0 (-1)	4 (2)	1 (-1)
Secure	7 (-.1)	11 (-.4)	22 (.4)
Twin2 sample			
Dismissing	2 (.5)	4 (.4)	4 (-.6)
Preoccupied	0 (-.9)	3 (1.1)	2 (-.4)
Secure	6 (.1)	11 (-.6)	23 (.4)

For the twin1 sample the three-way match between maternal AAI classification and infant attachment security was significant (κ=.17, p = .05). However for the twin2 sample the match was not significant (κ=.12, p = .15). The association between maternal and infant attachment security (F versus not-F and B versus not B) was not significant in either sample (twin1 ϕ = .04, p = .83; twin2 ϕ = .09, p = .52). Evidently, it was not the case that 3-way mismatches could be accounted for by systematic associations between maternal Dismissing status and infant resistance or maternal Preoccupation and infant avoidance. Most of the mismatches between maternal AAI and infant attachment security appeared to originate from those secure mothers with avoidant or resistance infants. Given the overabundance of resistant infants in this sample and no parallel increase in the number of adults classified as Preoccupied this lack of correspondence may not be surprising. Thus these data provide only very modest support for an association between maternal state of mind with respect to attachment and infant attachment security.

A series of log-linear analyses were then carried out in order to evaluate the multivariate hypothesis that maternal state of mind with respect to attachment predicts infant attachment security in both samples of twins simultaneously. Hierarchical log-linear analysis enables multivariate models of categorical data that permit a direct test of this hypothesis. Specifically, a set of nested models were tested which together assess whether maternal state of mind with respect to attachment predicts infant attachment classification and whether maternal AAI classification underlies the association between Strange Situation classification in twins. Two sets of analyses were carried using the 3-way and

dichotomous attachment classifications for both the AAI and Strange Situation classifications. The 4-way classifications were not analysed because the expected frequency in each cell of a 4 x 4 x 4 table would be prohibitively low. In each analysis three sets of nested models were tested which are illustrated schematically in fig. 5.1.

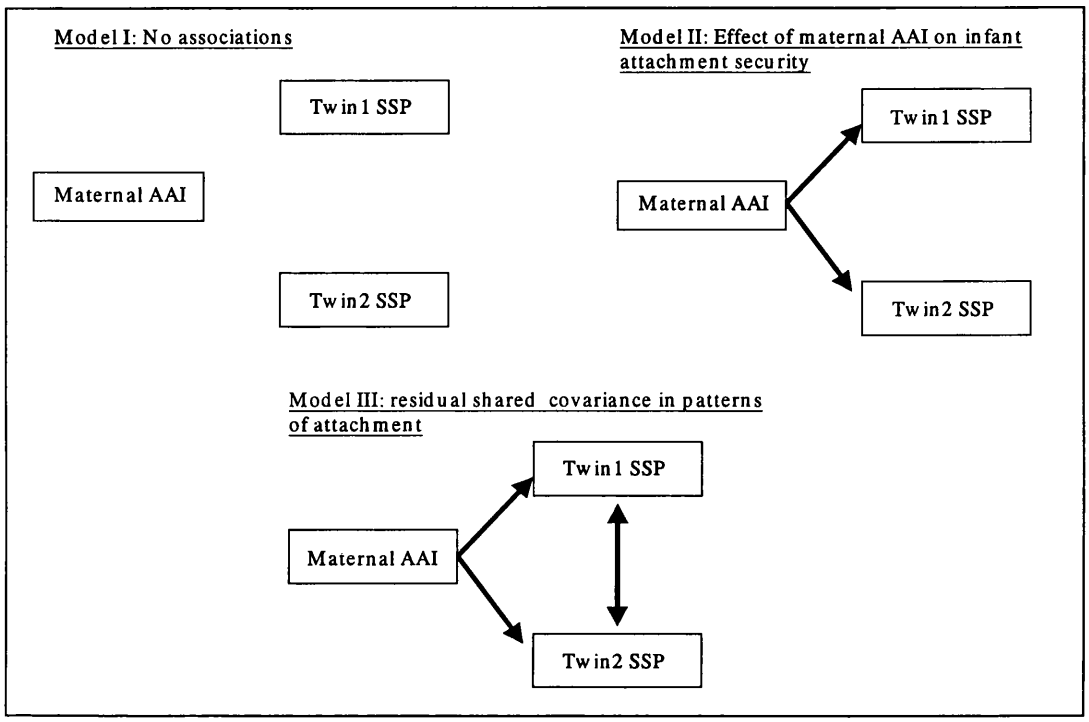


Fig. 5.1 Log-linear modelling of associations between maternal state of mind with respect to attachment and twin attachment classifications

Model I simply includes parameters associated with the marginal distributions of each variable considered separately. As such the first model assumes that there are no associations between any of the three variables. Model II includes associations between maternal AAI classification and both infants' attachment classifications. The difference in fit between model I and model II thus represent a test of the joint effect of maternal AAI on both twins' attachment security. Finally, model III allows for an association between twins' attachment classifications. The difference in fit between model II and model III then represents the association between twins' attachment classifications after controlling for the effect of maternal state of mind.

The fit of the three models for 3-way and dichotomous attachment classifications, as well as the significance of the difference in fit between them, are presented in table 5.3.

Table 5.3 Results of log-linear analyses of associations between adult attachment status and infant attachment security (n = 55)

Model	Likelihood ratio χ^2	Df	P-value of model χ^2	Incremental change in χ^2	P-value of change in χ^2
3-way classification					
I	29.006	20	.088	- - -	- - -
II	18.164	12	.111	10.842	.210
III	5.742	8	.676	12.422	.014
2-way classification					
I	5.140	4	.273	- - -	- - -
II	4.635	2	.098	0.505	.780
III	0.504	1	.478	4.131	.042

It can be seen from the above table that there was little evidence of an overall association between maternal state of mind and infant attachment classification when both samples of twins were analysed simultaneously. Similarly, after controlling for maternal AAI classification a significant association between twins' attachment security remained in both sets of analyses. In both cases the final model represented a good fit to the data. Indeed, not only did deletion of the effect of maternal AAI not significantly reduce overall model fit but the resulting model - with only the association between twins' attachment classifications included - fitted the data well (3-way χ^2 (16) = 14.67, p = .55; 2-way χ^2 (3) = .95, p = .81). As such the data indicated no significant 'main effect' of maternal attachment status on infant attachment classification nor did it suggest a three-way interaction between maternal AAI and both twin's attachment classifications.

A further set of loglinear analyses were carried out to test whether the observed associations between the AAI and infant attachment security were significantly smaller than expected on the basis of past singleton data. The singleton case-matched controls identified in Chapter 2 from the study by Fonagy et al (1991) were used for comparison. The loglinear analysis proceeded by estimating a model in which the frequencies are explained by a general cross-group association between the AAI and the Strange Situation and this model was then compared to the fit of an alternative model in which the size of

the association was moderated by sample (i.e. twins versus singletons). This analysis was carried out twice – once for the twin1 sample and once for the twin2 sample. Only the secure-insecure attachment classifications were analysed. The first in both cases did not appear to fit the data well and the improvement in fit between this model and one that allowed for moderation of the intergenerational effect was significant (twin1 Model 1: $\chi^2(1) = 6.27$ p = .012; twin2 Model 1: $\chi^2(1) = 4.96$ p = .026[1]).

5.4 Section 3: Maternal state of mind with respect to attachment, home observations of maternal sensitivity and infant attachment status

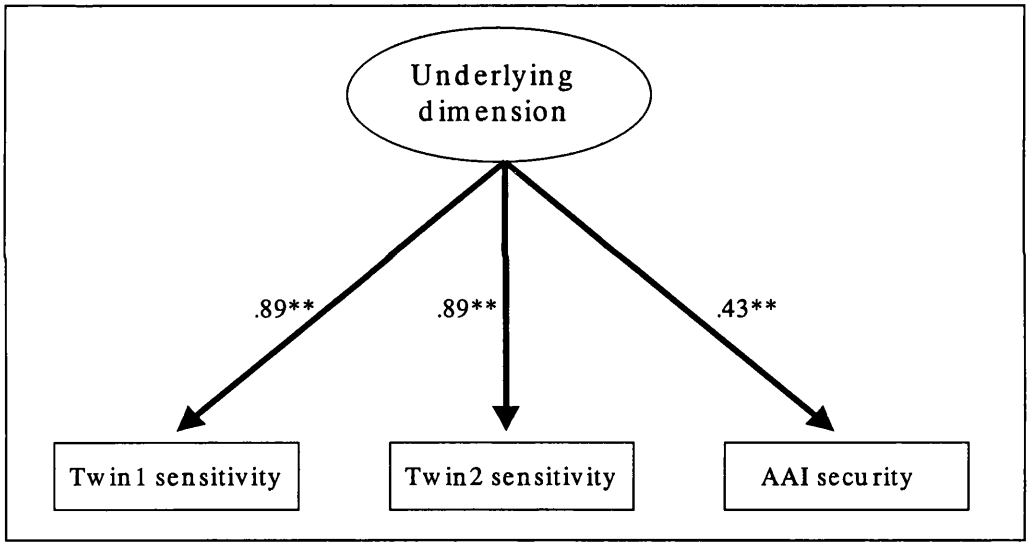
In chapter 3 of this thesis it was shown that shared patterns of attachment in twins as assessed in Ainsworth's Strange Situation were associated with a shared dimension of maternal interactive behaviour. The linear intergenerational model of attachment suggests that parental representations of attachment ought to influence an infant's attachment security by way of observable patterns of caregiving behaviour. This next section examines the relationship between adult attachment security and naturalistic observations of maternal sensitivity.

To test the hypothesis that there were mean differences in maternal sensitivity towards either twin between the four adult attachment groups two MANOVAs were carried out using the four-way and three-way AAI classifications with each twin's maternal sensitivity scores as the two dependent variables. In both cases the MANOVAs were non-significant (Four-way: Wilks' Lambda = .872, F(6, 96) = .23, p = .79; Three-way: Wilks' Lambda = .928, F(4, 98) = .93, p = .45). However, when the secure-insecure adult attachment groups were compared the MANOVA approached significance (Wilks' Lambda = .893, F(2, 50) = 3.00, p = .059). The individual correlations between maternal security and sensitivity were both significant (Twin1 sample: r = .30, p = .027; twin2 sample: r = .31, p = .022). The fact that the overall MANOVA only approached significance whilst the separate correlations were each significant on their own suggested that the effects of maternal attachment security on each twin's attachment classification were not independent of each other. In order to test this possibility formally a logistic regression was carried out with maternal security as the dependent variable and each twin's maternal sensitivity score as predictors. As before, the overall regression only approached significance ($\chi^2(2) = 5.74$, p = .057). As expected the independent regression

[1] The difference between the two models is equivalent to the χ^2 and significance for model I because the comparison model is saturated

coefficients for each twin's individual scores did not even approach significance (twin1 maternal sensitivity: B = .58, Wald = .39, p = .53; twin2 maternal sensitivity: B = .89, Wald = .82, p = .37).

To test the simple model that maternal attachment security and maternal sensitivity towards each twin could be explained by a single underlying dimension, a single-factor confirmatory factor analysis was carried out using Bentler's EQS structural equation modelling program (Bentler, 1989). For the purposes of identification the factor loadings for each twin's maternal sensitivity scores were constrained to be equal. Tetrachoric correlations were computed for the categorical maternal attachment status variable according to procedures developed by Lee et al (1992). The single-factor model and the resulting Generalised Least Squares standardised parameter estimates are shown in fig. 5.2.



(** p < .001)

Fig. 5.2 Single-factor model of adult attachment status and maternal sensitivity to infant twins

The model provided an excellent explanation of the data ($\chi^2(1) = .01$, p = .92). Bentler & Bonnett's Normed Fit Index (BBNFI) and LISREL's Goodness of Fit Index (GFI) were both 1.00. All three parameter estimates were significant at the p < .001 level.

Finally, a further structural model was estimated that aimed to test the notion that this underlying dimension would be associated with a shared dimension of infant attachment

security. The model was a simple extension of the single-factor model in which the above factor was assumed to cause a shared dimension of infant twins' attachment security.

The model is shown below in Fig. 5.3 along with the Generalised Least Squares parameter estimates. As before, Lee, Poon & Bentler's (1992) multivariate approach to the estimation of model parameters with categorical data were used. The factor loadings between the maternal dimension and each twin's maternal sensitivity score were constrained to be equal. Furthermore, the loadings between the shared attachment factor and each twin's attachment security were also constrained to be equal.

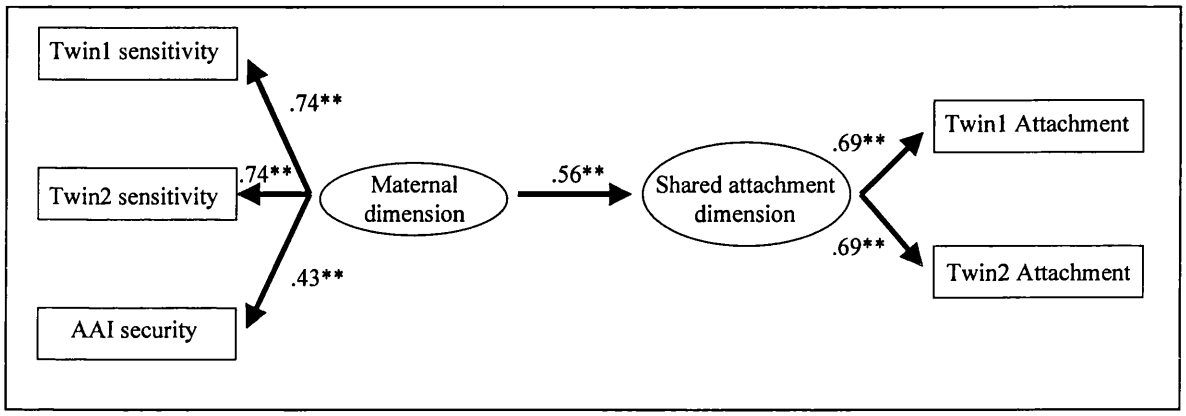


Fig. 5.3 Linear model of pathways between maternal attachment representations and behaviour and shared patterns of infant-mother attachment in twin (error terms omitted).

Overall the model appeared to fit the data only moderately well. In particular while the various fit indices indicated acceptable fit (BBNFI = .985, Comparative Fit Index = .991, LISREL GFI = .946), the data did depart significantly from that expected under the model (χ^2 (6) = 17.8, p = .03). Inspection of residuals suggested that the model overestimated the correlation between maternal AAI status and infant attachment security and underestimated the correlation between each twin's maternal sensitivity score. The model also underestimated the correlation between each twin's sensitivity and that same twin's attachment security – perhaps reflecting the child-specific pathways found in Chapter 4. Nonetheless, all parameter estimates were highly significant and the model was broadly consistent with the basic notion that shared patterns of parenting are associated with adult attachment representations and that this shared parental dimension was associated with shared aspects of infant attachment security in twins.

DISCUSSION

The aim of this study was to find evidence for a key prediction of contemporary attachment theory. According to current formulations of the mechanisms involved in the development of individual differences in infant-parent attachment children in the same family are expected to develop the same pattern of attachment to a given parent. Indeed, attachment theory goes much further than merely suggesting that shared environmental processes are important in the development of attachment. The internal working models view of attachment makes several specific, testable predictions about the nature of these shared environmental processes. In particular, contemporary attachment theory predicts that shared patterns of infant-parent attachment will be associated with a specific shared dimension of parental interactive behaviour and that this in turn will be related to that parent's own representations of attachment. The current study thus aimed to test this account by investigating maternal representations of attachment, observed patterns of maternal sensitivity and infant attachment security in twins.

The results of this study and those presented earlier in this thesis seem to broadly confirm the linear model of attachment in all but one –albeit significant - respect. Firstly, maternal representations of attachment as assessed in Mary Main's Adult Attachment Interview (AAI) were consistently associated with the quality of a parent's interactions with each of her infants. A mother classified as secure-autonomous was rated on average as being more sensitive to her infant's attachment signals in the naturalistic home-context at 9 months of age than those classified as Dismissing, Preoccupied or Unresolved with respect to loss. Secondly, maternal sensitivity appeared to be a relatively stable parental characteristic that was experienced similarly by both infants in a family. These consistencies in maternal behaviour appeared in turn to be related in a lawful fashion to patterns of secure-base behaviour observed in Ainsworth's Strange Situation three months later. These findings are exactly what would be predicted by the linear intergenerational model of the development of attachment. However, the results of this semi-longitudinal research is at odds with what might be expected from this model in one specific way: the AAI was not found to be directly - or at least consistently - associated with infant attachment security. This finding is to say the least surprising in view of the number of previous studies in singleton populations that have found substantial links between adult attachment representations and infant attachment security and raises certain questions about the representativeness of twin populations.

The finding that maternal sensitivity varied in a predictable way with adult attachment security replicates several previous studies. Furthermore, the size of the association found in this study closely matched that found by van Ijzendoorn in his meta-analysis of studies investigating maternal sensitivity and adult attachment security (van Ijzendoorn, 1995a). Van Ijzendoorn found an effect size equivalent to a correlation of .34 and in this study the correlation between AAI security and maternal sensitivity in both samples of twins was around .30. The present study was able to show that this effect was a shared one and that maternal sensitivity to each twin and adult attachment security could be assumed to be caused by a single underlying dimension. In each case these measures may thus be thought of as error-laden indicators of a true adult attachment dimension or internal working model. It is common to suggest that the AAI somehow causes maternal sensitivity but it is probably more reasonable to suppose that the AAI represents the verbal aspects of an adult's internal working model and that maternal sensitivity reflects behavioural components of the same underlying system. This particular aspect of the findings of this study is remarkably consistent with the internal working models view. Perhaps even more remarkably, this shared dimension of maternal attachment behaviour (verbal and behavioural) was directly associated with a shared dimension of infant attachment security. Taken together these findings fit well both with contemporary theory and with findings from research that has only examined one child per family.

Nonetheless, the lack of direct association between adult attachment representations in the AAI and infant attachment security is perplexing. There was only very modest evidence of an association - with the three-way correspondence between the AAI and the Strange Situation being significant in one sample of twins but not the other. The extent of intergenerational correspondence was also significantly less than that found in a previous investigation using a sample of singletons that were matched for maternal age. So, despite clear links between the AAI and maternal sensitivity and parallel associations between sensitivity and infant attachment it seems that those mothers who were sensitive and had secure infants were not necessarily the same mothers who were themselves secure and were rated as sensitive in their interactions. In other words, the component of variance in maternal sensitivity that was associated with adult attachment was not the same as that associated with infant attachment. There are several potential explanations of this result. The first is that the lack of association was a sampling aberration. It is quite possible that this null result was simply a type II error – a null finding in the face of a real effect.

Certainly, if maternal sensitivity is assumed to be a singular (i.e. non-heterogeneous) construct, the results of the model-fitting would seem to imply that this is indeed the case. However, the results of the model-fitting analysis did suggest that this pattern of covariance departed significantly from what might be expected by chance under this simple factor structure. However, this lack of fit was partly attributable to the failure of this model to take into account non-shared pathways between sensitivity and attachment and to the large correlation between twins for maternal sensitivity. This study of course is not the first study to fail to find a direct association between the AAI and the Strange Situation (see van Ijzendoorn, 1995a). Additionally, direct reliability data for the Adult Attachment Interview were not available in this study and hence lack of consistent rating could offer a potential explanation. Nonetheless, all raters had shown excellent levels of reliability in independent formal tests. Furthermore, if reliability were truly the source of the low association between the AAI and the Strange Situation it would also be expected to affect the AAI's association with measures of maternal sensitivity. Indeed, in previous studies the effect of adult attachment security on maternal sensitivity has been found to be consistently lower than its effect on infant attachment security. Logically it would seem more likely that measurement error would lead to a type II error for the association with maternal sensitivity than infant attachment security.

If measurement error is not the answer then the obvious alternative is the twin context itself. It may be that aspects of the twin situation disrupt the usual pathways between an adult's attachment representations and the relationship they have with their child. The effect of adult attachment on maternal sensitivity was of course still observable, but in the twin context it was not this aspect of sensitivity that played the major role in the development of attachment security. In Chapter 4 of this thesis it was suggested that twin's relationships with their parents influence each other and that the sensitivity of a mother's interactions with one child may have a negative impact on the security of the other. It is plausible that the key aspects of maternal behaviour in the twin context relate to competitive triadic interactions that are not directly related to the parent's attachment security. It certainly seems plausible that co-twin behaviour and the parent's moderation or response to these behaviours may play an especially important role in infant twins' feelings of security where competition for parental attention may be particularly intense. Future research will be able to directly test this possibility in two ways. To begin with, replication of this finding is needed urgently to clarify whether or not sampling error is responsible for this constellation of results or whether the twin situation genuinely

represents an ecological context in which family attachment relationships operate in a different way from those in non-twin families. Secondly, further research into the effect of infants' relationships with their parents and the effect of these relationships on each other in twins and closely-spaced siblings may serve to elucidate the factors that moderate the influence of adult attachment representations on infant attachment security.

These findings also raise interesting methodological issues. Arguably, one of the great strengths of attachment research is its strong theoretical base. Without this rich theoretical framework and the theory-driven research that it has given rise to the possibility of limitations to the generisability of twin data may well have been overlooked. Behaviour genetics research by contrast is largely atheoretical and measurement-oriented. Consequently, behaviour genetics research is unable for the most part to make many predictions about specific developmental processes. If research relied purely on the concordance between twins in attachment security, important potential limitations would be missed. The current study suggests that limitations in the capacity of twin populations to deliver truly generalisable findings need to be taken seriously.

Nonetheless, despite this limitation the results of this study are generally consistent with the linear model of attachment. A single, continuous causal factor seemed to underlie parents' attachment representations and behaviours and this latent attachment factor appeared to be responsible for the development of shared patterns of infant attachment behaviour in Ainsworth's Strange Situation. Perhaps one of the most pressing research questions for the future will be the extent to which this pattern of results will hold true in non-twin siblings. Research in three labs in Canada, Holland and the States is currently underway to do just that (van Ijzendoorn et al, unpublished manuscript). It will also be important to further explore the possibility of genetic factors that might equally well explain these findings. Certainly, from the small group of identical twins in this sample there was little evidence of genetic influences on attachment security. Nonetheless, the extreme lack of power afforded by this sample cautions against dismissing the possibility of genetic mediation of the intergenerational transmission of patterns of attachment. The categorical nature of most measures of attachment security coupled with likely modest genetic influences suggests that large samples of MZ and DZ twins and their parents will be needed to ensure adequate statistical power (Neale & Cardon, 1992).

The current study suggests that behaviour genetics research into the development of infant-parent attachment will prove to be a fruitful endeavour for attachment researchers and geneticists alike. For attachment researchers twin and adoption designs offer novel and powerful ways of exploring developmental processes and point to new methodologies for exploring attachment patterns in family systems. Behaviour genetics research also offers the possibility of directly addressing the issue of biological or genetic influences on attachment and renders the question of child effects tractable. At the same time, the methods and theory of attachment research highlights important issues for behaviour geneticists. The detailed observational procedures of attachment research offer behaviour geneticists with valuable techniques for addressing realistic developmental processes. Furthermore, the detailed theoretical framework that researchers have developed for understanding the development of attachment represents an important model for genetic research. A clear theoretical framework allows predictive specificity and offers an extremely valuable way of assessing the meaningfulness of behaviour genetic findings.

CHAPTER 6

THE ORIGINS OF SHARED AND NON-SHARED PATTERNS OF ATTACHMENT: AN EXPLORATORY ANALYSIS OF PREDICTORS OF CONCORDANCE

The current series of investigations aimed to document, in a preliminary manner, the extent of shared and non-shared influence on infant-parent attachment in a sample of twins as a novel way of exploring developmental processes in early socio-emotional development. Twins and siblings represent a valuable way of testing certain key predictions about sources of variance in attachment security. In particular, contemporary attachment theory suggests that the primary mechanisms involved in the development of patterns of attachment are ones shared by children in the same family and that– by implication – these factors should lead to considerable family resemblance in secure-base behaviour as observed in Ainsworth's Strange Situation. On the other hand, behaviour-genetic research in many areas of cognitive and socio-emotional development has pointed strongly to the significance of sources of variability in outcome that operate within families and hence lead to substantial differences between siblings in the development of cognitive abilities, personality and psychopathology (Plomin & Daniels, 1987).

Earlier chapters in this thesis presented findings from a twin study of infant-parent attachment using Ainsworth' Strange Situation which were generally consistent with both of these points of view. Firstly, there was evidence that twin resemblance for attachment security is greater than would be expected by chance and that this resemblance might not be explained by shared genetic factors. On the other hand, by far the majority of the variance in individual differences in patterns of attachment were of the non-shared kind - suggesting a very important and hitherto neglected role for within-family processes in the development of attachment security and insecurity. The fundamental unanswered question – and one that that is likely to be a central one in future attachment research – is this: how is it that children in the same family can have different attachment relationships with the same parent?

The significance of processes that lead to unique developmental outcomes - both in the domain of attachment and elsewhere – points unequivocally to the importance of research aimed at identifying the specific developmental mechanisms that give rise to these

remarkable within-family differences. Indeed, in Chapter 4 of this thesis some tantalising evidence was found that suggested the possibility that systematic differences in parental behaviour and sibling-sibling relationships may represent sources of differential experience for children growing up in the same family that may come to have an impact on the developing infant-parent attachment relationship. Nevertheless, these findings were not clear cut and without replication they must clearly be considered at best suggestive. Furthermore, only a relatively modest proportion of the variance in attachment security could be explained by these factors - leaving a great deal of variation in attachment security left to be accounted for. Research into the origins of within-family differences in developmental outcome is still in its infancy. Little is known about the likely origins of non-shared influence on development. This final chapter is an exploratory investigation of a range of factors that might plausibly be associated with non-shared patterns of attachment in twins.

Generally speaking, research into the causes of non-shared developmental outcomes can be divided into two broad kinds- each reflecting different methodological approaches to the problem of the non-shared environment. The first and more traditional approach relates non-shared patterns of developmental outcome to non-shared variance in putative causes. As such, the causal factors of interest are thought of as direct causes of behavioural outcome variables. In other words: non-shared outcome derives from child-specific causes. This approach is often tested with twin or adoption data using bivariate genetic models of which the analysis presented in Chapter 4 is a special case. In Chapter 4 the evidence for such direct causes of non-shared outcome in attachment security was unclear – child-specific pathways were found when covariate analyses were performed (logistic regression) but not when a latent variable model was used. It was suggested that the constraints required to ensure parameter identification in this latent variable model may have diminished the power of this analysis. Of course, the necessity for such constraints reflects the limits of twin data for separating shared and non-shared causal pathways. Furthermore, because the degrees of freedom of this model are so limited it was not possible to include contrast effects which were evident from univariate and regression analyses and as a result the common and specific factor model analysis may be miss-specified. Despite these difficulties, some promising evidence was found that suggested that child-specific patterns of maternal behaviour are associated with child-specific outcomes in attachment security. Bivariate modelling did suggests significant associations between non-shared components of variance in attachment and maternal

sensitivity. Little evidence was found for any other direct (shared or non-shared) influences on attachment security that might yield to this kind of bivariate analysis (See Chapter 3).

An alternative approach to the problem of predicting non-shared outcome is to identify broad distal factors associated with similarity or concordance between sibs regardless of their direct effects on outcome per se. To put it another way, *similarity* or *concordance* can be thought of as between-family variables and may be treated as such using standard statistical procedures such as multiple linear regression, discriminant function analysis or logistic regression. From this perspective, it is possible that positive predictors of similarity or concordance between sibs for attachment security may nevertheless be independent of attachment security itself. Such predictors of concordance may instead be considered to represent the between-family conditions that lead to within-family variability.

As yet little research of this kind has been carried out, although the work of Dunn & Plomin (1986) represents an important example. Dunn and Plomin (1986) carried out one of the first investigations of factors associated with within-family variability. Dunn & Plomin were interested in predicting the extent to which mothers behave consistently towards their children at comparable ages from assessments of maternal personality and IQ as well as measures of child temperament. Despite the fact that the second assessment of maternal behaviour followed the first by around two and a half years, Dunn & Plomin observed striking levels of consistency in maternal behaviour between siblings– a finding strongly replicated in a concurrent design by this study and others (see chapter 3 and DiLalla & Bishop, 1996). Even more importantly, Dunn & Plomin found maternal consistency to be associated with maternal personality factors and infant temperament. Mothers who rated themselves as high on neuroticism and emotionality and low on extraversion tended to be less consistent in terms of affection and intrusiveness towards each of their children. Furthermore, differences in temperament were also associated with differences in maternal consistency.

Dunn & Plomin's work sets an important agenda for developmental researchers in highlighting several significant issues. Firstly, their research suggests the limits of influence of maternal behaviour, at least as traditionally measured, on within-family variability in development in at least one specific sense – children at the same age level

are likely to receive similar levels of affection and control during infancy and early childhood. However, at any one point in time children of different ages may experience quite different maternal behaviour. It may be that concurrent discrepancies in parental behaviour play a more important role in the development of within-family differences than differences in maternal behaviour at particular developmental stages. Secondly, Dunn & Plomin's study points to the importance of between-family contexts that may be associated with within-family variability. The implication of Dunn & Plomin's research is that some contexts lead to greater within-family variability than others. In this sense Dunn & Plomin's finding suggest that models of non-shared influence on development may need to be interactive in nature –differential estimates of the non-shared environment may obtain under different social or biological circumstances.

Of course, from these data alone it is unclear what impact these dimensions of maternal behaviour might have on children's behavioural and emotional development. Nonetheless, evidence was reviewed in earlier sections of this thesis that is consistent with the view that maternal behaviours such as these influence the development of infant-parent attachment. Furthermore, evidence was also described that suggests that discrepancies in maternal affection and control may play a role in the development of symptoms of anxiety and depression in childhood. As such, research of this kind may help to identify the processes by which family-wide variables such as parental depression and anxiety may come to have an impact on socio-emotional development through the proximal process of parental consistency. From this point of view, family-wide variables such as parental depression need not be directly related to child outcome per se, but may influence parental consistency, which in turn might bring about shared or non-shared outcomes. Dunn & Plomin's work also suggests that children themselves contribute to the extent of non-shared patterns of behavioural development. Similar sibling temperament was found to be associated with more consistent patterns of maternal behaviour between siblings. Unfortunately, Dunn & Plomin do not address the question of direct influences of temperament – or indeed maternal personality - on maternal interactive behaviour and issues regarding collinearity between main effects and difference scores raise certain questions about the exact nature of the association between maternal consistency and child temperament. Nevertheless, this approach clearly represents an important direction for socio-emotional research and suggests that similarity or consistency in and of itself may represent an important dependent variable in future studies of the non-shared environment.

The aim of this final empirical chapter is thus to identify factors that might characterise twin pairs who are discordant with respect to attachment security. Following the format of Chapter 3 several measures of the family context will be used as discriminating variables in order to elucidate factors associated with within-family variation in attachment security. Firstly, given Dunn & Plomin's findings described above particular importance will be ascribed to parental symptoms of depression and infant temperament. It is predicted that discordant pairs will be differentiated from secure ones in showing greater levels of parental depression. Chapter 3 found little evidence that might suggest that temperament is directly related to attachment security and hence it seems unlikely that *differences* in temperament will predict discordance. Nonetheless, it is feasible that difficult temperament impacts upon concordance irrespective of its effect on security directly. For example, difficult temperament might introduce more variability in maternal behaviour and hence lead to discordance. Furthermore, following this logic it seems plausible that two difficult infants will be considerably more challenging than one and hence that each twin's temperament may interact in determining concordance. Given the strong association between neuroticism and anxiety (Ferrando, 1994; Martin, Jardine, Andrews & Heath, 1989) maternal symptoms of anxiety will be used as a predictor of twin discordance for attachment. Maternal self-reported interpersonal problems will also be considered because of the suggestion from Chapter 3 that this dimension of symptomatology may be relevant to the development of attachment. Finally, maternal education, age and social support will also be examined. In Chapter 4 it was shown that discordant pairs experienced greater differences in maternal sensitivity than those who were concordant for attachment (being both secure or both insecure). The final aim of this study will be to explore the role of maternal consistency in mediating links between the above distal factors and twin discordance in attachment.

METHODS

This Chapter is essentially a re-analysis of data presented in earlier sections of this thesis. Consequently, a description of the participants and measures is brief. Full details can be found in Chapters 2, 3, 4 and 5.

Participants

The participants in this study consisted of the 52 families of infant twins presented in Chapter 3 for which complete data was available concerning maternal sensitivity, social support, parental psychiatric symptomatology, temperament and infant attachment security.

Measures

Ainsworth's Strange Situation – The Strange Situation Procedure (Ainsworth et al, 1978) has been described in detail in previous Chapters (see especially Chapter 2). In this study only the secure-insecure distinction was considered. Furthermore, rather than assessing differences between infants classified as secure or insecure, the present study classified *families* as concordant or discordant for attachment security. Concordance was assigned when the infants were either both secure or both insecure (although notably there was only one pair in which one twin was given a classification of resistant while the other was classified avoidant). By this definition 31 twins were concordant and 21 were discordant.

Social support questionnaire

The social support questionnaire was described in detail in Chapter 3. In this Chapter only the total of the satisfaction with social supports ratings was used as a predictor in order to avoid redundancy and type I error. As noted in Chapter 3 the first item of this measure substantially reduced the internal consistency of the total score and was excluded from these analyses. Subsequently, this total score had acceptable levels of internal consistency (Cronbach's $\alpha = .86$).

The Revised Symptom Checklist - The SCL-90-R (Derogatis, 1983) was used as a measure of maternal symptoms. In the current study only the subscales of anxiety, depression and interpersonal problems were used in order to avoid type I error. As noted in the Introduction to this study, there are good reasons for expecting depression and

anxiety to be related to concordance in patterns of attachment. The SCL-90-R measure of interpersonal problems was also included because of suggestive evidence from the results of Chapter 3 that interpersonal problems may relate to attachment security and insecurity.

The EAS Temperament Questionnaire – Mothers of the twins in this study filled out Buss & Plomin's (1984) EAS temperament questionnaire as described in Chapter 3. The items of the EAS fall into three domains representing Emotionality, Activity and Sociability. Each of these domains showed good levels of internal consistency (.87 for emotionality, .83 for Activity and .75 for Sociability). Given their modest correlations between twins and between domains, each was entered as separate predictors. Consequently, there were six temperament predictors – three for each twin.

Statistical Analysis

Predictors of concordance were analysed using hierarchical logistic regression. To begin with, maternal characteristics were tested after controlling for maternal age and education. The impact of temperament characteristics on concordance was assessed in a separate logistic regression analysis. In the first step, the six temperamental factors were entered as predictors and in the second the between-twin interaction terms were entered to assess the significance of temperament interactions in predicting concordance after controlling for main effects. Only interactions between like domains were tested in order to minimise type I error. The mediating role of differences in maternal sensitivity was tested using Baron & Kenny's (1986) approach to mediation using logistic and linear multiple regression, the details of which are described more fully in the results section.

RESULTS

The results of this study are divided into three sections. The first describes analyses aimed to identify maternal characteristics that might discriminate between concordant and discordant twin pairs. The second section then examines infant characteristics that might similarly differentiate discordant pairs. The final section is then concerned with the role of maternal consistency in mediating links between maternal and infant characteristics and discordant outcome for attachment security. Baron & Kenny's (1986) approach to mediation effects will be used to do this and will be described in detail in this final section. Throughout, concordance will be defined dichotomously - as a match between twins at the level of attachment security or insecurity.

6.1 Section 1: Maternal predictors of within-family variability in attachment

Broadly following the plan of Chapter 3, several maternal or familial factors were considered as potential predictors of within-family discordance in attachment security. Specifically, maternal depression and anxiety were expected to discriminate between those pairs that were concordant for attachment and those that were not. Furthermore, maternal self-reported satisfaction with social support and maternal self-reported interpersonal problems were examined because of their potential relevance to attachment related processes suggested by analyses in Chapter 3. At the same time, maternal age and education were entered as covariates to assess their contribution to concordance and to control for their influence when interpreting the effects of the other maternal factors.

A hierarchical logistic regression was thus carried out with concordance as a dichotomous dependent variable. In the first step, maternal age and education were entered as predictors and in the second maternal anxiety, depression, interpersonal problems and social support were included in the model. The significance of the independent contribution of these predictors considered as a group after controlling for age and education was assessed by the difference in χ^2 between the two models (Tabachnik & Fidell, 1996). The χ^2 statistics of the two models and the B-values, odds ratios and associated significance levels are presented in table 6.1.

Table 6.1 Logistic regression of maternal factors and twin concordance for attachment security

	Logistic regression test statistics				
Predictor	B-value	Odds ratio	Wald	χ^2	p-value[d]
Model I	--	--	--	.620[a]	.733
Age	-.042	.958	.567	--	.293
Education	-.054	.947	.038	--	.350
Model II	--	--	--	19.618[b]	.003
Age	-.139	.870	3.411	--	.046
Education	.620	1.859	2.414	--	.100
Depression	-1.978	.138	3.080	--	.045
Anxiety	-.330	.719	.051	--	.825
Interpersonal problems	4.258	70.670	8.345	--	<.001
Social Support	.404	1.498	5.311	--	.004
Change (Model II – Model I)	--	--	--	19.000[c]	.001

[a] d.f. = 2; [b] d.f. = 6; [c] d.f. = 4;

[d] All p-values for independent effects are based on the difference in χ^2 between the relevant full model and a model with the IV in question dropped (evaluated with 1d.f). Tests based on the Wald statistic are known to be inaccurate, especially when B-values/odds ratios are large (Tabachnik & Fidell, 1996)

From table 6.1 it can be clearly seen that overall the maternal characteristics of anxiety, depression interpersonal problems and social support were powerful predictors of infant discordance for attachment security. The change in χ^2 between model I and model II was highly significant (p = .001), suggesting a substantial role for these variables in identifying discordant from concordant pairs after controlling for maternal age and education. Using a probability cut-off of .50 as a classification rule model II correctly classified 75% of cases as being either concordant or discordant.

Examination of the effects of individual variables suggested that fewer symptoms of interpersonal problems, greater symptoms of depression and less social support were significant independent predictors of discordance. Over and above statistical significance, the odds ratios are also helpful in appreciating the magnitude of the effects found in this analysis. Odds ratios reflect the change in the ratio of the probability of concordance to discordance following a one-unit change in the independent variable. As

such odds rations are scale-dependent direct comparison between IVs is difficult if there are substantial differences in metric (as is the case here). However, effects can be well illustrated by considering the increase in odds of concordance when there is a change in an IV between two well-defined values, such as the lowest score and median.

A change from the lowest observed value of depression (zero) to the median value (.69)[1] increased liability for concordance by a factor of 3.93. In other words the odds of a twin pair being discordant nearly quadruples when depression changes from zero to the median score for this sample. Similarly, an increase in interpersonal problems from the lowest score in the sample (zero) to the median (.438) lead to an increased likelihood of concordance by a factor of 6.44. The odds ratio of a change from the lowest score to the median in social support was 25.3 indicating a 25 times increase in the likelihood of concordance over this range of scores. Finally, given the suggestion that older parents were more likely to have discordant pairs the change in odds from the youngest (22.7) to the median age (34.3) was 5.1.

It should be noted that these estimates of odds ratios are subject to considerable sampling error. A conservative estimate can be obtained by calculating odds ratios on the basis of the lowest value of the 95% confidence interval of their respective B-values. Using these estimates the odds associated with a change from the lowest score to the median for depression was 1.17, interpersonal problems 1.82, social support 2.07 and maternal age 1.10.

6.2 Section II: Infant characteristics as predictors of within-family variability in attachment

This next section examines the influence of temperamental factors on discordance in infant-parent attachment relationships using Buss & Plomin's EAS (Buss & Plomin, 1984). Although in Chapter 3 little evidence was found for direct influences of temperament on infant attachment security in the Strange Situation, the aim of this section is to explore the possibility that child factors may nonetheless explain why some children show different attachment patterns to those of their co-twin.

[1] For all these odds ratio estimates, calculations are based on holding all other covariates at their mean

In the same manner as the previous section on maternal factors, a hierarchical logistic regression was carried out with twin concordance as the criterion. In the first model each twin's scores for Emotionality, Activity and Sociability were entered as direct predictors of concordance (resulting in 6 'main effects'). As in earlier sections of this thesis, the twins were randomly assigned to two groups - referred to as Twin1 and Twin2. Note that given the random allocation of twins to these groups robust independent main effects should be evident for both Twin1 and Twin2. In the second model three further predictors were included that represented the two-way interaction between one twin's score for a dimension of temperament with that of the other. Cross-domain interactions (e.g. Twin1 Emotionality x twin2 Activity) and higher-order interactions were not tested.

As such, the second model tests the hypothesis that the impact of one twin's temperament on concordance and discordance depends to some degree upon the temperament of the other. As before, this broad hypothesis is tested by the significance of the change in χ^2 between model I and model II. The results of this analysis are presented in Table 6.2.

The results of the logistic regression analysis strongly confirmed the view that temperamental factors are linked with concordance between twins in attachment security. To begin with, the overall significance of Model I ($p = .018$) suggested that there were direct main effects of temperament on concordance. Examination of the independent effects suggested that higher scores for emotionality were associated with a greater likelihood of concordance, although for twin2 the effect only approached significance. Model I also suggested that sociability may be involved with patterns of concordance with greater sociability also associated with a greater likelihood of concordance, although the effect was not consistent across both samples of twins.

Table 6.2 Logistic regression of temperamental predictors of twin concordance in attachment security

		Logistic regression test statistics			
Predictor	B-value	Odds ratio	Wald	χ^2	p-value[d]
Model I	--	--	--	15.318 [a]	.018
Twin1 Emotionality	.160	1.174	3.235	--	.057
Twin2 Emotionality	.199	1.220	3.140	--	.045
Twin1 Activity	-.080	.924	.674	--	.409
Twin2 Activity	.087	1.091	.554	--	.452
Twin1 Sociability	.157	1.170	4.359	--	.023
Twin2 Sociability	.015	1.016	.038	--	.840
Model II	--	--	--	29.158 [b]	<.001
Twin1 Emotionality	.869	2.386	4.326	--	.017
Twin2 Emotionality	.814	2.258	4.733	--	.011
Twin1 Activity	-.719	.487	2.012	--	.104
Twin2 Activity	-.408	.664	1.215	--	.250
Twin1 Sociability	1.092	2.980	4.712	--	.001
Twin2 Sociability	.893	2.443	4.281	--	.015
Twin1 x Twin2 Emotionality	-.050	.951	3.556	--	.045
Twin1 x Twin2 Activity	.061	1.063	1.756	--	.147
Twin1 x Twin2 Sociability	-.047	.953	4.000	--	.009
Change (Model II – Model I)	--	--	--	13.841 [c]	.003

[a] d.f. = 6;[b] d.f. = 9; [c] d.f. = 3; [d] See note below Table 6.1 regarding significance testing.

However, the analysis strongly suggested the presence of interaction effects (p = .003). Two of the three interaction terms were significant independent predictors of concordance. These results thus suggest that the effect of one infant's temperament on overall concordance is moderated by that of the other. In particular, it appeared that the effects of Emotionality and Sociability on concordance were significantly moderated by the temperament of the co-twin (p = .045 and .009, respectively). It is also interesting to note that the main effects in model II were consistent across twins once the interaction terms were taken into account. This may suggest that inconsistencies across twins in model I resulted from mis-specification.

In order to aid interpretation of these interaction effects, infant emotionality and sociability scores were plotted against the log odds of concordance - the results of which are shown below in Figures 6.1 and 6.2. In each figure the effect of twin1 temperament is plotted against the log odds of concordance at one of three levels of the other twin's temperament score (lowest, median and highest). Log odds were used – rather than the more familiar odds – because the logistic regression model is linear with respect to the log odds and hence log odds lend themselves to simple graphical representation.

Examination of Figures 6.1 and 6.2 reveals an interesting pattern of results – one that is consistent in form for both dimensions of temperament. Each line in Figures 6.1 and 6.2 represents the linear effect of temperament on the log-likelihood of concordance for attachment *at one level of the other twin's temperament score*. In both cases, the effect of *increasing* emotionality or sociability was to increase concordance when the other's temperament score was low and to decrease it when the other's temperament score was high. In other words, it appeared that the likelihood of concordance *diminished* as the co-twin's temperament score became more similar to that of the other's.

This is clearly a remarkable - and perhaps counterintuitive - result. It should be noted however that these analyses must be considered exploratory because specific predictions about outcome were not made in advance. Indeed, the results of these analyses are not what might have been anticipated had a priori predictions been made. Nonetheless, the consistency, magnitude and statistical significance of these effects make them arguably compelling.

Figure 6.1 Interaction effect of twin emotionality (EAS) and log odds of concordance in attachment security

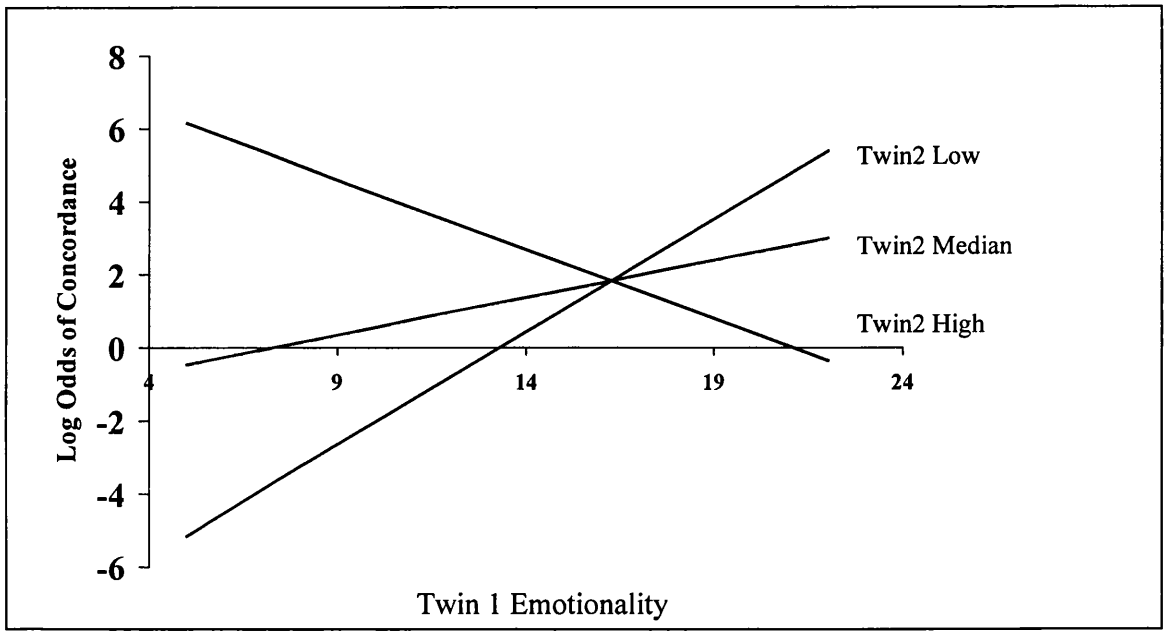
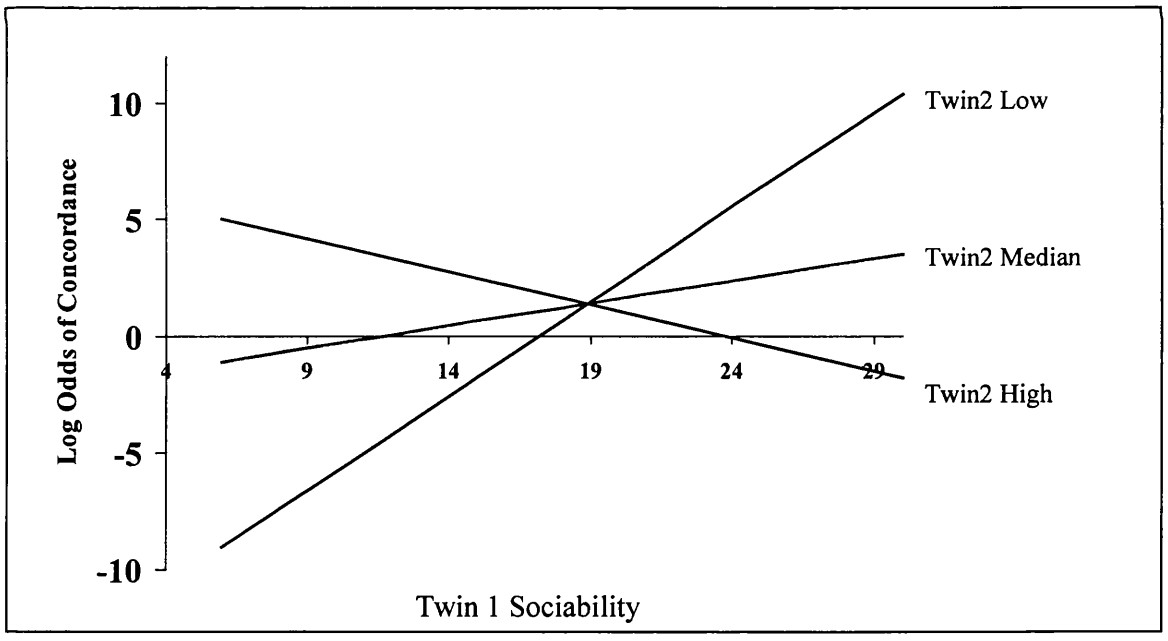


Figure 6.2 Interaction effect of twin sociability (EAS) and log odds of concordance in attachment security



Finally, two further logistic regression analyses were carried out to test the independence of the effects of maternal and child factors on concordance. Because there is no clear causal priority that can be assigned to either of these factors, two hierarchical analyses were performed. The first tested the independent effect of temperament after controlling for maternal factors and the other tested the independence of maternal factors after controlling for infant temperament. In the former analysis, the variables were entered in three steps – maternal factors first, followed by the main effects of temperament for twin1 and twin2 and finally the two-way interaction terms. In this way, separate tests were carried out for the independence of main effects and interactions.

Similarly, in the second analysis the independent effect of maternal characteristics was assessed by the improvement in model fit (χ^2) between a model that included all temperamental variables (main effects and interactions) and one that included temperamental variables *and* maternal factors. In both of these analyses only effects that had emerged as significant predictors in sections 1 and 2 were included. As such, the temperamental variables consisted of the main effects and interactions of emotionality and sociability from the EAS and the maternal factors consisted of depression, interpersonal problems, social support and age.

The first analysis, assessing the independent effect of temperament on the likelihood of concordance, revealed that the main effects and interactions both remained significant predictors of concordance after controlling for maternal characteristics (main effects: $\chi^2(4) = 16.62$, $p = .004$; interactions: $\chi^2(2) = 9.35$, $p = .009$). Conversely, the second analysis showed that maternal characteristics also remained significant predictors of concordance after taking infant temperament into account ($\chi^2(4) = 15.8$, $p = .003$). These analyses thus suggest that maternal characteristics and infant temperament are largely independent, additive contributing factors to concordance and discordance in attachment. When both maternal and infant characteristics were included as predictors, the logistic regression could be used to predict concordance with 90% accuracy ($\chi^2(10) = 41.9$, $p < .00001$). Clearly, because of the exploratory nature of these analyses the findings are likely to include a degree of over-fitting and probably over-estimate population parameters. As is always the case, only independent replication can unequivocally determine the generalisability of these findings. Nonetheless, the sheer size of their

effects suggest that these variables represent important potential sources of within-family variability in attachment security.

6.3 Section 3: The mediating role of differential maternal sensitivity

This final section aimed to test the possibility that the effects of maternal characteristics and infant temperament on the likelihood of concordance are mediated by the extent of maternal differential sensitivity. It would seem reasonable to assume, given the central place occupied by maternal sensitivity in the attachment literature, that these distal factors would come to influence concordance through their effects on maternal behaviour.

Baron & Kenny (1986) have described in detail the data-analytic steps that are necessary to infer true mediation effects. Baron & Kenny's approach can be illustrated with a simple path diagram. Figure 6.3 shows the structural relationships involved in a mediational pathway.

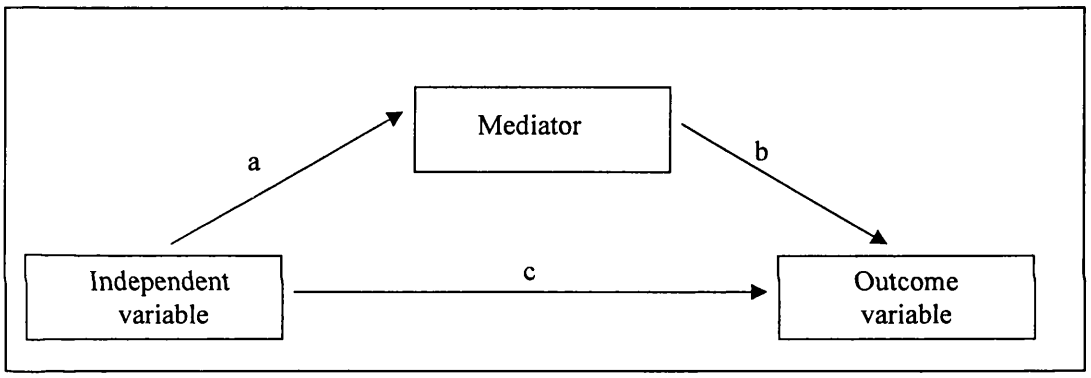


Figure 6.3 Mediational model form Baron & Kenny (1986)

Baron & Kenny suggest that in order to test whether the effect of an IV on outcome can be explained via the IV's association with a mediator, three regression models need to be tested:

1. *Regression of the mediator on the IV*
2. *Regression of the outcome on the IV and*
3. *Regression of the outcome on the mediator and the IV*

According to Baron & Kenny, for mediation to hold, regressions 1 and 2 must be significant and the effect of the mediator must be significant in regression 3. If the IV is non-significant in the third regression the implication is that the pathway between the IV and outcome is fully mediated by paths a and b. The approach is easily extended to cases

in which there are several mediators and IVs. Sobel (1988) has also provided an approximate significance test of the mediational pathway.

We already know that in this case the second condition holds true – there is a direct relationship between the IVs (in this case maternal and temperamental factors) and outcome (concordance). We also know from Chapter 4 that there is an association between differences in maternal sensitivity and concordance. Those twin pairs who were both secure or both insecure appeared to experience fewer differences between twins in maternal sensitivity than those pairs in which one infant was secure while the other was insecure ($r = -.39$, $p < .01$).

The question of mediation thus comes to down to the question of whether maternal sensitivity is a predictor of concordance after controlling for maternal and child factors (regression 3) and whether child and maternal factors are associated with maternal sensitivity (regression 1). If both conditions are true, mediation can be inferred. Accordingly, a multiple regression was carried out (multiple linear regression) of differences in maternal sensitivity on the maternal and temperamental predictors. The results of this analysis are shown below in Table 6.4.

Table 6.4 Results of regression predicting differences in maternal sensitivity from maternal and child factors

		Regression test statistics		
Predictor	β-value	t-statistic	F-statistic	p-value
Model	--	--	.92[a]	.52
Maternal age	-0.065	2.96	--	.69
Depression	-0.222	-1.20	--	.23
Interpersonal problems	-0.079	-.41	--	.68
Social support	-0.195	-1.22	--	.22
Twin1 Emotionality	0.049	.28	--	.78
Twin2 Emotionality	0.028	.16	--	.87
Twin1 Sociability	-0.176	-1.05	--	.87
Twin2 Sociability	-0.167	-.96	--	.33
Twin x Twin2 emotionality	0.027	.15	--	.88
Twin1 x Twin2 Sociability	0.193	1.17	--	.24

[a] d.f. = (10, 51)

It can be seen from Table 6.4 that there was little evidence to suggest that the predictors of concordance from the analyses presented previously were associated with the extent of maternal differential sensitivity. Overall the regression was non-significant and furthermore none of the individual predictors even approached significance. The results of this analysis thus suggest that that maternal and child factors come to influence concordance in attachment through processes independent of maternal sensitivity at least as measured in this study by Pederson & Moran's Maternal Behaviour Q-Set (Pederson et al, 1990).

To confirm this view, a logistic regression analysis was carried out that included differences between twins in maternal sensitivity as well as temperamental and maternal factors as predictors of concordance. As before, only the factors that had emerged as significant predictors in earlier analyses were included. The results of this analysis are shown in Table 6.3.

Table 6.3 Logistic regression of maternal sensitivity, maternal factors, infant temperament and concordance for attachment security

	Logistic regression test statistics				
Predictor	B-value	Odds ratio	Wald	χ^2	p-value[b]
Overall Model	--	--	--	46.80[a]	<.00001
Twin1 Emotionality	2.349	10.471	1.480	--	.021
Twin2 Emotionality	1.594	4.924	1.489	--	.052
Twin1 Sociability	1.427	4.164	2.563	--	.028
Twin2 Sociability	1.093	2.982	2.532	--	.058
Twin1 x Twin2 Emotionality	-.113	.893	1.345	--	.100
Twin1 x Twin2 Sociability	-.061	.940	2.404	--	.053
Depression	-6.359	.002	3.483	--	.002
Interpersonal problems	4.941	139.89	4.162	--	.005
Social Support	.581	1.788	1.910	--	.063
Age	.017	1.017	.009	--	.926
Differences in sensitivity	-7.744	.001	2.498		.020

[a] d.f. = 11; [b] as in previous analyses, p-values based on difference in χ^2 between full and reduced model

The important point to note from this table is that greater differences in maternal sensitivity were significantly predictive of discordance in attachment security (the outcome) after controlling for all other IVs. Thus, despite strong evidence of temperamental and maternal influences on concordance, there was little evidence to support the view that these effects might be mediated by their impact on differences in maternal sensitivity.

DISCUSSION

The aim of the present study was to identify conditions associated with within-family differences in attachment security as a way of pinpointing the origins of non-shared patterns of infant-parent attachment. The present study thus aimed to begin the process of addressing the challenging question of how children within the same family can come to have different attachment relationships with the same parent. This is very much a new frontier for attachment and socio-emotional research. There is very little existing work on which to base theory-driven research and as a consequence this study was largely exploratory in nature - following common sense ideas about developmental processes and leads from small-scale studies of siblings in other areas of development.

The findings of this research were remarkable in that substantial differences were found between those families whose infants were concordant for attachment security and those that were discordant. These findings are encouraging in that they suggest that there may be robust links between psychosocial factors and non-shared patterns of attachment. Perhaps one of the most serious concerns regarding the nature and prevalence of non-shared environmental effects on development is their common – although not inextricable – methodological confounding with measurement error (O'Connor et al, 1995). Consistent, replicable associations between non-shared environmental factors and meaningful predictors are extremely important in that they suggest that the non-shared environment may be a tractable problem and indeed a powerful indicator of systematic developmental processes.

The current study found evidence for a range of predictors of within-family differences in attachment security despite the fact that each of these factors was not associated with attachment security or insecurity directly. Evidence was found that suggests that both family factors and child factors are implicated in the development of differences within families in attachment security. Given their relative independence each of these predictors of discordance each will be discussed separately, before turning to the wider implications of these findings for future investigations of non-shared environment.

Maternal factors

A primary hypothesis of the study, derived largely from the work of Dunn & Plomin (1986), was that maternal personality characteristics would impact upon the likelihood of

concordance for attachment security, because of their effects on the consistency of caregiving. Dunn & Plomin's early study of maternal differential behaviour towards young siblings suggested that higher levels of maternal self-rated neuroticism and emotionality were associated with less consistency in terms of affection and intrusiveness for each child. Given the importance of affection and intrusiveness to almost all formulations of maternal sensitivity (see De Wolff & van Ijzendoorn, 1997) it seemed reasonable to suppose that these maternal characteristics would also play a role in within-family differences in infant attachment security. Furthermore, given the well-established finding that social support and demographic factors impact upon parenting (Belsky, 1996), tentative suggestions were made about their possible role too. On common sense grounds alone, it might be supposed that greater strain on family life - considered generally - would challenge a parent's capacity to behave in a consistent fashion. In turbulent and difficult circumstances extraneous influences may intrude upon mother-child interaction from time to time in relatively unpredictable ways - leading perhaps to disruptions in what might be considered a parent's 'habitual' caregiving style. On the other hand, challenging family circumstances may also increase the probability that a parent 'invests' differentially in each of her children, introducing the possibility of *systematic* differences in maternal behaviour under high-stress conditions.

Considerable evidence was found to support the broad idea that maternal characteristics are associated with differences in concordance. Increased reports of depressive symptoms were found – in line with predictions – to be associated with a greater likelihood that infant twins will show differences in attachment security as assessed in the Strange Situation. Furthermore, mothers who reported less social support were also more likely to have infants who were discrepant in terms of attachment security. Moreover, older mothers also appeared to be more likely to have children who were discordant for attachment security.

It seems likely that parental coping and its impact on differential maternal behaviour is the key mediating variable at play here. However, as will be discussed in more detail below, the current study found little evidence that might support the view that the effects of maternal characteristics on concordance can be observed in differential maternal sensitivity, at least measured by Pederson & Moran's Maternal Behaviour Q-Set (Pederson et al, 1990). It will thus be vital in the future not only to replicate these

findings but pursue the mechanisms that mediate between parental characteristics and non-shared patterns of attachment.

The finding that families experiencing greater difficulties are more likely to show differential patterns of infant attachment is certainly consistent with psychometric research using the Strange Situation with single children. Several studies have found greater instability over time in attachment classifications in families experiencing changes in life circumstances, chronic stressful living conditions or depression (Egeland & Sroufe, 1981; Vaughn et al, 1979). It may be that discordance in attachment security results from lawful instability in attachment assessments associated with family stress. Following this line of reasoning, one would not only expect to see greater *differences* in high-stress families when assessed concurrently but also greater *changes* in attachment security measured *prospectively* too. Furthermore, changes in attachment security over time ought to be associated with lawful changes in patterns of caregiving. These are clearly important questions that need to be addressed by future research. From both an applied and scientific point of view it will be important to establish the extent to which non-shared factors are stable over time or result from relatively short-term instability - quite apart from the question of random measurement error.

It is particularly interesting that maternal depression was associated with a greater likelihood of discordant attachment for several reasons. Firstly, it is well established that maternal depression is a risk factor for the development of later behavioural and emotional problems (Cicchetti et al, 1998; Radke-Yarrow & Klimes-Dougan, 1997). A considerable body of research has been dedicated to investigating the effects of maternal depression on infant-parent relationships as a way of identifying the specific risk factors associated with parental psychopathology (e.g. Cicchetti et al, 1998; Murray et al, 1993; Field, 1992). One important strand of this research has investigated the role that maternal depressive symptoms might play in the development of early insecure patterns of infant-parent attachment (e.g. DeMulder & Radke-Yarrow, 1991). However, the results of these studies have been somewhat inconsistent with both positive and negative findings (e.g. Radke-Yarrow, 1991). One potential explanation of these inconsistencies suggests itself in the light of the current study. The source of inconsistency may be instability or within-family differences in parent-child relationships that follow from parental depression. Also, given that within-family differences appear to be more likely when mothers experience feelings of depression, it would seem more important than ever to examine the

extent to which children within a family experience parental depression differently and hence are at differential developmental risk.

Furthermore, given the evidence that parental differential treatment may place a child at risk for symptoms of depression and anxiety (Dunn & McGuire, 1994), these findings, if corroborated, may offer important clues regarding the nature of the pathways that link parent and child psychopathology. Having said that, it is important to note that current research in the area of within-family effects of parental depression have focussed almost exclusively on non-clinical populations (although see Tarullo, DeMulder, Ronsaville, Brown & Radke-Yarrow, 1995). It is unclear at this stage whether the findings from these studies, including the current one, will generalise to clinical populations.

The picture was less clear-cut when maternal symptoms of interpersonal problems were considered than was the case for social support and depression. Somewhat surprisingly, in view of the earlier discussion, greater levels of interpersonal problems were associated with an increased likelihood of *concordance*. It is difficult to know what to make of this finding. On the one hand, the effect was a substantial one with the most conservative estimates suggesting a near doubling of the chances of concordance when the lowest symptom score was compared to the median in this sample. On the other, the finding seems counterintuitive. One could speculate that interpersonal problems represent a very different profile of problems from that of depression and low social support (and on the face of it of course they do), one that is less related to coping and more related to difficulties in relationships with family and friends. This distinction, it could be argued, might explain why it behaves differently as a predictor of concordance. In what way interpersonal problems relate to concordance for attachment security is however, unclear. Without independent support from past research and theory the finding is hard to interpret. Given the exploratory nature of this analysis and until replication data are available the effect should clearly be treated with caution.

It is also notable that symptoms of anxiety were not associated with a greater likelihood of discordance in this sample. Anxiety was expected to predict discordance because of its close links with the personality construct of neuroticism, which Dunn & Plomin (1986) suggest may be associated with greater maternal inconsistency. One plausible explanation for this null finding is that the SCL-90 (Derogatis, 1983) has a rather physiological definition of anxiety (trembling, sweating, palpitations, trouble falling

asleep) and de-emphasises anxiety-related cognitions and social behaviours. It is likely that it is these aspects of anxiety that overlap most closely with neuroticism. Another possibility is that anxiety influences dimensions of maternal behaviour that are simply not relevant to the development of attachment. Of course, a further possibility which cannot be ruled out is that sampling error is responsible for the findings of this study (Type II error) or those of Dunn & Plomin (Type I error).

Child factors

Perhaps the most intriguing finding to emerge from this study was the impact of temperamental characteristics. For two of the three dimensions of the EAS significant links were found between temperament and concordance. In general it appeared that infants who were more sociable or emotional were more likely to have the same attachment classification as their co-twin. More importantly in terms of the substantive interpretation of these temperament findings, highly significant interaction effects were found. For both dimensions of temperament it seemed that the effect of increasing emotionality or sociability depended on the emotionality or sociability of the other twin. If the other twin was highly emotional, for example, increasing emotionality tended to reduce the likelihood of concordance. Conversely, if the other twin was low on emotionality, increasing emotionality tended to increase the likelihood of concordance. The sociability dimension of the EAS closely mirrored this picture, with the substantive interpretation being precisely the same: Increasing distance between twins in temperament lead to an increased probability of concordance. Given the independence of these two interaction terms it seems unreasonable to argue that the similarity between these two effects results from the same underlying – potentially chance – finding. Taken together, the independence, consistency and sheer statistical significance of these effects suggest that they represent more than a mere sampling aberration.

Given the novelty of these findings one can only speculate about the mechanisms that might give rise to these kinds of effects. One seemingly plausible account is that temperamentally similar infants make more similar demands on their parents. It may be more difficult to deal with two infants when they make the same demands on parents than when they make quite different – and perhaps more complimentary – demands. Greater challenges in a specific domain of parenting may then result in greater within-families differences in attachment security. Again, the fact that these interaction effects were not found to be mediated by measures of maternal sensitivity raises some concerns about the

viability of this view. In the future it would be wise to carry out multiple measures of parenting if we are to identify these important mediating processes.

Another possible explanation of these temperament-interaction findings is that they represent a kind of 'niche-competition' effect. One might speculate that infants with similar temperaments are more likely to come into direct competition with each other because they share similar interests, tempos and needs. One particularly appealing implication of this view is that it removes the condition that maternal consistency should be an observable mediating factor. The mediating processes might instead involve twin-twin interactions or even triadic interactions between mother and both infants.

Finally, one could argue that the findings could be equally well explained by maternal psychological factors because the assessment of temperament used in this study was provided by maternal report. For example, it is possible that consistent maternal behaviour depends upon an elaborated mental representation of the child and that parents who do not strongly differentiate between their twins are more likely to behave inconsistently towards them. Certainly, behaviour-genetic research has shown that parental reports of temperament and child behaviour generally include a degree of rater bias (Simonoff, Pickles, Hewitt, Rutter, Loeber, Meyer, Neale & Eaves, 1995; Neale & Stevenson, 1989). Nonetheless, no research has investigated the implications of this bias for parenting and development. Instead, bias has generally been considered an error term to be partialled out of estimates of genetic and environmental parameters. Differentiating this 'intra-psychic' model from those described earlier would require multiple measures of temperament, perhaps including father-reports and observational assessments that could permit the separation of 'trait' variance from parent-specific variance in temperament ratings. Furthermore, to further substantiate the role of parental representations in within-family attachment processes it would be valuable in future research to use measures that are more specifically designed to tap representational processes, such as Slade's Parent Development Interview (Slade, Belsky, Aber & Phelps, in press)

For the time being, little can be said with any confidence about the mechanisms that mediate the associations found in this exploratory investigation. Certainly, there seems to be good reason to expect that parental and child characteristics will help to identify families in which one twin is classified as secure while the other is classified as insecure.

Indeed, the present study may offer a new way of bringing about an 'empirical rapprochement' between attachment and temperament (Belsky & Rovine, 1987) in which temperamental factors influence the likelihood of within-family variation in attachment security. These positive findings will represent important avenues for the investigation of non-shared environmental processes in the development of attachment. Clearly a great deal needs to be done in terms of understanding the specific processes that lead to non-shared outcome in attachment and the ways in which maternal and child characteristics impact upon within-family differences in attachment security. The present study found no evidence to suggest that differential maternal sensitivity is a mediating mechanism and in the future it would seem important to find out what kinds of processes give rise to differential developmental outcomes in the domain of attachment and elsewhere. It is difficult to say at this stage whether this null finding is a result of the specific measure of maternal sensitivity used in this study or whether alternative sources of influence will need to be identified in the future. Indeed, it is by no means guaranteed that parental behaviour is a primary cause of within-family differences in attachment at all. We should not ignore the possibility that biological or genetic factors could account for some of the differences in attachment security observed in this study. Indeed, the importance of large-scale replications with samples of twins and non-twin siblings cannot be overestimated for this new and exciting area of research into the development of infant-parent attachment.

CHAPTER 7

GENERAL DISCUSSION

One of Bowlby's most important contributions to our understanding of early emotional development was his integration of evolutionary, biological, developmental and cognitive theories into one unified account of human attachment behaviour. Bowlby proposed that infant attachment behaviour could be understood as having evolved as a primary means of survival through proximity to a parent. Bowlby believed that attachment behaviours are organised along the lines of a behavioural control system designed to dynamically monitor danger and regulate threat through behaviours aimed to bring about parental proximity. A central component of Bowlby's control systems view of attachment is the infant's knowledge or representation of significant aspects of the environment. The infant's 'internal working model' (IWM) is believed to play a primary role in regulating the expression and organisation of attachment behaviour. This idea has become the essential building block of contemporary thinking and research into individual differences in attachment and has lead to some major advances in our understanding of attachment processes across the lifespan.

According to the contemporary view, individual differences in attachment, as observed in Ainsworth's Strange Situation (Ainsworth et al, 1978), are thought to be caused by systematic differences in maternal sensitivity over the first year of life. The infant is thought to learn about and represent invariant aspects of maternal behaviour and to control the expression of attachment behaviour in accordance with expectations derived from working models of the attachment relationship. The child's internal working model is then thought to be carried forward across development and remains a relatively stable influence on thinking, feeling and behaviour in attachment related contexts across the lifespan. Ultimately, internal working models are believed to underlie parental sensitivity in adulthood and hence shape the transmission of attachment patterns from one generation to the next. This account of the intergenerational transmission of attachment has been nicely summarised by Steele & Steele (1994) and is shown below in figure 7.1.

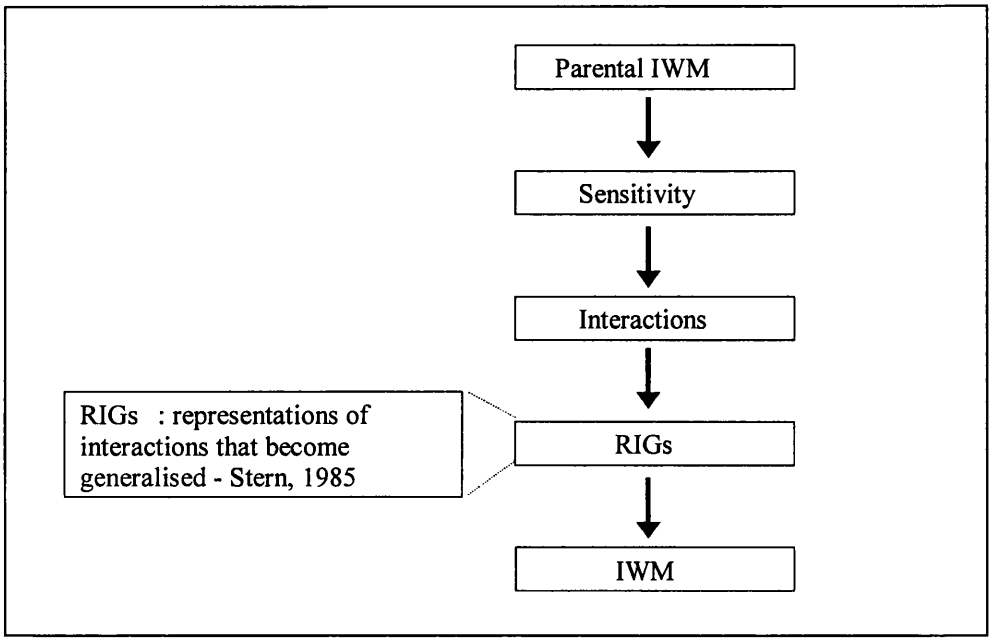


Figure 7.1 Model of the intergenerational transmission of attachment (adapted from Steele & Steele, 1994)

In the context of recent advances in behaviour-genetic research the linear model of attachment makes the, perhaps surprising, prediction that shared environmental factors are the primary determinants of infant attachment security. The aim of the present series of investigations was to test this linear, shared environmental model of attachment from a behaviour-genetic perspective. This thesis aimed to test the following broad hypotheses derived from contemporary attachment theory:

1. Infant attachment security is determined by shared environmental factors.
2. Individual differences in attachment security are not influenced by genetic factors
3. Shared patterns of attachment will be influenced by shared variance in maternal sensitivity
4. Shared patterns of maternal sensitivity will be associated with maternal representations of attachment

Furthermore, the current thesis aimed to explore the extent and causes of within-family differences in attachment security. In particular, given the prevalence of non-shared environmental factors in many areas of development (see Dunn & Plomin, 1995; Plomin &

Daniels, 1987) this thesis aimed to show that non-shared factors represent an important, if not dominant, set of systematic causes of individual differences in attachment security. Also, because the non-shared environment is typically confounded with measurement error an especially important task was to demonstrate the validity of non-shared components of variance in attachment security. Validation of non-shared components of variance in attachment security was attempted by searching for systematic relationships between maternal sensitivity and non-shared patterns of attachment and for robust links between discordance and social-contextual variables.

This final chapter discusses the findings of this thesis in relation to each of the goals outlined above. The discussion will also cover important areas for future research and the implications of the current findings for attachment theory, behaviour genetics and the study of twins as a special group.

7.1 Genetic and environmental influences on attachment: Evidence for the linear model of attachment

Bowlby and Ainsworth's ethological theory of attachment seems to make strong claims about the environmental causation of individual differences in attachment security. Despite the fact that Bowlby originally suggested that the majority of variability in attachment behaviour would be under genetic control (Bowlby, 1969/82), more recent formulations suggest that environmental factors are the primary causes of attachment security and insecurity. Indeed, contemporary work on attachment makes the even more restrictive claim that the primary causes of attachment security are specifically of the shared environmental kind. The most obvious direct test of this claim of attachment theory is the extent of concordance in patterns of attachment in infant twins.

The current study found, perhaps surprisingly, considerable evidence to support such an account, with near-identical concordances for MZ and DZ twins. In the context of converging evidence from research on attachment with siblings and twins there is good reason to expect this finding to be a robust one. To begin with, for siblings and DZ twins six independent investigations have found two-way concordance for attachment security of around 62%, which very closely matches that found in this study for both MZ and DZ twins (Ward et al, 1988; Teti & Ablard, 1989; Van Ijzendoorn et al, unpublished manuscript;

Riccutti, 1992). Only the study by Finkel et al has failed to replicate this finding. Overall, the estimates of concordance in siblings and DZ twins seem to vary remarkably little from sample to sample. Indeed, although the study of Finkel et al (1998) suggested the possibility of genetic influences on attachment security, their genetic estimate appears to derive from an unreasonably low concordance for DZ twins (38.5%) rather than from a higher concordance for MZ twins (67.6%). Given the robust finding of 62% concordance for non-twin siblings, the findings of Finkel et al seem to suggest a problem with the representativeness of their DZ group or indeed with the validity of their non-standard assessment procedure. The only other obvious alternative explanation of the discrepancy between the study of Finkel et al and the other existing studies of attachment in twins and siblings (including this one) is that the pattern of genetic and environmental influence changes substantially over time. Finkel et al's sample consisted of infants between 18 and 24 months of age, while the other studies cited above have focussed on the 12-14 month period. At this stage there are few convincing reasons to favour any one of these explanations over another and in the future longitudinal genetic studies of attachment may more directly address issues of this kind.

What is somewhat less certain then, is the concordance rate for MZ twins. Only three studies have assessed concordances in attachment for MZ twins (the current study, Riccutti (1992) and Finkel et al (1998)). Nevertheless, all of these studies found concordance rates around the 62 - 67% mark, again suggesting remarkable consistency between studies despite the relatively small sample sizes of each study considered individually. When all the available studies are considered together, the weight of evidence seems to favour an environmental account of the determinants of attachment security.

What is particularly remarkable about the findings of these studies of twins and siblings is that the results seem to point fairly consistently to the importance of specifically *shared* environmental influences on attachment security. The current study suggests that around 34% of the variance in attachment security can be accounted for by shared environmental factors. This figure not only confirms one of the basic assumptions of attachment theory but also seems to fit well with research that has documented a robust association between maternal representations of attachment and infant attachment security (of around $r^2 = .25$; see van Ijzendoorn, 1995a). In an age when shared environmental theories of development are

largely rejected by behaviour-geneticists (e.g. Scarr, 1992), the result seems a remarkable and significant one.

Of course, several behaviour-geneticists have suggested that shared environmental factors are likely to be more significant in infancy and early childhood than later in life and indeed genetic studies of individual differences in mental development and temperament seem to confirm this view (e.g. Plomin, 1987). Whether shared environmental influences are evident in measures of attachment in later childhood and adulthood remains an important question to be addressed by future research. Again, the importance of *longitudinal* genetic research cannot be overstated. Longitudinal genetic research would allow for the estimation of genetic and environmental influences at different developmental stages and of their influence on age-to age changes in attachment security. The internal working models view of attachment would predict that continuity over time in patterns of attachment would be driven by shared environmental factors – a prediction that could be elegantly tested by longitudinal genetic studies of attachment.

7.2 Developmental mechanisms of the shared environment

The evidence for shared environmental influences on attachment seems relatively compelling, but clearly simple correspondence between twins for attachment security is only an indirect test of the primary predictions of contemporary attachment theory. The 'linear intergenerational model' makes several more differentiated predictions about shared influences on attachment security. Firstly, the internal working models view suggests that maternal representations of attachment would be associated with patterns of maternal behaviour that are consistent across children in the same family. Secondly, these shared patterns of maternal behaviour ought to underlie shared patterns of infant-parent attachment. Furthermore, the pathway between maternal representations, maternal sensitivity and infant-attachment security should be a fully mediated causal chain. In other words, there should be a direct link between maternal representations of attachment and infant attachment security and this link should be fully - or at least substantially - accounted for by shared components of maternal behaviour (see van Ijzendoorn, 1995a).

To what extent did the data from the current study support this picture? To begin with, there was relatively clear evidence that maternal state of mind with respect to attachment was

associated with shared patterns of maternal sensitivity. Mothers who were classified as secure-autonomous in the Adult Attachment Interview were, to a significant extent, observed to be more sensitive and responsive to their infants during a semi-structured home observation. Furthermore, these associations between sensitivity and the AAI were non-independent – suggesting that those mothers who were secure-autonomous were likely to be more sensitive to *both* infants, consistent with the shared environmental view. Overall, a model that assumed that maternal sensitivity to each twin and maternal state of mind with respect to attachment were indicators of one underlying factor proved to be an excellent fit to the data. The evidence from this study seems to converge well with studies of the AAI and sensitivity in samples of singletons. The size of the association between the AAI and maternal sensitivity was very close to that found by van Ijzendoorn in his meta-analysis of sensitivity and adult attachment security (van Ijzendoorn, 1995a). Two further predictions of attachment theory are thus supported by the findings of this study. Firstly, maternal sensitivity appears – to a substantial degree – to be a trait-like characteristic that is consistent across children in the same family. Secondly, a significant proportion of the variance in this maternal 'responsivity trait' was associated with maternal representations of attachment assessed independently in patterns of speech during the Adult Attachment Interview.

Shared components of variance in maternal sensitivity also appeared to be associated with shared outcome in attachment security. Overall the associations between maternal sensitivity towards each twin and each twin's attachment security were fairly well described by a model that assumed that all these measures were caused by one single underlying factor. Bivariate analysis also suggested that a modest, but significant, proportion of the shared variance in sensitivity overlapped with shared variance in attachment security (the shared environmental correlation between these measures, r_c, was .39). Although these two alternative models (single-factor vs. bivariate) lead to different interpretations regarding the *extent* of shared mediation between sensitivity and attachment, both agree that some shared mediation is evident.

Of course, given the limited sample size of the study and hence the limited precision of these estimates, these findings should be treated as suggestive rather than definitive. It would be fair to say that the evidence regarding shared and non-shared mediation of the association between attachment and sensitivity was far from unambiguous and no doubt much of this

ambiguity arose as a result of sampling error. Large-scale replication would thus be highly desirable. The issue is important because it is a primary prediction of the linear model of attachment but also because it speaks directly to the question of whether consistency in maternal behaviour is a 'by-product' of shared method variance or whether shared patterns of maternal behaviour play a demonstrable role in independently assessed developmental processes. Non-independence of ratings of maternal sensitivity across twin pairs not only raises questions about the true consistency of maternal sensitivity but may also have lead to multi-collinearity and suppressor effects that may have limited the power of some analyses and the interpretability of the findings. Nevertheless, overall the results seem largely consistent with the shared representational view: Consistencies in maternal behaviour were substantial and appeared to be linked to shared outcomes in attachment.

However, the evidence for a direct link between the AAI and infant attachment security was, paradoxically, rather weak. A significant association was found between maternal AAI and infant attachment security in one sample of twins but not the other – a discrepancy that can only be explained by sampling error. Given the relatively small sample size in this investigation this may not be so surprising, although it certainly indicates a smaller effect than van Ijzendoorn's meta analysis might suggest (van Ijzendoorn, 1995a). If the correlation between the AAI and security in the Strange Situation were truly .50, the current study would have around 97% power to show such an effect (at $p < .05$). This is clearly a critical link in the causal chain that this study failed to support. Nonetheless, given the wealth of evidence from research in singletons regarding the association between the AAI and the Strange Situation, one can only presume that sampling error, procedural limitations or the twin situation itself is responsible for this null finding. If there *is* something unique about the twin situation, this would represent a clear limitation to the generalisability of the findings presented in this thesis. Until evidence from independent samples of twins is available it is simply not possible to say with confidence whether the use of twins in this context represents a threat to the generalisability of this research (more will be said regarding this issue under the heading "*Twin-specific effects and issues of generalisability*" below).

To summarise briefly, the current study found evidence that broadly supports the linear model of attachment. Parental representations of attachment were found to be related to shared patterns of maternal behaviour and shared patterns of maternal behaviour in turn were

found to be associated with concordance between twins for attachment security. The only aspect of the linear model that was not directly supported by the data was the fully mediated pathway between the AAI, maternal sensitivity and infant attachment security. Although the AAI was found to be associated with maternal sensitivity and maternal sensitivity was found to associated with attachment security, the direct link between the AAI and the Strange Situation was inconsistent – being significant for the 'twin1' sample but not for 'twin2'sample. Although sampling error may well account for this null finding, the possibility that the twin situation somehow disrupts this pathway should be taken seriously.

Of course, maternal representations of attachment are not the only factors that have been investigated by researchers interested in the development of infant-parent attachment. The current study included a range of measures designed to capture several areas of the family context that have been identified by some as potential distal causes of individual differences in attachment (e.g. Belsky et al, 1995). Surprisingly, neither maternal age, social support, psychiatric symptomatology or parenting stress were directly associated with attachment security. Similarly, this study found no strong evidence to support the view that individual differences in attachment security are associated with differences in infant temperament. The only positive social-contextual predictor of attachment security in this sample was maternal education and even this effect was not consistent across both sets of twins (twin1 and twin2). This somewhat disappointing outcome is perhaps less surprising when one considers the number of failures to replicate these associations between attachment security and these contextual variables (e.g. . Belsky, et al, 1995; Zeanah et al, 1993; Mengelsdorf et al, 1990). Indeed, as we shall later, these variables appeared to be more closely linked with the causes of differences *within* families than they were with differences between them.

7.3 Non-shared environments and infant-parent attachment relationships

Perhaps the most important finding from this investigation of attachment in families with twins is the substantial influence of non-shared environmental factors. The implications of this finding are likely to be wide-ranging, suggesting exciting avenues of inquiry for future developmental and clinical research. Approximately 64% of the variance in individual differences in attachment security appears to be attributable to differences *within* families, not between them – as traditional approaches to attachment might suggest. Indeed, the non-shared environment was evident in all aspects of attachment behaviour observed in

Ainsworth's Strange Situation. If non-shared influences on attachment can be shown to represent meaningful and reliable differences in family relationships, researchers interested in the causes and developmental consequences of attachment security will need to develop new and innovative ways of conceptualising and researching this important domain of socio-emotional development.

Repeated mention has been made of the importance of disentangling true differences in siblings' and twins' attachment relationships from discordances that may have arisen from measurement error. The issue is an important and methodologically challenging one. Given the relatively good psychometric properties of the Strange Situation (for details see the Introduction) it seems unlikely that measurement error can account for a large proportion of the discordant cases found in this study. As an illustration, consider that if non-shared influences were entirely absent, assessments of twins' attachment security could be thought of as repeated assessments of the same child (assuming that genetic influences are zero). The correlation between twins would thus represent a direct estimate of the reliability (test-retest or otherwise) of the Strange Situation. Certainly, estimates of the inter-rater reliability of the procedure would lead one to expect a correlation between twins of the order of .70 - .80 if this were the case. The long-term predictive validity of the Strange Situation would also suggest much higher levels of reliability (see for example Main et al (1985) as discussed in the Introduction). Of course, it should also be noted that concerns about the test-retest reliability of the Strange Situation have been raised in recent times (Belsky et al, 1996; Thompson, 1996) – underlining the importance of further research in this area. Nevertheless, the weight of evidence would seem to favour the view that the Strange Situation is a reliable instrument and hence that differences between twins and siblings for attachment security are likely to represent more than mere measurement error.

The present study sought to assess the validity of differences in attachment security by searching for consistent associations between differential outcome and psychosocial variables considered to be important potential predictors of attachment security. On the basis of theoretical considerations it was suggested that differences in maternal sensitivity would be the most likely source of within-family differences in attachment security and on the whole supportive evidence was found for this position. Firstly, discordant twin pairs were found to experience less similar maternal behaviour than concordant pairs, a finding consistent with

that of Ward et al's study of siblings (1988). Secondly, twin-specific maternal sensitivity was found to predict attachment security after controlling for the sensitivity score and attachment security of the co-twin. Furthermore, bivariate analyses suggested a fairly strong correlation between the non-shared components of variance in sensitivity and attachment security. Indeed, the evidence for non-shared pathways of influence between sensitivity and attachment (r_e = .49) was, if anything, stronger than that for shared pathways (r_c = .39). These analyses generally support the view that, to the modest extent that parents behave differently towards their infants, differences in maternal sensitivity lead to differences in attachment security. The finding is encouraging in that it suggests that traditional views regarding the proximal determinants of attachment and these new findings regarding within-family variance in attachment security are potentially reconcilable. Furthermore, the findings suggest that differences between twins are likely, to some degree, to represent real and meaningful differences in siblings' relationships with their parents.

Further evidence regarding the meaningfulness of within-family differences in attachment security emerged when psychosocial factors were used as predictors of concordance and discordance in attachment. Indeed, there appeared to be very substantial differences between those families in which both infants received the same secure-insecure classification and those in which the infants showed different patterns of attachment in the Strange Situation. These differences were apparent for both maternal and child characteristics. Maternal age, quality of social support, depressive symptoms and interpersonal problems were all significant independent predictors of discordance in attachment. Mothers who were older, who experienced less social support, greater levels of depression and less interpersonal problems were more likely to have infants who in the Strange Situation showed quite different patterns of response – one being secure while the other was insecure. It was suggested that the simplest interpretation of these findings was that greater levels of family strain – defined broadly – are associated with greater changes in family relationships and that it is these changes that underpin non-shared patterns of attachment. The evidence for this is, of course, indirect and it remains a very real possibility that these differences in infant attachment security do not result from greater instability in attachment classifications but remain highly stable over time. Nonetheless, this interpretation fits nicely with previous research on the psychometric properties of the Strange Situation (see Introduction and Egeland & Sroufe, 1981; Vaughn et al, 1979). Longitudinal research into patterns of

continuity and change in patterns of attachment in families with more than one child clearly represents an important and exciting direction for future research. Interestingly, this pattern of results was predicted by Lalumiere, Quinsey & Craig (1996), who argue that evolutionary considerations suggest that "under particular environmental conditions, such as low maternal support, siblings with different attachment histories compete less for limited resources" (Lalumiere et al, 1995). According to Lalumiere et al, within-family differences may serve important evolutionary functions. Lalumiere et al suggest that parental investment is a key factor in offspring survival and reproduction that is inevitably limited. In their view, maternal sensitivity represents a trade-off between the chances of a given offspring surviving to reproductive age and the parent's capacities for investing in other offspring. Given that sibling rivalry for parental resources is likely to have been a powerful force in human evolution, Lalumiere et al argue that a 'sibling differentiation mechanism' may have been favoured by natural selection in order to reduce sibling competition and is likely to play an especially important role in conditions of low parental investment. Certainly, the data from the current study would seem to offer indirect support for such a view. Indeed, the effects of temperament on concordance are also broadly in keeping with the views of Lalumiere and his colleagues.

Temperamental factors, as measured by Buss & Plomin's (1984) EAS, appeared to play a very significant role in concordance for attachment security. Although generally speaking infants who were more sociable and more emotional were more likely to be concordant for attachment, the picture appeared to depend quite strongly on between-twin interaction effects. For both sociability and emotionality, the effect of one twin's temperament on concordance depended on the level of the other's. Indeed, the pattern of results indicated that it was increasing *distance* between twins' temperaments that lead to greater concordance in attachment. The findings are striking, firstly because of the sheer statistical significance of the effects and secondly because they suggest a hitherto unanticipated role for temperament in the development of attachment. Rather than being a direct cause of attachment security or insecurity per se, the current study suggests that temperament may play a role in sibling differences. Several researchers have suggested that temperament may be considered as an interactive variable. For example, Crockenberg (1981) found that difficult temperament interacted with levels of maternal social support, such that insecure attachments were particularly likely under conditions of low social support *and* difficult infant temperament.

Indeed, Plomin & Daniels (1984) have discussed the various ways in which temperament interactions can be conceptualised. Plomin & Daniels suggested three broad kinds – 1) interactions between temperament and environment, 2) interactions between temperament and parental characteristics and 3) interactions between temperament and other child characteristics. When Plomin & Daniels say "other child characteristics" they mean of course other domains of the same child's behaviour or personality. However, the current study suggests an additional interaction term that could be added to this list: Interactions with *another* child's temperament. The logic of this view is simple – it seems likely that in a wide variety of contexts the effect of one child's temperament in a multi-child family will depend on that of the others' – because the personality of one's sibs represents a very significant aspect of one's environment. In many cases, two difficult children are likely to be very much more demanding than one. Furthermore, two children with similar interests and needs would seem to be more likely to come into direct competition with one another. In other circumstances, more similar temperaments might lead to greater *co-operation* between sibs and hence less conflict. The investigation of interactions between sibling temperament would seem to be an exciting new direction for research into socio-emotional development in families with more than one child – and one which may throw new light on the methods and conceptual tools needed to understand the complexities of the family system.

The ideas of Lalumiere and his colleagues also suggest interesting ways of conceptualising the effects of competitive processes in development. In the current context, one might suppose that given the relatively fixed nature of temperamental differences and the relative plasticity of attachment organisation (depending heavily on learning over the first year of life), the 'sibling differentiation mechanism' operates to drive siblings towards different attachment strategies in order to minimise conflict for parental resources caused by similar infant temperament. Whether the 'sibling differentiation mechanisms' resides in the child or the parent is an interesting question. Is it the case that parents invest differentially in their infants under conditions of high potential competition or is it that infants themselves adopt different strategies under these circumstances? In that respect it is interesting to note that the current study found no evidence that these temperament interactions were associated with differences in maternal sensitivity to each child. Of course, at this early stage, one can only speculate about the mechanisms underlying these effects. Indeed, without further replication,

these findings should be treated with caution simply because they were not predicted a priori and are, as far as the author is aware, without precedent.

Taken together, the most important implication of these analyses of predictors of concordance is simply that there are systematic differences between those families whose infants are concordant for attachment and those that are not. These findings suggest that robust processes will be found that will indicate why children in the same family can come to have different attachment patterns from their siblings. Further research of this kind, coupled with research aimed at disentangling measurement error from the non-shared environment, is needed urgently and is likely to reap substantial rewards in terms of novel data and theory in early socio-emotional development.

7.4 Contrast effects and the effect of relationships on relationships: Further evidence of competitive processes?

One of the surprising and intriguing results to emerge from this investigation was the apparent contrast effect of one twin's sensitivity score on the other twin's attachment security. After controlling for twin1 sensitivity, for example, twin2 sensitivity was negatively associated with twin1 attachment security in a logistic regression. This seems a particularly surprising result given the strong positive correlation between each twin's sensitivity score. On the face of it, this finding might suggest that infants are somehow sensitive to the kinds of interactions between their parent and co-twin and that the more sensitive these co-twin interactions are, the more likely it is that the target twin will be insecure. Certainly, such a finding would be an important one and would have exciting implications for the way that we understand triadic interactions and the effect of relationships on relationships. If this finding could be shown to represent a real developmental process it would also raise interesting questions regarding the socio-cognitive mechanisms that underlie such apparently complex capacities. The negative effect of the co-twin's interactions with their common parent may suggest that something akin to jealousy may be at play and that competitive interactions may be important in the development of insecure patterns of attachment. In the context of the earlier discussion regarding interactions between twins' temperaments this seems plausible. Furthermore, informal observations suggest that jealousy and rivalry between even quite young twins is relatively common (Bryan, 1992). Experimental work by Hart et al (1998) also supports the notion that infants of 11-12 months

of age are sensitive to the focus of a parent's attention and are upset when that attention is focussed on another child. Much of the work of Dunn & Kendrick (1982) suggests that competition and jealousy are important issues in families with more than one child, issues which emerge remarkably early on in life.

Questions regarding the effect of one child's parental interactions on the security of the other were also explored using simple difference scores. Could these analyses shed any further light on the issue of the effects of relationships on relationships? The principal findings of these analyses were that maternal differential treatment (the difference in sensitivity between twins) negatively predicted attachment security for the twin who was comparatively worse off and positively predicted attachment security for the twin who experienced relatively greater levels of maternal sensitivity. For the lower-scoring twin, this effect remained after controlling for their raw sensitivity score, but the effect disappeared for the twin who scored relatively higher in terms of maternal sensitivity. These analyses thus suggested that *relative* differences in maternal sensitivity influence infant attachment security. Again, this would seem to lead to the conclusion that infants are sensitive to the kinds of interactions that take place between their mother and co-twin and that relatively minor differences between their own experiences and that of their sibling impact upon their attachment security.

However, caution must be exercised in interpreting these results because the contrast effects clearly result from the fact that the co-twin's security score is acting as a suppressor variable. Suppressor relations raise the possibility that these contrast effects emerged as an artefact of shared method variance in assessments of each twin's sensitivity score. Indeed, it was shown that suppressor effects may also lead to correlations between outcomes and difference scores and hence that any cautions that apply to the regression analyses are likely to be equally applicable to the difference scores too. Overall then it seems wise to interpret these findings with caution. In the future investigations of these kinds should carry out independent assessments of each twin's score for sensitivity (or any other predictor) in order to minimise the chances of truly artefactual contrast effects. As such, it would seem important in the future to investigate contrast effects from multiple vantage points: Independent *converging* evidence for contrast effects would justify much greater confidence in their meaningfulness. For example, given that these contrast effects have been interpreted as possible evidence for competitive processes in the development of attachment, direct observations of competitive

behaviour would powerfully supplement more indirect methods based on regression analyses and negative cross-sibling paths.

Thus, although some interesting possibilities were raised by these data it would be premature to conclude that sibling contrast effects are involved in the development of attachment security in families with more than one child. The pattern of results may have arisen from measurement problems associated with the assessment of maternal sensitivity. The possibility that children are sensitive to differences in parental treatment is a provocative one and is clearly worthy of further investigation.

7.5 Twin-specific effects and issues of generalisability

All of the conclusions drawn from this study, and indeed from all studies using twins, depend upon the extent to which findings from twins are generalisable to non-twin populations. It is beyond question that life for families with twins is in many ways different from those of non-twin families (Bryan, 1992). Parents of twins often experienced considerable levels of stress surrounding the birth of their twins and often experience considerable difficulties over the first year of life (Segal, 1999). Twins themselves are known to be different from singletons in the timing of acquisition of some developmental skills, most notably language (see Rutter & Redshaw, 1991). The very fact that twins spend the first year of their lives in the constant company of their co-twin and share the vast majority of their adult-interactions might seem self-evidently to limit the generalisability of twin studies. Nevertheless, developmental differences between twins and singletons are few and far between and indeed appear, on the whole, to be limited to relatively early delays in language (Rutter & Redshaw, 1992). Furthermore, there have only been a handful of examples of twin studies that have been shown to depart from the basic findings of studies using non-twin populations (such as non-twin siblings and adoptees, see for example Plomin & Rende, 1995). What can be said about the likely generalisability of the findings of this study?

To begin with, there seems to be quite strong converging evidence that the extent of concordance in attachment security for twins is the same as that for non-twin siblings (van Ijzendoorn et al, in press; Teti & Ablard, 1990; Ward et al, 1988). Indeed, the similarity in estimates of concordance among studies of twins and singletons is striking. Furthermore, there was little evidence that the rates of insecure attachment observed in this study differed

substantially from that expected from a singleton population with a similar social and economic profile. On the other hand, there did appear to be more resistant infants in this sample of twins than is usual in British and American samples of singletons. Indeed, the majority of those infants classified as insecure received a classification of C_1 or C_2. It certainly seems reasonable to suggest that these increased levels of resistance may have resulted from the increased competition for parental resources that is an inevitable part of the first year of life for baby twins. Certainly, there was little evidence that the Strange Situation procedure itself led to increases in resistance as a result of prior separation for the second twin. It would be interesting to see whether closely-spaced sibs show a similar increase in resistant behaviour – as one might expect if this interpretation is correct. Related to this, Teti et al (1996) found increases in insecurity upon the birth of a sibling in a sample of pre-schoolers, although their reliance on the Waters & Deane (1985) Q-sort measure of attachment security precludes any conclusions regarding resistance per se. Increased levels of resistance in twins certainly makes sense given that resistance is considered to be caused by *inconsistent* parental sensitivity (Cassidy & Berlin, 1994). Many parents of twins will tell you that it is hard to be consistent to two babies at once (see Bryan, 1992).

To the extent that patterns of attachment in twins are different from those of singletons these differences must surely limit the extent of generalisability to non-twin samples. Certainly, until direct replication data from non-twin siblings is available it would seem wise to bear such potential limitations in mind. Furthermore, the fact that the majority of insecure infants in this sample of twins were resistant obviously implies that the findings of the current study may not apply to the contrast between security and avoidance. For example, issues of sample size and power aside, the current study says comparatively less about the possible genetic influences on avoidance than it does about such influences on resistance.

Further evidence of twin-specific processes emerged in the context of the association between parental representations of attachment and infant attachment security. The size of the association was clearly smaller than that found by many researchers in singletons populations (see van Ijzendoorn, 1995a) and was significantly smaller than the association found in a matched control group of singletons. The most likely cause of this null finding can again be found in the increased levels of resistance in this sample of twins. Only 5 parents in the current study were classified as Preoccupied in the Adult Attachment Interview and it is self-

evident that this could in no way account for the relatively large number of resistant infants in this sample.

Overall then there appears to be enough evidence to suggest that direct, unqualified extrapolation from this study to wider non-twin populations would be premature at this early stage of research into attachment processes in families with more than one child.

For those interested in the unique ecology of twin development these findings raise important issues that are clearly worthy of further research. If it were true that insecure patterns of attachment in twins tends to involve resistance rather than avoidance this would seem to have significant implications for the likely course of emotional development in twins. One might expect that anxiety-related behavioural problems would be more common than aggressive, externalising ones and that twins would be at somewhat greater risk for dependency and bullying (see, for example, Matas et al, 1984). The current study also suggests the possibility that competition between twins may represent an important issue in the development of infant-parent attachment. Prospective studies of the implications of insecure patterns of attachment in twins would seem to be an important avenue for future research in twin development.

7.6 Conclusions

Bowlby's theory of attachment and the empirical and theoretical work that it inspired places internal working models at the heart of the determinants of attachment. The current study aimed to assess this representational view in the context of families with more than one child. For the most part the evidence from this study of twins broadly confirms the predictions of contemporary attachment theory. The study of patterns of attachment in twins and siblings has shown consistently that family resemblance for patterns of attachment is greater than would be expected by chance and that this resemblance is accounted for largely by shared environmental factors. Furthermore, the current study suggests that maternal sensitivity itself can be considered a shared environmental factor that is to a significant extent associated with shared patterns of infant-parent attachment. Nevertheless, perhaps the most important and exciting finding of this study of twins is the prevalence of non-shared, unique influences on patterns of attachment. The current study was able to show, at least in a preliminary way, that these differences in attachment classifications represent meaningful differences in family

relationships and suggests that the focus of attachment research in the future should shift to an examination of the within-family causes of attachment security and insecurity.

Figure 7.2 summarises the framework for attachment theory suggested by the current results. According to the current view, shared environmental factors exert their influence via biases in information processing which affect the caregiver's interaction with the child. Thus, during ongoing interactions these cognitive processes serve to bias the trajectory of the early attachment relationship in one direction rather than another. These biases are thought to be present before the birth of the child – although a specific child may elicit qualitatively or quantitatively different distortions in information processing as the caregiver develops separate internal working models of each of her children. Clearly child characteristics will influence these interactions and hence the temperament of the child will inevitably impact upon the parent's emerging representation of the child and the parent-child relationship. The parent's representation of the child is thus conceived of as influencing and being influenced by interactions that occur between parent and infant.

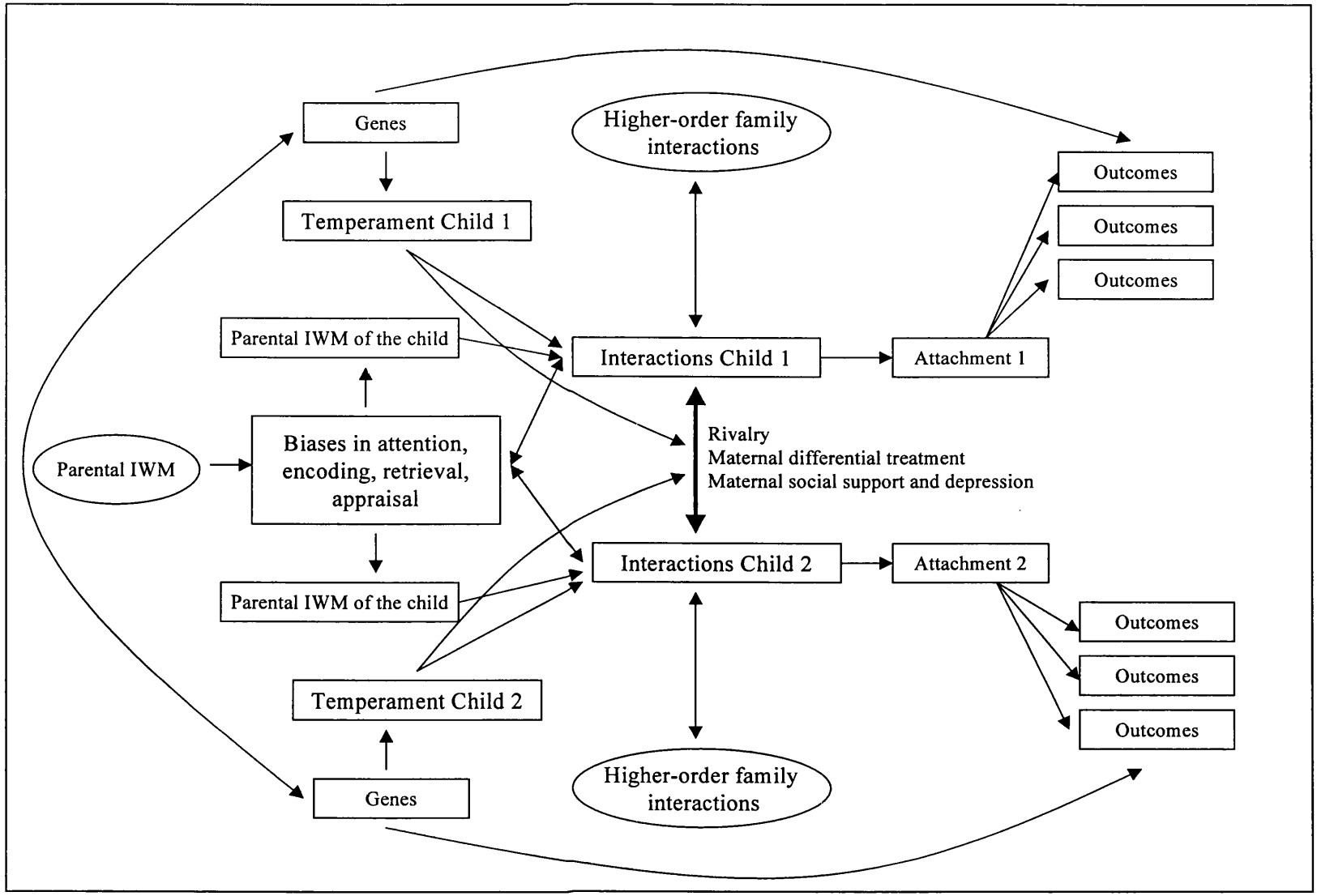
An important discovery of the study concerned the moderating influence of parental characteristics on concordance between twins for attachment security. It appears that parental characteristics that are likely to influence parent-child interactions, in this case depression and social support, can enhance or amplify differences between twins and increase the potential for non-shared environmental effects. One possible explanation of this findings is that maternal differential treatment is greater under conditions of low social support and greater depression, although no direct evidence was identified to support this hypothesis. A further finding emphasises the importance of considering the influence of temperament on attachment in the context of the family as a whole, rather than the direct influence of temperament on infant-caregiver interactions. It appears that, at least in terms of concordance for attachment security, the effect of temperament is moderated by the temperament of the co-twin. In the present author's view this effect may result from competitive interactions between twins as well as an infant's sensitivity to the sibling's interactions with their common parent. These complex processes clearly require further observational study. The context of such studies should, according to this view, be the entire family as higher order family interactions are likely to represent powerful moderating influences on caregiver-infant interactions with any one child. Speculatively we may consider the possibility that the entire

family system may be classified in terms of the extent to which it compromises or supports secure infant-parent attachment relationships amongst children in the same family.

The present study provided good support for the predictability of attachment classifications on the basis of home observations of mother-infant interaction. This has been an elusive association (van Ijzendoorn, 1995a) and the relative success of the present study may be attributed to a combination of improved methods of observation and the simultaneous consideration of within-family processes that may have moderated the impact of observed interactions on attachment in other studies. The findings clearly demonstrated that, as expected, the quality of interaction is specific to some degree to the individual child and that the association between sensitivity and attachment is accounted for by both shared and non-shared factors.

The model thus suggests that uncorrelated influences on parent-infant interactions and processes that lead to active differentiation between children in the same family will play an important role in our understanding of early socio-emotional development and patterns of attachment in families with more than one child. These differences in within-family relationships are likely to take place against a background of shared factors that parents bring to their relationships with their children, factors that are known to exist even before the birth of the child (Fonagy et al, 1991). The model shown in Figure 7.2 thus integrates previous theory and research in attachment with a new outlook which emphasises the importance of within-family differences in patterns of infant-parent interaction and attachment relationships. As in previous models of attachment, the infant is thought ultimately to represent patterns of parent-infant interaction –patterns of interaction which vary between children in the same family. These representations of interactions then regulate the expression of attachment and underlie patterns of attachment behaviour in times of stress and separation.

Figure 7.2 Shared and non-shared model of the development of attachment in families with more than one child



Finally, the lack of genetic influences on *infant* attachment should not be considered as implying an absence of genetic influences on the commonly observed developmental sequelae of patterns of attachment. It is perfectly possible that while attachment security in infancy is only to a small degree influenced by the child's genetic constitution the outcomes of secure or insecure classification in later childhood are likely to include substantial genetic influence. It is known that patterns of genetic influence may change dramatically over time, with some genes exerting their influence at specific stages of development (Plomin, 1987). Thus in studying the outcomes of infant attachment in a longitudinal perspective, genetic influences should be taken seriously. In fact, some of the recently observed discontinuities between infant attachment and attachment in later childhood may be due not to changes in environments (e.g. Sroufe, 1996) but to the increased influence of genetics. Of course, the strength of genetic and environmental influences on outcome may vary by domain. Only genetically informative research designs are capable of exploring the interplay between the genetic and environmental factors that mediate between early patterns of attachment and later developmental outcomes. A follow up of the present sample in the early pre-school years would yield vital information in relation to this question.

7.7. Implications for future research

Given the significance of within-family variation in attachment, new approaches to the study of the relationships between attachment and family processes are needed urgently. Perhaps the single most important direction for attachment research is the basic description of patterns of family interaction as they impact upon the development of infant-parent attachment. The current study suggests that it will be essential that studies of attachment adopt a family systems perspective. The notion that dyadic relationships between parents and their children cannot be understood in isolation from the constellation of other relationships within the family has long been considered of the utmost importance to those interested in the development of attachment (Stevenson-Hinde & Byng-Hall, 1992; Marvin & Stewart, 1990; Byng-Hall, 1986). Despite this, relatively little has been done towards this end, either in terms of measurement or in terms of the basic theoretical structures necessary to systematically investigate attachment in families with more than one child. Cicchetti, Cummings, Greenberg & Marvin (1990) in their overview of attachment research note that "there has been essentially no research on attachment that reflects

an overriding family perspective. This is due largely to a lack of a conceptual framework that expands attachment theory to a family systems level". Nearly a decade on this view seems more apt than ever. There is a clear need for basic observational work on patterns of family interaction in families with more than one child. The little systemically-oriented work that has been done thus far has focussed on the role of the marital relationship in the development of the attachment, perhaps because of the more immediately tractable measurement issues involved. In that respect, the observational work of Dunn and her colleagues (e.g. Dunn & Kendrick, 1982) is likely to be a valuable resource in the future for empirical investigations of the family system. A thorough understanding of the organisation of family relationships is likely to require intensive observational work, carefully designed semi-structured lab-based assessments and novel experimental approaches.

The prevalence of within-family differences in attachment security also challenges the way that attachment researchers consider the causal influences on infant-parent attachment relationships. What role if any should be ascribed to the infant's representational models in the development of non-shared patterns of attachment? It seems feasible - perhaps likely - that an infant's representations of attachment would include more complex aspects of family interactions beyond those that take place solely between mother and infant. Such representations might serve to organise infants' expectations about the outcome of typical family interactions. Furthermore, the model outlined above suggests that parental representational processes might also offer potential explanations of within-family differences in attachment security. Slade et al (in press) have developed an interview-based assessment of parental representations of the child, which in a sample of single children was found to be associated with attachment security. It remains an exciting possibility that this association is to some degree non-shared and may thus represent a further potential source of within-family influences on the development of attachment.

The non-shared environment is also likely to have a profound impact on our understanding of the clinical implications of early patterns of mother-infant attachment. Increased attention will need to be paid to differences in children's experiences within the family and to the importance of interdependence and conflict in family processes. Again, family systems approaches seem likely to play a vital role in understanding the links between patterns of attachment and the development of later emotional disturbance. The recognition of differences in children's relationships within

the family will play a critical role in developmental and clinical models of attachment and socio-emotional development.

The findings of the current study raise many questions about the development of attachment in families with more than one child that are worthy of immediate investigation. Several key suggestions for future research are given below:

1. *Large-scale replication of the current study in a longitudinal, multivariate genetic design.*
   Given the small sample size of the current study there is a great need for a large-scale replication. Lack of statistical power severely limits the conclusions that can be drawn from this study, particularly in relation to genetic effects. The possibility of genetic influences on attachment remains an intriguing possibility.
2. *Establishment of the test-retest reliability of non-shared patterns of attachment in twins and non-twin siblings.*
   Given the confounding of measurement error and non-shared patterns of attachment, the establishment of the test-retest reliability of the Strange Situation in families with more than child seems vital. Furthermore, the current study suggested – indirectly – that non-shared patterns of attachment may emerge as a result of greater instability in attachment classifications in families undergoing difficulties and stress. As such, it would seem especially important to investigate patterns of lawful continuity and change in within-family attachment relationships and their antecedents from a longitudinal genetic perspective.
3. *Further research into the causes of non-shared patterns of attachment.*
   Although the current study suggests that maternal behaviour may play a role in differential outcomes for attachment, much remains to be done in understanding the reasons why many siblings come to develop different patterns of attachment. Important possibilities include temperamental factors, differences in maternal resource allocation and sibling rivalry.
4. *Investigations of the extent and antecedents of sibling rivalry.*
   The current study suggests that sibling rivalry is likely to be more intense for those infants with similar temperaments and in families experiencing greater stress (parental depression, low social support) and that sibling competition may have implications for non-shared environmental approaches to the development of attachment. Nevertheless, direct evidence in support of this hypothesis is needed.
5. *Investigations of the socio-cognitive mechanisms underlying sibling rivalry.*

If it is true that infants are sensitive to the kinds of interactions that occur between their parent and co-twin, what can we learn about the cognitive capacities that might support such behaviour? Can infants of 9 months discern the focus of a parent's attention and respond differentially in accordance with such computations (as the research of Hart et al (1998) suggests is true for 11-12 month olds)? To what extent can infants make judgements about *relative* parental resource allocation? To what extent do infants of 9 months recognise the meaning of parental emotion-expressions directed towards another child? For example, it would be interesting to replicate the Hart et al study but include conditions in which maternal emotional expression towards the toy baby is varied from positive, neutral and negative. Coupled with attachment data such a design would represent an exciting exploration of sibling relationships, early social cognition and patterns of attachment.

6. *The longitudinal assessment of the sequelae of non-shared patterns of attachment.*
   It is self-evident that the longitudinal developmental implications of non-shared patterns of attachment is a critical area for future research. Indeed, over and above the direct effects of non-shared patterns of attachment on non-shared outcomes, relative differences in maternal sensitivity and attachment security may have specific developmental effects that will only be evident when researchers examine more than one child per family. Areas of particular interest would include childhood behaviour problems, social-problem solving, peer relationships and theory of mind skills.
7. *Parental representations of their children.*
   Slade et al (in press) have shown that parents' representations of their children as assessed by the Parent Development Interview are associated with infant attachment security. Such a finding raises the exciting possibility that non-shared patterns of attachment may be understood as emerging from differences in parents' representations of their children.
8. *Within-family variability in attachment and the family system.*
   A major challenge for research into attachment and the non-shared environment is the proper treatment of the effects of family interaction patterns on developing attachment relationships. Assessment procedures based on the Strange Situation designed for families with more than one child, as well as fathers, might throw light on the regulation of attachment and separation at the family level. Semi-structured observational procedures aimed at assessing patterns of family interaction surrounding other common events such as parental arguments, tidying up, turn-taking situations or prohibitions would also be important in describing the organisation

of the family system. Consistencies in family patterning might be understood in terms of Byng-Hall's (1986) notion of family scripts.

Understanding the relations between patterns of family interaction and continuities, changes and within-family differences in attachment security represents an exciting goal for theory and research in the future. The revelation of the non-shared environment has had a profound impact on the way developmental psychologists conceptualise the causes of individual differences in behavioural development, but the full implications of this new perspective are only beginning to be felt by researchers in early socio-emotional development.

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Appendix A.1
EQS Script for Test of MZ - DZ Differences in Population Covariance Matrices

```
/Title
Test of the equality of covariance matrices for MZ and DZ twins
Group 1 - DZ Twins
/Specifications
Groups = 2;Cases=38; Variables=5; Method=ML;
categories = v24, v25;
Matrix = raw; analysis=cov;data='c:\eqs\attach.ess';
/LABELS
V1=ZYGOSITY; V2=T1PROX1; V3=T2PROX1; V4=T1PROX2; V5=T2PROX2;
V6=T1CONT1; V7=T2CONT1; V8=T1CONT2; V9=T2CONT2; V10=T1RES1;
V11=T2RES1; V12=T1RES2; V13=T2RES2; V14=T1AVOID1; V15=T2AVOID1;
V16=T1AVOID2; V17=T2AVOID2; V18=T1DISORG; V19=T2DISORG;
V20=T1MAIN;
V21=T2MAIN; V22=T1BELSKY; V23=T2BELSKY; V24=T1BVNB; V25=T2BVNB;
V26=T1DISSEC; V27=T2DISSEC;
/Equations
v24 = 2*F1;
v25 = 2*F2;
/Variances
F1 = 1.0;F2 = 1.0;
/Covariances
F1, F2 = 0.2*;
/PRINT
 digit=3;
 linesize =80;
/End

/Title
Group 2 - MZ Twins
/Specifications
Cases=20; Variables=5; Method=ML;
categories = v24, v25;
Matrix = raw; analysis=cov;data='c:\eqs\attachmz.ess';
/LABELS
V1=ZYGOSITY; V2=T1PROX1; V3=T2PROX1; V4=T1PROX2; V5=T2PROX2;
V6=T1CONT1; V7=T2CONT1; V8=T1CONT2; V9=T2CONT2; V10=T1RES1;
V11=T2RES1; V12=T1RES2; V13=T2RES2; V14=T1AVOID1; V15=T2AVOID1;
V16=T1AVOID2; V17=T2AVOID2; V18=T1DISORG; V19=T2DISORG;
V20=T1MAIN;
V21=T2MAIN; V22=T1BELSKY; V23=T2BELSKY; V24=T1BVNB; V25=T2BVNB;
V26=T1DISSEC; V27=T2DISSEC;
/Equations
V24 = 2*F1;
V25 = 2*F2;
/Variances
F1 = 1.0; F2 = 1.0;
/Covariances
```

```
F1, F2 = 0.2*;
/Constraints
(1, F1, F2) = (2, F1, F2);
(1, V24, F1) = (2, V24, F1);
(1, V25, F2) = (2, V25, F2);
/PRINT
 digit=3;
 linesize =80;
/End
```

Appendix A.2

EQS Script for Cholesky decomposition for shared and non-shared environmental effects (single-group analysis)

```
/TITLE
Cholesky decomposition of association between sensitivity and
attachment
(shared and non-shared parameters only - single group analysis)
/SPECIFICATIONS
 DATA='C:\EQS\MAIN.ESS'; VARIABLES=  4; CASES= 56;
 METHODS=ML, ROBUST;
CATEGORIES = V3, V4;
 MATRIX=RAW;
/LABELS
-
/EQUATIONS
V1 = F2;
V3 = F1;
V2 = F4;
V4 = F3;
F1 = *F5 + *F9;
F2 = *F5 + *F6 + *F9 + *F10;
F3 = *F7 + *F11;
F4 = *F7 + *F8 + *F11 + *F12;
/VARIANCES
F5 TO F12 = 1.0;
/COVARIANCES
F5, F7 = 1.0; F6, F8 = 1.0;
/CONSTRAINTS
(F1, F5) = (F3, F7);
(F1, F9) = (F3, F11);
(F2, F5) = (F4, F7);
(F2, F9) = (F4, F11)
(F2, F6) = (F4, F8);
(F2, F10) = (F4, F12);
/PRINT
FIT=ALL;
/LMTEST
/END
```