Sibling Relationship Quality:
A Longitudinal Study of Twins and their Families

Katharine Mary Mark

Thesis submitted for the degree of Doctor of Philosophy (PhD)

University of Sussex

September 2016

Signed Declaration

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature: ……

Katharine Mary Mark

26th September 2016

Acknowledgements

The research upon which this thesis is based has been facilitated by a number of people. First and foremost, by my primary supervisor, Dr. Alison Pike, who I would like to express my deepest gratitude to. She has been an inspiration to me, and a truly wonderful source of guidance and understanding over what have been three challenging years. Alison's insightful feedback, as well as her patience, empathy and encouragement, have been invaluable - I would not have been able to complete this journey without her. She has helped me grow in confidence to become a better researcher, and I feel very lucky to have had the pleasure of working with her.

I am also indebted to Dr. Bonamy Oliver, my secondary supervisor, who has provided me with ongoing advice, and has always encouraged and supported me. Along with her incredible knowledge, Bonny's kindness has always shone through, bringing with it a sense of comfort. I am so appreciative of all her help, and I will never forget what she has done for me.

A huge thank you goes to my brilliant colleague and my dear friend, Rachel Latham. I have been in awe of Rachel since we first met – her talent knows no bounds, and working with her has made me strive to achieve more. Perhaps more importantly though, she has been a truly wonderful friend, in the good times and the bad. She has always gone out of her way to support me both academically and personally, and having her in my life has been a joy. I will so miss collecting data together and sharing an office, but I know our close friendship will be long-standing.

I also want to thank Prof. Robin Banerjee for his comments on my work, and for his exceptionally helpful advice over the years. He has been a fantastic assessor. Thank you to Amelia Smith and Vix Simcock, who, along with Rachel, have made working in the office

much more fun. Also, to my parents, for making undertaking this degree possible financially, and to Sophie Wilkinson, for always being there when I needed her. I am very appreciative too, of the families who participated in this project – I have met some lovely mothers, fathers and children.

I feel it only apt to dedicate my work to my own siblings – my two younger brothers, Jamie and Louis Shaw. I have always been fascinated by the similarities and differences between us, and they have inspired my interest and passion into fraternal relationships over the years. I feel very fortunate to have such a close and meaningful bond with the boys, along with a great deal of banter!

Finally, I am eternally grateful to my wonderful husband, Gregory Mark, who has stuck by me through the hard times with exceptionally good grace. He has never faltered in showing me extraordinary amounts of care and compassion, along with a little bit of tough love when it has been needed. His undoubting belief in me has been both touching and overwhelming. Greg is my role model and my best friend - going home to him at the end of each day has given me the strength to complete this thesis.

UNIVERSITY OF SUSSEX

KATHARINE MARY MARK

THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PhD)

SIBLING RELATIONSHIP QUALITY:
A LONGITUDINAL STUDY OF TWINS AND THEIR FAMILIES

SUMMARY OF THESIS

The overarching goal of this thesis was to examine sibling relationship quality in young twin children, as well as the ways in which this key bond is associated with other familial relationships within the home environment. The three articles included were part of a longitudinal and multi-method study, run by myself and my colleague - the Twins, Family and Behaviour study. Accounts were collected from 282 mothers and 132 fathers of twins, over a two-year time period. Parents completed postal questionnaires and a telephone interview, and observations via Skype recorded them interacting with each of their children. The research was unique, as it employed a number of novel measures and sophisticated analyses that have not yet been used within a longitudinal twin sample such as this. Results showed that, contrary to expectations, no mean level differences emerged when monozygotic twin pairs, dizygotic twin pairs, and non-twin pairs were compared on their sibling relationship quality (Paper 1). Behavioural genetic modelling also revealed that sibling interactions were mainly influenced by the shared environment, common to both children within the dyad, but also by the genetic propensities of the siblings themselves (Paper 1). Using the innovative Preschool Five Minute Speech Sample interview, we found that mothers who expressed more family-wide positive, and less family-wide negative, emotion towards

their children reported more positivity within the sibling relationship – even when controlling for questionnaire measures of the mother-child relationship (Paper 2). Finally, opposing the majority of past literature, cross-lagged tests evidenced that earlier positivity within the sibling bond was predictive of later marital satisfaction, and of positivity within both the mother-child and the father-child bond (Paper 3). The implications of the findings include: the generalisability of studies of twins in childhood to the wider non-twin sibling population (Paper 1); the usefulness of maternal speech sample measures in capturing unique variance in sibling relationship quality (Paper 2); and the impact of affectionate sibling exchanges on entire family systems (Paper 3). Future research would benefit from exploring the nature of the relationship between twin brothers and sisters further, using both younger and older children's reports of their family interactions, within a more ethnically and socioeconomically diverse sample.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1: General Introduction

The bond between brothers and sisters is often the most enduring in life, beginning at birth, and lasting through into old age (Howe, Ross, & Recchia, 2011). In childhood, most siblings spend more time with one another than they do with their parents (McHale & Crouter, 1996), and their relationship is characterised by ambivalence – interactions tend to be high in both positivity and negativity at this stage of development (Kramer, 2010). Relationships among siblings have been the focus of academic study for a number of decades, primarily because their quality links to individual children's adjustment. Warmth and affection displayed within these dyads predicts better social skills, higher academic achievement, fewer behavioural problems and more confidence (Brody, 2004), whereas maladjusted pathways emerge when sibling relationships are typified by hostility and aggression (Slomkowski, Rende, Conger, Simons, & Conger, 2001). Saying that, a moderate number of sibling disputes is beneficial to children, allowing them to learn negotiation tactics and develop conflict resolution skills (Dunn & Slomkowski, 1992).

The overarching goal of this thesis was to examine sibling relationship quality in young twin children, as well as the ways in which this key bond is associated with other familial relationships within the home environment. In this chapter, I will first provide an overview of the literature on sibling relationships, by describing the informing theories. I will then consider predictors of the bond between siblings, along with methodological factors that need to be borne in mind. Finally, a summary of the aims of this thesis will be provided, along with an outline of the sample, procedure and ethical issues of my research.

Theoretical Perspectives of Sibling Relationship Quality

Family Systems Theory

Despite the fact that there is no single recognised model of sibling relationships (Caspi, 2011), there are a number of relevant theoretical perspectives. Of particular salience is family systems theory, first introduced by Bowen in 1978 (see Figure 1.1). This is a holistic framework that centres on the interactive and bidirectional nature of relationships within families. It states that the family system is an organised whole, and that the dyadic subsystems (such as the mother-child relationship, the father-child relationship, the mother-father relationship, and the sibling relationship) that make up this whole are interdependent (Ng & Smith, 2006). Bowen's (1978) work has enjoyed widespread use in the family intervention literature. For example, it has been applied to the understanding of psychopathology, such that underlying disturbances in the family system can be a response to illness symptoms in a family member (Miklowitz, 2004). Furthermore, family systems theory has been increasingly employed within the child and adolescent development literature.

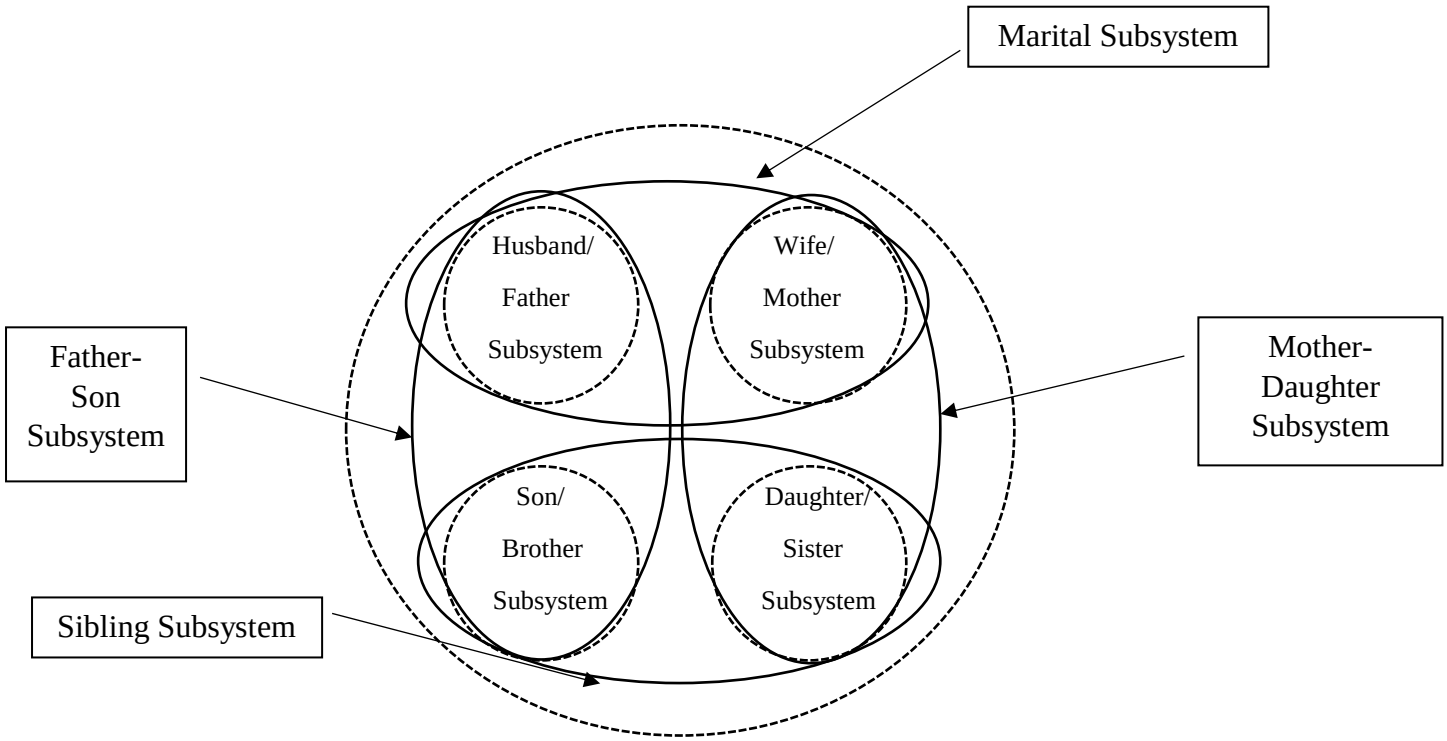

Figure 1.1. Diagram of Bowen's (1978) Family Systems Theory

Note. Diagonal pairings of each subsystem are also evident – the husband/father and the daughter/sister subsystem, and the wife/mother and the son/brother subsystem. Source adapted from http://www.thepentecostalfamily.org/family-systems-theory.html.

According to the system, sibling relationships, as well as other familial relationships, exist within the larger context of the family environment. Similarities are therefore expected between the affective qualities of these different bonds, because behaviour from one pairing shifts onto others (Bowen, 1978). This transfer of emotion has also been acknowledged by Engfer's (1988) spill-over hypothesis, which argues for the 'spill over' of feelings and behaviours between family members. Transfer between the spousal bond and the mother-child bond has been most extensively studied; for example, Erel and Burman (1995) used a meta-analysis to confirm that more aggression documented between parents was indicative of more negativity between mothers and their children. Recently, however, authors have shown that spill over is also relevant for exchanges between brothers and sisters, as the quality of their interactions seems to follow in the footsteps of their parents' relationships (Cox, 2010).

Sibling relationships are, therefore, thought to be influenced by adult-centric exchanges within the home, tying in with the notion that parents have more of an impact on their offspring than vice versa (Yu and Gamble, 2008). Importantly, then, family systems theory indicates that sibling relationships should be explored in relation to all other dyads within the family.

Ecological Systems Theory

Bronfenbrenner's (1992) ecological systems theory has a number of similarities to family system-based outlooks. However, by looking at a child's development within the context of the system of relationships that form his or her surrounding environment, it has a broader scope. According to the ecological model, complex layers, each of which have an effect on the child, fuel social and emotional growth. Bronfenbrenner emphasised the fact that interactions between factors in a child's biological makeup, in their immediate family environment, and in their societal landscape steer adjustment – these subsystems are shown in Figure 1.2. Specifically, the microsystem represents the immediate settings that have a direct impact on children's experiences (for example, family, peer group, and school); the mesosystem represents links between microsystems, as changes in one may affect changes in another (for example, the link between family and school); the exosystem represents settings that children do not directly participate in, but that affect the functioning of the microsystem (for example, parental employment, and work experience); and the macrosystem represents settings that are further removed from children, but that still exert a profound impact (for example, social values, political institutions, and government policies). Variation in any one layer is thought to ripple throughout the others, such that all influences are interrelated (Darling, 2007).

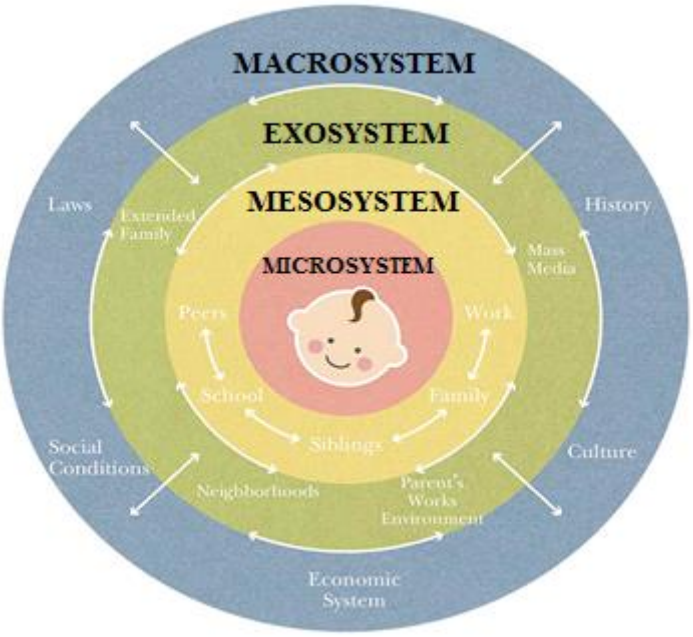

Figure 1.2. Diagram of Bronfenbrenner's (1992) Ecological Systems Theory

Note. Source adapted from http://ace.edu.hk/en/child-psychology/child-psychology-theory/dr-bronfenbrenners-ecological-systems-theory/.

Ecological systems theory proposes multiple levels of contextual influence on individual development, but these layers are also relevant to sibling relationships. In an interesting piece on the application of Bronfenbrenner's (1992) framework to siblings, Whiteman, McHale and Soli (2011) described the ways in which the subsystems can have their effect. They argue that forces within the microsystem can support close and involved sibling bonds, by defining the distinct activities undertaken by brothers and sisters, based on their age and gender. When considering the mesosystem, siblings may modify their behaviour towards one another in different contexts, reflecting the dyad's movement between the family and neighbourhood setting and the school setting. The exosystem may be at play through parental circumstances – for example, if a mother works long hours, an older sibling may have to take responsibility for their younger brother(s) and/or sister(s), which, in turn, may affect the bond between them. Finally, broader societal contexts, relevant to the macrosystem, are known to influence family relationships. More specifically, rivalry, a common sibling

dynamic in individualistic, Western cultures, is not considered central in more community-oriented cultures (Nuckolls, 1993).

Attachment Theory

Another vital theory to consider when studying sibling relationships is that of attachment, put forward by John Bowlby and Mary Ainsworth (Ainsworth & Bowlby, 1991). It was first developed to explain why infants become attached to their caregivers, and emotionally distressed when separated from them. Early work by Bowlby (1982), drawing on principles of evolutionary theory, states that attachment behaviours exhibited in infancy are regulated by an innate system that operates to keep the child safe, through the maintenance of their proximity to the mother figure. Although the need for this sense of security is believed to be universal, Beijersbergen, Juffer, Bakermans-Kranenburg and van Ijzendoorn (2012) posit that individual differences occur in the way children connect with their parents at this young age, in part because of the target adult's characteristics and caregiving skills. Once an attachment style is established in an individual, it tends to remain relatively stable, to operate outside of conscious awareness, and to play an important role in guiding cognition, emotion and behaviour when interacting with others (Shaver, Collins, & Clark, 1996).

The model for observational procedures designed to assess attachment in infants and pre-schoolers is the Strange Situation (Ainsworth & Bell, 1970). This places increasing stress on a single child, via a number of stages. Firstly, exploration/play is assessed while the primary caregiver is in the room; secondly, exploration/play is coded when the child is left alone with a stranger; and finally, attachment-seeking behaviour is measured when the mother returns - Table 1.1. shows the actions associated with different attachment styles at each of these stages. The method has also been carried out with older sibling and younger sibling pairings, in order to explore the quality of the sibling attachment. Interestingly, studies

employing the Strange Situation procedure have shown that little more than 50 percent of older children offer care to a distressed younger brother or sister within ten seconds of their mother leaving them alone (Howe & Ross, 1990). However, Teti and Ablard (1989) argue that early attachment with parents can account for such individual differences in affect and caregiving within sibling dyads. They found that children responded less aggressively and felt less vulnerable when parental attention turned to a brother or sister, only if they were securely attached to their mother. Similarly, positive attachment bonds between the mother and their first-born are predictive of that child's adjustment, which, in turn, impacts upon sibling relationship quality (Dunn, 2000).

Table 1.1. Attachment Behaviour Associated with Differing Attachment Styles

Attachment Style	Reaction to Stranger	Reaction to Separation from Mother	Reaction to Reunion with Mother
Secure	Child is indifferent to the stranger when mother is present, but when alone will ignore stranger	Becomes upset and distressed when mother leaves, will usually cry and cannot be consoled by stranger	Happy when reunited and is quickly calmed down when the mother returns, so can continue exploring
Insecure-avoidant	Child plays with stranger regardless of mother's presence, and doesn't check whether mother is there	Is not distressed by mother's absence, and can seek comfort from stranger	Shows no interest in mother's return
Insecure-ambivalent	Child shows fear of stranger and avoids them whether or not mother is present	Severe reaction to the mother's absence, clearly distressed	Child will want mother's comfort but may push her away when approached

Note. Source adapted from http://flipped.gardenpsychology.co.uk/a2-psychology/a2-class-resources/child/child-content/the-strange-situation/.

Social Learning Theory

Social learning theory has repeatedly been used to explain the presentation of certain behaviours, attitudes and beliefs by children within a family. This approach was developed by Bandura (1977), who contended that most human learning is inherently social in nature, and is based on the observation and imitation of others' actions. A series of classic studies (Bandura, 1965; Bandura, Ross, & Ross, 1963) involved preschool children watching a short film in which an adult hit, kicked and shouted at a large inflatable toy doll. When youngsters were then left alone in a playroom with the doll, while hidden cameras recorded their actions, those who had seen the toy being punished imitated this aggressive behaviour, regardless of whether they were offered a reward for doing so. This was taken to be indicative of social learning by the children, via an adult role model. As explained by Siegler, Eisenberg, DeLoache and Saffran (2014), such a process can only occur if four basic cognitive systems are present - attention (to others' behaviour); encoding (what is observed); storing (the information in memory); and retrieving (it at a later point). Another example of social learning is shown in Table 1.2, highlighting how a child can both influence, and be influenced, by the surrounding environment.

Table 1.2. A Hypothetical Example of Bandura's (1977) Social Learning Theory

Child's Behaviour	Social Environment
1. Child enjoys playing violent video games	
	2. Child encourages peers to begin playing violent video games together
3. Interacting with peers, child plays violent games more and more often	
	4. Child and other peer group members encourage one another to play increasingly violent video games
5. Child's increasing skill leads to great enjoyment of violent games, and to spending more time with the group and less time with other friends	
	6. Child and other group members become desensitized to violence in games
7. Child becomes desensitized to violence in other contexts and becomes less empathic	
	8. Child and other group members encourage each other to behave more aggressively in general
9. Child becomes more aggressive with peers, leading to rejection by non-group members and further commitment to the violent-games group	

Note. Source adapted from Anderson and Bushman's (2001) paper.

Such social learning processes are probably the most common set of mechanisms used to explain the relationship between siblings, especially during childhood and adolescence. Research into the theory focuses on the salience of parents as role models - Bandura (1977) proposed that mothers and fathers are the ultimate candidates for offspring to copy, because

they tend to be warm and nurturing, high in status, and similar to the children themselves. Specifically, parents exert direct efforts in an attempt to influence sibling relationships - namely in the form of intervening in sibling disputes (Perlman & Ross, 1997) - which have proven to be beneficial. However, Parke and Buriel (1998) claim that mothers' and fathers' indirect, and sometimes unrecognised, bearing on the sibling bond, through their function as models in their marital interactions, and in their dyadic exchanges with the children themselves, is just as powerful. The literature also shows that, through their leadership roles as tutors, managers, and caregivers, older siblings often provide younger siblings with information on how to behave (Lam, Solmeyer, & McHale, 2012). Moreover, siblings tend to reinforce one another's behaviour through daily communication (Patterson, 1984). Such bolstering and replication between brothers and sisters is crucial for shaping the dynamics of their relationship, and these practices also help us comprehend why siblings can develop similar attributes and attitudes as they grow older (Whiteman, McHale, & Crouter, 2007).

Behavioural Genetic Method

Finally, behavioural genetic studies are a tool used to disentangle genetic and environmental influences on a wide range of constructs, including interpersonal relationships. Typically, and as described by Plomin, DeFries, Knopik and Neiderhiser (2013), such research estimates heritability, along with shared environmental influences (non-genetic factors that make family members similar), and non-shared environmental influences (non-genetic factors that make family members different, including measurement error). To do this, variation in the genetic relatedness of identical (monozygotic; who share 100 percent of their genes) and fraternal (dizygotic; who share 50 percent of their genes) twins is utilised – see Figure 1.3 for a visual representation of how these different twin pairs are formed during conception. The basic premise here is that comparisons of the correlations between these two types of twin pairs on a particular trait enable inferences to be made about the relative

contribution of genetics and the environment. According to Plomin and Bergeman (1991), the logic of these behavioural genetic designs is relatively straightforward – if genetic factors affect a phenotype, then resemblance for this should increase with increasing genetic relatedness. This means that identical twins will be more similar to each other on this particular measured trait than fraternal twins. In terms of environmental effects, identical twins raised together share the same environment (as well as the same genes), therefore any differences within these pairs are assumed to be the result of the non-shared environment. Since fraternal twins share half as many genes as identical twins, if a particular trait was fully explained by heritability, then the former should be half as similar as the latter. If fraternal twins are more than half as similar as identical twins, this indicates shared environmental influence. In reality, however, it is often a gene-environment interplay that drives phenotypes (Plomin, DeFries, & Loehlin, 1977).

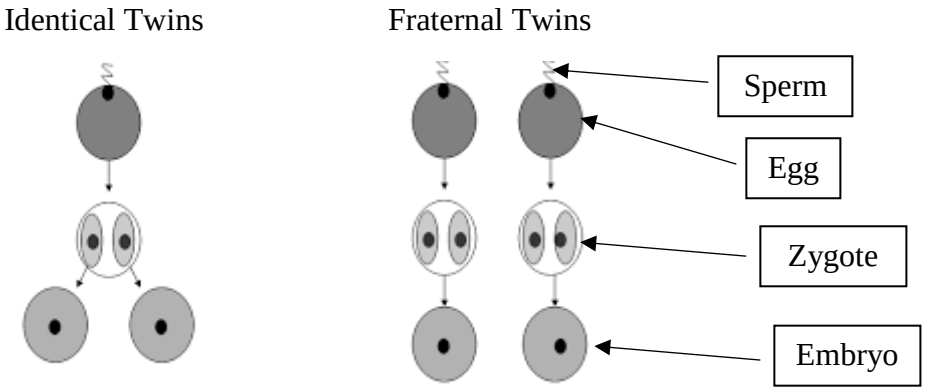

Figure 1.3. Diagram of the Conception of Identical and Fraternal Twin Pairs

Note. Identical twins are created from one sperm and one fertilised egg. One zygote is formed, which then splits into two embryos. Contrastingly, fraternal twins are created from two sperm and two fertilised eggs at the same time. Two zygotes and two embryos are then formed. Source adapted from https://repo.lib.semmelweis.hu/bitstream/handle/123456789/637/T%C3%A1rnoki%20%C3%81D_DOIs.pdf?sequence=4.

The vast majority of non-behavioural genetic work examining interpersonal connections has implied that such relationships are purely environmental (Horwitz & Neiderhiser, 2015). For example, links between parenting behaviours and child outcomes have been thought to be down to the direct environmental effects of the parents on the child.

Only relatively recently has research begun to show that genetic influences often explain as much of the variance in the bond between family members (Kendler & Baker, 2007) - a finding that can be clarified by gene-environment correlations. Scarr and McCartney (1983) explain this interplay as people creating their own experiences, which are, to an extent, influenced by their individual genes. When such heritability results are uncovered, this is not an indication that individuals' genes directly impact on the way that others treat them. Rather, these genetic estimates show that individuals' inherited characteristics are operating to influence their relationships (Horwitz, Marceau, & Neiderhiser, 2011). For example, children's temperaments are partly genetically determined, and parents will likely treat a child who has a difficult temperament differently to a child who has an easier temperament. Therefore, we can say that the effect of differential mothering or fathering towards children is genetically influenced. Although parenting is the most thoroughly studied family relationship in genetic research of this kind, sibling relationships in childhood have been identified as an important focus. There has been very limited investigation into these dyads to date, but it seems that sibling bonds show much shared environmental influence (McGuire, Palaniappan, & Larribas, 2015), reflecting reciprocity between brothers and sisters.

Predictors of Sibling Relationship Quality

Developmental Stage

The early work of Jean Piaget (1932) revealed important differences between the thinking of adults and children, thus supporting a developmentally sensitive approach to studying human behaviour. He proposed discrete stages of development, marked by qualitative steps, as opposed to gradual increases in the number and complexity of behaviours, concepts and ideas, to explain the processes by which children grow mentally. During early childhood (between the ages of two and seven), in what Piaget termed the

preoperational stage, individuals' egocentrism (the inability to see situations from another person's point of view) decreases, and their theory of mind increases. The latter concept, coined by Premack and Woodruff (1978), is closely linked to egocentric cognitions, and refers to our understanding of other people as mental beings, each with their own psychological states. Such improvement in cognitive development, during young childhood, is influenced by children's relationships. Within the context of siblings, research has indicated that children with more siblings, and particularly more older siblings, perform better on theory of mind tasks (Jenkins & Astington, 1996). Furthermore, both cooperative sibling interactions (McAlister & Peterson, 2013), and constructive conflicts between brothers and sisters (Randell & Peterson, 2009), help children pay attention to the reactions, beliefs, and feelings of others. As well as exchanges that take place within the home, the child's transition into school encourages peer relationships to form at this age, whilst also improving their intellectual and self-regulatory capabilities (Shonkoff & Phillips, 2000). In order to further investigate family relationships during such an important and complex development stage, my thesis is focused on siblings in young childhood, between the ages of three- and seven-years-old.

Gender

The gender of children is another characteristic that influences the quality of sibling relationships, though gender differences have been shown to decrease with age (Bedford, 1996). In young childhood, brother-brother pairs display more aggression and negativity in their interactions, as well as less involvement and warmth (Endendijk et al., 2013). Female pairs, on the other hand, show the highest rates of positivity, devotion, and emotional intimacy (Buist, Dekovic, Meeus, & Van Aken, 2002). This pattern of findings highlights both biological and cultural norms regarding gender in the Western world (Gray, 2001). In general, females tend to exhibit more nurturing behaviour, empathy, and emotional

expression towards others, and are often more motivated to initiate and maintain family relationships (Cicirelli, 1996). These typically feminine traits mean that dyads including one sister are more warm than those without – in other words, opposite-sex dyads get on better than brother-brother dyads, and fall between all-female and all-male sibling pairs in terms of their positivity and negativity (Rosenberg, 1982). Dunn and Kendrick (1982a) have also argued for the importance of gender constellations of children - their research emphasised rivalry and competition between same-sex pairs, over opposite-sex pairs. I considered all three sibling gender constellations in this thesis.

Methodological Considerations of Sibling Relationship Quality

Twin Siblings

There are a number of methodological effects that should be kept in mind when carrying out research into sibling relationship quality. Following on from the theoretical summary of behavioural genetics, and of relevance to the study of families, is whether results gleaned from samples of twin siblings can be applied to samples of non-twin siblings. This is an important question, as co-twins are nearly always used for genetic investigations, whereas differently-aged siblings tend to be recruited in the developmental, family-based literature. Opposing generalisation across all sibling types, the twin relationship is often considered one of the most unique and intimate (Segal, 1997). It is thought that twins have the potential to develop attachments to one another, in the same way that children do with their parents, because, more so than non-twin siblings, they often spend extended periods of time together, share common experiences, including their birthday, and turn to each other for support and comfort (Woodward, 1998). Identical twin children may also display a special regard for one another because they share all of their genes (Segal & Ream, 1998). Empirical evidence by Fraley and Tancredy (2012) has confirmed that twins, and particularly monozygotic twins, do

indeed enjoy a closer and more intense psychological bond than do more typical brothers and sisters. In line with these results, caution needs to be taken when generalising from twins to non-twin sibling pairs.

Number of Siblings

The vast majority of developmental research has relied on one child per family, with the implicit assumption being that the nature of different children's relationships within the home environment, as well as the effects these relationships can have, is similar (Hetherington, Reiss, & Plomin, 1994). While this may be the case within some families, such a supposition means that important within-family variability is often ignored. In reality, siblings can be very different from one another, and the characteristics of an older child's bond with their mother or father may vary considerably from those of a younger child's (Plomin, Asbury, & Dunn, 2001). Baumrind (1993) stated that these distinctions often stem from maternal responsiveness to individual differences between their children, as mothers attempt to provide equally. Interestingly, we now know that even shared factors, common to all children within a family, such as interparental conflict, can be experienced differently by siblings (Mark & Pike, 2016).

By recruiting multiple children per family, and paying attention to within-family variation, the creation of both child-specific and family-wide scores is possible. This can be implemented for child outcomes, as well as for family relationships. Indeed, when focusing on parenting, Jenkins and her colleagues (2009) have suggested including both the family average (by calculating the mean score across two or more children within a family), and the differential rating (either by calculating the deviation of each child's score from the family average, or by simply subtracting one child's score from the other's) whenever possible. A specific example of the value of differentiating between these influences comes when we

consider the role of mothers in children's sibling relationship quality. It is known that children who are exposed to negative and hostile mothering generally tend to display higher levels of aggression (Chang, Schwartz, Dodge, & McBride-Chang, 2003), which can subsequently effect their bond with their brothers and/or sisters (Brody, Stoneman, & McCoy, 1994a). However, one of the challenges of family research has been to disentangle the effects of overall positivity or negativity within the home, from expressions of positivity or negativity that are directed more towards one child within the family. By calculating both the family average score and the differential score for a given family, researchers are better equipped to unpick the associated consequences of both aspects of parenting.

Working through an example then, in order to create an overall family-wide indicator of mothering, family averages (across the two twins) can be calculated. To create a child-specific differential indicator, difference scores can be calculated. In a particular family, a mother might score a 2 for her positivity in relation to the older sibling, and a 3 on the same measure for the younger sibling. Family-wide positive mothering would then be 2.5 ((3 + 2) ÷ 2 = 2.5; the average of these two scores). The associated difference score can be calculated by taking the absolute difference between the twins' scores. Here, differential positive mothering would be 1 (3 – 2 = 1). Within a family context, these values enable researchers to test whether children's sibling relationship quality is impacted upon by the specific mothering they receive (Shanahan, McHale, Crouter, & Osgood, 2008), and/or by the average levels of mothering experienced overall (Brody, 1998).

The Current Thesis

Thesis Aims

This thesis examined sibling relationship quality and its links with other family relationships – the mother-child relationship, the father-child relationship, and the marital relationship. My investigation had five overarching goals:

1. To compare the nature of sibling relationship quality between twin siblings and non-twin siblings.
2. To utilise behavioural genetic techniques to determine the genetic, shared environmental, non-shared environmental, and twin-specific environmental influences on sibling relationship quality.
3. To examine the longitudinal prediction of sibling relationship quality from other family relationships.
4. To explore the role of family-wide and child-specific parenting in sibling relationship quality.
5. To draw on novel and innovative research methods to explore family relationships.

All five of these aims were addressed using data from the Twins, Family and Behaviour study, a longitudinal research project conducted by myself and my fellow PhD colleague, Rachel Latham, over the last three years. I joined the research team when the study was being set up, and have led recruitment efforts, design ideas, data collection, data coding, and scale construction. The study is an ongoing investigation into twin siblings and their families, thus far consisting of four time points, spanning a two-year period. Gathering these longitudinal data enabled me to adopt a developmental approach to sibling relationship quality, by studying its link with family relationships across early to middle childhood. The first and second aims listed were also addressed using previously collected data from the Sisters and Brothers Study (Pike, Coldwell, & Dunn, 2006), another longitudinal project of sibling relationships among children in middle childhood. Employing both data sets for these goals allowed me to compare sibling relationship quality across differing samples.

Recruitment of Participants

Focusing on the Twins, Family and Behaviour study, families were recruited when target twin children were infants. These same children are now six- and seven-years-old, and most are beginning their second year of primary school. Mothers of twins born within England and Wales in 2009 were contacted by the Office for National Statistics and asked if they would like to participate in the study. Following this, Rachel and I contacted mothers to ask whether they had a partner living with them who would be willing to take part. In addition, we expanded the sample by: (a) broadening the participation criteria to include twins born in 2010 as well as in 2009; (b) asking participants to put us in touch with any other eligible families they knew who might like to take part; and (c) advertising through Twitter, via a well-known registered UK twins charity (the Twins and Multiple Births Association). Eight hundred mothers were approached by the Office for National Statistics, and 287 (35.9%) agreed to take part by returning a form detailing their contact information. Of these 287 mothers, 274 returned their initial questionnaire. One hundred and twenty-three fathers (121 biological fathers, 1 stepfather and 1 guardian of the twins) also agreed to be involved, and a further 59 families came forward to participate following our additional recruitment attempts. Thus 346 families were recruited overall, of which 274 were consistently engaged with the research.

Procedure

After agreeing to participate, all involved parents were sent an information pack about the study, an initial base-line postal questionnaire, a consent form, and a prepaid envelope. At this first time point, when twins were three-years-eight-months-old, 274 mothers and 122 fathers completed the questionnaire and posted it back. Demographic information was gathered - participants were asked to report their date of birth, as well as their twins' names

and dates of birth, their relationship to the twins, their marital status, their household income, their highest educational qualification, and their occupation. Following this were six individual questionnaires, measuring: 1) the zygosity of twins (i.e., identical or fraternal); 2) household chaos; 3) parental feelings towards each twin; 4) the parent-child relationship for each twin; 5) parenting practices towards each twin; and 6) disruptive behaviour displayed by each twin. Rachel and I coded and entered all data when the questionnaires were returned.

Together, the two of us re-established contact with the families approximately 12 months later to invite them to participate in the second time point. This involved a 40-minute semi-structured recorded telephone interview with each parent. We arranged a convenient day and time to speak with each individual, and sent electronic information packs and consent forms out to all those who agreed to take part. The interview consisted of six sections, measuring: 1) any significant life events within the family (e.g., deaths, moving house); 2) parental expressed emotion towards each twin (i.e., this was measured twice, and counterbalanced as to which twin was asked about first); 3) the co-parenting relationship for each twin (i.e., the degree to which parents worked together to parent their children; this was measured twice, and counterbalanced as to which twin was asked about first); 4) parental personality; 5) marital quality; and 6) the twin-twin relationship. Here, twins were four-years-eight-months-old, and our sampling pool consisted of 230 mothers and 107 fathers. We coded all of the measures, excluding parental expressed emotion, during the interview, and subsequently entered these data following the call. We also coded a substantial number of the expressed emotion passages (via the Preschool Five Minute Speech Sample measure, by Daley, Sonuga-Barke and Thompson (2003)), by listening back to the recordings, transcribing them, and then coding the information according to a well-known coding scheme. More information about this specific measure can be found in Chapter 3.

Rachel and I carried out the third phase approximately nine months after the second phase. We contacted families to invite them to participate in an observed parent-child interaction task, which was carried out via Skype. Children were five-years-five-months-old at this time point, and 151 mothers and 106 fathers agreed to be involved. Again, electronic consent forms were sent to parents who agreed to take part via email. This part of the study was designed to measure mothers' and fathers' relationship with each of their twins; thus, when both parents were participating, each family completed four separate interaction tasks: 1) the mother-older twin dyad; 2) the mother-younger twin dyad; 3) the father-older twin dyad; and 4) the father-younger twin dyad. The order in which these pairings took part was counterbalanced across families. We designed a new tool to measure the parent-child relationship here, based on previous research using etch-a-sketch toys as the basis of a joint, interactive game (Deater-Deckard, Pylas, & Petrill, 1997). Our version was electronic, allowing parents and their children to play on their computer via remote recording. Before the arranged date of their session, parents were emailed a link, directing them to the online etch-a-sketch toy. At this point, they were also given a username and password to log onto the free communication and call program, Skype. We Skype video-called the family when their time slot arrived, so that we could see each other. We then explained the rules of the game – to copy two pictures on the etch-a-sketch toy, shown on the website they had been directed to. The parent had to control the vertical line drawing, and the child had to control the horizontal line drawing. Lines were drawn using keys on the computer keyboard (i.e., 'O' and 'M' controlled up and down movements, and 'A' and 'D' controlled side-to-side movements), and both individuals were told not to touch the other's keys. After a quick practice, dyads were given eight minutes to attempt the drawings together (Figure 1.4 below shows a mother-child pair doing this). During this time, we switched off our video so that the pair could no longer

see us. All Skype calls were recorded and stored securely by Rachel and me, and later coded by students within the University of Sussex.

Figure 1.4. An Example of a Mother-Child Dyad Carrying out the Etch-a-Sketch Online Task Together

Approximately seven months after the third phase, I contacted families for a final time, and asked them to complete a further questionnaire. After agreeing to participate, all involved parents were sent an information pack, a follow-up postal questionnaire, another consent form, and a prepaid envelope. At this fourth phase, when twins were six-years-old, 143 mothers and 104 fathers completed and returned the questionnaire. Parents were asked an open question at the start, to assess whether any significant life events had occurred since we last spoke to them. Following this were 16 individual questionnaires (eight of which parents had been asked to answer previously), measuring: 1) household chaos; 2) parental feelings towards each twin; 3) the parent-child relationship for each twin; 4) parental sense of competence; 5) parenting practices towards each twin; 6) parental depression, anxiety and stress; 7) marital quality; 8) the co-parenting relationship for each twin; 9) interparental conflict that occurs in front of each twin; 10) parental alliance for each twin (i.e., the extent to which a parent acknowledges and values the parenting roles and tasks of their partner); 11) the emotionality, activity, sociability and shyness of each twin; 12) the social competence of

each twin; 13) the prosocial behaviour and psychopathological behaviour of each twin; 14) the callous-unemotional traits of each twin (i.e., the extent to which the child lacks empathy, guilt, and emotional expression); 15) disruptive behaviour displayed by each twin; and 16) the twin-twin relationship. Additionally, mothers were asked about: 1) any other siblings that the twins had; 2) who lived within their family home; 3) their health during their pregnancy with the twins; and 4) details of the birth of the twins.

Figure 1.5 shows the overall structure of the four time points within the Twins, Family and Behaviour study.

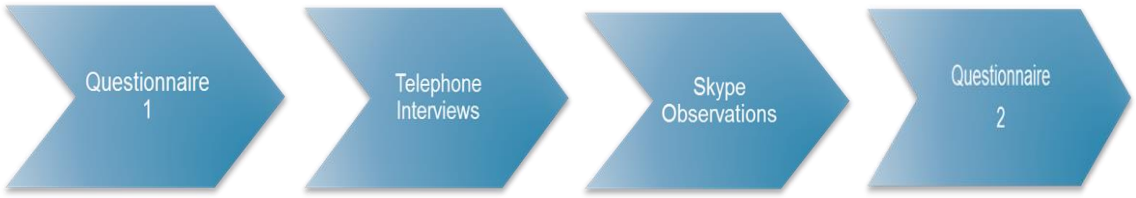

Figure 1.5. The Structure of the Four Phases of the Twins, Family and Behaviour Study

Families could opt in and out of the study phases as they pleased, which resulted in unequal numbers of parents participating at each time point. At phase one, Rachel and I sent out questionnaires and information packs in the post, and, at phase four, I did this for a second time. If the questionnaires were not returned within a month, we sent parents a friendly reminder via phone (a call and/or a text), email and/or post. We did this three times in total if we still had not heard back (and re-sent a postal questionnaire at the time of the second reminder). At phase two and phase three, we contacted involved families via phone (a call and/or a text) and/or an email initially, to explain the research and ask if they would like to take part. Again, we reminded families about the study phase three times if we received no response. For all time points, if we had no response following three reminders, we interpreted the family's lack of response as an indication that they did not wish to participate.

We had several strategies to reach families whose contact details had changed since the first wave of the study. Firstly, we encouraged families to let us know about these alterations at each time point, either by including a form for them to fill out if they had moved (at phase one and phase four), or by verbally asking them if the details they had provided us with were still correct (at phase two and phase three). Secondly, we always attempted to get in touch with parents via any method possible – this included by email, phone call, text, and/or post. Often one of their details had changed, but they were contactable by other means. Finally, if we still could not reach the participant, we emailed, phoned and/or wrote to their listed contact (typically a family member or close friend), whose details the parent had provided at the start of the study. We asked them either to let us know the individual's new contact information, or to pass on the details of the study phase to the family. If all these steps had been followed and we were still unable to reach the family, they were considered uncontactable.

Rachel and I sent postal thank you cards to families who participated at each time phase, and certificates to children who were involved at phase three. We also designed and posted a yearly newsletter before Christmas in 2013 and 2014, detailing our progress and the upcoming plans for our research.

Ethical Issues

It is important to discuss the Twins, Family and Behaviour study's adherence to ethical guidelines. The research was approved by the ethics committee at the University of Sussex, and myself and the rest of the study team followed the British Psychological Society's (2014) guidelines precisely. Rachel and I gained written informed consent from each involved parent at all four phases, after they had been given detailed information relating to the study. At phase one and phase four, paper consent forms were sent out with

questionnaires and prepaid envelopes for return. At phase two and phase three, electronic consent forms were emailed to participants, which were subsequently emailed back to us on completion. Paper consent forms were filed, and stored in a locked drawer at all times, while electronic consent forms were saved in a password protected shared computer file at the University of Sussex. Study phases did not go ahead with parents until their consent had been received, even if this meant having to postpone organised appointment times.

At phase three, during the observational task, participating twin children also took part in the study. Because individuals cannot legally give their informed consent until they are 18-years-old, we instead gained the children's assent. We clearly explained the online task to each child over a Skype video call, before asking them whether they had any questions, and whether they would like to have a go at the game. We took their verbal agreement as a sign to proceed – children had a clear understanding of what the task involved, and thus were capable of providing their assent in this manner.

Participants' identities were kept anonymous and confidential at all times. Each family was assigned a number at the start of the study, and this was used at each of the four phases. Consent forms, which documented family member's names, were stored separately from the data provided. The database linking each family's details with their identification number was accessible only by myself, Rachel, and other members of the research team. It was password protected, and saved to a shared drive at the University of Sussex.

Special ethical consideration was given to our audio recordings (from the telephone interview at phase two) and video recordings (from the online observation task at phase three). These were carried out in a controlled laboratory setting at the University of Sussex. The room was booked, ensuring no one else could enter while the interview or observation was taking place. Rachel and I had our own recording devices for both phases – these were

not in use by anyone else, and were kept in a locked drawer at all times. The audio and visual records were transferred from the recording equipment into a password protected computer file at the University of Sussex. Each file was renamed, to correspond with the target family's unique identification number.

Summary

To summarise, this chapter provided a brief review of relevant theories of sibling relationship quality. It also addressed predictors of sibling relationships, as well as methodological considerations that may influence interactions within the sibling dyad. I have also described the Twins, Family and Behaviour study here, in order to encapsulate the sample and the procedures utilised within my ongoing research. Progressing through this thesis, Chapters 2, 3 and 4 are structured in a similar way, and use data from phases one, two and four (as described above). Each delivers a detailed evaluation of the applicable literature, and reports and discusses findings to tackle specific hypotheses relating to the five main goals of the thesis. They all consider limitations and future research, and end with a conclusion. Chapter 2 presents analyses comparing twin siblings' relationship quality with non-twin siblings' relationship quality. Furthermore, it employs behavioural genetic techniques to estimate the heritable and environmental effects of the bond between brothers and sisters. Chapter 3 examines the prediction of sibling relationship quality from maternal expressed emotion towards children, both in the form of family-wide mothering (i.e., the average expressed emotion across both twins) and differential mothering (i.e., the difference in expressed emotion between twins). Chapter 4 explores the longitudinal links between the parent-child relationship, marital quality and sibling relationship quality, by employing a conservative cross-lagged design. In this way, I was able to assess the direction of the associations between these family relationships. Finally, Chapter 5 contains a general

discussion of the thesis. It synthesises findings from Chapters 2, 3 and 4, discusses the strengths and limitations of the project, and explores directions for further work in this field.

Chapter 2: Using Twins to Better Understand Sibling Relationships (Paper 1)

Abstract

We compared the nature of the sibling relationship in dyads of varying genetic relatedness, employing a behavioural genetic design to estimate the contribution that genes and the environment have on this familial bond. Two samples were used – the Sisters and Brothers Study consisted of 173 families with two target non-twin children ($M_{\text{older child age}}$ = 7.42 years, $SD_{\text{older child age}}$ = 0.84; $M_{\text{younger child age}}$ = 5.22 years, $SD_{\text{younger child age}}$ = 0.61); and the Twins, Family and Behaviour study included 234 families with two target twin children ($M_{\text{child age}}$ = 4.70 years; $SD_{\text{child age}}$ = 0.37). Mothers and fathers reported on their children's relationship with each other, via a postal questionnaire (the Sisters and Brothers Study) or a telephone interview (the Twins, Family and Behaviour study). Contrary to expectations, no mean level differences emerged when monozygotic twin pairs, dizygotic twin pairs, and non-twin pairs were compared on their sibling relationship quality. Behavioural genetic analyses also revealed that the sibling bond was modestly to moderately influenced by the genetic propensities of the children within the dyad, and moderately to substantially influenced by the shared environment common to both siblings. In addition, for sibling negativity, we found evidence of twin-specific environmental influence – dizygotic twins showed more reciprocity than did non-twins. Our findings have repercussions for the broader application of results from future twin-based investigations.

Mark, K.M., Pike, A., Latham, R.M., & Oliver. B.R. (2016). Using twins to better understand sibling relationships. *Behavior Genetics.* Advance Online Publication. doi: 10.1007/s10519-016-9825-z

I contributed to 50% of the data collection, and carried out all of the analyses and write-up, under supervision, for this paper. I am, therefore, listed as first author.

Introduction

Siblings (and twins specifically) have played a prominent role in genetically sensitive studies. For example, pairs of siblings of varying genetic relatedness (i.e., monozygotic or identical, and dizygotic or fraternal twins) have been used to understand the genetic and environmental contributions for specific traits (McGuire, 2001). However, similarities and differences between siblings have dominated this literature, whilst sibling relationship quality in its own right has been relatively neglected (McGuire, Palaniappan, & Larribas, 2015). The aim of the current study was to focus on the nature of sibling dynamics from a behavioural genetic perspective. We compared levels of positivity and negativity within the sibling relationship for differing sibling pairs (monozygotic twins, dizygotic twins, and non-twin siblings). In addition, we estimated the contribution that genes, the shared environment and the non-shared environment make to this phenotype. We investigated these goals using parental reports of sibling relationships, with two samples (one twin sample and one non-twin sample) of brothers and sisters in early to middle childhood.

Sibling Relationship Quality

Much research attention has been given to the nature of the relationship between non-twin brothers and sisters in recent decades (Brody, 1998; McHale, Updegraff, & Whiteman, 2012). For many, sibling relationships are their most enduring, starting in infancy and persisting through to old age (Cicirelli, 1982). During childhood specifically, siblings spend much of their time together, often more than with parents or peers (McHale & Crouter, 1996), and these intense relationships are typically characterised by both spontaneity and ambivalence (Dunn & Kendrick, 1982). The quality of the sibling relationship in these early years has been linked with social adjustment and well-being throughout the life span (Brody, 2004). Both cooperative and affectionate behaviours, as well as conflictual and hostile

behaviours, within these interactions play an important role in children's development (Furman & Buhrmester, 1992).

Gender influences on sibling relationship quality are robust. In general, girls show more positive behaviour towards siblings than do boys (Abramovitch, Corter, Pepler, & Stanhope, 1986), with older sisters being particularly prosocial towards their younger siblings (Abramovitch, Corter, & Lando, 1979). Contrastingly, boys have been found to engage in more negative sibling behaviours, such as physical aggression, arguing, and teasing (Brody, Stoneman, MacKinnon, & MacKinnon, 1985). Dyadic gender differences also follow this pattern. For example, Buist, Dekovic, Meeus and Van Aken (2002) showed that sisters have a significantly greater attachment to each other than do brothers, and Maccoby (1998) argued that pairs of brothers display particularly high levels of antisocial behaviour.

Sibling Relationship Quality in Twin Dyads

Despite the wealth of studies that have focused on sibling relationship quality and its correlates and consequences, few have targeted the twin relationship. These same-age individuals represent an unusual type of sibling dyad, although data from the Office for National Statistics (2013) suggest that they are becoming increasingly common - 15.6 out of every 1000 deliveries were multiple births in the year 2013. Alongside serving a valuable role in genetically sensitive designs (Plomin, DeFries, Knopik, & Neiderhiser, 2013), twins have captivated the public's imagination, perhaps because both classic literature and the modern media portray this type of sibling bond as one that is exceptionally special and intimate (Burlington, 1945; Playfair, 2002; Segal, 1999).

Twin relationship research has drawn on the theoretical perspectives of kin selection and inclusive fitness. These outlooks emphasise natural selection, whereby individuals attempt to ensure the survival of their own genes by protecting closely related family

members over all others (Hamilton, 1964). In line with such a concept, and according to Neyer (2002), monozygotic twins have a special regard for one another because they share more of their genetic makeup than do dizygotic twins or non-twin siblings. Thus, they may be more motivated to behave altruistically towards each other, to invest in their co-twin's well-being, and to rely on each other, in order to guarantee their (and their twin's) reproductive success (Neyer & Lang, 2003). Indeed, research following a large Finnish cohort of teenage twins revealed that monozygotic pairs were more likely to report being dependent on their twin sibling than were dizygotic pairs (Penninkilampi-Kerola, Moilanen, & Kaprio, 2005), a result that was replicated using maternal reports in three-year-old twins as well (Fortuna, Goldner, & Knafo, 2010). Similarly, according to Scarr and McCartney (1983), individuals belonging to a monozygotic dyad generally choose each other as friends and companions to a greater extent than do individuals belonging to a dizygotic dyad.

Using the alternative attachment-based theoretical explanation, Tancredy and Fraley (2006) have argued that the so-called 'twin situation' naturally encourages the development of a secure attachment bond, regardless of whether the target siblings are monozygotic or dizygotic. These authors claim that twins form distinctively close relationships in comparison to non-twin siblings, due to circumstances such as sharing birthdays, peer groups, and bedrooms, and spending a lot of time in proximity to one another. Further support for attachment theory comes from Fraley and Tancredy's (2012) later work, which suggests that twin children rely more heavily on their co-twin for safety and security than do non-twin siblings. Differently-aged siblings also claim to be happier without their brothers or sisters around, whereas twins state a preference for being in each other's company (Segal, 1999). This derivative of attachment theory therefore places less of an emphasis on genetic relatedness, instead highlighting the importance of the distinct environment that twins experience.

There are marked divergences in the main theoretical studies discussed (i.e., Fraley & Tancredy, 2012; Neyer, 2002; Neyer & Lang, 2003; Tancredy & Fraley, 2006), in terms of the age and gender of the participants used, as well as the methods employed. For example, Neyer and Neyer and Lang, who argue for an inclusive fitness interpretation, explored twin relationships in old age, whereas Fraley and Tancredy and Tancredy and Fraley, who support an attachment framework, recruited younger adults. Neyer himself acknowledged that the bond between siblings' changes across development, thus differently-aged samples might well have influenced the dissimilar trajectories put forward by the two theories. Similarly, the gender of the children included varied across the four central studies – same-sex twin pairs were used for the inclusive fitness research (Neyer and Neyer & Lang), whereas a group of mixed-sex siblings were tested in the attachment research (Tancredy & Fraley). Including opposite-sex dizygotic and non-twin dyads in Neyer's papers may have resulted in differences emerging between identical and fraternal pairs' interactions, as predicted by attachment-based theories. Finally, Neyer and Neyer and Lang carried out detailed interviews with their twins to capture the nature of the sibling relationship, whereas Fraley and Tancredy used a one-item online questionnaire. It seems likely that the rather broad latter measure might fail to differentiate between the groups of siblings, and this should be borne in mind.

Behavioural Genetics and Sibling Relationship Quality

Behavioural genetics is a field of study in which phenotypic variation among individuals is separated into heritable and environmental components, using family members (often siblings) of differing genetic relatedness (Plomin, DeFries, & Loehlin, 1977). For example, monozygotic and dizygotic pairs' intraclass correlations are compared, and significant heritability is assumed if these values are considerably higher for monozygotic than for dizygotic twins. Sibling relationship quality dimensions can themselves be treated as phenotypes, to which behavioural genetic techniques can be applied.

There are few studies that have examined genetic and environmental contributions to twin relationship quality (McGuire et al., 2015), and those that are available have varied in terms of the age of the participants, ranging from young childhood (Lemery & Goldsmith, 2001) through to mid-adolescence (Pike & Atzaba-Poria, 2003); the size of the sample, ranging from 124 children (Rende, Slomkowski, Stocker, Fulker, & Plomin, 1992) through to 701 (Plomin, 1994); and the measures employed, ranging from parental questionnaires (Lemery & Goldsmith) through to unstructured observations (Rende et al.). Only two such studies, those conducted by Lemery and Goldsmith and Pike and Atzaba-Poria, have made twin relationship quality their focus, with the remainder concentrating on adoptive and non-adoptive sibling pairs (e.g., Rende et al.). Impressively, Reiss, Neiderhiser, Hetherington and Plomin (2000) report findings regarding adolescent sibling relationship quality from six family types, incorporating a twin and stepfamily design within a single study. Despite the vast variations across the relevant research, the results of these studies have been broadly similar, allowing researchers to glean insights into the ways in which genes and the environment influence sibling relationship quality.

Behavioural genetics has demonstrated evidence of a modest genetic contribution to sibling relationship quality, yet the extent to which this heritability influences positivity (characterised by warmth, closeness, and affection; Furman & Buhrmester, 1985) and negativity (characterised by aggression, competition, and rivalry; Furman & Buhrmester, 1985) between siblings varies from study to study. Interestingly, Lemery and Goldsmith (2001) discovered that there was negligible (and non-significant) genetic influence on their measure of sibling cooperation, whilst a substantial heritability estimate (of 41 percent) emerged for sibling conflict. Pike and Atzaba-Poria (2003) also replicated this pattern of results, finding that sibling rivalry and hostility were strongly affected by genes, but that sibling affection was not. Generally, it has been found that aggressive behaviour is influenced

by genes to a greater extent than is prosocial behaviour (Eley, Lichtenstein, & Stevenson, 1999), and this outcome also plays out in the parenting literature (Oliver, Trzaskowski, & Plomin, 2014). However, some findings suggest otherwise - for example, Rende and colleagues (1992) uncovered more substantial genetic influence for sibling positivity than for sibling negativity.

As well as genetic factors, shared environmental influence has also emerged as an important contributor to sibling relationship quality (McGuire et al., 2015; Reiss et al., 2000). For Lemery and Goldsmith (2001), these estimates accounted for 61 percent of variance in sibling positivity, and 28 percent in sibling negativity. Correspondingly, large and significant shared environment values were found by Rende and colleagues (1992). For example, sibling cooperation yielded an estimate of 75 percent, with this increasing to 85 percent for sibling conflict. McGuire, Manke, Eftekhari and Dunn (2000) focused their paper on sibling negativity, using a sample of full (biological) siblings and unrelated (adoptive) siblings, rather than twins. The authors reported evidence of a significant environmental contribution towards conflict within these dyads when children's reports were explored. All of these findings indicate that siblings tend to behave in a reciprocal way towards one another, perhaps due to the general family environment, or specific parenting styles, that both children experience within the home (Pike & Atzaba-Poria, 2003).

The Current Study

Much of the existing research exploring sibling relationship quality in twins has compared monozygotic and dizygotic twins in the absence of a non-twin group (e.g., Penninkilampi-Kerola et al., 2005), or compared twins to non-twins without considering twin zygosity (e.g., Tancredy & Fraley, 2006). With the exception of Reiss and colleagues' (2000) work, the behavioural genetic papers discussed here have also either left out non-twin

siblings in their research (e.g., Lemery & Goldsmith, 2001), or have recruited biological siblings versus adoptive siblings (e.g., McGuire et al., 2000). These methodologies make it difficult to confirm, or disconfirm, inclusive fitness or attachment theories when studying sibling relationships. For the first time, we compared the nature of the relationship between monozygotic twins, dizygotic twins, and non-twin siblings in early to middle childhood, and, within the same study, we used behavioural genetic techniques to disentangle genetic and environmental contributions to sibling relationship quality.

Using parental reports of sibling relationship quality, we tested the rival hypotheses that either (a) monozygotic twins would have higher levels of sibling relationship quality positivity, and lower levels of sibling relationship quality negativity, than would dizygotic twins or non-twin siblings, in line with Neyer and Lang's (2003) interpretation of inclusive fitness theory; or that (b) monozygotic twins and dizygotic twins would have higher levels of sibling relationship quality positivity, and lower levels of sibling relationship quality negativity, than would non-twin siblings, in line with Tancredy and Fraley's (2006) secure attachment explanation. It was also hypothesised that (c) sibling relationship quality would differ significantly as a function of gender. As suggested by previous research (Buist et al., 2002; Maccoby, 1998), it was expected that female-female sibling dyads would have higher levels of sibling relationship quality positivity than would male-male or opposite-sex dyads, and that male-male sibling dyads would have higher levels of sibling relationship quality negativity than would female-female or opposite-sex dyads. Finally, using a behavioural genetic approach, it was hypothesised that (d) sibling relationship quality positivity would yield substantial shared environmental influence and modest genetic influence; and that (e) sibling relationship quality negativity would yield substantial genetic influence and modest shared environmental influence.

Method

Participants and Recruitment

The study used two samples. The first consisted of 173 families, each with two non-twin children, from the Sisters and Brothers Study (Pike, Coldwell, & Dunn, 2006). Schools in the south of England were approached and asked to send letters to parents of children in reception (4- to 5-year-olds) and Year 1 (5- to 6-year-olds) classes who had an older brother or sister aged 8 years or younger. However, many were unable (or unwilling) to target specific children and sent letters to all children in these classes. Letters were sent home via the children, although there was no guarantee that parents received these. Because of this opt-in procedure, it was not possible to estimate refusal rates accurately.

Within this sample, 118 families (68.2%) were two-parent families and 55 (31.8%) were single-mother families. Both mothers and fathers participated in 101 of the families (58.1%). In 68 of the remaining families, data were collected from mothers only, and for the additional two families, data were collected from fathers only. We did not restrict our inclusion criteria to two-parent families, because we were interested in obtaining views from as many parents as possible. The average ages of the mothers and fathers were 36.20 years (*SD* = 4.99) and 40.31 years (*SD* = 5.18) respectively. For the older siblings and younger siblings, the average ages were 7.42 years (*SD* = 0.84) and 5.22 years (*SD* = 0.61) respectively. Parents ranged from working- to middle-class in terms of their educational and occupational backgrounds, and approximately equal numbers of the four sibling sex constellations (boy-boy, boy-girl, girl-girl, and girl-boy) were present in the sample.

The second sample saw data collected from mothers and fathers, along with their twin children, as part of the Twins, Family and Behaviour longitudinal study (see Chapter 1 for details of the full recruitment procedure). This paper focused on information obtained from

telephone interviews conducted with 234 of these families of twins. Both mothers and fathers participated in 103 of the families (44.0%). In 127 of the remaining families, data were collected from mothers only, and for the additional four families, data were collected from fathers only. Table 2.1 shows demographic information for the participants from the Twins, Family and Behaviour study.

Table 2.1. Demographic Information for the Twins, Family and Behaviour Study Sample

Demographic Information	Mother-Specific		Father-Specific		Twin-Specific	
	N = 230	%	*N* = 107	%	*N* = 234	%
Marital status			-	-	-	-
Married to parent of twins	182	79.1				
Cohabiting with parent of twins	20	8.7				
Married to other	2	0.9				
Cohabiting with other	4	1.7				
Single unmarried	11	4.8				
Single divorced	5	2.2				
Single separated	4	1.7				
Single widowed	2	0.9				
Highest educational qualification						
Post-graduate degree	72	31.3	24	25.0	-	-
Undergraduate degree	74	32.2	34	35.4		
2+ A level passes (grades A-E)	19	8.3	9	9.4		
1 A level pass (grades A-E)	7	3.0	6	6.3		
5+ GCSEs or O levels (grades A-C)	18	7.8	6	6.3		
1-4 GCSEs or O levels (grades A-C)	20	8.7	11	11.5		
GCSE(s) or O level(s) with grades D-G	12	5.2	4	4.2		
Other qualifications obtained outside the UK	6	2.6	2	2.1		
No qualifications	2	0.9	0	0		
Twin zygosity						
MZ pairs	-	-	-	-	84	36.5
DZ same-sex pairs					76	33.0
DZ opposite-sex pairs					70	30.4
Unclassified					4	1.71
Age	*M* = 38.78 *SD* = 4.45		*M* = 40.89 *SD* = 6.41		*M* = 4.70 *SD* = 0.37	

Note. MZ = monozygotic/identical twins; DZ = dizygotic/fraternal twins.

Procedure and Measures

As part of the Sisters and Brothers Study (Pike et al., 2006), participating families were visited at home, where parents and children were interviewed and parents completed questionnaires. The Twins, Family and Behaviour study did not include home visits. Instead, involved parents were asked to complete a postal questionnaire and a 40-minute telephone interview.

Sibling Zygosity. We classified twins within the Twins, Family and Behaviour study as either monozygotic or dizygotic, via a parent report zygosity questionnaire designed by Price and colleagues (2000) and adapted from Goldsmith's (1991) original scale. The measure involves two steps for classifying zygosity, and has been found to be highly reliable in comparison to blood (Plomin, Rende, & Rutter, 1991) and DNA (Price et al., 2000) testing procedures. Firstly, certain individual items are used as definite markers of zygosity. Twins described as looking as alike as 'two peas in a pod' by their parents, as opposed to looking as alike as 'brothers and sisters' or not looking 'much alike at all', were classified as monozygotic. This question alone has been shown to correctly categorise a high proportion of twin pairs (Cederlof, Friberg, Jonsson, & Kaij, 1961). Twins described as not looking 'much alike at all' or as having 'clear differences' in eye colour, hair colour or hair texture were classified as dizygotic, except where they were described as being as alike as 'two peas in a pod', in which case they were left as unclassified. 83.1% of same-sex twins were classified using these specific individual items. For the remaining twins, items were scored numerically, with low scores given to responses indicating similarity between twins and high scores given to responses indicating dissimilarity between twins. For example, other questions asked were, 'Do any of the following people ever mistake the twins for each other? Other parent; older brothers or sisters; other relatives; babysitter/day carer; parents' close friends; parents' casual friends; people meeting the twins for the first time'. Answers to these

questions were rated on a 4-point scale, where 1 = yes, often and 4 = never/rarely. Parents were also asked whether the twins' teeth began to come through at the same time, and whether they could tell the twins apart when looking at a new photograph. The scores for questions that were answered were summed and then divided by a maximum possible score, in order to create a physical similarity quotient lying between 0 (representing maximum physical similarity) and 1 (indicating maximum physical dissimilarity). Twin pairs with physical similarity quotient scores below the median were classified as monozygotic, and twin pairs with physical similarity quotient scores above the median were classified as dizygotic.

Sibling Relationship Quality. Both twin and non-twin relationship quality was measured using the same adapted version of the Maternal Interview of Sibling Relationships (Stocker, Dunn, & Plomin, 1989). In the Sisters and Brothers Study (Pike et al., 2006), parents completed this via a questionnaire, and in the Twins, Family and Behaviour study, the same items were read aloud to parents during their telephone interview. Parents were asked to rate how often their children displayed 13 varying behaviours relating to different aspects of the sibling relationship, including companionship, quarrels, sharing, competing and jealousy. Four of the items were scored for the sibling relationship overall (for example, 'Of the time the siblings spend together, how often do they play together?'), and nine required ratings for the twin 1/older sibling and the twin 2/younger sibling individually (for example, 'On a day-to-day basis, how often does (twin 1/older sibling) show affection towards (twin 2/younger sibling)?; and how often does (twin 2/younger sibling) show affection towards (twin 1/younger sibling)?'). Varying response scales were used throughout; the most commonly used were a percentage-based scale, where 1 = less than 5% of their time together and 6 = almost all of their time together, and a frequency-based scale, where 1 = once a month or less and 6 = just about every day. Factor analysis yielded composite scores for sibling relationship

quality positivity (11 items) and sibling relationship quality negativity (3 items). Resultant Cronbach's alphas for these scales were .85 and .84 for sibling relationship quality positivity (for mother and father reports, respectively) and .78 and .74 for sibling relationship quality negativity (for mother and father reports, respectively).

Results

Preliminary Analyses

Table 2.2 shows descriptive statistics for the Maternal Interview of Sibling Relationships (Stocker et al., 1989) variables, across the three sibling zygosity groups (monozygotic twin pairs, dizygotic twin pairs, and non-twin pairs). Table 2.3 presents similar descriptive statistics for the three sibling sex constellation groups (male-male pairs, female-female pairs, and opposite-sex pairs).

Table 2.2. Descriptive Statistics for the Maternal Interview of Sibling Relationships (Stocker et al., 1989) Scales, as a Function of Sibling Zygosity

MISR Scales	MZ Twin Pairs		DZ Twin Pairs		Non-Twin Pairs	
	M	*SD*	*M*	*SD*	*M*	*SD*
Mother report SRQ positivity	4.55	0.59	4.50	0.63	3.59	0.68
Mother report SRQ negativity	3.38	1.18	3.41	1.13	2.70	0.97
Father report SRQ positivity	4.52	0.53	4.32	0.61	3.60	0.68
Father report SRQ negativity	3.27	1.01	3.29	0.97	2.63	0.93

Note. MISR = Maternal Interview of Sibling Relationships; SRQ = sibling relationship quality; MZ = monozygotic/identical twins; DZ = dizygotic/fraternal twins.

Table 2.3. Descriptive Statistics for the Maternal Interview of Sibling Relationships (Stocker et al., 1989) Scales, as a Function of Sibling Sex Constellation

MISR Scales	Male-Male Pairs		Female-Female Pairs		Opposite-Sex Pairs	
	M	*SD*	*M*	*SD*	*M*	*SD*
Mother report SRQ positivity	4.08	0.84	4.36	0.65	3.97	0.82
Mother report SRQ negativity	3.43	1.14	3.04	1.13	2.92	1.07
Father report SRQ positivity	3.90	0.92	4.22	0.62	3.93	0.67
Father report SRQ negativity	3.20	0.96	2.89	0.96	2.80	1.07

Note. MISR = Maternal Interview of Sibling Relationships; SRQ = sibling relationship quality.

Following our analyses of the descriptive statistics, we created unstandardised residual variables for mother and father reports of sibling relationship quality positivity and negativity, in order to control for the mean age of the sibling dyad.

Table 2.4 shows correlations among these Maternal Interview of Sibling Relationships (Stocker et al., 1989) composite variables. Father reports of sibling relationship quality positivity and negativity were moderately correlated, but mother reports were not. Mother and father reports of sibling relationship quality positivity were highly correlated, as were their reports of negativity.

Table 2.4. Correlations Among the Maternal Interview of Sibling Relationships (Stocker et al., 1989) Composite Scales

MISR Scales	1	2	3	4
1. Mother report SRQ positivity				
2. Mother report SRQ negativity	-.06			
3. Father report SRQ positivity	.49**	-.19**		
4. Father report SRQ negativity	-.13*	.50**	-.21**	

Note. MISR = Maternal Interview of Sibling Relationships; SRQ = sibling relationship quality. The MISR (Stocker et al.) composite scales used are unstandardised residuals that control for mean age of siblings. * p <.05; ** p <.01.

Two-way Analysis of Variance (ANOVA) Tests

In order to assess mean level differences on the Maternal Interview of Sibling Relationships (Stocker et al., 1989) scale, for both the sibling zygosity groups and the sibling sex constellation groups, we carried out four two-way (sibling zygosity x sibling sex constellation) ANOVAs, using mother reports of sibling relationship quality positivity, mother reports of sibling relationship quality negativity, father reports of sibling relationship quality positivity, and father reports of sibling relationship quality negativity as the dependent variables. Three of these tests had strong observed power (Field, 2013), with estimates above .80 (mother reports of sibling relationship quality positivity = .94; mother reports of sibling relationship quality negativity = .87; and father reports of sibling relationship quality positivity = .88). Father reports of sibling relationship quality negativity had a marginally lower power value of .75.

Sibling Zygosity. Unexpectedly, there was a non-significant main effect of sibling zygosity on sibling relationship quality, for all of the four models tested: $F(3, 389) = 1.61$, $p = .187$ for mother reports of sibling relationship quality positivity; $F(3, 389) = 0.86$, $p = .465$

for mother reports of sibling relationship quality negativity; $F(3, 200) = 1.73$, $p = .162$ for father reports of sibling relationship quality positivity; and $F(3, 200) = 1.06$, $p = .369$ for father reports of sibling relationship quality negativity.

Neither our hypothesis (a), that monozygotic twins would have higher levels of sibling relationship quality positivity, and lower levels of sibling relationship quality negativity, than would dizygotic twins or non-twin siblings; nor our hypothesis (b), that monozygotic twins and dizygotic twins would both have higher levels of sibling relationship quality positivity, and lower levels of sibling relationship quality negativity, than would non-twin siblings, were supported.

Sibling Sex Constellation. Unexpectedly, there was a non-significant main effect of sibling sex constellation on mother reports of sibling relationship quality positivity, $F(2, 389) = 0.37$, $p = .690$; father reports of sibling relationship quality positivity, $F(2, 200) = 1.92$, $p = .149$; and father reports of sibling relationship quality negativity, $F(2, 200) = 1.47$, $p = .232$. However, there was a significant main effect on mother reports of sibling relationship quality negativity, $F(2, 389) = 3.41$, $p = .034$. As recommended by Field (2013), we used Gabriel *post hoc* tests, due to the difference in sample sizes. These tests revealed significant differences between male-male pairs and female-female pairs ($p = .006$), with the former scoring more highly on sibling relationship quality negativity ($M = 0.39$) than the latter ($M = -0.22$). There was also a significant difference between male-male pairs and opposite-sex pairs ($p = .005$), again with the former scoring more highly on sibling relationship quality negativity ($M = 0.31$) than the latter ($M = -0.10$). There was a non-significant difference between female-female pairs and opposite-sex pairs for mother reports of sibling relationship quality negativity ($p = 1.00$).

These findings partially supported our hypothesis (c) - female-female sibling dyads did not have higher levels of sibling relationship quality positivity than did male-male or

opposite-sex dyads; however, male-male sibling dyads did show higher levels of sibling relationship quality negativity than did female-female or opposite-sex dyads, when mother reports were considered.

Interaction Effects. There was a non-significant interaction effect between sibling zygosity and sibling sex constellation on sibling relationship quality: $F(4, 389) = 1.36$, $p = .247$ for mother reports of sibling relationship quality positivity; $F(4, 389) = 0.58$, $p = .679$ for mother reports of sibling relationship quality negativity; $F(4, 200) = 1.22$, $p = .302$ for father reports of sibling relationship quality positivity; and $F(4, 200) = 1.45$, $p = .218$ for father reports of sibling relationship quality negativity.

Behavioural Genetic Analyses

For the remaining analyses, and in contrast to the dyadic sibling relationship quality positivity and negativity values used in the ANOVAs, we calculated two individual scores for older sibling/twin 1 and younger sibling/twin 2 for the sibling relationship quality constructs. This was done by creating a sibling 1 and a sibling 2 average across the nine Maternal Interview of Sibling Relationships (Stocker et al., 1989) items that required ratings for the two children individually. We then created unstandardised residual variables, in order to control for the mean age of the sibling dyad, as well as for each child's sex.

Intraclass Correlations. Table 2.5 shows siblings' intraclass correlations. Monozygotic twins had consistently higher correlations than both dizygotic twins and non-twin siblings, suggesting genetic influence. The correlations were also fairly large across the three groups, indicating shared environmental influence. Finally, the monozygotic correlations were very high overall, suggesting little non-shared environmental influence.

Table 2.5. Intraclass Correlations Among the Maternal Interview of Sibling Relationships (Stocker et al., 1989) Composite Scales, as a Function of Sibling Zygosity

MISR Scales	Sibling Intraclass Correlations		
	MZ Twin Pairs	DZ Twin Pairs	Non-Twin Pairs
Mother report SRQ positivity	.89***	.60***	.69***
Mother report SRQ negativity	.93***	.74***	.65***
Father report SRQ positivity	.85***	.80***	.78***
Father report SRQ negativity	.97***	.72***	.73***

Note. MISR = Maternal Interview of Sibling Relationships; MZ = monozygotic/identical twins; DZ = dizygotic/fraternal twins. The MISR (Stocker et al.) scales used are unstandardised residuals that control for mean age of siblings and sex of each child. *** p <.001.

Univariate ACTE Quantitative Analyses. Although intraclass correlations are informative, a model fitting approach is a more powerful and explicit way of testing genetic and environmental contributions to sibling relationship quality (Eaves, Last, Young, & Martin, 1978). This method also provides additional information, lacking in correlation tests, such as confidence intervals for variance estimates. In this study, maximum-likelihood model fitting analyses were performed using the program R (R Development Core Team, 2009) and the modelling package Open Mx (Neale, 1991). The ACTE behavioural genetic model (Jinks & Fulker, 1970) was assumed, which evaluates the effects of additive genetic influences (A), shared environmental influences (C), twin-specific environmental influences (T), and non-shared environmental influences (E). 'T' was incorporated here to test whether twins, being the same age, may be more similar to one another than would be expected based on genetic or shared environmental factors.

Figure 2.1 shows the basic structure of the model. It takes into account genetic methods at the level of the correlations between the latent variables (A, C, T, and E). The

curved double-headed arrow linking ‘A’ between the siblings is set to 1.00 for monozygotic twins, because these pairs share 100 percent of their genes, and 0.50 for dizygotic twins and non-twin siblings, because these pairs share 50 percent of their genes. The path linking ‘C’ for the twins/non-twins is set to 1.00 in all cases, thereby equating the shared environment across all pairs, because siblings in all three groups were reared together. The arrow linking ‘T’ is set to 1.00 for both monozygotic twins and dizygotic twins, and 0.00 for non-twin sibling pairs, assessing the extent to which environmental factors that are specific to twins are important. ‘E’ for the three groups is not joined by a curved double-headed arrow, because non-shared environmental influences are not common to both siblings, and instead account for intrapair differences not accounted for by non-shared genes. This component also contains measurement error.

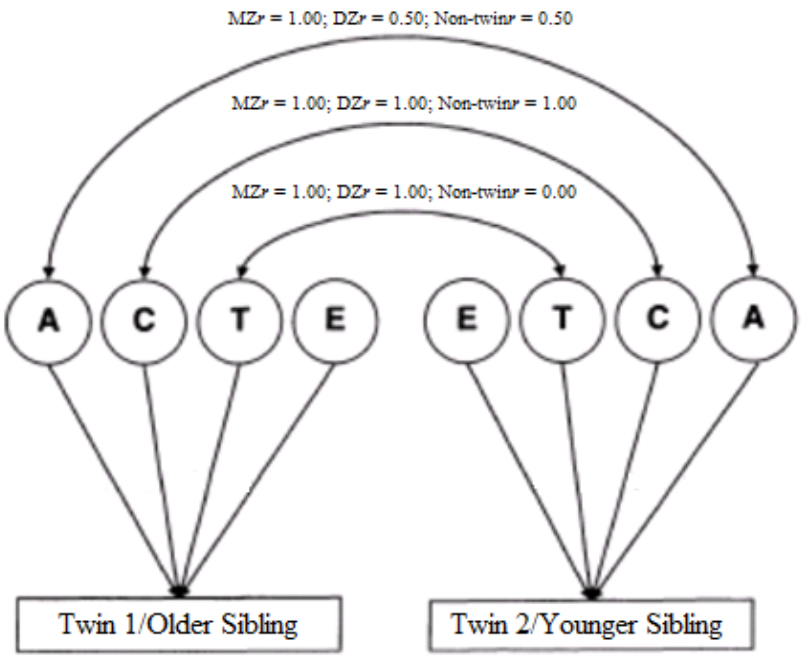

Figure 2.1. A Univariate ACTE Quantitative Genetic Model (Jenkins & Fulker, 1970)

Note. Twin 1/Older Sibling and Twin 2/Younger Sibling are measured variables for the two twins/siblings – here, either mother report of sibling relationship quality positivity, mother report of sibling relationship quality negativity, father report of sibling relationship quality positivity, or father report of sibling relationship quality negativity, each for both twin 1/older sibling and twin 2/younger sibling. The latent variables A, C, T and E are the genetic factor, the shared environmental factor, the twin-specific environmental factor, and the non-shared environmental factor, respectively. The curved, two-headed arrows indicate correlations between the variables they connect; the one-headed straight arrows represent paths, standardised partial regressions of the measured variables on the latent variable.

We calculated four separate univariate ACTE models, for mother reports of sibling relationship quality positivity, mother reports of sibling relationship quality negativity, father reports of sibling relationship quality positivity, and father reports of sibling relationship quality negativity respectively. Table 2.6 contains the results of the univariate analyses. Significant heritability estimates emerged for mother reports of sibling relationship quality positivity, mother reports of sibling relationship quality negativity, and father reports of sibling relationship quality negativity, but not for father reports of sibling relationship quality positivity. Genetic influence explained a moderate proportion of variance in mother reports of sibling relationship quality positivity, whereas these values were modest for mother reports of sibling relationship quality negativity and father reports of sibling relationship quality negativity.

The shared environmental estimates accounted for the most variance in sibling relationship quality overall, and were moderate to substantial and significant across all four of the Maternal Interview of Sibling Relationships (Stocker et al., 1989) measures. This component was particularly high for father reports of sibling relationship quality positivity. Negligible and non-significant estimates for the twin-specific environment were revealed for both mother and father reports of sibling relationship quality positivity. However, this estimate was modest for mother reports of sibling relationship quality negativity, and moderate for father reports of sibling relationship quality negativity. The non-shared environment accounted for small but significant amounts of variance for all four sibling relationship measures.

The findings from the univariate analyses partially supported our hypothesis (d), that sibling relationship quality positivity would yield modest genetic influence and substantial shared environmental influence, and our hypothesis (e), that sibling relationship quality negativity would yield substantial genetic influence and modest shared environmental

influence. Genetic estimates were modest to moderate across both sibling relationship quality positivity and negativity, and non-twin specific shared environmental estimates were moderate to substantial.

Table 2.6. Model Fitting Estimates of Genetic and Environmental Components of Variance for the Maternal Interview of Sibling Relationships (Stocker et al., 1989) Composite Scales

MISR Scales	Components of Variance				AIC Value
	h^2	c^2	t^2	e^2	
Mother report SRQ positivity	.49* [.37 - .64]	.40* [.25 - .51]	.00 [.00 - .13]	.11* [.08 - .15]	1534.35
Mother report SRQ negativity	.34* [.24 - .45]	.33* [.19 - .52]	.25* [.13 - .42]	.08* [.06 - .11]	1789.71
Father report SRQ positivity	.17 [.00 - .32]	.70* [.51 - .81]	.00 [.00 - .20]	.14* [.09 - .21]	701.00
Father report SRQ negativity	.30* [.19 - .44]	.26* [.11 - .47]	.40* [.15 - .58]	.05* [.03 - .08]	805.75

Note. MISR = Maternal Interview of Sibling Relationships; h^2 = additive genetic variance; c^2 = shared environmental variance; t^2 = twin-specific environmental variance; e^2 = non-shared environmental variance; AIC = Akaike information criterion. Values in parentheses are confidence intervals for each variance estimate. * = confidence intervals indicate the value is significant.

Discussion

We set out to compare the nature of the relationship between monozygotic twins, dizygotic twins, and non-twin siblings, and to disentangle genetic and environmental contributions to sibling relationship quality using these three sibling groups. Surprisingly, and in opposition to both inclusive fitness theory (Neyer & Lang, 2003) and to our first hypothesis (a), monozygotic twin pairs within our sample did not have significantly higher levels of sibling relationship quality positivity, or significantly lower levels of sibling relationship quality negativity, than did dizygotic twin pairs or non-twin pairs. Likewise, the derivative of secure attachment theory put forward by Tancredy and Fraley (2006), informing our second hypothesis (b), was not supported - monozygotic twins and dizygotic twins did

not have significantly higher levels of sibling relationship quality positivity, or significantly lower levels of sibling relationship quality negativity, than did non-twin siblings. In other words, there were no substantial differences in the ways that siblings of varying genetic relatedness behaved towards one another. In relation to our third hypothesis (c), sex constellation differences did emerge, partially supporting the prediction proposed. Our fourth and fifth hypotheses (d) and (e) were also partly verified, through the modest to moderate genetic influence and the moderate to substantial shared environmental influence found for sibling relationship quality. Note, however, that a significant difference was only found between sibling relationship quality positivity and sibling relationship quality negativity when the twin-specific environment was considered.

Theoretical Explanations of Sibling Relationship Quality

The current study did not support Neyer and Lang's (2003) proposal, that monozygotic twins have a special regard for one another because they share more of their genetic makeup than do dizygotic twins or non-twins. Within our sample, parents reported that monozygotic twins behaved no more positively, and no less negatively, towards each other than did dizygotic twins or non-twin siblings. Consequently, kinship theory cannot be applied here, because there was no evidence that identical twins were more motivated to behave altruistically towards each other. The measures employed in our study did differ from those of previous papers in important ways, and thus may have caused this discrepancy in findings. Indeed, we did not ask parents to directly rate levels of siblings' closeness or dependence, as Neyer and Lang, Neyer (2002) and Penninkilampi-Kerola and colleagues (2005) did. Rather, we primarily asked mothers and fathers about each child's observable actions towards his/her sibling, making the questionnaire less driven by subjective perceptions, and more focused on actual behaviour.

Correspondingly, the nature of sibling relationship quality across twins (in general) and non-twins was similar. This finding also disconfirms the alternative theoretical perspective regarding twin attachments put forward by Tancredy and Fraley (2006) - that all twins (whether monozygotic or dizygotic) form distinctively close relationships with each other in comparison to non-twin brothers and sisters. When reviewing these results, we must take into account the young age, and small age range, of our samples, compared to that of previous studies (Tancredy & Fraley; Fraley & Tancredy, 2012). During this early developmental stage, children are typically living at home and sibling relationships are particularly intense, with brothers and sisters often spending more time with one another than with their parents (McHale & Crouter, 1996). It may be fair to say then, that these ties during early childhood are relatively 'forced' - individuals making up sibling dyads have little choice but to engage with each other. Because of this, a measure of sibling relationship quality at this age may not be indicative of long-term relational characteristics that differentiate between twin versus non-twin siblings. Perhaps the enduring nature of sibling relationship attachments only becomes clear when children are older, spending more time away from the family home and being able to choose the extent of time and effort they put into their sibling relations (Furman & Buhrmester, 1992).

Sex Constellation Differences in Sibling Relationship Quality

Differences did emerge in relation to gender. Specifically, higher levels of sibling relationship quality negativity were found for male pairs than for both female pairs and opposite-sex pairs. However, this finding only held true for mother accounts. Inspection of the means showed that mothers reported higher levels of negativity between boy-boy twins than did fathers, perhaps because the mothers in these relatively traditional samples spent more time with the children, providing them with more opportunities to witness frequent negative behaviours. It was also hypothesised that female-female sibling dyads would have

higher levels of sibling relationship quality positivity than would male-male or opposite-sex dyads, yet this was not confirmed. The general pattern of results in relation to negativity within this sample was consistent with our expectations, and runs parallel to Brody and colleagues' (1985) and Maccoby's (1998) earlier gender work. It also ties in with Nash's (1979) notion that caregivers tend to teach boys the meaning of social relationships to a lesser extent than to girls. Saying that, it was surprising that the sex constellation of dyads did not play a part in sibling relationship quality positivity, as Abramovitch and colleagues (1979; 1986) and Buist and colleagues (2002) have reported that cooperation between siblings also varies by gender.

Such a lack of consistency across sibling positivity and sibling negativity results reflects the fact that sibling relationships are not *either* good *or* bad, but, instead, often tend to be characterised by ambivalence (Pike, Coldwell, & Dunn, 2005). Indeed, these two constructs were statistically unrelated when mother reports were considered here, confirming that these features can co-occur. As such, positivity and negativity displayed between brothers and sisters should be treated as separate constructs, rather than opposite ends of a single dimension (see Dallaire et al., (2006) for a similar argument for parenting).

Behavioural Genetics and Sibling Relationship Quality

The monozygotic twins in this study were rated as more similar in their behaviour towards one another than were the dizygotic twins, leading to modest to moderate heritability estimates. Given that these sibling behaviours were based on parent reports, it could be that this merely reflected parents' *beliefs* about their twins. However, our finding of genetic influence confirms previous work reviewed by McGuire and colleagues (2015), bolstering our interpretation that genes themselves are a likely causal agent. The effect of genes on the bond between siblings is suggestive of the children's own characteristics contributing to

sibling relationship quality, and indeed the existing evidence endorses this. For example, Lemery and Goldsmith (2001) and Pike and Atzaba-Poria (2003), who also used twin pairs within their study design, found that the target children's temperaments could explain much of the moderate genetic influence they uncovered. Lemery and Goldsmith discovered this result when using parental reports of sibling conflict in their young children, and Pike and Atzaba-Poria concurred when they gathered teenagers' reports of their own hostility and rivalry towards their co-twin.

Also in line with the existing evidence (Lemery & Goldsmith, 2001; McGuire et al., 2000; Reiss et al., 2000; Rende et al., 1992), parents tended to rate their children's behaviour towards one another in similar terms, yielding a large shared environmental component. This is indicative of consistency among children within the same family, once genetic similarity has been accounted for. To the extent that such a result is reflective of true behavioural resemblance, it is congruent with Bowen's (1978) family systems theory. Siblings and twins growing up within a family often have similar experiences, and the characteristics of specific dyadic bonds can 'spill over' and influence other familial interactions (Engfer, 1988). Lemery and Goldsmith have argued that the parent-child relationship, and parenting *per se*, is the most salient aspect of the shared environmental contribution to relationships between siblings. As well as the individual impact of mothers' and fathers' parenting, siblings may be exposed to other collective familial elements that can lead to high shared environmental estimates. For example, parental mental health, marital quality, and socioeconomic status are all family-wide factors, which may act to make siblings more similar to one another (Rowe, 1983).

We were also able to investigate the degree to which environmental factors that were specific to twins influenced variation in sibling relationship quality. Interestingly, this twin-specific effect was moderate and significant for negativity, but not for positivity. This

indicates that parents of both monozygotic and dizygotic twins reported their children demonstrating more similar levels of conflictual behaviour than did parents of non-twin siblings. We propose two possible interpretations for such a finding. It may be that mothers and fathers of twins *perceived* these pairs to be more reciprocal in their negative interactions, and thus overestimated behavioural similarities between them in their sibling relationship quality reports. Alternatively, the parental accounts documented here could have reflected reality - it may be that twin dyads genuinely were more reciprocal in their negative sibling behaviours than were non-twins.

Limitations and Future Directions

We used parental self-report measures to assess the quality of sibling relationships within our sample. However, parents tend to overestimate the consistency of both their behaviour towards their offspring, and of their children's behaviour towards them and other family members (Pike, Reiss, Hetherington, & Plomin, 1996). A future study may therefore benefit from using videotaped sibling interactions, which would allow sibling relationship quality to be rated by trained researchers during a standardised semi-structured task. Saying this, we would argue that all methodologies have their flaws (Pike & Oliver, 2015), and several perspectives are needed to capture the intricacies of the sibling bond.

In addition, there were relatively low levels of negative sibling relationship quality, and relatively high levels of positive sibling relationship quality, in both our twin and non-twin samples. While families were broad in educational qualifications and occupational status in both studies, neither sample was fully representative of the UK population, particularly at the lower end of the socioeconomic spectrum. Numerous studies have found that factors such as social class or race can affect family dynamics (Bronfenbrenner, 1979), and sibling interactions can be intertwined with other familial relationships (Engfer, 1988). Further

explorations into sibling relationship quality are needed within more diverse samples, including broadening ethnicity, family type, and socioeconomic status, to determine whether our findings can be generalised across these groups.

Conclusions

Importantly, the current research demonstrates that studies of twins in childhood can be generalised to the wider non-twin sibling population. We discovered no differences in the quality of the bond between identical twin pairs, fraternal twin pairs, and non-twin sibling pairs. In other words, these distinct groups of siblings behaved similarly to each other, displaying equivalent levels of positivity and negativity within their relationships. This was an unexpected finding, and one that has repercussions for the broader application of results from future twin-based investigations. We also conclude that genetically influenced traits of children impact upon their sibling interactions, but that, unlike other family relationships, sibling dynamics are primarily characterised by reciprocity.

Chapter 3: The Maternal Emotional Climate Predicts Twin Relationship Quality

(Paper 2)

Abstract

We investigated the association between maternal expressed emotion and twin relationship quality, after controlling for a questionnaire measure of the mother-child relationship. This was explored within a community sample of 156 mothers and their two twin children ($M_{\text{child age}}$ = 3.69 years; $SD_{\text{child age}}$ = 0.37). Mothers reported on the twin and mother-child relationship via questionnaire. They were also interviewed about each child using the innovative Preschool Five Minute Speech Sample, which yields information about relative positive: negative expressed emotion. Mothers who expressed more family-wide positive, and less family-wide negative, emotion about their children overall reported more positivity, but not negativity, within the twin sibling relationship – even when controlling for the mother-child relationship. Counter to expectations, discrepancies in mothers' expressed emotion between their twins also predicted more positive sibling relationships. Our findings corroborate the well-established spill-over effect of relations within the family. Most importantly, the Preschool Five Minute Speech Sample provides information about mothering that questionnaire reports may not, and thus it is a useful tool in better understanding the twin family system.

Mark, K.M., Pike, A., Latham, R.M., & Oliver. B.R. (in press). The Maternal Emotional Climate Predicts Twin Sibling Relationship Quality. *Twin Research and Human Genetics.*

I contributed to 50% of the data collection, and carried out all of the analyses and write-up, under supervision, for this paper. I am, therefore, listed as first author.

Introduction

This research is situated within a family systems approach, whereby families are viewed as emotional units of interdependent individuals, none of whom can be understood in isolation from one another (Bowen, 1978). It is now well documented that the nature and valence of parenting can 'spill over' into other familial relationships, including the sibling bond (Pike, Coldwell, & Dunn, 2005). The majority of past studies have recruited non-twin siblings, and employed questionnaires or observations, to access such family dynamics. Capturing an additional, more nuanced perspective of the emotional climate of the family may be key in enhancing our understanding. For the first time, the current study investigated the prediction of twin relationship quality by an interview measure of maternal expressed emotion, the Preschool Five Minute Speech Sample (Daley, Sonuga-Barke, & Thompson, 2003). We controlled for a questionnaire measure of the mother-child relationship, and participants were a community sample of mothers and their twin children. Prior to describing previous research linking the mother-child and sibling and twin subsystems, we provide an overview of the Preschool Five Minute Speech Sample (Daley et al.).

The Preschool Five Minute Speech Sample

The Five Minute Speech Sample was originally developed by Magana and colleagues (1986) as a quick and reliable way to measure levels of expressed emotion within families. Expressed emotion is a construct that allows researchers to quantify the feelings individuals convey about family members, by focusing on critical and hostile attitudes and extreme emotional involvement from parents towards their adult children (Brown & Rutter, 1966). These specific intrafamilial traits have repeatedly been associated with relapse in those suffering from schizophrenia (Leff & Vaughn, 1981), and, more recently, have emerged in relation to psychopathology in middle childhood (Baker, Heller, & Henker, 2000). In 2003,

Daley and colleagues modified the Five Minute Speech Sample (Magana et al.) for use with parents of preschool-aged children. This latter version, the Preschool Five Minute Speech Sample (Daley et al., 2003), was used in the current study, and includes coding of positive, as well as negative, expressions of emotion.

The unusual interview-style structure of the Five Minute Speech Sample (Magana et al., 1986), and the Preschool Five Minute Speech Sample (Daley et al., 2003), requires parents to deliver a five-minute monologue about their child. Such a procedure is thought to encourage the disclosure of authentic and unbiased feelings from mothers and fathers. Thus, the measure is able to overcome some of the limitations associated with self-report questionnaires and researcher-led observations. In this way, it may help to improve our understanding of family dynamics. Specifically, questionnaire methods are often criticised because of the risk of rater bias – parents may be more likely to present themselves in a positive light, and to report being more consistent in their behaviour and feelings towards each of their children than is actually the case (Kowal, Krull, & Kramer, 2006). Observational coding of parenting, often based on a parent and child carrying out a shared task, is commonly considered to be the 'gold standard'. However, these tasks require the willingness of both parents and children to participate, in a staged, and often artificial, environment (Yelland & Daley, 2009). Moreover, we would argue that researchers might not capture a typical period of interaction, since they only tend to observe parent-child pairs for five to ten minutes on one particular day (Pike & Oliver, 2015).

The Five Minute Speech Sample (Magana et al., 1986), and Preschool Five Minute Speech Sample (Daley et al., 2003), provide a valuable complement to more traditional measures, because parents' spontaneous speech: (1) is less likely to be affected by rater bias than are structured questionnaire responses; (2) is, unlike observational interactions, unobtrusive, as it can be carried out via telephone interview; and (3) has been shown to be

reflective of how parents behave towards their children on a daily basis (Wamboldt, O'Connor, Wamboldt, Gavin, & Klinnert, 2000).

Parenting and Sibling Relationship Quality

Consideration of multiple relationships within the family, and recognising that dyadic subsystems of relationships influence one another, is at the heart of the family systems approach (Bowen, 1978). Specifically, the current study is informed by the well-established spill-over hypothesis (Engfer, 1988), which argues for the transfer of positive and negative emotion from one familial bond to another. Such transmission has been displayed across varying interactions within a family unit (for example, between the marital and the parent-child relationship (Erel & Burman, 1995)), but it is the spill over between mother-child and sibling pairings that is of interest here. Empirical evidence supports this effect – research has found that problematic mother-child relations go hand-in-hand with more hostile sibling relations (Brody, Stoneman, & McCoy, 1994b), and that positive mother-child relations are associated with more intimate sibling relations (Brody, 1998). Indeed, Pike and colleagues (2005) suggest that parental feelings and behaviours may be directly modelled by children in their interactions with siblings.

Differential Parenting and Sibling Relationship Quality

Both absolute levels of parenting within families, and the differential expression of parents' positivity and negativity towards siblings within families, have been shown to predict sibling relationship quality (Shanahan, McHale, Crouter, & Osgood, 2008). From an early age, children are intensely aware of - and compare - the behaviour of their parents towards them versus their sibling(s) (Dunn & Munn, 1985), and parental differential treatment has been associated with more conflictual sibling relationships (McHale, Crouter, McGuire, & Updegraff, 1995). However, despite the negative consequences that this unequal

treatment can have on both sibling relationship quality, and on individual children's outcomes (Jenkins, Rasbash, Leckie, Gass, & Dunn, 2012), it is fairly commonplace within families (Brody, Copeland, Sutton, Richardson, & Guyer, 1998). Interestingly, Kowal and Kramer (1997) found that the usual negative effects of parents' differential behaviour on sibling relationship quality were ameliorated if children perceived such conduct to be fair and justified in the circumstances.

Expressed Emotion and Sibling Relationship Quality

Although maternal expressed emotion is known to influence the atmosphere within the home environment (McCarthy, Lau, Valeri, & Weisz, 2004), there has been little research investigating the connection between the Five Minute Speech Sample (Magana et al., 1986), or the Preschool Five Minute Speech Sample (Daley et al., 2003), and sibling relationship quality. The interview measures have been included in sibling-based research, to the extent that parents have completed speech samples for two children within the same family. For example, Cartwright and colleagues (2011) carried out the Five Minute Speech Sample (Magana et al.) with parents of non-twin siblings (one who had been diagnosed with Attention Deficit Hyperactivity Disorder, and one who had not), and found that 'maternal expressed emotion is an important marker of parental response to Attention Deficit Hyperactivity Disorder' (p. 10). The authors confirmed that the parent-driven emotional climate was predominantly a child effect, with little or no role for shared family influences on the components of the Five Minute Speech Sample (Magana et al). Despite such research, however, and as far as we are aware, Petalas and colleagues (2012) authored the only study looking directly at the association between maternal expressed emotion and the sibling bond, within a clinical sample of five- to 17-year-old children with Attention Deficit Hyperactivity Disorder. Here, more conflict was reported between siblings when mothers made many critical comments about either one or both children.

Twin Relationship Quality

Twins represent an unusual sibling dyad, but the Office for National Statistics (2013) suggests that twin births are becoming increasingly common - 15.6 out of every 1000 deliveries were multiple births in the year 2013. Both classic literature and the modern media tend to portray the twinship bond as one that is exceptionally special and intimate (Playfair, 2002). Indeed, this view has been supported by a number of empirical studies, claiming that twin dyads are unique due to the lack of birth order and developmental differences between them (Burlington, 1945; Fraley & Tancredy, 2012; Segal, 1999).

In the context of parenting, it is known that mothers of twins tend to be less responsive to, to have less physical contact with, and to talk less to their children in comparison to mothers of non-twins (Leonard & Denton, 2006). Parents of twins often encounter childrearing challenges, simultaneously trying to treat each child fairly and equally while responding to their differences and preferences, which can lead to considerable internal conflict, guilt and feelings of inadequacy (Beck, 2002). Parenting experiences of families raising twin children may provide nuanced insights, due to the unusual, and somewhat more stressful nature of mothering and fathering in this situation. Studying twinships may be particularly helpful when considering parental differential treatment. Parenting that is perceived as being unequal or unfair to children may be felt more keenly by twins in comparison to non-twins. Differences in developmental stages, and therefore needs, are the primary reason why siblings may accept discrepancies in the caregiving provided by their parents (Kowal et al., 2006). However, recruiting twins controls for any age and age gap variance, thus removing a major determining factor of parenting, and particularly differential treatment (O'Connor & Croft, 2001). Ultimately, studying a twin sample eradicates these central confounding factors from the sibling dyad, and allows us to put parenting, and especially differential parenting, under the microscope.

When thinking specifically about maternal expressed emotion towards twins, the pool of research available is virtually non-existent. Caspi and colleagues (2004) carried out the Five Minute Speech Sample (Magana et al., 1986) with mothers of twins, and found that their differential emotional attitudes towards their children were associated with subsequent antisocial behaviour at age seven. The authors ruled out the possibility that the link was genetically mediated, and instead concluded that maternal expressed emotion is an environmentally mediated risk factor for problematic child behaviour. However, as far as we are aware, no studies have investigated the prediction of twin relationship quality from mothers' emotional attitudes towards their children.

The Current Study

For the first time, the present study used the Preschool Five Minute Speech Sample (Daley et al., 2003) to investigate spill over between maternal expressed emotion and twin relationship quality, in order to better conceptualise the relationships between these family dyads. Importantly, this link was explored while accounting for maternal questionnaire reports of the mother-child relationship. To address the lack of research focusing on twin relationship quality, we recruited a community sample of mothers with young twin children (aged 4.70 years). We also included both family-wide levels of maternal expressed emotion, as well as a simple differences model (Dunn, Stocker, & Plomin, 1990) of differential expressed emotion between siblings within a family, as predictors of twin relationship quality.

Specifically, we hypothesised that: (a) mothers would show different patterns of expressed emotion with each of their twins; (b) family-wide maternal expressed emotion (i.e., mothers' average expressed emotion across both twins) would predict twin relationship quality, after controlling for questionnaire reports of the mother-child relationship –

specifically, positive family-wide maternal expressed emotion would predict more positive, and less negative, twin relationship quality, and negative family-wide maternal expressed emotion would predict more negative, and less positive, twin relationship quality; and (c) differential maternal expressed emotion (i.e., the difference between mothers' expressed emotion towards one twin compared to the other) would predict more negative, and less positive, twin relationship quality, after controlling for questionnaire reports of the mother-child relationship.

Method

Participants and Recruitment

Data were collected from mothers, along with their twin children, as part of the Twins, Family and Behaviour longitudinal study. Data were collected in four phases, over a two- to three-year period (see Chapter 1 for details of the full recruitment procedure). The current paper focuses on 156 of these mothers of twins. This subset of participants had completed an initial postal questionnaire, a telephone interview, and a follow-up postal questionnaire, during the first, second and fourth phases of the study, respectively. At phase one, 89.0% of the participating families were intact two-parent households where the biological mother and father were either married or cohabiting, whilst 9.7% of mothers reported being single (either unmarried, separated, divorced or widowed), and 1.3% stated they were either married or cohabiting with someone other than the twins' biological father. Mothers had an average age of 37.99 years (SD = 4.26). Children had an average age of 3.69 years (SD = 0.37) at phase one, 4.67 years (SD = 0.39) at phase two, and 5.98 years (SD = 0.49) at phase four.

Twin zygosity was determined using a parent questionnaire, shown to be more than 95% accurate when compared to blood (Plomin, Rende, & Rutter, 1991) and DNA (Price et

al., 2000) testing procedures. Of the 156 twin pairs included in the study, four pairs could not be classified in terms of their zygosity. Of the remaining 152 pairs, 59 (38.8%) were monozygotic (or identical), 44 (28.9%) were dizygotic (or fraternal) same-sex, and 49 (32.2%) were dizygotic opposite-sex.

In comparison with the national average for England and Wales (Office for National Statistics, 2014), the sample was skewed towards those of higher socioeconomic status. The mothers included were substantially more qualified – 69.5% of the sample reported having an undergraduate degree or above as their highest educational attainment, compared to 27.2% of the general population. Correspondingly, only 0.6% of our participants reported having no educational qualifications, compared to 22.7% of the general population.

Procedure and Measures

Participants completed an initial postal questionnaire at phase one of the study, as well as a follow-up postal questionnaire at phase four. Researchers also carried out 40-minute semi-structured telephone interviews with each mother at phase two.

The Mother-Child Relationship. For the Parent-Child Relationship Scale questionnaire (Hetherington & Clingempeel, 1992), administered during phase one of the Twins, Family and Behaviour study, via postal questionnaire, mothers were asked to rate 15 items about aspects of their relationship with each of their twins. These were rated on a 5-point scale, ranging from 1 = not at all to 5 = extremely. Two subscales are derived from this measure: 1) mother-child relationship positivity, for example ‘How affectionate is your child towards you?’ (Cronbach’s alphas = .75 and .69 for maternal reports concerning the older and younger twins, respectively); and 2) mother-child relationship negativity, for example ‘How much do you criticise your child?’ (Cronbach’s alphas = .70 and .72 for maternal reports concerning the older and younger twins, respectively).

Expressed Emotion. The Preschool Five Minute Speech Sample (Daley et al., 2003) was used to assess maternal expressed emotion in relation to each twin separately, during a telephone interview at phase two of the study. Specifically, a researcher told each mother, 'I'd like to hear your thoughts and feelings about (*twin name*), in your own words and without me interrupting with any questions or comments. When I ask you to begin, I would like you to speak for five minutes, telling me what kind of a person (*twin name*) is and how the two of you get along together. During this time I prefer not to answer any questions or comments, but I will tell you when the five minutes have passed.' If the participant stopped speaking before the five minutes had elapsed, we waited 30 seconds before prompting, as respondents often continued talking on their own. After 30 seconds had passed, the respondent was prompted with the comment 'Please tell me anything about (*twin name*) for a few more minutes'. If the respondent still did not speak, we simply allowed the full five minutes to elapse before moving on to the next part of the interview.

The Preschool Five Minute Speech Sample (Daley et al., 2003) was coded in pairs by trained researchers, using an adapted version of the original coding scheme. There were two frequency counts for coding: 1) positive comments, which are usually descriptive words or statements that reflect praise, approval or appreciation towards the child, or that indicate a positive trait (for example '(*Twin name*) is sociable'); and 2) critical comments, which are usually descriptive words or statements that find fault with the child, or that indicate a negative trait (for example '(*Twin name*) is irritable'). For each minute of the Preschool Five Minute Speech Sample (Daley et al.), pairs of coders tallied how many times each mother made one of these statements. Initially, we carried out this coding individually, without conferring with our coding partner, and subsequently, after each minute of speech, coders came together to discuss the scores they had assigned. When disagreements arose, coders

deliberated over the score until an agreement was reached. Interrater reliability for the initial individual codes was .90 for positive comments, and .83 for critical comments.

Proportion scores were computed, reflecting the number of positive comments compared to the number of critical comments made by mothers for each twin. The former were divided by the latter, so that values between 0 and 1 were indicative of more critical than positive comments, and values above 1 were indicative of more positive than critical comments. For example, in a particular family, if a mother uttered 3 positive comments and 1 critical comment about one of her twins, this would generate a proportion score of 3 (3 ÷ 1 = 3); whereas if a mother uttered 1 positive comment and 3 critical comments, this would generate a proportion score of 0.33 (1 ÷ 3 = 0.33).

Twin Relationship Quality. Twin relationship quality was measured using an adapted version of the Maternal Interview of Sibling Relationships (Stocker, Dunn, & Plomin, 1989). At phase four of the study, mothers were asked to rate how often their children displayed 13 varying behaviours, relating to different aspects of the sibling relationship, including companionship, quarrels, sharing, competing and jealousy, via a follow-up postal questionnaire. Four of the items were scored for the twin sibling relationship overall (for example 'Of the time the siblings spend together, how often do they play together?'), and nine required ratings for the older twin and the younger twin individually (for example 'On a day-to-day basis, how often does (*older twin name*) show affection towards (*younger twin name*)?; and how often does (*younger twin name*) show affection towards (*older twin name*)?'). Varying response scales were used throughout; the most common were a percentage-based scale, where 1 = less than 5% of their time together and 6 = almost all of their time together, and a frequency-based scale, where 1 = once a month or less and 6 = just about every day. Factor analysis yielded composite scores for twin

relationship quality positivity (11 items) and twin relationship quality negativity (3 items). Resultant Cronbach's alphas for these scales were .85 for the former and .78 for the latter.

Results

Preliminary Analyses

First, unstandardised residual variables were created for mother reports of twin relationship quality positivity and negativity at phase four, in order to control for both the number of boys within each twin pair, and the children's ages. These residual scores were used for all analyses, apart from for the descriptive statistics.

Additionally, overall family-wide ratings and difference scores between twins were created for both the Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992) and for the Preschool Five Minute Speech Sample (Daley et al., 2003) proportion measures. In order to create the overall family-wide indicators, we calculated family averages (across the two twins), and to create the differential indicators, difference scores were calculated. For example, in a particular family a mother might score a 2 for mother-child relationship positivity on the Parent-Child Relationship Scale (Hetherington & Clingempeel) in relation to the older twin, and a 3 on the same measure for the younger twin. Family-wide mother-child positivity would then be 2.5 ((3 + 2) ÷ 2 = 2.5). The associated difference scores were calculated by taking the absolute difference between the twins' scores. Here, differential mother-child positivity would be 1 (3 – 2 = 1). It is worth noting that we did not assess the direction of differential scores for the Parent-Child Relationship Scale (Hetherington & Clingempeel) or the Preschool Five Minute Speech Sample (Daley et al.). In other words, we did not attend to whether it was the older twin or the younger twin that received a higher score on these particular measures, because, in either case, more differential maternal reports were expected to relate to poorer sibling relationship quality. Thus, these absolute differences reflect the magnitude, but not the direction, of any discrepancies described by mothers.

Descriptive Statistics

Descriptive statistics for all study variables are shown in Table 3.1. In order to assess whether the mean values of the differential mother-child relationship and the expressed emotion variables differed from a null value of 0, one-sample *t*-tests were conducted. All measures tested had mean values that were significantly greater than 0. This indicated that mothers within our sample generally did make a significant amount of positive and critical comments about their children during the Preschool Five Minute Speech Sample (Daley et al., 2003), and also tended to display differential feelings and emotions when talking about each of their twins.

Table 3.1. Descriptive Statistics for All Study Variables

	M	*SD*	Range	*t*-value
Phase One				
Family-wide M-C positivity	3.26	0.35	2.25 – 3.90	-
Family-wide M-C negativity	1.29	0.60	0.00 – 3.50	-
Differential M-C positivity	0.09	0.16	0.00 – 0.90	7.12***
Differential M-C negativity	0.21	0.27	0.00 – 1.00	9.66***
Phase Two				
Family-wide maternal EE	3.67	2.70	0.50 – 14.00	-
Differential maternal EE	3.03	3.23	0.00 – 14.80	9.95 ***
Phase Four				
TRQ positivity	3.77	0.61	1.30 – 5.89	-
TRQ negativity	2.45	1.08	0.00 – 5.00	-

Note. M-C = mother-child; EE = expressed emotion; TRQ = twin relationship quality. *** $p < .001$. *t*-values are from one-sample *t*-tests, where the mean value of each variable was compared to a value of 0.

Correlations

Table 3.2 shows correlations among the residualised twin relationship quality variables, the mother-child relationship variables, and the expressed emotion variables. Five out of a possible 12 correlations were significant, all but one of which were in the expected direction. For the family-wide mother-child relationship scores from the questionnaire, mothers who reported a more positive relationship with both children also reported more positivity within the twin sibling relationship. Similarly, mothers who reported a more negative relationship with both children also reported more negativity between the twin siblings. In terms of the differential mother-child relationship scores from the questionnaire, mothers who reported having a more positive relationship with one twin compared to the other, also reported less positivity within the twin sibling relationship. For the proportional expressed emotion variables, mothers who made more family-wide positive, than family-wide critical, expressed emotion comments also reported more positivity between the twin siblings. Unexpectedly, mothers who were more differential in terms of their expressed emotion tended to report *more* positivity between the twin siblings.

Table 3.2. Correlations Among the Maternal Interview of Sibling Relationships (Stocker et al., 1989), the Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992), and the Preschool Five Minute Speech Sample (Daley et al., 2003) Measures

	Phase Four	
	TRQ Positivity	TRQ Negativity
Phase One		
Family-wide M-C positivity	.28***	-.02
Family-wide M-C negativity	-.06	.22**
Differential M-C positivity	-.18*	-.07
Differential M-C negativity	-.08	.04
Phase Two		
Family-wide maternal EE	.17*	.04
Differential maternal EE	.27**	.03

Note. TRQ = twin relationship quality; M-C = mother-child; EE = expressed emotion. * $p < .05$; ** $p < .01$; *** $p < .001$. We used unstandardised residuals of twin relationship quality positivity and twin relationship quality negativity here, in order to account for the age and sex of twins.

Regression Analyses

In order to assess whether the maternal expressed emotion measures predicted twin relationship quality over and above the mother-child questionnaire scores, we carried out hierarchical multiple regressions for twin relationship quality positivity and twin relationship quality negatively separately. These are shown in Table 3.3 and Table 3.4. The family-wide mother-child relationship measures (family-wide mother-child positivity, and family-wide mother-child negativity) from the questionnaire at phase one were entered in step 1; family-wide maternal expressed emotion was entered in step 2; the differential mother-child relationship measures (differential mother-child positivity, and differential mother-child

negativity) from the questionnaire were entered in step 3; and differential maternal expressed emotion was entered in step 4. By entering the variables in this order, we were able to test whether maternal expressed emotion could predict twin relationship quality, while controlling for the mother-child relationship.

Twin Relationship Quality Positivity. Table 3.3 shows the regression analysis for twin relationship quality positivity. Family-wide mother-child positivity were a significant predictor of twin relationship quality positivity in all 4 steps. More family-wide mother-child positivity, from the questionnaire reports, was predictive of more twin sibling positivity. In step 2 and step 3, and in line with our expectations, family-wide maternal expressed emotion also significantly predicted twin relationship quality positivity, over and above the questionnaire measure of the mother-child relationship. The more positivity (versus negativity) in mothers' expressed emotion, the more positivity reported in the twin sibling relationship. Finally, and unexpectedly (though reflective of the correlations), step 4 showed that more differential maternal expressed emotion also predicted (at trend level) positivity between the twin siblings.

Table 3.3. The Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992) and the Preschool Five Minute Speech Sample (Daley et al., 2003) Measures, Regressed onto Twin Relationship Quality Positivity

	b	*SE b*	*β*
Step 1			
Constant	-1.46	0.47	
Family-wide M-C positivity	0.45	0.14	0.30**
Family-wide M-C negativity	-0.02	0.09	-0.02
Step 2			
Constant	-1.62	0.46	
Family-wide M-C positivity	0.44	0.13	0.30**
Family-wide M-C negativity	-0.03	0.09	-0.04
Family-wide maternal EE	0.05	0.02	0.22**
Step 3			
Constant	-1.47	0.50	
Family-wide M-C positivity	0.40	0.15	0.27***
Family-wide M-C negativity	-0.03	0.09	-0.03
Family-wide maternal EE	0.05	0.02	0.22**
Differential M-C positivity	-0.23	0.31	-0.08
Differential M-C negativity	0.00	0.19	0.00
Step 4			
Constant	-1.31	0.51	
Family-wide M-C positivity	0.37	0.15	0.24**
Family-wide M-C negativity	-0.03	0.09	-0.03
Family-wide maternal EE	0.01	0.04	0.04
Differential M-C positivity	-0.31	0.31	-0.10
Differential M-C negativity	-0.02	0.18	-0.01
Differential maternal EE	0.04	0.03	0.23^{+}

Note. M-C = mother-child; EE = expressed emotion. We used unstandardised residuals of twin relationship quality positivity here, in order to account for the age and sex of twins. R^2 = .09 for step 1; ΔR^2 = .05 for step 2 (p = .01); ΔR^2 = .01 for step 3 (p = .75); ΔR^2 = .02 for step 4 (p = .13). + p < .10 (trend level); ** p < .01; *** p < .001.

Twin Relationship Quality Negativity. Table 3.4 shows the regression analysis for mother reports of twin relationship quality negativity. Family-wide mother-child positivity,

from the questionnaire reports, was a (trend level) predictor of twin relationship quality negativity in step 1 and step 2. More family-wide mother-child positivity was predictive of less twin sibling negativity. In step 3 and step 4, however, when all other variables were taken into account, questionnaire reports of family-wide mother-child negativity became positively predictive (at trend level) of negativity between twin siblings, and family-wide mother-child positivity was no longer significant.

Table 3.4. The Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992) and the Preschool Five Minute Speech Sample (Daley et al., 2003) Measures, Regressed onto Twin Relationship Quality Negativity

	b	*SE b*	*β*
Step 1			
Constant	-1.38	0.88	
Family-wide M-C positivity	0.36	0.26	0.13^{+}
Family-wide M-C negativity	0.21	0.17	0.12
Step 2			
Constant	-1.37	0.89	
Family-wide M-C positivity	0.36	0.26	0.13^{+}
Family-wide M-C negativity	0.21	0.17	0.12
Family-wide maternal EE	-0.00	0.04	-0.01
Step 3			
Constant	-0.89	0.97	
Family-wide M-C positivity	0.22	0.28	0.08
Family-wide M-C negativity	0.25	0.17	0.14^{+}
Family-wide maternal EE	-0.01	0.04	-0.01
Differential M-C positivity	-0.69	0.60	-0.12
Differential M-C negativity	-0.13	0.36	-0.04
Step 4			
Constant	-0.77	0.99	
Family-wide M-C positivity	0.20	0.29	0.07
Family-wide M-C negativity	0.25	0.17	0.14^{+}
Family-wide maternal EE	-0.04	0.07	-0.08
Differential M-C positivity	-0.75	0.61	-0.13
Differential M-C negativity	-0.15	0.36	-0.04
Differential maternal EE	0.03	0.05	0.09

Note. M-C = mother-child; EE = expressed emotion. We used unstandardised residuals of twin relationship quality positivity here, in order to account for the age and sex of twins. R^2 = .03 for step 1; ΔR^2 = .00 for step 2 (p = .94); ΔR^2 = .21 for step 3 (p = .41); ΔR^2 = .00 for step 4 (p = .56). + p < .10 (trend level).

Discussion

The link between parenting and the sibling bond has long been established (Brody, 1998; Dunn & Munn, 1985). However, for the first time, we investigated the spill over between maternal expressed emotion and twin relationship quality, while accounting for a questionnaire measure of the mother-child relationship. This study was novel in that a specific, and under-researched, aspect of mothering was assessed, using the innovative Preschool Five Minute Speech Sample (Daley et al., 2003). Furthermore, we explored our aims within a community sample of mothers and their two young twin children, in order to see whether the speech-based interview measure could help us better understand dynamics within families with twins. By creating both average and differential scores of mothers' expressed emotion, we were also able to examine whether mothering was stable across children, and whether it was the child-specific or family-wide aspects of parenting that were most salient for twin relationship quality.

In line with our first hypothesis (a), there was evidence that mothers within our sample showed different patterns of expressed emotion towards each of their twins. One sample *t*-tests revealed that they displayed significant levels of differential expressed emotion when talking about their children, and also when reporting on their relationship with their children via questionnaire. Our second hypothesis (b), that family-wide maternal expressed emotion would predict twin relationship quality, over and above questionnaire reports of the mother-child relationship, was partially confirmed. Making proportionately more positive than critical expressed emotion comments when describing their children predicted mothers' reports of twin relationship quality positivity, but not negativity, after the mother-child relationship was controlled for. Unexpectedly, results concerning our third and final hypothesis (c), that differential maternal expressed emotion would predict twin relationship quality, over and above questionnaire reports of the mother-child relationship, were in the

unexpected direction. Making proportionately more positive than critical expressed emotion comments about one twin compared to the other predicted twin relationship quality positivity, but not negativity.

Differential Expressed Emotion

Supporting both our first hypothesis (a), and the relevant previous research (Brody et al., 1998; Shanahan et al., 2008), this study revealed some clear differences in the way mothers' described each of their twins during the Preschool Five Minute Speech Sample (Daley et al., 2003). Indeed, this disparity in mothers' expression of feelings and behaviour towards their twin siblings was frequent, and thus seems to be a relatively typical occurrence within everyday family life.

In general, parents tend not to differentiate between their children, and particularly their monozygotic twins, when using traditional self-report measures, and therefore score siblings within a family very similarly to one another (Caspi et al., 2004; Pike, Reiss, Hetherington, & Plomin, 1996). Consequently, the evidence of differential expressed emotion in this twin sample is a promising indication of the potential utility of the speech-based measure employed. We suggest that the way mothers freely describe their children may capture variance in parenting that is not revealed by typically employed questionnaire assessments, and, in this way, the Preschool Five Minute Speech Sample (Daley et al., 2003) is a valuable tool for gaining a more complete picture of twin family life.

Family-Wide Mothering to Twin Relationship Quality

Engfer's (1988) well-established spill-over proposal, that emotion or behaviour can be transferred from one familial bond to another within the home environment, was reinforced by the current study, as was our second hypothesis (b). Specifically, we found evidence of

strong positive spill over between the mother-child and the twin sibling subsystems. As expected, the utterance of more family-wide positive than critical comments by mothers about both of their children predicted positivity within the twin relationship, and these findings held after controlling for mothers' questionnaire reports (although, notably, not after differential maternal expressed emotion had been taken into account). Correspondingly, we also found that the questionnaire reports of family-wide mother-child positivity (across both siblings) predicted a closer bond between twins. Weak prediction also emerged for twin relationship quality negativity, from the questionnaire reports of both family-wide mother-child positivity and family-wide mother-child negativity. These results replicate Brody and colleagues' (1994b; 1998) work, linking closer mother-child relations with more affectionate sibling interactions, and more negative mother-child relations with more conflictual sibling interactions, and highlight the importance of the general emotional atmosphere within the home environment.

Although we did not explore the processes through which such transference may occur, it seems likely that social learning theory (Bandura, 1977), whereby individuals can learn new patterns of behaviour through reinforcement and observation of others, is at play here. Indeed, authors suggest that children can copy helpful and loving maternal behaviours and emotions (Whiteman, McHale, & Soli, 2011), as well as negative family dynamics (Straus, Gelles, & Steinmetz, 1980), and then apply this modelling to subsequent sibling interactions. In the context of this research, mothers' use of positive language predicted the nature of the twin sibling relationship. Perhaps being exposed to this within the family environment means that children replicate such communications when engaging with their co-twin. Furthermore, children belonging to a positive family climate, within which they are likely to experience more positive comments and behaviour from their mother, may feel more

secure and settled in the home, and such internal feelings may, in turn, be more conducive to a child playing nicely with their sibling(s) (Teti & Ablard, 1989).

Differential Mothering to Twin Relationship Quality

Contrary to our hypothesis (c), and opposing McHale and colleagues' (1995) view that the sibling relationship tends to be negatively affected by unequal parental treatment, differential expressed emotion from mothers towards their children weakly predicted twin relationship quality *positivity*, over and above a questionnaire measure of the mother-child relationship. In other words, mothers who made proportionately more positive than critical comments about one twin in comparison to the other, also reported more affection between their two twin children; whereas equal expressed emotion by mothers was linked to *less* twin sibling positivity.

While emphasising child-specific mothering, these findings directly oppose the previous literature, showing that discrepancies in parenting are negatively associated with brotherly and sisterly interactions (Dunn & Munn, 1985). The lack of results for negative twin relationship quality is somewhat surprising, considering the belief that feelings of anger and rivalry tend to be induced in the less favoured sibling in the face of parental differential treatment (Brody, Stoneman, McCoy, & Forehand, 1992; Richmond, Stocker, & Rienks, 2005). However, this does tie in with the compensatory hypothesis put forward by Hay, Vespo and Zahn-Waxler (1998). These authors found that the more hostile a mother's behaviour towards one of her children, compared to the other, the less the favoured child objected to their brother or sister. Perhaps dealing with the demands of parental differential treatment leads siblings to rely on, or care for, each other, and thus increases affection between them. It is also worth noting here, that while our measure of expressed emotion was

very informative, the presence of mothers' differential *feelings* towards their twins is not necessarily an indicator of actual differential *behaviour*.

Generalisability

This research employed families with young twin children, in a bid to understand the link between mothering, and particularly maternal expressed emotion, and sibling relationship quality in these unusual fraternal dyads. By recruiting twin siblings, age and age gap variances are automatically controlled for, meaning a large determining factor of parenting is removed (O'Connor & Croft, 2001). Eliminating these central confounding factors within the sibling dyads meant that we were able to capture a more nuanced outlook into family life. Ultimately, twins are a sharp scalpel for eradicating demographic inequalities from brother and sister pairs (Fraley & Tancredy, 2012), allowing us to put aspects of parenting - family-wide and child-specific mothering here - under the microscope.

Twin relationships themselves have repeatedly been portrayed as exceptionally special and intimate (Burlington, 1945; Fraley & Tancredy, 2012; Playfair, 2002; Segal, 1999). Moreover, parents are thought to encounter unique childrearing experiences when raising twins. For example, it is known that mothers tend to be less responsive to, to have less physical contact with, and to talk less to twins in comparison to non-twins (Leonard & Denton, 2006). Indeed, Beck (2002) claims that parents' unique involvement in childrearing within this context often results in feelings of guilt and inadequacy. Interestingly however, our pattern of results runs contrary to previous research emphasising the individuality of the twin bond, and instead bolsters our earlier work justifying the generalisation of non-twin outcomes to samples of twins (see Chapter 2). In the current study, we found that maternal expressed emotion predicted the bond between twins, just as it predicts the bond between non-twin brothers and sisters (Petalas et al., 2012). Thus, this chapter also demonstrates

generalisability across twin and non-twin siblings. Saying this, such results are novel, and do require replication.

Limitations and Future Directions

An important limitation within our research comes from the fact that the quality of both the mother-child and the twin sibling bond was reported on by mothers, meaning that these constructs could have shared variance. This may have inflated the significance of the results found here. A future study would benefit from assessing the link between maternal expressed emotion and twin relationship quality using children's perspectives, alongside parental views. We know that parents tend to overestimate the consistency of their behaviour towards their offspring, and of their children's behaviour towards them and other family members (Pike et al., 1996). Additionally, children's observations about the fairness of equal, or unequal, parental treatment towards siblings may be the most salient factor when assessing sibling relationship quality (Kowal & Kramer, 1997).

It is also important to acknowledge that families in this study were not fully representative of the UK's population. Firstly, we only focused on mothers within our sample, despite the fact that the majority of participating twin children belonged to a two-parent household. Brody and colleagues (1994b) have shown the particular importance of fathers when considering sibling relationship quality, perhaps because their unavailability bestows a certain psychological salience on their relationships with their children, making dyadic characteristics more likely to spill over. Secondly, these mothers were well educated, and, as such, our sample was skewed towards the higher end of the socioeconomic spectrum. Numerous studies have found that demographics such as social class and race can affect family dynamics (Bronfenbrenner, 1992), so this must be borne in mind. Finally, we focused on children within a very specific age range in this sample, and we acknowledge that sibling

relationships can vary in their nature over time. It may be that twins become more alike, and therefore closer, as they grow older, because they live apart and no longer have the need to establish distinct identities within the family home (Neyer, 2002). In order to extend the application of our findings then, future research exploring the links between expressed emotion and twin relationship quality should gain information from mothers and fathers of older twins, from more diverse socioeconomic and ethnic backgrounds.

Conclusions

As expected from family systems theory (Bowen, 1978) and the spill-over hypothesis (Engfer, 1988), this research demonstrates that individual relationships within the family influence each other. It was found that mothers' family-wide expressed emotion towards their twin children predicted positive twin relationship quality, more strongly than did differential expressed emotion. Therefore, the overall family climate, rather than child-specific experiences within the home, was most salient for predicting positivity within the twin sibling dyad. Crucially, evidence for the usefulness of the Preschool Five Minute Speech Sample (Daley et al., 2003) is provided here. The prediction of twin relationship quality positivity from expressed emotion held after mothers' questionnaire reports of their relationship with their children had been taken into account, indicating that speech samples add a unique perspective. Consequently, assessing expressed emotion within the home environment is important for gaining a complete picture of twin family life.

Chapter 4: Longitudinal Associations Between Sibling Relationship Quality, Marital Quality and the Parent-Child Relationship: A Cross-Lagged Analysis

(Paper 3)

Abstract

Using a longitudinal, cross-lagged design, we investigated associations between positive aspects of the sibling relationship, the parent-child relationship, and the marital relationship over time. These were explored within a community sample of 229 mothers and 122 fathers of twin children ($M_{\text{child age}}$ = 3.69 years, $SD_{\text{child age}}$ = 0.37), over a two-year time period. Study data were collected in four phases; we included information from phases one and two (labelled as Time 1) and phase four (labelled as Time 2) in the current study. Parents reported on positivity within the mother-child and the father-child relationship via questionnaire at phases one and four. They also reported on positivity within the sibling relationship, and the quality of their marriage, via telephone interview and questionnaire at phases two and four, respectively. Bidirectional associations were evident between the mother-child and the sibling relationship. Strikingly, sibling relationship quality at Time 1 was associated with positivity within all three of the other family dyads at Time 2: marital satisfaction, and mother-child and father-child positivity. Our findings corroborate the well-established spill-over effect of multiple relations within the family. Most importantly, we show that affectionate sibling interactions can have an influence on the wider family system, and may, consequently, improve the general atmosphere within the home.

Mark, K.M., Pike, A., Latham, R.M., & Oliver. B.R. (2016). *Longitudinal associations between mother-child and sibling relationships: A cross-lagged analysis.*Manuscript submitted for publication.

I contributed to 50% of the data collection, and carried out all of the analyses and write-up, under supervision, for this paper. I am, therefore, listed as first author.

Introduction

The current research is situated within a family systems approach, whereby families are viewed as emotional units of interdependent individuals, none of whom can be understood in isolation from the others (Bowen, 1978). It is well documented that 'spill over' can occur between familial relationships, namely between the marital relationship, the parent-child relationship, and the sibling bond (Parke et al., 2001). Whilst previous studies have been informative, most have relied on cross-sectional data. Furthermore, the majority of evidence has focused on the impact of conflicted and hostile interactions between family members; more positive aspects have been relatively neglected. For the first time, we investigated associations between positive marital quality, positivity within the parent-child relationship, and positive sibling relationship quality, using a longitudinal, cross-lagged design, intended to clarify reciprocal links between these familial relationships. This aim was carried out with twin pairs during early to middle childhood, using parental reports over a two-year time period.

Theoretical Perspective

Consideration of multiple relationships within the family, and recognising that dyadic subsystems of relationships influence one another, is at the heart of the family systems approach (Bowen, 1978). Specifically, the current study is informed by the well-established spill-over hypothesis (Engfer, 1988), which argues for the transfer of emotion from one familial bond to another. This transmission has been displayed across different relationships within a family unit, including between the marital relationship (Erel & Burman, 1995), the parent-child relationship (Brody, Stoneman, & McCoy, 1994a), and the sibling relationship (Brody, Stoneman, McCoy, & Forehand, 1992). The quality of these three core dyadic bonds is central to the general atmosphere within the home environment, which, in turn, can

influence children's emotional and physical well-being across the lifespan (Fingerman & Bermann, 2000). The potential long-lasting impact of the family milieu means it is vital for both researchers and practitioners to directly address its impacts, particularly in the early years, when children spend much of their time with immediate relatives (Christian, 2006).

Marital Quality and the Parent-Child Relationship

When exploring spill over between family members, Erel and Burman (1995) carried out the first thorough meta-analysis documenting the transmission of emotion from the marital relationship to the bond between parents and children. Although such transference can be depicted from slightly different angles, it is generally assumed that marital conflict primes subsequent parent-child interactions, through the shift of tension from one dyad to the other (Gerard, Krishnakumar, & Buehler, 2006). Previous longitudinal studies have linked earlier marital dissatisfaction with later parental hostility (Harold & Conger, 1997), as well as with conflict within the parent-child relationship (Acock & Demo, 1999). In the former paper, spousal negativity, assessed via both parental reports and observer ratings following an interaction task, was highly positively correlated with mothers' and fathers' displays of anger, coercion and resentment towards their children a year later. As well as signifying negative spill over between these family pairings, these results also indicate that marital conflict places psychological demands on parents. Perhaps such preoccupation forces them to retreat emotionally, which, in turn, compromises their ability to foster closeness and affection with their offspring (Stocker & Youngblade, 1999).

In a comprehensive systemic review of gender differences and spill over, incorporating 39 studies, Krishnakumar and Buehler (2000) found evidence that fathering is more sensitive to the effects of the marital relationship than is mothering. It is thought that men typically respond to spousal conflict by withdrawing from both their wives (Christensen

& Heavey, 1990) and their children (Grych & Fincham, 1990). To clarify such a hypothesis, Kerig, Cowan and Cowan (1993) carried out a longitudinal study of family interactions to explore the impact of the marriage on the parent-child bond, using observational methods. In line with previous studies, they discovered that parental negativity, at a later time point, was highest in less maritally satisfied fathers. It seems, therefore, that fathers are more likely to transfer disappointment in a marriage onto a child, because of their greater tendency to be influenced in their role as a father by their role as a husband (Lamb & Elster, 1985).

Marital Quality and Sibling Relationship Quality

In a similar vein, several investigators have demonstrated that marital quality plays a critical role in predicting sibling relationship quality. Whether assessed by parents' diaries of children's reactions to spousal conflict, or laboratory observations involving simulated fights, infants as young as 12-months-old have been found to respond to episodes of anger between their mother and father with signs of distress, ranging from crying to an increase in aggression (Cummings, 1987). Numerous field studies have suggested that such hostility directly causes negative emotional responses in children of all ages, who often direct these reactions towards their siblings (Yu & Gamble, 2008). Indeed, Brody, Stoneman and McCoy's (1994b) longitudinal work revealed that parental reports of marital satisfaction determined both positivity and negativity within the sibling relationship one year later. However, interestingly, this prediction did not hold when sibling relationship quality was tested again four years after the initial follow-up.

Authors interpret the direct pathway between marital quality and sibling relationship quality as being indicative of the spill-over effect (Engfer, 1988), with positive and negative qualities of the marriage mirrored between siblings, via a transfer of emotion between these dyads. However, alternative explanations should also be considered. For example, the

connection between marital quality and sibling relationship quality may also be illuminated by social learning theory (Bandura, 1977), whereby children imitate the behaviour they witness in the home context. Conger, Stocker and McGuire (2009) support the notion that children can copy helpful and loving, as well as negative and critical, spousal displays, and then apply this modelling to subsequent sibling interactions.

The Parent-Child Relationship and Sibling Relationship Quality

As well as being affected by marital quality, sibling exchanges are partly dependent on the relationship between parents and children within the family. Spill over has been well documented between parent-child and sibling pairings, with predictive pathways tending to flow from parents to their children (Volling & Belsky, 1992). For example, longitudinal research has found that problematic parent-child relationships predict more hostile sibling relations (Brody et al., 1994a), and that positive parent-child relationships predict more intimate sibling relations (Dunn & Kendrick, 1982b). Indeed, Pike, Coldwell and Dunn (2005) suggest that parental feelings and behaviours may be directly modelled by children in their interactions with their brothers and sisters.

When exploring potential theories behind the relatedness of mother-child relationships, father-child relationships and sibling relationships, attachment perspectives (Bowlby, 1958) are highly relevant. These propose that children develop internal representations of relationships from exchanges with their primary caregivers, which they subsequently use to maintain connections with others (Sroufe & Fleeson, 1986). In the case of siblings, Teti and Ablard (1989) have shown that early attachment can account for ensuing individual differences in positive affect and caregiving within these dyadic bonds. Further emphasising the salience of such processes for sibling pairs, the authors also found that children reacted less negatively and felt less threatened when parental attention turned to a

brother or sister, if they were securely attached to their mother. Correspondingly, positive attachment bonds between the mother and their first-born are predictive of that child's adjustment, which, in turn, impacts upon sibling relationship quality (Dunn, 2000).

Positive Aspects of Family Relationships

In our discussion of the previous literature, we have mainly documented findings linking problematic marital, parent-child and sibling bonds, since the literature is dominated by negative aspects of these relationships. It is worth noting, however, that potential spill-over effects between more positive interactions within the family are also important to consider. In terms of the association between parenting and marital quality, Cowan and Cowan (2000) and Grych's (2002) longitudinal work has indicated that positive mood and affect, generated by a healthy marriage, allows parents to engage in optimal mothering or fathering, characterised by responsiveness, warmth and acceptance. Correspondingly, both marital satisfaction (Volling & Belsky, 1992) and the parent-child relationship (Volling, 2003) can predict warmth between siblings at a later time point. Despite such findings, ongoing studies highlighting these more positive pathways, which are independent from more negative familial elements (Furman & McQuaid, 1992), have been minimal in comparison with those looking at conflicted exchanges. Detecting constructive and encouraging spill over, that may foster children's positive developmental adjustment, as well as protecting them from maladjustment, is essential for the creation of preventive clinical interventions (Nantel-Vivier, Pihl, Cote, & Tremblay, 2014).

The Current Study

For the first time, we used a cross-lagged design to clarify the longitudinal links between marital quality, the parent-child relationship, and sibling relationship quality. To address the relative lack of research on more genial aspects of these familial relationships, we

included measures of marital satisfaction, positivity within the parent-child relationship, and positivity within the sibling relationship, as opposed to more typical measures of negativity (e.g., Brody et al., 1992). We gathered mother and father reports of their young children over a two-year period, in a bid to overcome the limitations of cross-sectional studies. By carrying out a cross-lagged model, we were able to test for associations between subsequent marital quality, mother-child relationships, father-child relationships, and sibling relationship quality, from these same measures at an earlier time point. Most importantly, these models provide a conservative estimate of longitudinal associations (Kenny, 2014), since they account for stability in the dyadic characteristics over time, and within-time cross-sectional correlations between relationship subsystems. For example, we were able to test whether marital quality at the earlier time point was longitudinally associated with the mother-child relationship at the later time point, while accounting for stability in marital quality and the mother-child relationship over time, and for cross-sectional correlations between marital quality and the mother-child relationship at both time points. Figure 4.1 shows the basic structure of the cross-lagged analysis for this paper.

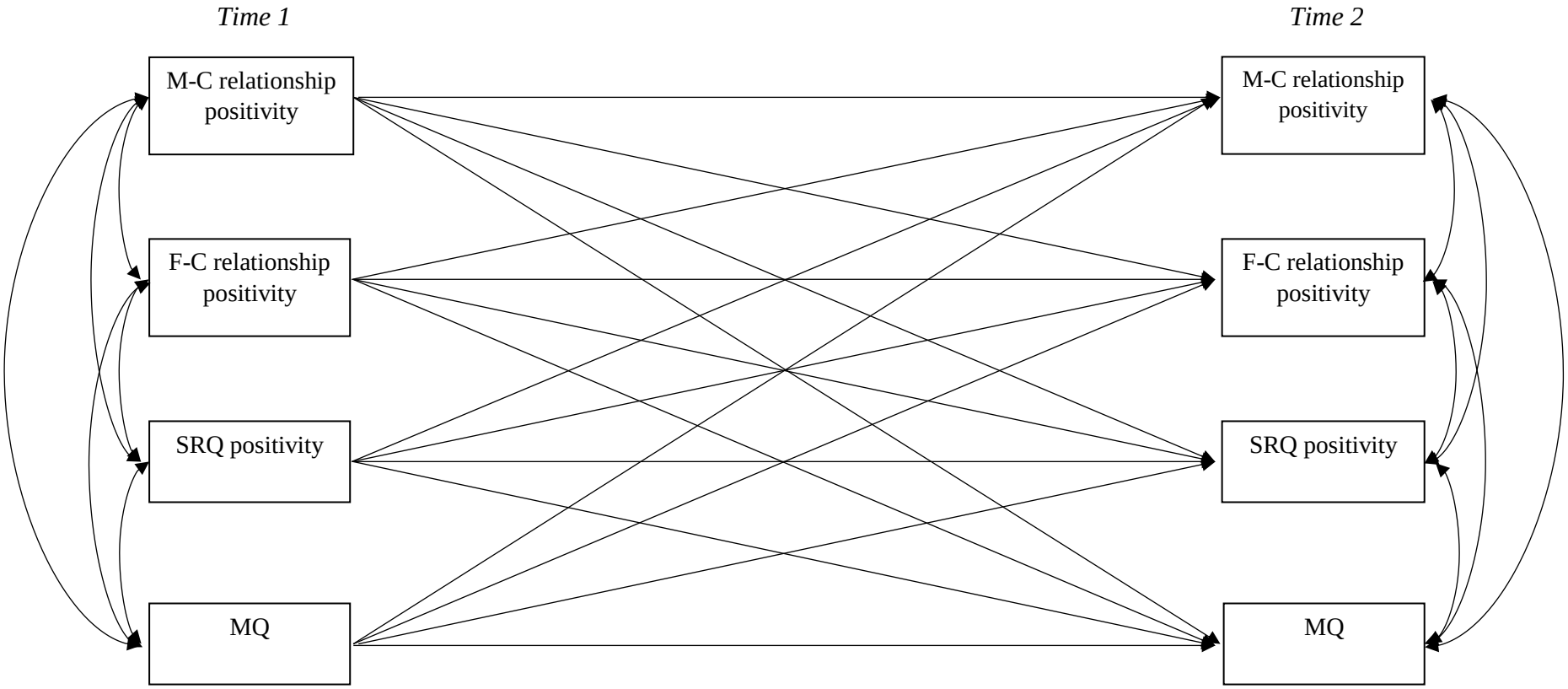

Figure 4.1. Diagram of Cross-Lagged Model

Note. M-C = mother-child; F-C = father-child; SRQ = sibling relationship quality; MQ = marital quality. Double-headed curved arrows represent within-time cross-sectional correlations; single-headed horizontal arrows represent autoregressive paths of stability from a variable at Time 1, to the same variable at Time 2; single-headed diagonal arrows represent cross-lagged paths from a variable at Time 1, to a different variable at Time 2.

The current study was based on a sample of twin children. The Office for National Statistics (2013) suggests that twin births are becoming increasingly common. Both classic literature and the modern media tend to portray the twinship bond as one that is exceptionally special and intimate (Playfair, 2002). However, we have previously found that this is not the case in young childhood (see Chapter 2) – our research shows that twin pairs and non-twin pairs display similar levels of sibling relationship quality to one other, justifying the generalisation of twin findings to samples of non-twin brothers and sisters. Furthermore, the lack of birth order effects (Fraley & Tancredy, 2012) between twin children serves to remove possible confounding factors that are not the focus of our research.

The aim of this study was to carry out a longitudinal, cross-lagged analysis into relations among family relationships, focusing specifically on marital quality, the mother-child bond, the father-child bond, and sibling relationship quality at two time points. We expected to find positive spill over between these four, core family dyads. We also anticipated that the temporal direction of association over time would flow from the parents to the offspring, as previous research (cited above) suggests that adults in families are more influential than children.

Method

Participants and Recruitment

We recruited mothers and fathers, along with their twin children, as part of the Twins, Family and Behaviour longitudinal study (see Chapter 1 for details of the full recruitment procedure). Study data were collected in four phases, over a two- to three-year period. We include information from phases one and two (subsequently labelled Time 1), and phase four (subsequently labelled Time 2) here. During phase one, 229 mothers and 122 fathers completed an initial postal questionnaire. During phase two (M = 0.98 years, SD = 0.37 years, after phase one), 230 mothers and 107 fathers took part in a researcher-led telephone

interview. Finally, during phase four (*M* = 1.31 years, *SD* = 0.45 years, after phase two), 143 mothers and 104 fathers completed a further postal questionnaire. In order to maximise the number of cases put forward for analyses, pairwise deletion was used.

At phase one, 89.0% of the participating families were intact two-parent households where the biological mother and father were either married or cohabiting, whilst 9.7% of mothers reported being single (unmarried, separated, divorced or widowed), and 1.3% stated they were either married or cohabiting with someone other than the twins' biological father. Mothers and fathers had an average age of 37.99 years (*SD* = 4.26) and 39.76 years (*SD* = 6.64) respectively. The children had an average age of 3.69 years (*SD* = 0.37) at phase one, 4.67 years (*SD* = 0.39) at phase two, and 5.98 years (*SD* = 0.49) at phase four.

Twin zygosity was determined using a parent questionnaire, shown to be more than 95% accurate when compared to blood (Plomin, Rende, & Rutter, 1991) and DNA (Price et al., 2000) testing procedures. Of the 234 twin pairs included in analyses, four pairs could not be classified in terms of their zygosity. Of the remaining 230 pairs, 84 (36.5%) were monozygotic (or identical), 76 (33.0%) were dizygotic (or fraternal) same-sex, and 70 (30.4%) were dizygotic opposite-sex.

In comparison with the national average for England and Wales (Office for National Statistics, 2014), the sample was skewed towards those of higher socioeconomic status. The parents included were substantially more qualified – 63.5% of mothers and 58.4% of fathers reported having an undergraduate degree or above as their highest educational attainment, compared with 27.2% of the general population. Correspondingly, only 0.9% of mothers and no fathers reported having no educational qualifications, compared with 22.7% of the general population.

Measures

The Parent-Child Relationship. For the Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992), mothers and fathers were asked to rate 15 items about aspects of their relationship with each of their twins, via a postal questionnaire at both Time 1 and Time 2 of the Twins, Family and Behaviour study. Items were scored on a 5-point scale, ranging from 1 = not at all to 5 = extremely. Two subscales per parent were derived from this measure – parent-child relationship positivity (10 items; for example, 'How affectionate is your child towards you?') and parent-child relationship negativity (5 items; for example, 'How much do you nag your child about what he/she is doing wrong?'). We used parent-child relationship positivity for each parent, reflecting mother-child relationship positivity, and father-child relationship positivity. Items were averaged to create a score between 1 and 5 for these subscales, with a higher score indicating more positivity within the relationship. Cronbach's alphas were .80 for maternal reports, and .79 for paternal reports. For the current study, we were interested in overall mother-child and father-child relationship quality within families, such that we averaged scores across twins. Further justification for taking the mean value across siblings came from the Cronbach's alphas that emerged here – .55 for the father-child relationship across both twins, and .89 for the mother-child relationship across both twins.

Sibling Relationship Quality. Sibling relationship quality was measured using an adapted version of the Maternal Interview of Sibling Relationships (Stocker, Dunn, & Plomin, 1989). Parents were asked to rate how often their children displayed 13 behaviours relating to different aspects of the sibling relationship. Items were read aloud to mothers and fathers during the telephone interview at Time 1 of the study, and the same questions were answered via postal questionnaire at Time 2. Four of the items were scored for the sibling relationship overall (for example, 'Of the time the siblings spend together, how often do they

play together?'), and nine required ratings for twin 1 and twin 2 individually (for example, 'On a day-to-day basis, how often does (twin 1) show affection towards (twin 2)?; and how often does (twin 2) show affection towards (twin 1)?'). Varying response scales were used throughout; the most common were a percentage-based scale, where 1 = less than 5% of their time together and 6 = almost all of their time together, and a frequency-based scale, where 1 = once a month or less and 6 = just about every day. The measure consists of two subscales – sibling relationship quality positivity (11 items) and sibling relationship quality negativity (3 items), with the former being used here. Items were averaged to create an overall sibling relationship quality positivity score between 1 and 6, with a higher score indicating more positivity within the relationship. Associated Cronbach's alphas were .85 and .77 for mothers' and fathers' reports respectively. We wanted a family-wide sibling relationship quality measure that accounted for both parents' perceptions, thus we combined mother and father reports of sibling relationship quality positivity at Time 1 and Time 2 of the study (*r*s = .25 - .51).

Marital Quality. Mothers and fathers reported on the quality of their marriage/relationship using the 6-item Quality Marriage Index (Norton, 1983). Items from this scale include, 'My marriage/relationship with my partner makes me happy', and 'My marriage/relationship with my partner/husband/wife is very stable'. Items were read aloud to parents during the telephone interview at Time 1 of the study, and the same questions were answered via postal questionnaire at Time 2. Responses to five out of the six items were given on a 7-point scale, where 1 = disagree strongly and 7 = agree strongly. For the final item ('Please rate the degree of happiness, everything considered, in your marriage/relationship'), a 10-point rating scale was used, where 1 = low and 10 = high. Items were averaged to create an overall Quality Marriage Index score between 1 and 7.5, with a higher score indicating higher marital quality. Cronbach's alphas for these scales were .92 for

mother reports, and .90 for father reports. Again, we required a marital quality measure that accounted for both parents' perceptions, and thus we combined mother and father reports of marital quality at Time 1 (r = .53) and Time 2 of the study (rs = .54).

Results

Preliminary Analyses

Descriptive statistics for all study variables are shown in Table 4.1.

Table 4.1. Descriptive Statistics for All Study Variables

	M	*SD*	Range
Time 1			
M-C relationship positivity	3.27	0.36	2.25 – 4.00
F-C relationship positivity	3.19	0.43	2.10 – 4.70
SRQ positivity	4.36	0.44	3.06 – 5.11
MQ	6.88	0.65	4.42 – 7.50
Time 2			
M-C relationship positivity	4.22	0.32	3.35 – 5.00
F-C relationship positivity	4.13	0.36	3.25 – 4.80
SRQ positivity	3.78	0.61	1.30 – 4.89
MQ	6.82	0.77	4.00 – 7.50

Note. M-C = mother-child; F-C = father-child; SRQ = sibling relationship quality; MQ = marital quality.

Unstandardised residual variables were created for all measures, to allow us to control for both the age of twin pairs, and the number of boys within each dyad. The latter was included because male children are known to exhibit less positivity within their sibling relationship than are female children (Buist, Dekovic, Meeus, & Van Aken, 2002). These residual scores were used for all further analyses.

Correlations

Table 4.2 shows correlations among the residualised study variables, all of which were in the expected direction. The positive Parent-Child Relationship Scale (Hetherington & Clingempeel, 1992), the Maternal Interview of Sibling Relationships scale (Stocker et al., 1989) and the Quality Marriage Index (Norton, 1983) scale all showed stability across time, as indicated by the highly significant positive correlations between reports at Time 1 of the study and reports at Time 2. For the mother-child and father-child relationship at both Time 1 and Time 2, parents who reported a more positive relationship with their twins also reported more positivity within the sibling relationship, and a higher quality marriage. In terms of sibling relationship quality at both Time 1 and Time 2, parents who reported more positive sibling interactions also reported a more positive marriage.

Table 4.2. Correlations Among All Study Variables

	1.	2.	3.	4.	5.	6.	7.	8.
Time 1								
1. M-C relationship positivity	-							
2. F-C relationship positivity	.30***	-						
3. SRQ positivity	.27**	.31**	-					
4. MQ	.25**	.19*	.19*	-				
Time 2								
5. M-C relationship positivity	.61***	.28**	.32**	.27**	-			
6. F-C relationship positivity	.22*	.71***	.42***	.25**	.34***	-		
7. SRQ positivity	.40***	.36***	.68***	.29**	.36***	.29**	-	
8. MQ	.21*	.36***	.44***	.74***	.28**	.26**	.30**	-

Note. M-C = mother-child; F-C = father-child; SRQ = sibling relationship quality; MQ = marital quality. We used unstandardised residuals for all variables here, accounting for the age and sex of twins. * p <.05; ** p <.01; *** p < .001.

Cross-Lagged Model

In order to test for stability over time, cross-sectional within-time associations, and longitudinal associations between sibling relationship quality positivity, marital quality, and positivity within the mother-child and the father-child relationship simultaneously, these variables were modelled in a cross-lagged analysis. The model was found to fit the data satisfactorily, x^2 (22) = 252.98, p <.001; RMSEA = 0.00 (90% C.I. = 0.00 – 0.00); CFI = 1.00; TLI = 1.00. The results are shown in Figure 4.2; we present the standardised path coefficients, and 95% confidence intervals.

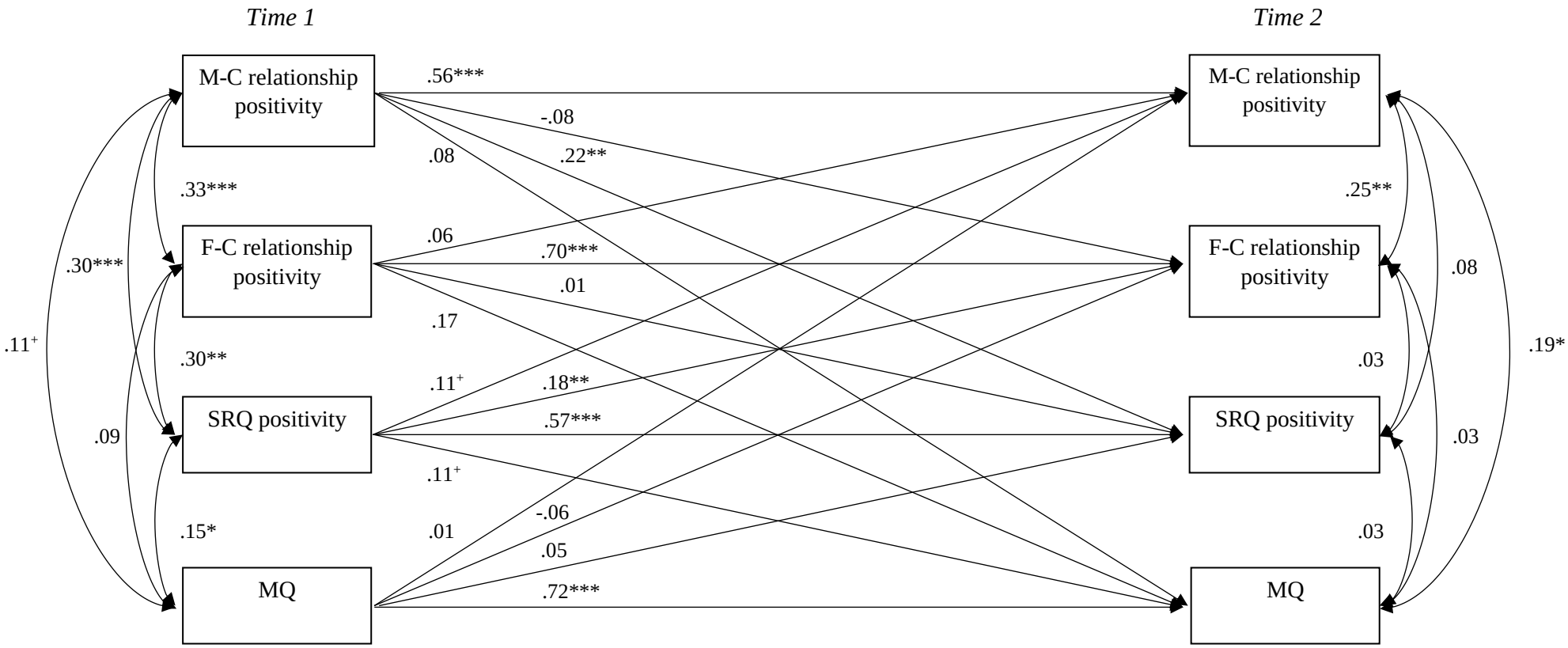

Figure 4.2. Cross-Lagged Model of All Study Variables

Note. M-C = mother-child; F-C = father-child; SRQ = sibling relationship quality; MQ = marital quality. We used unstandardised residuals for all variables here, accounting for the age and sex of twins. + p <.10 (trend level significance); * p <.05; ** p <.01; *** p <.001.

Moderate, and significant, positive cross-sectional associations were evident at Time 1, between mother-child relationship positivity and father-child relationship positivity, mother-child relationship positivity and sibling relationship quality positivity, and father-child relationship positivity and sibling relationship quality positivity. A more modest, yet still significant, positive association was found between sibling relationship quality positivity and marital quality. Corresponding cross-sectional associations at Time 2 revealed a moderate, significant, positive association between mother-child relationship positivity and father-child relationship positivity, and a modest, significant, positive association between mother-child relationship positivity and marital quality.

Autoregressive pathways in Figure 4.2 represent stability within each relationship subsystem, across Time 1 and Time 2. Coefficients suggested considerable stability in mother-child relationship positivity, father-child relationship positivity, sibling relationship quality positivity, and marital quality over time. All of these pathways were highly significant, with father-child relationship positivity and marital quality showing particularly high levels of consistency across the two time points.

Of primary focus here are the longitudinal cross-construct associations given by the cross-lagged paths, which indicate the extent to which mother-child relationship positivity, father-child relationship positivity, sibling relationship quality positivity, and marital quality are linked to one another over time, while accounting for within-construct stability over time, and cross-sectional within-time associations. We found that positivity within the mother-child relationship at Time 1 was significantly associated with sibling relationship quality positivity at Time 2. Notably, we found that sibling relationship quality positivity at Time 1 was significantly

associated with all other cross-construct variables at Time 2 – father-child relationship positivity, marital quality, and mother-child relationship positivity (although the latter at trend level).

Discussion

For the first time, the current paper used a longitudinal, cross-lagged design to explore associations between marital quality, positivity within the parent-child relationship, and positive sibling relationship quality, in early to middle childhood over a two-year time period. This methodology allowed us to address the limitations of cross-sectional studies, to improve our understanding of positive dynamics within the family. Using maternal and paternal reports of their young twin children, and as expected, there was evidence of positive spill over between these core family dyads. Specifically, cross-lagged paths revealed some bidirectionality between positivity within the mother-child relationship and positivity within the sibling relationship over time. Moreover, positivity within the sibling relationship at Time 1 of the study was associated with all other family relationships at Time 2. This suggests that longitudinal links may run *from* SRQ positivity *to* these other family relationships, rather than the other way around.

Prediction from the Parent-Child Relationship and Marital Quality

Engfer's (1988) well-established spill-over proposal, that emotion or behaviour can be transferred from one familial bond to another within the home environment, was reinforced by the current study. Specifically, we found evidence of strong positive spill over between the mother-child and the sibling subsystems. As expected, mothers' reports of a close, affectionate bond with their children was associated with later positivity between siblings. Such a result replicates Brody and colleagues' (1994a), Dunn and Kendrick's (1982b), and Volling and Belsky's (1992) longitudinal work, linking warmer mother-child relations with warmer sibling interactions, and negative mother-child relations with conflictual sibling interactions. The lack of

paternal findings is salient here – unlike for mothers, fathers' reports of their bond with their children at Time 1 was not associated with sibling relationship quality at Time 2. Youngblade, Park and Belsky (1993) have shown a similar lack of association from the father-child bond to offspring's subsequent behaviour. Perhaps the traditional tendency for fathers to spend less time with their children than mothers (Hewlett, 2000) means that they have less of an influence over the way their children interact within other relational contexts, including with their siblings.

Unexpectedly, there was no indication of positive spill over from marital satisfaction to subsequent positivity between siblings, as has been demonstrated previously. Our work therefore contradicts the longitudinal findings of Brody and colleagues (1994b), Cummings (1987), and Yu and Gamble (2008), which highlight the association between the nature of the spousal relationship, and subsequent behaviour displayed within sibling interactions. Note, however, that differences in the methodology used in the current study, compared to in previously cited work, may explain such discrepancies. We recruited Caucasian mothers and fathers of children aged three- to five-years-old, and employed parental questionnaires to measure positivity within the four family relationships of interest. Contrastingly, prior research has relied on mothers only (Cummings; Yu & Gamble), older-aged siblings (Brody et al.), observational assessments (Cummings; Brody et al.), and/or ethnic-minority participants (Yu & Gamble). Perhaps there was something about the specific characteristics of our sample, or of parents' perceptions of the larger family system, that prevented spill over from occurring between marital quality and sibling relationship quality.

Prediction from Sibling Relationship Quality

The most notable and surprising finding from our study was that positivity within the sibling relationship at Time 1 was longitudinally associated with all other family relationships at Time 2. A strong association was evident between sibling relationship quality and father reports of warmth within their relationship with their children, and a trend level association emerged when the mother-child relationship and marital quality were considered. The majority of past studies imply that causal pathways flow from parents to their children – in other words, from the parent-child relationship (Brody et al., 1994a), and the interparental bond (Brody et al., 1994b), to the sibling bond – and this seems reasonable given the longitudinal designs employed. The discovery that the behaviour of children within their sibling relationship was linked to the characteristics of these adult-based dyadic subsystems over a year later was therefore unanticipated.

Although we did not explore the processes through which such spill over from positivity within the sibling relationship occurred, it seems unlikely that social learning theory (Bandura, 1977) is responsible. Authors suggest that children imitate helpful and loving maternal behaviours (Whiteman, McHale, & Soli, 2011) and spousal displays (Conger et al., 2009), as well as negative family dynamics (Straus, Gelles, & Steinmetz, 1980), and then apply this modelling to subsequent sibling interfaces. This replication is particularly persistent within the family environment - children are thought to mirror parental models because they provide nurturance, are high in status and are similar to them (Perlman & Ross, 1997). However, this learning perspective does not support the replication of children's behaviour by adults within the family, because parents are assumed to be more influential than younger family members (Volling & Belsky, 1992).

Instead, it seems intuitive to think of our findings in the context of the spill-over effect (Engfer, 1988). Rather than verifying longitudinal work linking the parent-child relationship and marital quality to subsequent sibling relationship quality (Dunn & Kendrick, 1982b; Yu & Gamble, 2008), the current study found that positive feelings and behaviours were likely transferred *from* the sibling relationship *to* these two more adult-based dyads. In this way, we show that sibling interactions seem to have an influence on wider family structures. Family systems theory (Bowen, 1978) is certainly important here – it is clear that subsystems of relationships influence one another, and consequently impact upon the general atmosphere within the home. Yet, within our study, the emphasis is on the salience of what Bell (1968) termed 'child effects': the younger members of the family appear to be active partners, rather than passive recipients, in their family relationships (Prout, 2002). When thinking specifically about sibling relationship quality, previous research has shown that sibling conflict is a primary concern for parents (Smith & Ross, 2007). Following on from this, perhaps a more positive and uplifting mood is induced within the household when mothers and fathers see that siblings are getting on well with each other.

Although our results were unexpected, and oppose the majority of relevant studies, we posit that this is reflective of our focus on positive, rather than negative or conflictual, interactions within the family. That is, we solely considered intimacy and affection within the marital relationship, the parent-child relationship, and the sibling relationship. Such exchanges have been relatively neglected within the literature, such that including these more unusual positive measures may have contributed to the finding that sibling relationship quality was longitudinally associated with the mother- and father-child relationships, and marital quality. According to Furman and McQuaid (1992), both positive and negative family relationship

quality need to be given appropriate attention, because they represent two completely separate, and minimally correlated, dimensions. Moreover, Nantel-Vivier and colleagues (2014) point out that identifying constructive and encouraging spill over, that may foster children's positive developmental adjustment, as well as protecting them from maladjustment, is essential for the creation of preventive clinical interventions. Our focus on positive, as opposed to negative, relationships between family members, addressed these needs.

We must also take the conservative nature of the cross-lagged model employed into consideration (Kenny, 2014), because this was an important strength of the study. Such a methodology renders it likely that the longitudinal association between positivity within the sibling relationship and all other family relationships was a robust and valid finding, as it held after cross-sectional paths and stability paths were taken into account. Speaking tentatively, the lack of longitudinal association between both earlier marital quality and the father-child bond, and later warmth within the sibling relationship, may also be a true reflection of the link between these dyadic interactions in this sample. We can thus conclude that, out of the adult-centric family pairings incorporated here, the mother-child relationship seems primary for influencing closeness between brothers and sisters. More importantly, positivity within child-based sibling pairings may directly affect warmth and affection between mothers and fathers, and between parents and their children.

Limitations and Future Directions

An important limitation of the current research comes from the fact that the quality of the marital relationship, the parent-child relationship, and the sibling relationship were all reported on by parents. This means that these constructs have shared method variance, potentially

inflating the significance of the results found here. A future study would benefit from assessing the impact of sibling relationship quality on other familial dyads using children's perspectives alongside parental views. We know that children as young as four-years-old are able to provide consistent and meaningful accounts of their family relationships (Pike et al., 2005), and that their perceptions and interpretations of events within the home are key to understanding family life (Kowal & Kramer, 1997).

Moreover, low statistical power, resulting from the relatively small number of participants, was most likely an issue when considering the father-child relationship within our analysis. Substantially fewer fathers than mothers took part in the study, reducing the chance of detecting complex, though systematic, effects (Cohen, 2013). This lack of power was especially evident for the modest coefficient (β = .17) found in the cross-lagged model between father-child relationship positivity at Time 1 and marital quality at Time 2 (see Figure 4.2). This coefficient failed to reach significance, despite smaller effect sizes successfully doing so – for example, trend level significance appeared between sibling relationship quality positivity at Time 1 and both mother-child relationship positivity and marital quality at Time 2, despite the comparatively low value of .11. Further studies attempting to replicate our results should therefore ensure a more extensive sample, especially of fathers.

It is also important to acknowledge that families in the Twins, Family and Behaviour study were not fully representative of the UK population. Firstly, the parents were well educated, and, as such, our sample was skewed towards the higher end of the socioeconomic spectrum. Numerous studies have found that demographics such as social class or race can affect family dynamics (Bronfenbrenner, 1992), so this must be borne in mind. Secondly, we explored the twin bond in this paper. Although our earlier work (see Chapter 2) justifies the generalisation of

twin relationship quality findings to samples of non-twin brothers and sisters, such results are novel, and require replication. Finally, we have focused on children within a very specific age range in this sample, and we accept that family dynamics, and particularly sibling relationships, can vary in their nature over time (Neyer, 2002). In order to extend the application of our findings then, future research exploring longitudinal associations between marital quality, parent-child relationships and sibling relationship quality should gain information from mothers and fathers of both older and younger twins, and non-twin siblings, from more diverse socioeconomic (and ethnic) backgrounds, over a longer time period.

Conclusions

As expected from family systems theory (Bowen, 1978) and the spill-over hypothesis (Engfer, 1988), this research demonstrates that individual relationships within the family influence each other. Surprisingly, it was found that positivity within the sibling relationship, at an earlier time point, was longitudinally associated with the bond between mother and child, the bond between father and child, and marital quality, at a later time point. Therefore, sibling relationship quality seemed to have an important influence on the family as a whole. As a consequence, assessing longitudinal pathways that flow *from* children, and specifically from interactions between siblings, outwards *to* parents is salient for gaining a complete picture of family life. This is particularly relevant for potential interventions, considering the long-lasting impact of the family milieu on the emotional and physical well-being of individual family members (Christian, 2006; Fingerman & Bermann, 2000).

Chapter 5: General Discussion

This thesis has presented findings on sibling relationship quality in young twin children, as well as on the ways in which these dyadic bonds are associated with other familial relationships within the home environment. Firstly, Chapter 1 put forward a brief literature review of the relevant theories of sibling relationship quality, and it also described the overall sample and procedure used within the Twins, Family and Behaviour study. Secondly, Chapter 2 showed that, contrary to expectations, no mean level differences emerged when monozygotic twin pairs, dizygotic twin pairs, and non-twin pairs were compared on their sibling relationship quality. Behavioural genetic analyses also revealed that sibling exchanges were mainly influenced by the shared environment, common to both children within the dyad, but also by the genetic propensities of the siblings themselves. Thirdly, using the innovative Preschool Five Minute Speech Sample (Daley, Sonuga-Barke, & Thompson, 2003) interview, Chapter 3 found that mothers who expressed more family-wide positive, and less family-wide negative, emotion towards their children reported more positivity within the sibling relationship – even when controlling for questionnaire measures of the mother-child relationship. Finally, Chapter 4 used cross-lagged tests to show that earlier positivity within the sibling bond was longitudinally associated with later marital satisfaction, and with positivity within both the mother-child and the father-child bond.

Since more detailed results were discussed in Chapter 2, Chapter 3 and Chapter 4, Chapter 5 aims to synthesise findings from these preceding papers into three key ideas: generalisability; bidirectionality; and the valence of sibling relationship quality. Subsequently, I highlight the strengths and limitations of the Twins, Family and Behaviour study, and suggest recommendations for future research.

Main Themes of my Thesis

Generalisability. Perhaps the most striking finding presented in this thesis comes in the form of our ability to generalise from the sibling relationship quality of twins to the sibling relationship quality of non-twins. These two differing types of sibling pairs displayed equivalent levels of positivity and negativity in their exchanges with each other, suggesting that no significant dissimilarities exist between them (see Chapter 2). This result was also supported by an additional, and unpresented, finding related to Chapter 3.

My colleague and I decided that the Preschool Five Minute Speech Sample (Daley et al., 2003), measuring expressed emotion, might benefit from some adaptation. The original assessment had seldom been used with twins (Caspi et al., 2004), and, after carrying out a trial run of the speech sample with a practice family, we felt that adding in another element would help to better capture the way in which mothers talked about their same-aged children. Specifically, we added two 'twin comparison' codes to the scheme – representing the extent to which parents directly compared the target child being spoken about to their co-twin. To give an example, '(Twin name) is much friendlier than his brother' would be coded as a mother making a 'positive twin comparison', because the target child is being compared positively to his co-twin. In contrast, '(Twin name) struggles to make friends, whereas his brother is very sociable' would be coded as a 'critical twin comparison', because the target child is being compared negatively to his co-twin. Although some parents did not compare their twins at all during their speech samples, to the point that they could have been describing a singleton child, a number frequently did. Intuitively, such a modification felt like an important one to my colleague and I, encapsulating the ways in which mothers and fathers often drew parallels between their twin

children. Despite our instincts, however, these comparison codes did not correlate with the quality of the twin relationship, or with the twins' behaviour.

Both of these findings indicate that the nature of the bond that exists between twins is not quantitatively different from that of non-twins. Chapter 2 explicitly showed this, by directly comparing the two forms of dyads on their sibling relationship quality; whereas the expressed emotion results were subtler, finding that the specific twin-based codes were not associated with sibling interactions. These were novel and unexpected results, considering the vast majority of past research relating to twins has emphasised their special and unique bond (Playfair, 2002), as well as mothers' differential treatment of them (Thomas, 1996). The 'file-drawer' effect, coined by Robert Rosenthal (1979), is worth noting here. This refers to positive-results bias, whereby authors are more likely to submit, and publication editors to accept, positive results than negative or inconclusive results. In the context of sibling relationship quality then, it may be that others have verified the lack of differences between twin and non-twin brothers and sisters, but that these findings have simply not been published. Similarly, the 'replication crisis', a methodological difficultly in which researchers have found that the results of many studies are impossible to replicate on subsequent investigation, may be at play within the sibling and twin-based literature (Pashler & Wagenmakers, 2012). Ultimately, my thesis tentatively advocates that research on the nature of the exchanges between young twin siblings can be safely applied across both same-aged and differently-aged sibling pairs.

Bidirectionality. The results from this dissertation also highlight the potential bidirectionality that can occur between parenting and sibling relationship quality. Most reports imply that mothering and fathering subsequently influence children's outcomes. Indeed, children's friendships (Masten & Coatsworth, 1998), academic performance (Roksa & Potter,

2011), psychopathology (Caron, Weiss, Harris, & Catron, 2006), and prosocial behaviour (Farrant, Devine, Maybery, & Fletcher, 2012), as well as many other constructs, are predicted by parenting. Most importantly here, so are sibling relationships. For example, a classic study by Volling and Belsky (1992) investigated this link using a longitudinal study of child and family development, recruiting middle-class Caucasian mothers, fathers and sibling pairs. The authors found that mother-child attachment insecurity predicted sibling antagonism at a later time point, and that positively affectionate and facilitative fathering predicted later prosocial behaviour between siblings. The notion here is that adults within a family are more powerful and influential than are children (Brody, Stoneman, & McCoy, 1994a; 1994b), and this direction of effect certainly seems logical. In line with such developmental work, Chapter 3 of this thesis clearly showed that aspects of mothering (specifically, maternal expressed emotion towards children) predicted brothers' and sisters' interactions.

Although there has been strong evidence to support the pathway of influence running from parenting to the sibling relationship, many of the studies endorsing this have been cross-sectional in nature. Yu and Gamble (2008) provide one such illustration – they employed a low-income sample of Mexican-American families, finding a moderate cross-sectional association between mothers' parenting style and exchanges between brothers and sisters. Their interpretation, like many others', was that mothering subsequently impacts upon the bond between siblings (r = .46). However, using data collected at one point in time makes it very difficult to untangle the direction of effects between two variables. The authors' findings cannot explicitly tell us which way the causality path runs. Similarly to Yu and Gamble's work, the data utilised from Chapter 3 of this thesis were collected within the same time phase. Thus, even though statistical prediction of sibling relationship quality was found from the parenting measure

of maternal expressed emotion, it may be the case that sibling relationship quality can also predict mothering.

Verifying the opposite directionality of the link between parenting and sibling relationship quality, and highlighting the limitations of cross-sectional data, are the results from Chapter 4. Here, I employed a cross-lagged analysis - a conservative test of longitudinal associations over time. By looking at family relationships, including the sibling relationship, the mother-child relationship, and the father-child relationship, across two separate time points, I unexpectedly revealed that associations seemed to flow from the sibling bond to the mother and father parenting constructs (as well as to marital quality). This finding underlines the salience of child effects (Bell, 1968), signifying that children are active participants in their relationships, and can be as influential as adults within the context of the family (Prout, 2002). Interestingly, however, Chapter 4 also indicated that a close, affectionate bond between mothers and their children was longitudinally associated with positivity between siblings. Consequently, there was clear evidence of bidirectionality between mothering, but not fathering, and the quality of the sibling relationship, with pathways of longitudinal associations flowing from both mother to children, and from children to mother.

Valence of Sibling Relationship Quality. Another emerging theme from the Twins, Family and Behaviour study is differences in the correlates of positivity versus negativity within the sibling relationship. Chapter 2 emphasised associations between the gender constellation of sibling dyads and negativity within their exchanges. Specifically, male pairs were found to score more highly on negativity within their sibling relationships than both female pairs and opposite-sex pairs, but only when mother reports were utilised. As well as this, behavioural genetic analyses revealed a moderate twin-specific environmental influence on sibling negativity only,

highlighting that twins were more similar to each other in their negativity than would be expected by estimates for their genes or their shared environment. On the other hand, expressed emotion uttered by mothers about their children predicted warmth and affection between siblings, but not competition and rivalry (see Chapter 3). We therefore see a distinct divergence in results between positive and negative aspects of sibling relationship quality.

Such a pattern of findings reflects the fact that sibling relationships are not *either* good *or* bad. Indeed, sibling positivity and negativity were statistically unrelated (r = .01 for mother reports, and r = -.10 for father reports), meaning that these features can co-occur, and that they should be treated as separate constructs, rather than opposite ends of a single dimension (see Dallaire et al., (2006) for a similar argument for parenting). My results suggest that the development and maintenance of negativity within the sibling relationship is most influenced by characteristics of the children themselves. Opposingly, the presence of positivity within the sibling relationship is most affected by the overall family climate. Such interpretations are drawn from Chapter 2, whereby gender and the twin-specific environment were most salient for siblings' negative interactions; and also from Chapter 3, whereby mothers' family-wide expressed emotion towards their children predicted siblings' positive interactions.

Further support for the separateness of these sibling elements emerged from unpresented data analyses exploring links between the quality of the sibling bond and children's conduct problems and prosocial behaviour. Specifically, the nature of children's behaviour was significantly correlated with sibling negativity (r = .38 for conduct problems, and r = -.25 for prosocial behaviour), but not with sibling positivity (r = -.12 for conduct problems, and r = .09 for prosocial behaviour). This additional finding corroborates the notion that hostility and aggression displayed between brothers and sisters are primarily influenced by the traits of the

children within the dyad. On the other hand, warmth and affection between siblings were not linked with children's behaviour, reinforcing the fact that positive aspects of the fraternal relationship tend to be more greatly affected by family-wide parenting.

The observed differences between the determinants of sibling positivity and sibling negativity are somewhat coherent with previous research within the field of family psychology. For example, the findings of a large scale, longitudinal, and child-based twin study undertaken by Oliver, Trzaskowski and Plomin (2014) can be drawn upon for support. The authors used questionnaires to investigate the genetic and environmental etiology of parental control and parental feelings towards their children, at ages nine, 12 and 14. After conducting twin-modelling analyses, it was found that negativity, across both of these parenting aspects, was substantially more genetically influenced (44%) than was positivity (12%). That is, parental negativity was influenced by genetically informed child characteristics to a much greater extent than was parental positivity. Such a heritability estimate represents the fact that children's individual traits and temperaments elicit hostility and aggression from mothers and fathers towards their offspring. Correspondingly, Oliver and colleagues discovered that positivity, across both parental control and parental feelings, was substantially more influenced by the shared environment than was negativity. That is, parental positivity was characterised by mothers' and fathers' overall, family-wide parenting consistency across their two twins. Such an environmental estimate represents the fact that the general family-wide parenting context influences warmth and affection between parents and their children. Although this twin study did not directly investigate the relationship between siblings, the presented pattern of findings reflects the discrepancies found between positive and negative aspects of family relationships in this thesis. In line with Oliver and colleagues' outcomes, I too found that negative aspects of the

sibling bond were more greatly associated with children's characteristics, while positive aspects were more greatly associated with the overall parenting atmosphere within the home environment.

Implications

There are several potential implications that can be drawn from the work presented in this thesis. When considering theory development and methodology, my findings in Chapter 2 provide support for behavioural genetic models. Specifically, we illustrate the benefit of the ACTE twin modelling design, originally proposed by Jinks and Fulker (1970), which includes non-twin children in order to test for twin-specific effects. Similarly, Chapter 3 and Chapter 4 verify the well-established family systems theory (Bowen, 1978). The former documents spill over of emotion between the mother-child and the sibling relationship, while the latter shows the impact of the bond between brothers and sister on wider family dynamics. In contrast to such theoretical substantiations, results from Chapter 3 call into question the claims of attachment theory (Bowlby, 1982). Bowlby's notion reflects the fact that a child's relationship with his/her primary caregiver forms the basis of all future interactions, including the nature of other dyadic relationships within the family (Pinel-Jacquemin & Gaudron, 2013). However, through a longitudinal cross-lagged test, we found that the relationship between twins may influence each youngster's rapport with their mother and father, as well as the romantic relationship between their parents. This provides evidence of, what are termed, 'child effects' (Bell, 1968).

Running alongside theory-based implications are conceivable practical and clinical applications of my papers. For example, the unexpected conclusion in Chapter 4, that siblings can influence all other dyadic family exchanges, highlights an opportunity for intervention. The fact that younger family members have the ability to alter the general milieu of the home

environment means they can be targeted when the parent-child or the marital relationship is suffering. Feinberg, Solmeyer and McHale (2012) confirm the need for such child-centred frameworks, stating that, while there is ample advice available for parents on strategies to reduce sibling conflict and rivalry, there are very few empirically validated, family-focused, and prevention-oriented intervention approaches that focus on the relationship between brothers and sisters. Considering the emphasis on twins in this thesis, it is interesting to ponder whether such a steer towards typical siblings would also be worthwhile for families of these same-age children. Indeed, research shows that mothers and fathers of twins often feel anxious that parenting advice and interventions aimed at improving family dynamics may not be relevant to them (Chang, 1990). Our findings suggest that this is not the case, however. According to Chapter 1, twin siblings and non-twin siblings are comparable in the positivity and negativity they display towards each other; therefore, the specific subgroup of parents of twins can be reassured that sibling-based interventions would be equally pertinent for them.

Strengths of my Thesis

One of the key strengths of this thesis was the examination of sibling relationships over a two-year period in early childhood, spanning the important transition to primary school. This longitudinal approach allowed me to glean an insight into developmental changes in the nature, correlates and consequences of sibling relationship quality within the home environment. Furthermore, directionality could be tentatively addressed within the Twins, Family and Behaviour study. For example, Chapter 4 explored the longitudinal links between sibling relationship quality and the mother-child relationship, the father-child relationship and the marital relationship at two different time points. The analyses showed that the sibling bond, at the first time point, was longitudinally associated with all other dyadic family relationships at the

second time point. Despite the indication here that sibling relationship quality *caused* these wider changes, however, we must be cautious, and remember that true causality can only be confirmed through the use of experimental designs (Campbell & Stanley, 2015).

Another upside of the study was that it was possible to repeat the measures of interest at the different research phases, when this was warranted – for example, children were scored on their sibling relationship quality (via the Maternal Interview of Sibling Relationships (Stocker, Dunn, & Plomin, 1989)) at both phase two and phase four. This replication meant that levels of positivity and negativity within each family relationship could be compared directly across time points, such that any deviations would reflect true developmental changes, as opposed to methodological differences.

Another important strength of the study was its multi-method approach. The use of numerous quantitative data collection techniques is now considered a common feature of good research, as differing procedures can offer alternative benefits, and help to gain a more holistic picture of a particular construct (Blaikie, 2003). Such a method contributed to a number of the interesting findings in this thesis. For example, Chapter 3 investigated sibling relationship quality, as reported on via a postal questionnaire, and absolute and differential levels of maternal expressed emotion, as reported on via a semi-structured telephone interview. Similarly, Chapter 4 demonstrated the longitudinal associations between family relationships, through the use of both a questionnaire and an interview. Observations of parent-child relationships were also gathered from participating families, but the inclusion of this data was beyond the scope of my thesis.

Finally, my research in Chapter 2 was enhanced by the comparison of the Twins, Family and Behaviour study to another similar sample, the Sisters and Brothers Study (Pike, Coldwell,

& Dunn, 2006). This second study focused on non-twin siblings during early to middle childhood. By incorporating family information from this previously collected data, I was able to compare across differing types of sibling dyads, and examine divergences between twin and non-twin children in regards to their sibling relationship quality. Such a comparison meant that I could address issues of generalisability across the two samples (McBride, 2016). Additionally, behavioural genetic analyses could be carried out, utilising information about the sibling bond from monozygotic twins and dizygotic twins, as is usual, but also from differently-aged siblings, enhancing the design of the model (Matteson, McGue, & Lacono, 2013). Surprisingly, and as discussed in Chapter 2, the inclusion of samples from both of these research studies highlighted that there were no quantitative differences in the way siblings interacted in these dissimilar groups. Thus, one of my conclusions was that generalisability from twin siblings to non-twin siblings is possible. In terms of behavioural genetics, the additional inclusion of the twin-specific environmental influence, as a consequence of having the two differing samples available, revealed that twins, compared to non-twins, were more similar to each other in their negativity than would be expected by the estimates for their genes or their shared environment. If the twin group only had been included, shared environmental influence would have remained high, and unpicking the effects that were specific to twins would have been impossible.

Limitations and Future Directions of my Thesis

The reliance on parental reports of sibling relationship quality, along with mothering and fathering dimensions and marital quality in Chapter 4, limited my interpretation of the associations between this central dyadic bond and other family relationships. Evidence of links between these variables emerged across the thesis. However, the fact that they were all reported on by parents of the target twins, meant that these constructs could have shared substantial

amounts of method variance (Podsakoff, MacKenzie, & Lee, 2003). This could have inflated the significance of the results found in my dissertation, particularly in Chapter 4, such that the outcomes should be interpreted somewhat cautiously. In general, self-report parental measures tend to be the most critiqued means of data gathering, as they are thought to be low in objectivity and to run the risk of rater-bias (Pike & Oliver, 2015). Ultimately, mothers' and fathers' accounts of sibling relationship quality, the mother-child relationship, the father-child relationship, and the marital relationship represent their perceptions only, which may not be reflective of objective reality. Indeed, empirical evidence shows that parents generally tend to overestimate the consistency of both their behaviour towards their offspring, and of their children's behaviour towards them and other family members (Pike, Reiss, Hetherington, & Plomin, 1996).

A future study would therefore benefit from assessing children's perspectives on sibling relationship quality, and other family bonds, alongside parental views. Gaining the younger family members' outlooks is extremely salient, as past research has shown that their interpretation of events and relationships within the home is key to understanding family life (Kowal & Kramer, 1997). Pike, Coldwell and Dunn (2005) have also demonstrated that siblings can provide reliable and meaningful reports, even during early childhood, through the employment of the Berkeley Puppet Interview (Ablow & Measelle, 1993). This technique helps youngsters answer questions about differing family situations. During the assessment, a researcher wears two identical hand puppets, getting them to make opposing statements about, for example, their brother or sister (e.g., 'I like my sister'; 'I don't like my sister'). Following this, the child is asked, 'How about you?' Their response can subsequently be coded on a 7-point scale of positivity and negativity.

Verifying the importance of gaining children's reports, and in specific relation to the bond between brothers and sisters, many children report differences between themselves and their siblings in all aspects of their family interactions, including in their exchanges with each other (Dunn & Plomin, 1990). In fact, the extent of these discrepancies is quite remarkable, and Dunn (1993, p. 53) provides a real-life example of this in her book on young children's close relationships. Nancy (aged 10) offers a vivid account of her younger brother Carl (aged 6), stating '… he's nice to me. I think I'd be very lonely without Carl. He comes and meets me at the gate after school and I think that's very friendly… He's very kind… Don't really know what I'd do without a brother.' Meanwhile, Carl offers a rather different description of his relationship with Nancy: 'She's pretty disgusting and we don't talk to each other much. I don't really know much about her. Sometimes when I do something wrong she tells me off quite cruelly.' Such a discrepancy emphasises how valuable accounts from multiple younger family members can be. Including a measure of their perceptions of family relationships, perhaps via the puppet interview described above, would be an extremely worthwhile addition to any research aiming to extend or replicate the findings of this thesis.

Although the presence of both child-report and parent-report data is advantageous for family-based research, such methods are subjective in nature. During phase three of the Twins, Family and Behaviour study, my colleague and I carried out and recorded observations with each parent and child dyad over Skype. Such a methodology allowed us to rate these family relationships during a standardised semi-structured task, effectively removing any rater-bias that may occur via self-reports by the participants themselves (Semmer, Grebner, & Elfering, 2003). Unfortunately, I was unable to focus any of my analyses on these video-recorded interactions during this thesis, because their coding has not yet been completed. However, future studies

should strive to explore this previously collected data, in order to gather a complete picture of the link between parent-child relationships and sibling relationship quality. As well as these parent-child dyadic observations, it would also be useful to record the twins interacting with one another. While discussing the advantages of multi-informant studies, it is worth noting that all approaches have their flaws. I would argue that several perspectives are needed to capture the intricacies of family relationships, such as the sibling bond.

Another limitation of the research relates to its sample. It is important to acknowledge that families in the Twins, Family and Behaviour study were not fully representative of the UK's population. Firstly, the mothers and fathers recruited were extremely well educated, and, as such, the participants were skewed towards the higher end of the socioeconomic spectrum. They were also almost exclusively White British. Bronfenbrenner (1992) has stressed that demographics such as social class or race can affect family dynamics, thus this thesis' outcomes should be explored within a broader range of individuals, from more diverse socioeconomic (and ethnic) backgrounds. Furthermore, the vast majority of the involved families were traditional in the fact that they were intact, with most of the twins' mothers and fathers reporting being in a long-term committed relationship. Less typical families are increasing at a rapid rate (Kalmijn, 2007), so future research should explore sibling relationship quality in children living in less conventional contexts – perhaps in single parent and stepfamilies, or in lesbian and gay families.

The Twins, Family and Behaviour study focused on children within a very specific age range, between the ages of three- and seven-years-old. There is no doubt that this period in early childhood, whereby children transition into school and develop their theory of mind (Piaget, 1932), is exceptionally critical for development. We do accept, however, that sibling relationships can fluctuate in their nature over time. It may be that brothers and sisters become

more alike, and therefore closer, as they grow older, because they live apart and no longer have the need to establish distinct identities (Neyer, 2002). Alternatively, the fact that they spend less time together, and perhaps have less in common away from the family home, may foster distance and detachment within the sibling relationship (Bedford, 1996). Interestingly, Cicirelli's (1996) support for a weakening in the emotional closeness of siblings over time was put down to marriage, particularly if one sibling disapproved of the other's choice of spouse. In order to extend the application of my findings then, future research exploring the links between sibling relationship quality and other family relationships should gain information from both younger and older samples of children.

As discussed in Chapter 1, involving two siblings per family was a strength of my thesis. Doing so enabled me to assess important within-family effects (Plomin, DeFries, McClearn, & McGuffin, 2001), seen especially in Chapter 3, where family-wide and child-specific parenting was measured. Saying that, however, we know that multiple sibling pairings existed in some families within the Twins Family and Behaviour study. The Office for National Statistics (2012) states that 14 percent of families with dependent offspring have three or more children under their care. Beyond the reach of the current work, future research could explore whether the sibling relationship quality of one sibling pair within a given family is replicated across all pairings. If so, this would indicate a large shared environmental effect, and the fact that children are similar as a result of the common experiences they share within the home environment (Plomin, DeFries, & Loehlin, 1977). Jenkins, Rasbash, Leckie, Gass and Dunn's (2012) work supports this supposition, finding that 37 percent of the variance in sibling hostility, and 32 percent of the variance in sibling affection, could be accounted for by family-level effects. Put differently, there were similarities between the different sibling relationships within each family.

If, on the other hand, different pairings displayed unique characteristics, this would reflect a large genetic effect and the fact that children within the same family are different as a result of their heritable personality traits (Plomin et al., 1977). Such an extension to the sibling design would be particularly interesting in families with both twin and non-twin children, and would allow additional insights into the behavioural genetic contributions of sibling relationship quality.

Finally, I explored the twin bond in this thesis. As discussed in Chapter 1, twins represent an unusual sibling dyad. The depiction of this form of fraternal bond as one that is remarkably special and intimate has been reinforced by both traditional literature and the modern media, as well as by a number of academics (Burlington, 1945; Playfair, 2002; Segal, 1999). Indeed, most of the empirical evidence available argues that twin pairs are unique due to the lack of birth order and developmental differences between them (Fraley & Tancredy, 2012). It is thought that they have the potential to develop attachments to one another, in the same way that children do with their parents, because, more so than differently-aged siblings, they often spend extended periods of time together, share common experiences, including their birthday, and turn to each other for support and comfort (Woodward, 1998). Chapter 2 of this thesis has argued that this is not the case in young childhood – my findings show that twin pairs and non-twin pairs display similar levels of positivity and negativity within their sibling relationships, justifying the generalisation of twin findings to samples of non-twin brothers and sisters. This was an unexpected, yet novel and important, finding. As such, however, it certainly requires replication in future studies, with twins of older ages too.

Summary

In just a few decades, understanding of the role of siblings in children's development, both inside and outside the home, has progressed from a narrow focus on birth order effects, to an appreciation of the complex ways in which siblings interact with different aspects of their environment. Drawing primarily on family systems theory (Bowen, 1978) and the spill-over hypothesis (Engfer, 1988), this thesis examined sibling relationship quality in twins. Specifically, I investigated associations between positivity and negativity within sibling interactions, and the nature of other family relationships – namely the mother-child relationship, the father-child relationship, and the marital relationship. Data were utilised from an ongoing longitudinal study of family dynamics, the Twins, Family and Behaviour study, run by myself and my colleague, and, in Chapter 2 only, from previously collected parental reports of non-twin siblings too. The results highlighted the generalisability of twin relationship quality to non-twin siblings; the impact of shared environmental and genetic influences on sibling relationships; the prediction of the sibling bond by family-wide parenting; and the longitudinal association between sibling interactions and other family relationships. Overall, the outcomes of this thesis open up many avenues for future research to comprehend the correlates and consequences of sibling relationships in the diverse contexts of modern families.

Appendices

Appendix 1. Consent Form for Phase One of the Twins, Family and Behaviour Study – Initial Postal Questionnaire

Please tick each box

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐
3. I understand that unidentifiable data collected during the study may be analysed by individuals from the TEDS team and other researchers. Access to identifiable data is strictly controlled and used only by authorised TEDS staff, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data. ☐
4. I agree to take part in the above study. ☐

If you have any questions at any time, please contact the TEDS team on freephone 0800 317029, or email teds-project@kcl.ac.uk

Your name: ……..…….…

Relationship to the twin (e.g. mother, guardian etc): …….…….…….……..

Your address: ……..…… ……...…….……

…….…….

…….…….……...…….

Postcode: …….……..

Your telephone number: ……..…….……

Your email: ……..

SIGNATURE: ……

Date: (day/month/year) …..…/…..…/……..

It would be useful if we could have the contact details of a relative or friend that we could contact should we be unable to reach you – for example, if you move house.

First name: …… Last name: ……

Address: ……..……

……..…….. ……

……

Postcode: ……..

Telephone: ……...……..

Email: ……..……

Appendix 2. Consent Form for Phase Two and Phase Three of the Twins, Family and Behaviour Study – Telephone Interview and Skype Observation Task

Please tick to indicate your consent to take part in the next stage of the study. Where mothers and fathers are both participating, please ensure each give their respective consent.

1. I confirm that I have read and understand the information sheet for the TFaB study. I have had the opportunity to consider the information, ask questions and had these answered satisfactorily. Mother ☐ Father ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. Mother ☐ Father ☐

3. I understand that unidentifiable data collected during the study may be analysed by individuals from the TFaB team. Access to identifiable data is strictly controlled and used only by authorised TFaB staff, where it is relevant to taking part in this research. I give permission for these individuals to have access to my data Mother ☐ Father ☐

4. I agree to take part in the telephone interview part of the study. I understand that these conversations will be recorded and transcribed. Mother ☐ Father ☐

5. I agree to take part in the video-interaction part of the study. I understand that these interactions will be recorded. Mother ☐ Father ☐

If you have any questions at any time, please contact the team on 01273 877052, or email TFaB@sussex.ac.uk

Mother's name …….

Mother's signature ……...

Father's name……

Father's signature…… ……

You may volunteer to allow us to use sections of any video-taped interactions between you and your child in public (e.g. at academic conferences, as teaching materials etc.) Names will not be used. If you would like to allow us to do this, please tick the box below and sign your name. This does not affect your participation in any way.

Mother's name……..

Mother's signature…… ……

Father's name…….

Father's signature……..

Please return this form to us at TFaB@sussex.ac.uk prior to your telephone interview/observation task.

Appendix 3. Consent Form for Phase Four of the Twins, Family and Behaviour Study – Follow-Up

Postal Questionnaire

Thank you for your participation in our study so far! Please name and sign this form to indicate your consent to take part in the next stage of the study.

1. I confirm that I have read and understood the information sheet for this stage of the TFaB study. I have had the opportunity to consider the information, ask questions and had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected.

3. I understand that unidentifiable data collected during the study may be analysed by individuals in the TFaB team. Access to identifiable data is strictly controlled and used only by Authorised TFaB staff, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data.

4. I agree to take part in the next questionnaire part of the study.

If you have any questions at any time, please contact the TFaB team on 01273 877052, or email us on TFaB@sussex.ac.uk

Your name ……

Your signature ……

Your relationship to the TFaB twins:

☐
Mother

☐
Father

☐
Other
(please
describe)
……

Please return this form to us in the envelope provided.

Appendix 4. Information Sheet for Phase One of the Twins, Family and Behaviour Study – Initial Postal Questionnaire

THANK YOU FOR TAKING PART IN OUR STUDY SO FAR!

This sheet tells you a bit about why we are doing this research and what is involved for in these next steps for you and your family. If you would like to hear more about our study or have any questions please contact the team on 01273 877052 or email bonamy.oliver@sussex.ac.uk.

What is the purpose of this study?

As parents you already know that your children develop differently. As parents of twins, you have a wonderful chance to see how your children develop together.

Children develop in many different ways, and in different situations. As a parent you have a wonderful opportunity to watch how your children learn and become the people they are. You have a special knowledge and we would like you to share it with us. We are interested in your twins because they let us see how genes and experience work together to influence their development.

Do both mothers and fathers have to take part?

No. It is up to each of you to decide to take part in the study. That is, we are interested in hearing from you even if only mother or only father wishes to participate. All we ask is that you sign the consent form before taking part. You are free to withdraw at any time, individually, without giving a reason.

What will happen if I take part?

You will receive a questionnaire in which we ask about your family, including where you live, any qualifications you may have, who lives with you, your household income, and how similar your twin children are to each other. We also ask you some questions about your children's behaviour and your thoughts about being a parent. The questionnaire will take around 40 minutes to complete. Your answers will be kept strictly confidential. There will be no cost to you, as all postage costs will be paid by us. After this, there will be ongoing opportunities for you and your family to participate with our research.

You can be part of the study for as long as you wish, and will hear about the findings through our yearly newsletters.

What are the possible benefits of taking part?

The information we get from this study will help us understand how children develop together.

Will my taking part in this study be kept confidential?

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence. All the data that your family provides are strictly confidential; you and your twins are identified only by a number in the study datasets. Identifiable data will be only accessed by

authorised persons in the research team and stored in a secure location. The data your family provides will be kept for a minimum of 10 years after completion of the study, as recommended by the Medical Research Council (MRC). **We will not pass your family's information on to any other organisations.** The data may be retained for our use in future studies subject to further ethical approval.

What will happen if I don't want to carry on with the study?

Either of you can withdraw from the study at any time without giving a reason; data already collected will be stored anonymously but no new data collected. In addition, it is your right to withdraw your data at any time prior to publication of results. No identifying information is included in such publications.

What happens to the results of the findings of the research study?

The findings will be published in scientific journals, and also made available on our web site after the completion of the study.

Who has reviewed the study?

This study has been reviewed by the Sciences & Technology Cross-Schools Research Ethics Committee, Sussex University. If have any concerns about the way in which the study is conducted as it progresses, please contact the Chair of the Ethics Committee (R.De-Visser@sussex.ac.uk).

Questions about the study?

Please call Bonamy Oliver on: 01273 877052

Or email: bonamy.oliver@sussex.ac.uk

Interested in taking part in the study?

Please email: Katie Mark – K.M.Mark@sussex.ac.uk or

Rachel Latham – rml29@sussex.ac.uk

Thank you so much for your time!

Appendix 5. Information Sheet for Phase Two and Phase Three of the Twins, Family and Behaviour Study – Telephone Interview and Skype Observation Task

THANK YOU FOR TAKING PART IN OUR STUDY SO FAR!

This sheet tells you a bit about why we are doing this research and what is involved in these next steps for you and your family. If you would like to hear more about our study, or if you have any questions, please contact the team on 01273 877052 or email TFaB@sussex.ac.uk.

What is the purpose of this study?

As parents you already know that your children develop differently. As parents of twins, you have a wonderful chance to see how your children develop together.

Children develop in many different ways, and in different situations. As a parent you have a wonderful opportunity to watch how your children learn and become the people they are. You have a special knowledge and we would like you to share it with us. We are interested in your twins because they let us see how genes and experience work together to influence their development.

Do both mothers and fathers have to take part?

No. It is up to each of you to decide to take part in the study. That is, we are interested in hearing from you even if only mother or only father wishes to participate. All we ask is that each person signs the consent form before taking part. You are free to withdraw at any time, individually, without giving a reason.

What will happen if I take part?

So far we have asked parents to complete an initial questionnaire booklet, in order for us to learn more about you and your family. We asked about where you live, any qualifications you may have, who lives with you, your household income, and how similar your twin children are to each other. We also asked you some questions about your children's behaviour and your thoughts about being a parent. Thank you for your participation in this first stage of our research.

We would now like to speak to participating mothers and fathers over the telephone. The telephone interview will last between 30 and 40 minutes, and we will be asking about significant family life events and family relationships.

For the next stage of our study, we will be asking participating mothers and fathers to play an online game (if you have access to the internet) with each of the twins which will be videoed via Skype technology. This will allow us to capture real-life interactions between you and your children.

You can be part of the study for as long as you wish, and you will hear about the findings through our yearly newsletters.

What are the possible benefits of taking part?

The information we get from this study will help us understand how children develop together.

What will happen if I don't want to carry on with the study?

Participating mothers and fathers can withdraw from the study at any time without giving a reason; data already collected will be stored anonymously but no new data collected. In addition, it is your right to withdraw your data at any time prior to publication of results. No identifying information is included in such publications.

Will my taking part in this study be kept confidential?

Yes. We will follow ethical and legal practice, and all the information that your family provides is strictly confidential. You and your twins are identified only by a number in the study datasets, and any identifiable data will only be accessed by authorised persons in the research team and stored in a secure location. The data your family provides will be kept for a minimum of 10 years after completion of the study, as recommended by the Medical Research Council (MRC). We will not pass your family's information on to any other organisations. The data may be retained for our use in future studies, subject to further ethical approval.

What happens to the results of the findings of the research study?

The findings will be published in scientific journals, and also made available on our web site after the completion of the study.

Who has reviewed the study?

This study has been reviewed by the Nottingham 1 Research Ethics Proportionate Review Sub-Committee and the Sciences & Technology Cross-Schools Research Ethics Committee, Sussex University. If have any concerns about the way in which the study is conducted as it progresses, please contact the Chair of the Ethics Committee (R.De-Visser@sussex.ac.uk).

Questions about the study?

Please call Bonamy Oliver on: 01273 877052

Or email: TFaB@sussex.ac.uk

Thank you so much for your time!

Appendix 6. Information Sheet for Phase Four of the Twins, Family and Behaviour Study – Follow-Up Postal Questionnaire

THANK YOU FOR TAKING PART IN OUR STUDY!

We hope you have enjoyed taking part in our study so far.

This information sheet tells you a bit about why we are doing this research and what is involved for you and your family if you take part in the next phase.

What is the purpose of this study?

As your children grow up, you'll know how differently they develop from each other and from other children. As parents of twins, you have a wonderful chance to see how your children develop together.

As a parent you have a fantastic opportunity to watch how your children navigate through childhood. We would like you to continue to share your insights with us. We are interested in your twins because they let us see how genes and experience work together to influence their development.

Do both mothers and fathers have to take part?

No. It is up to each of you to decide to take part in the study. That is, we are interested in hearing from you even if only mother or only father wishes to participate. All we ask is that you sign the consent form before taking part. You are free to withdraw at any time, individually, without giving a reason.

What will happen if I take part?

In the enclosed questionnaire, we ask you questions about who lives in your home, what your home is like, how the relationships work in your home and the kinds of people your twins are becoming. The questionnaire will take around 40 minutes to complete. Your answers will be kept strictly confidential. There will be no cost to you - all postage costs will be paid for by us.

We ask that you return the consent form in the smaller envelope, and the completed questionnaire - on which you are identified only by ID number - in the larger envelope.

What are the possible benefits of taking part?

The information we get from this study will help us understand how children develop together.You will hear about the findings from the study through our yearly newsletters.

Will my taking part in the study be kept confidential?

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence. You and your twins are only identified by a number in the study datasets.

Identifiable data will be only accessed by authorised persons in the research team and stored in a secure location. The data your family provides will be kept for a minimum of 10 years after completion of the study, as recommended by the Medical Research Council (MRC). **We will not pass your family's information on to any other organisations.** The data may be retained for our use in future studies, subject to further ethical approval.

What will happen if I don't want to carry on with the study?

You can withdraw from the study at any time without giving a reason; data already collected will be stored anonymously but no new data collected. In addition, it is your right to withdraw your data at any time prior to publication of results. No identifying information is included in such publications.

What happens to the results of the findings of the research study?

The findings will be published in scientific journals, and also made available on our web site after the completion of the study.

Who has reviewed the study?

This study has been reviewed by the Sciences & Technology Cross-Schools Research Ethics Committee, Sussex University. If have any concerns about the way in which the study is conducted as it progresses, please contact the Chair of the Ethics Committee (crecscitec@sussex.ac.uk).

Questions about the study?

Please contact the team on our team mobile 07847 814140, or Bonamy Oliver on 01273 877052, or email tfab@sussex.ac.uk.

Thank you so much for your time!

Appendix 7. Included Measure of Zygosity - Questionnaire by Price and colleagues (2000)

If your twins are one boy and one girl (opposite sex), then please go to page 11.

1. Have you ever been told by a *health professional* (for example doctor, nurse, consultant) that your twins are identical or non-identical?

□	YES, identical	□	YES, non-identical	□	NO

2. Do *you* think your twins are identical or non-identical?

□	Identical	□	Non-identical

3. Are there differences in the *shade* of your twins' hair?

□	Clear difference	□	Only slight difference	□	None

4. Are there differences in the *texture* of your twins' hair (fine or coarse, straight or curly etc)?

□	Clear difference	□	Only slight difference	□	None

5. Are there differences in the colour of your twins' eyes?

□	Clear difference	□	Only slight difference	□	None

6. Are there differences in the shape of your twins' ear lobes?

□	Clear difference	□	Only slight difference	□	None

7. Did the twins' teeth begin to come through at about the same time?

□	Matching teeth on the same side came through within a few days of each other
□	Matching teeth on opposite sides came through within a few days of each other
□	The twins had different teeth come through within a few days of each other
□	The twins' first teeth did not come through within a few days of each other
□	The twins' teeth have not come through yet

8. (a) Do you know your twins' ABO blood group?

□	Yes	□	No

(b) If YES, what is their blood group?

Older twin	□	A	□	B	□	AB	□	O
Younger twin	□	A	□	B	□	AB	□	O

9. As your twins have grown older, how has the likeness between them changed?

□	Remained the same	□	Become less	□	Become greater

10. If you look at a new photograph of your twins, can you tell them apart (without looking at their clothes or using any other cues)?

□	YES, easily
□	YES, but it is hard sometimes
□	NO, I often confuse them in photographs

11. Do any of the following people ever mistake your twins for each other?

(a) Other parent of the twins

□	YES, often
□	YES, sometimes
□	Rarely or never
□	There is no other parent

(b) Older brothers or sisters

□	YES, often
□	YES, sometimes
□	Rarely or never
□	There are no older brothers or sisters

(c) Other relatives

□	YES, often
□	YES, sometimes
□	Rarely or never

(d) Babysitter/day carer

□	YES, often
□	YES, sometimes
□	Rarely or never
□	There is no babysitter/day carer

(e) Parents' close friends

□	YES, often
□	YES, sometimes
□	Rarely or never

(f) Parents' casual friends

□	YES, often
□	YES, sometimes
□	Rarely or never

(g) People meeting the twins for the first time

□	YES, often
□	YES, sometimes
□	Rarely or never

12. If the twins *are* ever mistaken for one another, does this ever occur when they are together?

□	YES, often
□	YES, sometimes
□	NO, almost never
□	They are not mistaken for one another

13. Would you say that your twins:

□	are as physically alike as “two peas in a pod” (virtually the same)
□	are as physically alike as brothers and sisters are
□	do not look very much alike at all

Appendix 8. Included Measure of Twin/Sibling Relationship Quality - Maternal Interview of Sibling Relationships by Stocker, Dunn and Plomin (1989)

This section is about your twins' relationship with each other. Please read each statement carefully and circle a number on the scale to indicate the most appropriate response.

1. Companionship

Some brothers and sisters spend a lot of time together, whereas others have very different interests and aren't together very much. Being together can be when both twins are in the same room but not necessarily playing together (e.g., mealtimes, watching television).
During the week how much are your twins together?

Almost never *(a few minutes in morning and evening each day)*	Hardly ever *(10-15 minutes in morning and evening each day)*	Somewhat *(an hour or two each day)*	Pretty often *(3 or 4 hours each day)*	Quite a bit *(a good part of each day)*	Just about all the time *(most of each day)*
0	1	2	3	4	5

2. Playing Together

Out of the time your twins spend together, how often do they play together?
(e.g., interacting with each other around a shared activity, rather than watching TV or eating a meal together)

Almost never *(less than 5% of time together)*	Hardly ever *(about 10% of time together)*	Occasionally *(about 20% of time together)*	Sometimes *(about 30% of time together)*	Pretty often *(at least 50% of time together)*	Regularly *(almost all of time together, 75-100%)*
0	1	2	3	4	5

3. Pretend Play

How often do your twins play make-believe games together?
(e.g., playing doctors and nurses, monsters, spacemen, superman, mother and babies).

Almost never *(less than 5% of time together)*	Hardly ever *(about 10% of time together)*	Occasionally *(about 20% of time together)*	Sometimes *(about 30% of time together)*	Pretty often *(at least 50% of time together)*	Regularly *(almost all of time together, 75-100%)*
0	1	2	3	4	5

4. Quarrels

Most brothers and sisters argue and quarrel. How often do your twins squabble when they are together?

Almost never *(less than 5% of time together)*	Hardly ever *(about 10% of time together)*	Occasionally *(about 20% of time together)*	Sometimes *(about 30% of time together)*	Pretty often *(at least 50% of time together)*	Regularly *(almost all of time together, 75-100%)*
0	1	2	3	4	5

5. Wanting to play together

How often are each of your twins interested in playing together?

	Almost never *(less than 5% of time together)*	Hardly ever *(about 10% of time together)*	Occasionally *(about 20% of time together)*	Sometimes *(about 30% of time together)*	Pretty often *(at least 50% of time together)*	Regularly *(almost all of time together, 75-100%)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

6. Affection

How often do your twins show affection for each other on a day-to-day basis?
(e.g., being affectionate in their play, being pleased to see each other if separated at school)?

	Almost never *(once a month or less)*	Hardly ever *(once every 2 weeks)*	Occasionally *(about once a week)*	Sometimes *(a couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

7. Comforting each other

(a) If one of your twins is hurt or upset, how often does each of them show concern at the other's distress if one of them did not cause the distress?

	Almost never *(once a month or less)*	Hardly ever *(once every 2 weeks)*	Occasionally *(about once a week)*	Sometimes *(a couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

(b) How often do your children show concern at the other's distress if one of them was the cause of distress?

	Almost never *(once a month or less)*	Hardly ever *(once every 2 weeks)*	Occasionally *(about once a week)*	Sometimes *(a couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

8. Teaching, Helping

How often do your children spontaneously teach or help each other?
(e.g., if one needs help with a chore or working something out)

	Almost never *(once a month or less)*	Hardly ever *(once every two weeks)*	Occasionally *(about once a week)*	Sometimes *(a couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

9. Caretaking

If you asked one to take care of the other, or if you asked one to help the other to do something, how willing would they be to do it?

	Not willing *(always or almost always refuses to do so)*	Very unwilling *(generally refuses to do so)*	Occasionally willing *(usually complains but does it)*	Sometimes willing *(sometimes resistant)*	Usually willing *(generally no complaints)*	Always willing *(hardly ever complains)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

10. Physical Fights

How often do your twins' quarrels turn into hitting one another?

	Almost never *(less than 5% of their quarrels)*	Hardly ever *(about 10% of their quarrels)*	Occasionally *(about 20% of their quarrels)*	Sometimes *(about 30% of their quarrels)*	Pretty often *(at least 50% of their quarrels)*	Regularly *(almost all of their quarrels, 75-100%)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

11. Sharing

How much do your twins share their possessions?

	Almost never	Rarely	Shares only a few things	Shares some things *(but minds about a few special things)*	Shares most things *(but occasionally refuses to share something special)*	Shares just about anything
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

12. Competition

How often do your children make competitive remarks or act competitively?
(e.g., if one has just done something, does the other insist of showing that he/she can do it too, or better)?

	Almost never *(once a month or less)*	Hardly ever *(less than once a week)*	Occasionally *(about once a week)*	Sometimes *(couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

13. Jealousy and Rivalry

Most children feel jealous at times of the attention and affection their brothers and sisters receive from their parents. How often do each of your children appear jealous?
(e.g., by interrupting/disrupting the game you or your partner is playing with their sibling, or by being naughty.)

	Almost never *(once a month or less)*	Hardly ever *(less than once a week)*	Occasionally *(about once a week)*	Sometimes *(couple of times a week)*	Pretty often *(several times a week)*	Regularly *(just about every day)*
Older twin:	0	1	2	3	4	5
Younger twin:	0	1	2	3	4	5

Appendix 9. Included Measure of the Parent-Child Relationship – Parent-Child Relationship Scale by Hetherington and Clingempeel (1992)

Please answer these questions in relation to your relationship with your older and younger twins.

	Not at all	**A little**	**Somewhat**	**Very**	**Extremely**
1. How much do you enjoy spending time alone with your child? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
2. How much do you think your child enjoys spending time alone with you? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
3. How satisfied are you with the amount of time you spend alone with your child? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
4. How satisfied do you think your child is with the amount of time you spend alone with him/her? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
5. Is it easy to be affectionate towards your child? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
6. How affectionate is your child towards you? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
7. How much do you care about what your child thinks about you? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
8. How much does your child care about what you think of them? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
9. How much do you think of your child? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐

	Not at all	**A little**	**Somewhat**	**Very**	**Extremely**
10. How much do you nag your child about what he/she is doing wrong? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
11. How much does your child nag you about what you are doing wrong? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
12. How much do you criticise your child? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
13. How much does your child criticise you? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
14. How often does your child get into disagreements with you? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
15. How much do you enjoy being your child's parent? **Older twin** **Younger twin**	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐

Appendix 10. Included Measure of Maternal Expressed Emotion – Preschool Five Minute Speech Sample by Daley, Sonuga-Barke and Thompson (2003)

Now, for the next couple of parts I'd like you to think about *(twin name – note, two separate speech samples were carried out for each twin).*

This part will feel a little bit odd, but I'd like to hear your thoughts and feelings about *(twin name),* in your own words and without me interrupting with any questions or comments. When I ask you to begin, I'd like you to speak for five minutes, telling me what kind of a person *(twin name)* is and how the two of you get along together.

After you begin to speak, I prefer not to answer any questions until after the five minutes are over, but I'll tell you when your time is up. Do you have any questions before we begin? (*if no)* Okay great, whenever you're ready.

Appendix 11. Coding Manual for Maternal Expressed Emotion – Preschool Five Minute Speech Sample by Daley, Sonuga-Barke and Thompson (2003)

CRITICAL COMMENTS

- Negative comments about the child's behaviour and/or personality.
- Code qualified & unqualified comments separately
- Frequency count.
- Scored on the basis of tone and critical phrases.

Critical phrases: Frequency of statements that criticise, find fault with the child, use descriptive words which indicate a negative trait of the child and typically said in a negative tone.

"Libby is a selfish girl." (unqualified)

"Sarah is sometimes a nightmare to put to bed at night." (qualified)

Tone: It is possible to score on the basis of tone, even if the content of the statement doesn't contain critical content. To do this, establish a baseline level of tone for the respondent so that you are able to notice possible fluctuations in tone which, depending on their direction, will denote positive or critical comments.

Guidelines for scoring strings of comments

Statements about related or similar behaviours are scored as one critical comment.

"She's destructive, she destroys her toys, my plants, everything."

As these all relate to the child's destruction, one critical comment is scored.

Statements about unrelated behaviours are coded as separate critical comments

"Sarah's a bad tempered girl, always grumpy and disobedient."

'Bad tempered' and 'disobedient' are two unrelated behaviours so scored as 2 critical comments.

Caveats to coding critical comments

1. Do not code stereotyped descriptions unless accompanied by a negative tone. "She is such a monkey." "He's a scamp."
2. Critical comments must be the opinion of the respondent e.g. "Elizabeth is argumentative" but not "Elizabeth's teacher says she is argumentative."
3. Only code comments in the present or recent past. Anything that refers to past phases if, if at all, only coded under 'expressions of change.'

POSITIVE COMMENTS

- Statements of praise, approval or appreciation.
- Code qualified & unqualified comments separately
- Frequency count.
- Scored on the basis of tone and positive phrases.

Positive phrases: Frequency of statements that praise, or indicate appreciation or approval for the child, use descriptive words which indicate a positive trait of the child and typically said in a positive tone. Qualified positive phrases are those which are accompanied by a word or phrase which 'takes the shine off' the complement- e.g 'sometimes kind.'

> "David is a very thoughtful boy." (unqualified)
>
> "When she's in the right mood Charlotte has a great sense of humour." (qualified)

Some parents with poorer vocabulary may choose to talk around these issues rather than use specific descriptive words- these descriptive phrases can also be coded as positive phrases.

> "She's always making things out of old pieces of paper and boxes, she can turn an old box into anything."

Tone: It is possible to score on the basis of tone, even if the content of the statement doesn't contain positive content. To do this, establish a baseline level of tone for the respondent so that you are able to notice possible fluctuations in tone which, depending on their direction, will denote positive or critical comments. Rate conservatively, if in doubt do not rate a positive comment.

Guidelines for scoring strings of comments

Statements about related or similar behaviours are scored as one critical comment.

> "She's very musical, she plays the recorder very well and sings."

As these all relate to the child's musical ability, one positive comment is scored.

Statements about unrelated behaviours are coded as separate positive comments

> "He's a bright boy, and he's very good at sport."

'Bright' and 'sporty' are two unrelated behaviours so scored as 2 positive comments.

Caveats to coding positive comments

1. Do not code comments coined in the negative- "he's a great kid, not."
2. Only code comments on the present or recent past. Anything that refers to past phases if, if at all, only coded under 'expressions of change.'

Appendix 12. Coding Sheet for Maternal Expressed Emotion - Preschool Five Minute Speech Sample by Daley, Sonuga-Barke and Thompson (2003)

Coding Options	**Minute 1**		**Minute 2**		**Minute 3**		**Minute 4**		**Minute 5**	
	I	**A**	**I**	**A**	**I**	**A**	**I**	**A**	**I**	**A**
Frequency Codes										
1. Positive comments										
Unqualified										
Qualified										
2. Critical comments										
Unqualified										
Qualified										

Note. Codes were given for each minute of the Preschool Five Minute Speech Sample. I = initial code, which one coder gives initially by themselves; A = agreed code, which both coders within a pair agree upon. We combined unqualified and qualified positive comments, and unqualified and qualified critical comments, creating an overall score for each.

Appendix 13. Included Measure of Marital Quality – Quality Marriage Index by Norton (1983)

Please answer these questions in relation to your partner/husband/wife. If you do not have a partner living with you, please skip this section.

	Disagree Strongly	**Disagree Moderat-ely**	**Disagre e a Little**	**Neither Agree nor Disagree**	**Agree a Little**	**Agree Moderat-ely**	**Agree Strongly**
1. We have a good marriage/relationship	☐	☐	☐	☐	☐	☐	☐
2. My relationship with my partner/husband/wife is very stable	☐	☐	☐	☐	☐	☐	☐
3. Our marriage/relationship is strong	☐	☐	☐	☐	☐	☐	☐
4. My marriage/relationship with my partner makes me happy	☐	☐	☐	☐	☐	☐	☐
5. I really feel like part of a team with my partner/husband/wife	☐	☐	☐	☐	☐	☐	☐

6. Please rate (out of 10) the degree of happiness, everything considered, in your marriage/ relationship by circling a number below:

1 2 3 4 5 6 7 8 9 10

References

Ablow, J.C., & Measelle, J.R. (1993). *The Berkeley puppet interview: Interviewing and coding system manuals.* University of Oregon, Department of Psychology.

Abramovitch, R., Corter, C., & Lando, B. (1979). Sibling interaction in the home. *Child Development, 50,* 997-1003.

Abramovitch, R., Corter, C., Pepler, D., & Stanhope, L. (1986). Sibling and peer interaction: A final follow-up and a comparison. *Child Development, 57,* 217-229.

Acock, A.C., & Demo, D.H. (1999). Dimensions of family conflict and their influence on child and adolescent maladjustment. *Sociological Inquiry, 69,* 641-658.

Ainsworth, M.D.S., & Bell, S.M. (1970). Attachment, exploration, and separation: Illustrated by the behavior of one-year-olds in a strange situation. *Child Development, 41,* 49-67.

Ainsworth, M.S., & Bowlby, J. (1991). An ethological approach to personality development. *American Psychologist, 46,* 333-341.

Anderson, C.A., & Bushman, B.J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science, 12,* 353-359.

Baker, B.L., Heller, T.L., & Henker, B. (2000). Expressed emotion, parenting stress, and adjustment in mothers of young children with behavior problems. *Journal of Child Psychology, 41,* 907-915.

Bandura, A. (1965). Influence of models' reinforcement contingencies on the acquisition of imitative responses. *Journal of Personality and Social Psychology, 1,* 589-595.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A., Ross, D., & Ross, S.A. (1963). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology, 66,* 3-11.

Baumrind, D. (1993). The average expectable environment is not good enough: A response to Scarr. *Child Development, 64,* 1299-1317.

Beck, C.T. (2002). Releasing the pause button: Mothering twins during the first year of life. *Qualitative Health Research, 12,* 593-608.

Bedford, V. (1996). Relationships between adult siblings. In A. Auhagan, & M. Von Salisch (Eds.), *The diversity of human relationships* (pp. 120-140). New York, NY: Cambridge University Press.

Beijersbergen, M.D., Juffer, F., Bakermans-Kranenburg, M.J., & van Ijzendoorn, M.H. (2013). Remaining or becoming secure: Parental sensitive support predicts attachment continuity from infancy to adolescence in a longitudinal adoption study. *Developmental Psychology, 48,* 1277-1282.

Bell, R.Q. (1968). A reinterpretation of the direction of effects in studies of socialization. *Psychological Review, 75,* 81-95.

Blaikie, N. (2003). *Analyzing quantitative data*. London, England: Sage Publications.

Bowen, M. (1978). *Family therapy in clinical practice.* Northvale, NJ: Jason Aronson.

Bowlby, J. (1958). The nature of the childs tie to his mother. *International Journal of Psychoanalysis, 39,* 350-371.

Bowlby, J. (1982). *Attachment and loss: Attachment (2nd ed.).* New York, NY: Basic Books.

British Psychological Society (2014). *Code of human research ethics.* Leicester, England: British Psychological Society.

Brody, G.H. (1998). Sibling relationship quality: Its causes and consequences. *Annual Review of Psychology, 49,* 1-24.

Brody, G.H. (2004). Siblings' direct and indirect contributions to child development. *Current Directions in Psychological Science, 13,* 124-126.

Brody, G.H., Stoneman, Z., MacKinnon, C., & MacKinnon, R. (1985). Role relationships and behavior among preschool-aged sibling pairs. *Developmental Psychology, 21,* 124-129.

Brody, G.H., Stoneman, Z., & McCoy, J.K. (1994a). Forecasting sibling relationships in early adolescence from child temperaments and family processes in middle childhood. *Child Development, 65,* 771-784.

Brody, G.H., Stoneman, Z., & McCoy, J.K. (1994b). Contributions of family relationships and child temperaments to longitudinal variations in sibling relationship quality and sibling relationship styles. *Journal of Family Psychology, 8,* 274-286.

Brody, G.H., Stoneman, Z., McCoy, J.K., & Forehand, R. (1992). Contemporaneous and longitudinal associations of sibling conflict with family relationship assessments and family discussions about sibling problems. *Child Development, 63,* 391-400.

Brody, L.R., Copeland, A.P., Sutton, L.S., Richardson, D.R., & Guyer, M. (1998). Mommy and Daddy like you best: Perceived family favouritism in relation to affect, adjustment and family process. *Journal of Family Therapy, 20,* 269-291.

Bronfenbrenner, U. (1979). Contexts of child rearing: Problems and prospects. *American Psychologist, 34,* 844-850.

Bronfenbrenner, U. (1992). Ecological systems theory. In R. Vasta (Ed.), *Six theories of child development: Revised formulations and current issues* (pp. 187-249). London, England: Jessica Kingsley Publishers.

Brown, G.W., & Rutter, M.L. (1966). The measurement of family activities and relationships. *Human Relations, 19,* 241-263.

Buist, K.L., Dekovic, M., Meeus, W., & Van Aken, M.A.G. (2002). Developmental patterns in adolescent attachment to mother, father and sibling. *Journal of Youth and Adolescence, 31,* 167-176.

Burlington, D.T. (1945). The fantasy of having a twin. In R.S. Eissler (Ed.), *The psychoanalytic study of the child: Vols. 1-25* (pp. 205-210). London, England: Yale University Press.

Campbell, D.T., & Stanley, J.C. (2015). *Experimental and quasi-experimental design for research.* Boston, MA: Houghton Mifflin.

Caron, A., Weiss, B., Harris, V., & Catron, T. (2006). Parenting behavior dimensions and child psychopathology: Specificity, task dependency, and interactive relations. *Journal of Clinical Child and Adolescent Psychology, 35,* 34-45.

Cartwright, K.L., Bitsakou, P., Daley, D., Gramzow, R.H., Psychogiou, L., Simonoff, E., Thompson, M.J., & Sonuga-Barke, E.J.S. (2011). Disentangling child and family influences on maternal expressed emotion toward children with Attention-Deficit/Hyperactivity Disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 10,* 1042-1053.

Caspi, J. (2011). *Sibling development: Implications for mental health practitioners.* New York, NY: Springer Science and Business Media.

Caspi, A., Moffitt, T.E., Morgan, J., Rutter, M., Taylor, A., Arseneault, L., Tully, L., Jacobs, C., Kim-Cohen, J., & Polo-Tomas, M. (2004). Maternal expressed emotion predicts children's antisocial behavior problems: Using monozygotic-twin differences to identify environmental effects on behavioral development. *Developmental Psychology, 40,* 149-161.

Cederlof, R., Friberg, L., Jonsson, E., & Kaij, L. (1961). Studies on similarity diagnosis in twins with the aid of mailed questionnaires. *Acta Geneticae Medicae et Gemellologiae, 11,* 338-362.

Chang, C. (1990). Raising twin babies and problems in the family. *Acta Geneticae Medicae et Gemellologiae: Twin Research, 39,* 501-505.

Chang, L., Schwartz, D., Dodge, K.A., & McBride-Chang, C. (2003). Harsh parenting in relation to child emotion regulation and aggression. *Journal of Family Psychology, 17,* 598-606.

Christensen, A., & Heavey, C.L. (1990). Gender and social structure in the demand/withdraw pattern of marital conflict. *Journal of Personality and Social Psychology, 59,* 73-81.

Christian, L.G. (2006). Understanding families: Applying family systems theory to early childhood practice. In D. Koralek (Ed.), *Spotlight in young children and families* (pp. 4-11). Washington, DC: National Association for the Education of Young Children.

Cicirelli, V.G. (1982). Sibling influence throughout the lifespan. In M.E. Lamb, & B. Sutton-Smith (Eds.), *Sibling relationships: Their nature and significance across the lifespan* (pp. 267-284). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cicirelli, V. (1996). Sibling relationships in middle and old age. In G. Brody (Ed.), *Sibling relationships: Their causes and consequences* (pp. 47-73). Norwood, NJ: Ablex Publishing Corporation.

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences (2nd ed.).* New York, NJ: Lawrence Erlbaum Associates.

Conger, K.J., Stocker, C., & McGuire, S. (2009). Sibling socialization: The effects of stressful life events and experiences. *New Directions for Child and Adolescent Development, 126,* 45-59.

Cowan, C.P., & Cowan, P.A. (2000). *When partners become parents: The big change for couples.* Mahwah, NJ: Lawrence Erlbaum Associates.

Cox, M.J. (2010). Family systems and sibling relationships. *Child Development Perspectives, 4,* 95-96.

Cummings, E.M. (1987). Coping with background anger in early childhood. *Child Development, 58,* 976-984.

Daley, D., Sonuga-Barke, E.J.S., & Thompson, M. (2003). Assessing expressed emotion in mothers of preschool AD/HD children: Psychometric properties of a modified speech sample. *British Journal of Clinical Psychology, 42,* 53-67.

Dallaire, D.H., Pineda, A.Q., Cole, D.A., Ciesla, J.A., Jacquez, F., LaGrange, B., & Bruce, A.E. (2006). Relation of positive and negative parenting to children's depressive symptoms. *Journal of Clinical Child and Adolescent Psychology, 35,* 313-322.

Darling, N. (2007). Ecological systems theory: The person in the centre of the circles. *Research in Human Development, 4,* 203-217.

Deater-Deckard, K., Pylas, M.V., & Petrill, S.A. (1997). *The parent-child interaction system (PARCHISY).* London, England: Institute of Psychiatry.

Dunn, J. (1993). *Young children's close relationships: Beyond attachment.* London, England: Sage Publications.

Dunn, J. (2000). State of the art: Siblings. *The Psychologist, 13,* 244-248.

Dunn, J., & Kendrick, C. (1982a). *Siblings: Love, envy, and understanding.* London, England: Grant McIntyre Limited.

Dunn, J., & Kendrick, C. (1982b). Siblings and their mothers: Developing relationships within the family. In M. Lamb, & B. Sutton-Smith (Eds.), *Sibling relationships: Their development and significance* (pp. 39-59). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dunn, J., & Munn, P. (1985). Becoming a family member: Family conflict and the development of social understanding in the second year. *Family Development and the Child, 56,* 480-492.

Dunn, J., & Plomin, R. (1990). *Separate lives: Why siblings are so different.* New York, NY: Basic Books.

Dunn, J., & Slomkowski, C. (1992). Conflict and the development of social understanding. In C. Shantz, & W. Hartup (Eds.), *Conflict and development* (pp. 70-92). Cambridge, England: Cambridge University Press.

Dunn, J., Stocker, C., & Plomin, R. (1990). Nonshared experiences within the family: Correlates of behavioral problems in middle childhood. *Development and Psychopathology, 2,* 113-126.

Eaves, L.J., Last, K.A., Young, P.A., & Martin, N.G. (1978). Model-fitting approaches to the analysis of human behaviour. *Heredity, 41,* 249-320.

Eley, T.C., Lichtenstein, P., & Stevenson, J. (1999). Sex differences in the etiology of aggressive and nonaggressive antisocial behaviour: Results from two twin studies. *Child Development, 70,* 155-168.

Endendijk, J.J., Groeneveld, M.G., van Verkel, S.R., Hallers-Haalboom, E.T., Mesman, J., & Bakermans-Kranenburg, M.J. (2013). Gender stereotypes in the family context: Mothers, fathers, and siblings. *Sex Roles, 68,* 577-590.

Engfer, A. (1988). The interrelatedness of marriage and the mother-child relationship. In R.A. Hinde, & J.S. Hinde (Eds.), *Relationships within families: Mutual influences* (pp. 104-118). Oxford, England: Oxford University Press.

Erel, O., & Burman, B. (1995). Interrelatedness of marital relations and parent-child relations: A meta-analytic review. *Psychological Bulletin, 118,* 108-132.

Farrant, B.M., Devine, T.A.J., Maybery, M.T., & Fletcher, J. (2012). Empathy, perspective taking and prosocial behaviour: The importance of parenting practices. *Infant and Child Development, 21,* 175-188.

Feinberg, M.E., Solmeyer, A.R., & McHale, S.M. (2012). The third rail of family systems: Sibling relationships, mental and behavioral health, and preventive interventions in childhood and adolescence. *Clinical Child and Family Psychology Review, 15,* 43-57.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics.* London, England: Sage Publications.

Fingerman, K.L., & Bermann, E. (2000). Applications of family systems theory to the study of adulthood. *International Journal of Aging and Human Development, 51,* 5-29.

Fortuna, K., Goldner, I., & Knafo, A. (2010). Twin relationships: A comparison across monozygotic twins, dizygotic twins, and nontwin siblings in early childhood. *Family Science, 1,* 205-211.

Fraley, R.C., & Tancredy, C.M. (2012). Twin and sibling attachment in a nationally representative sample. *Personality and Social Psychology Bulletin, 38,* 308-316.

Furman, W., & Buhrmester, D. (1985). Children's perceptions of the qualities of sibling relationships. *Child Development, 56,* 448-461.

Furman, W., & Buhrmester, D. (1992). Age and sex differences in perceptions of networks of personal relationships. *Child Development, 63,* 103-115.

Furman, W., & McQuaid, E.L. (1992). Intervention programs for the management of conflict. In C.U. Shantz, & W.W. Hartup (Eds.), *Conflict in child and adolescent development* (pp. 402-429). New York, NY: Cambridge University Press.

Gerard, J.M., Krishnakumar, A., & Buehler, C. (2006). Marital conflict, parent-child relations, and youth maladjustment. *Journal of Family Issues, 27,* 951-975.

Goldsmith, H.H. (1991). A zygosity questionnaire for young twins: A research note. *Behavior Genetics, 21,* 257-269.

Gray, M.R. (2001). The effects of age and gender on perceived quality of the sibling relationship. Retrieved from http://www.anselm.edu/internet/psych/theses/sr2001.htm/gray/gray.html.

Grych, J.H. (2002). Marital relationships and parenting. In M. Bornstein (Ed.), *Handbook of parenting: Vol. 4. Social conditions and applied parenting* (pp. 203-225). Mahwah, NJ: Lawrence Erlbaum Associates.

Grych, J.H., & Fincham, F.D. (1990). Marital conflict and children's adjustment: A cognitive-contextual framework. *Psychological Bulletin, 108,* 267-290.

Harold, G.T., & Conger, R.D. (1997). Marital conflict and adolescent distress: The role of adolescent awareness. *Child Development, 68,* 333-350.

Hay, D.F., Vespo, J.E., & Zahn-Waxler, C. (1998). Young children's quarrels with their siblings and mothers: Links with maternal depression and bipolar illness. *British Journal of Developmental Psychology, 16,* 519-538.

Hetherington, E.M., & Clingempeel, W.G. (1992). Coping with marital transitions: A family systems perspective. *Monographs of the Society for Research in Child Development, 57,* 1-242.

Hetherington, E.M., Reiss, D., & Plomin, R. (1994). *Separate social worlds of siblings: The impact of nonshared environment on development.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Hewlett, B.S. (2000). Culture, history, and sex: Anthropological contributions to conceptualizing father involvement. *Marriage and Family Review, 29,* 59-73.

Horwitz, B.N., & Neiderhiser, J.M. (2015). *Gene-environment interplay in interpersonal relationships across the lifespan.* New York, NY: Springer Science and Business Media.

Horwitz, B.N., Marceau, K., & Neiderhiser, J.M. (2011). Family relationship influences on development: What can we learn from genetic research? In K. Kendler, S. Jaffee, & D. Romer (Eds.), *The dynamic genome and mental health: The role of genes and environments in development* (pp. 128-144). New York, NY: Oxford University Press.

Howe, N., & Ross, H.S. (1990). Socialization, perspective-taking, and the sibling relationship. *Developmental Psychology, 26,* 160-165.

Howe, N., Ross, H.S., & Recchia, H. (2011). Sibling relations in early and middle childhood. In P.K. Smith, & C.H. Hart (Eds.), *The Wiley-Blackwell handbook of childhood social development* (2nd ed.) (pp. 356-372). Oxford, England: Wiley-Blackwell.

Jenkins, J.M., & Astington, J.W. (1996). Cognitive factors and family structure associated with theory of mind development in young children. *Developmental Psychology, 32,* 70-78.

Jenkins, J., Cheung, C., Frampton, K., Rasbash, J., Boyle, M.H., & Georgiades, K. (2009). The use of multilevel modeling for the investigation of family process. *European Journal of Developmental Science, 3,* 131-149.

Jenkins, J., Rasbash, J., Leckie, G., Gass, K., & Dunn, J. (2012). The role of maternal factors in sibling relationship quality: A multilevel study of multiple dyads per family. *Journal of Child Psychology and Psychiatry, 53,* 622-629.

Jinks, J.L., & Fulker, D.W. (1970). Comparison of the biometrical genetical, MAVA, and classical approaches to the analysis of the human behavior. *Psychological Bulletin, 73,* 311-349.

Kalmijn, M. (2007). Explaining cross-national differences in marriage, cohabitation, and divorce in Europe, 1990-2000. *Population Studies, 61,* 243-263.

Kendler, K.S., & Baker, J.H. (2007). Genetic influences on measures of the environment: A systematic review. *Psychological Medicine, 37,* 615-626.

Kenny, D.A. (2014). *Cross-lagged panel design.* Wiley StatsRef: Statistics Reference Online.

Kerig, P.K., Cowan, P.A., & Cowan, C.P. (1993). Marital quality and gender differences in parent-child interaction. *Developmental Psychology, 29*, 931-939.

Kowal, A., & Kramer, L. (1997). Children's understanding of parental differential treatment. *Child Development, 68,* 113-126.

Kowal, A.K., Krull, J.L., & Kramer, L. (2006). Shared understanding of parental differential treatment in families. *Social Development, 15,* 276-295.

Kramer, L. (2010). The essential ingredients of successful sibling relationships: An emerging framework for advancing theory and practice. *Child Development Perspectives, 4,* 80-86.

Krishnakumar, A., & Buehler, C. (2000). Interparental conflict and parenting behaviors: A meta-analytic review. *Family Relations, 49,* 25-44.

Lam, C.B., Solmeyer, A.R., & McHale, S.M. (2012). Sibling relationships and empathy across the transition to adolescence. *Journal of Youth and Adolescence, 41,* 1657-1670.

Lamb, M.E., & Elster, A.B. (1985). Adolescent mother-infant-father relationships. *Developmental Psychology, 21,* 768-773.

Leff, J., & Vaughn, C. (1981). The role of maintenance therapy and relatives' expressed emotion in relapse of schizophrenia. *The British Journal of Psychiatry, 139,* 102-104.

Lemery, K.S., & Goldsmith, H.H. (2001). Genetic and environmental influences on preschool sibling cooperation and conflict: Associations with difficult temperament and parenting style. In K. Deater-Deckard, & S. Petrill (Eds.), *Gene-environment process in social behaviours and relationships.* Philadelphia, PA: Haworth Press.

Leonard, L.G., & Denton, J. (2006). Preparation for parenting multiple birth children. *Early Human Development, 82,* 371-378.

Linver, M.R., Brooks-Gunn, J., & Kohen, D.E. (2002). Family processes as pathways from income to young children's development. *Developmental Psychology, 38,* 719-734.

Maccoby, E. (1998). *The two sexes: Growing up apart, coming together.* Cambridge, MA: Harvard University Press.

Magana, A.B., Goldstein, M.J., Karno, M., Miklowitz, D.J., Jenkins, J., & Falloon, I.R.H. (1986). A brief method for assessing expressed emotion in relatives of psychiatric patients. *Psychiatry Research, 17,* 203-212.

Mark, K.M., & Pike, A. (2016). Links between marital quality, the mother-child relationship and child behaviour: A multi-level modelling approach. *International Journal of Behavioral Development.*

Masten, A.S., & Coatsworth, J.D. (1998). The development of competence in favourable and unfavourable environments: Lessons from research on successful children. *American Psychologist, 53,* 205-220.

Matteson, L.K., McGue, M., & Lacono, W.G. (2013). Shared environmental influences on personality: A combined twin and adoption approach. *Behavior Genetics, 43,* 491-504.

McAlister, A.R., & Peterson, C.C. (2013). Siblings, theory of mind, and executive functioning in children aged 3-6 years: New longitudinal evidence. *Child Development, 84,* 1442-1458.

McBride, D.M. (2016). *The process of research in psychology.* Thousand Oaks, CA: Sage Publications.

McCarthy, C.A., Lau, A.S., Valeri, S.M., & Weisz, J.R. (2004). Parent-child interactions in relation to critical and emotionally over involved expressed emotion (EE): Is EE a proxy for behavior? *Journal of Abnormal Child Psychology, 32,* 83-93.

McGuire, S. (2001). Nonshared environment research: What is it and where is it going? *Marriage and Family Review, 33,* 31-57.

McGuire, S., Manke, B., Eftekhari, A., & Dunn, J. (2000). Children's perceptions of sibling conflict during middle childhood: Issues and sibling (dis)similarity. *Social Development, 9,* 173-190.

McGuire, S., Palaniappan, M., & Larribas, T. (2015). The sibling relationship as a source of shared environment. In B.N. Horwitz, & J.M. Neiderhiser (Eds.), *Gene-environment interplay in interpersonal relationships across the lifespan* (pp. 83-95). New York, NY: Springer Science and Business Media.

McHale, S.M., & Crouter, A.C. (1996). The family contexts of children's sibling relationships. In G.H. Brody (Ed.), *Sibling relationships: Their causes and consequences* (pp. 173-195). Westport, CT: Ablex Publishing Corporation.

McHale, S.M., Crouter, A.C., McGuire, S.A., & Updegraff, K.A. (1995). Congruence between mothers' and fathers' differential treatment of siblings: Links with family relations and children's well-being. *Child Development, 66,* 116-128.

McHale, S.M., Updegraff, K.A., & Whiteman, S.D. (2012). Sibling relationships and influences in childhood and adolescence. *Journal of Marriage and Family, 74,* 913-930.

Miklowitz, D.J. (2004). The role of family systems in severe and recurrent psychiatric disorders: A developmental psychopathology view. *Development and Psychopathology, 3,* 667-688.

Nantel-Vivier, A., Pihl, R.O., Cote, S., & Tremblay, R.E. (2014). Developmental association of prosocial behaviour with aggression, anxiety and depression from infancy to adolescence. *Journal of Child Psychology and Psychiatry, 55,* 1135-1144.

Nash, S.C. (1979). Sex role as a mediator of intellectual functioning. In M.A. Wittig, & A.C. Petersen (Eds.), *Sex-related differences in cognitive functioning: Developmental issues* (pp. 263-302). New York, NY: Academic Press.

Neale, M.C. (1991). *Mx: Statistical modeling.* Richmond, VA: Department of Human Genetics.

Neyer, F.J. (2002). Twin relationships in old age: A developmental perspective. *Journal of Social and Personal Relationships, 19,* 155-177.

Neyer, F.J., & Lang, F.R. (2003). Blood is thicker than water: Kinship orientation across adulthood. *Journal of Personality and Social Psychology, 84,* 310-321.

Ng, K.M., & Smith, S.D. (2006). The relationships between attachment theory and intergenerational family systems theory. *The Family Journal: Counseling and Therapy for Couples and Families, 14,* 430-440.

Norton, R. (1983). Measuring marital quality: A critical look at the dependent variable. *Journal of Marriage and Family, 45,* 141-151.

Nuckolls, C.W. (1993). *Siblings in South Asia*. New York, NY: Guilford Press.

O'Connor, T.G., & Croft, C.M. (2001). A twin study of attachment in preschool children. *Child Development, 72,* 1501-1511.

Office for National Statistics (2012). *Family size in the UK, 2012.* London, England: Office for National Statistics.

Office for National Statistics (2013). *Births in England and Wales by characteristics of birth 2, 2013* (p. 5). London, England: Office for National Statistics.

Office for National Statistics (2014). *Local area analysis of qualifications across England and Wales.* London, England: Office for National Statistics.

Oliver, B.R., Trzaskowski, M., & Plomin, R. (2014). Genetics of parenting: The power of the dark side. *Developmental Psychology, 50,* 1233-1240.

Parke, R.D., & Buriel, R. (1998). Socialization in the family: Ethnic and ecological perspectives. In W. Damon, & N. Eisenberg (Eds.). *Handbook of child psychology: Vol. 3. Social, emotional and personality development* (5th ed.). New York, NY: Wiley.

Parke, R.D., Kim, M., Flyr, M., McDowell, D., Simpkins, S.D., Kilian, C.M., & Wild, M. (2001). Managing marital conflict: Links with children's peer relationships. In J.H. Grych, & F.D. Fincham (Eds.), *Interparental conflict and child development: Theory, research, and application* (pp. 291–314). New York, NY: Cambridge University Press.

Pashler, H., & Wagenmakers, E.J. (2012). Editors' introduction to the special section on replicability in psychological science: A crisis of confidence? *Perspectives on Psychological Science, 7,* 528-530.

Patterson, G.R. (1984). Siblings: Fellow travelers in coercive family processes. In R.J. Blanchard, & D.C. Blanchard (Eds.), *Advances in the study of aggression*: *Vol. 1* (pp. 173-213). London, England: Academic Press.

Penninkilampi-Kerola, V., Moilanen, I., & Kaprio, J. (2005). Co-twin dependence, social interactions, and academic achievement: A population-based study. *Journal of Social and Personal Relationships, 22,* 519-541.

Perlman, M., & Ross, H.S. (1997). The benefits of parental intervention in children's disputes: An examination of concurrent changes in children's fighting styles. *Child Development, 68,* 690-700.

Petalas, M.A., Hastings, R.P., Nash, S., Hall, L.M., Joannidi, H., & Dowey, A. (2012). Psychological adjustment and sibling relationships in siblings of children with Autism spectrum disorders: Environmental stressors and the broad Autism phenotype. *Research in Autism Spectrum Disorders, 6,* 546-555.

Piaget, J. (1932). *The moral development of the child.* London, England: Kegan Paul.

Pike, A., & Atzaba-Poria, N. (2003). Do sibling and friend relationships share the same temperamental origins? A twin study. *Journal of Child Psychology and Psychiatry, 44,* 598-611.

Pike, A., Coldwell, J., & Dunn, J.F. (2005). Sibling relationships in early/middle childhood: Links with individual adjustment. *Journal of Family Psychology, 19,* 523-532.

Pike, A., Coldwell, J., & Dunn, J. (2006). *Family relationships in middle childhood.* London, England: National Children's Bureau for the Joseph Rowntree Foundation.

Pike, A., & Oliver, B.R. (2015). Parenting in childhood. In B.N. Horwitz, & J.M. Neiderhiser (Eds.), *Gene-environment interplay in interpersonal relationships across the lifespan* (pp. 57-81). New York, NY: Springer Science and Business Media.

Pike, A., Reiss, D., Hetherington, E.M., & Plomin, R. (1996). Using MZ differences in the search for nonshared environmental effects. *Journal of Child Psychology and Psychiatry, 37*, 695-704.

Pinel-Jacquemin, S. & Gaudron, C.Z. (2013). Siblings: Parent-child attachments, perceptions, interaction and family dynamics. *Journal of Communications Research, 5*, 1-30.

Playfair, G.L. (2002). *Twin telepathy: The psychic connection*. London, England: Vega.

Plomin, R., Asbury, K., & Dunn, J. (2001). Why are children in the same family so different? Nonshared environment a decade later. *The Canadian Journal of Psychiatry, 46*, 225-244.

Plomin, R., & Bergeman, C. (1991). The nature of nurture: Genetic influence on 'environmental' measures. *Behavioral and Brain Sciences, 14,* 373-427.

Plomin, R., DeFries, J.C., Knopik, V.S., & Neiderhiser, J.M. (2013). *Behavioral genetics* (6th ed.). New York, NY: Worth Publishers.

Plomin, R., DeFries, J.C., & Loehlin, J.C. (1977). Genotype-environment interaction and correlation in the analysis of human behavior. *Psychological Bulletin, 84,* 309-322.

Plomin, R., DeFries, J.C., McClearn, G.E., & McGuffin, P. (2001). *Behavioral genetics* (4th ed.). New York, NY: Worth Publishers.

Plomin, R., Rende, R., & Rutter, M. (1991). Quantitative genetics and developmental psychopathology. In D. Cicchetti, & S. Toth (Eds.), *Rochester symposium on developmental psychopathology: Internalizing and externalizing expressions of dysfunction: Vol. 2* (pp. 155-202). Hillsdale, NJ: Lawrence Erlbaum Associates.

Podsakoff, P.M., MacKenzie, S.B., & Lee, J.Y. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88,* 879-903.

Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences, 1,* 515-526.

Price, T.S., Freeman, B., Craig, I., Petrill, S.A., Ebersole, L., & Plomin, R. (2000). Infant zygosity can be assigned by parental report questionnaire data. *Twin Research, 3,* 129-133.

Prout, A. (2002). Researching children as social actors: An introduction to the children 5-16 programme. *Children and Society, 16,* 67-76.

R Development Core Team (2009). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Randell, A.C., & Peterson, C.C. (2009). Affective qualities of sibling disputes, mothers' conflict attitudes, and children's theory of mind development. *Social Development, 18,* 857-874.

Reiss, D., Neiderhiser, E., Hetherington, E.M., & Plomin, R. (2000). *The relationship code: Deciphering genetic and social influences on adolescent development.* Cambridge, MA: Harvard University Press.

Rende, R.D., Slomkowski, C.L., Stocker, C., Fulker, D.W., & Plomin, R. (1992). Genetic and environment influences on maternal and sibling interaction in middle childhood: A sibling adoption study. *Developmental Psychology, 28,* 484-490.

Richmond, M.K., Stocker, C.M., & Rienks, S.L. (2005). Longitudinal associations between sibling relationship quality, parental differential treatment, and children's adjustment. *Journal of Family Psychology, 19,* 550-559.

Roksa, J., & Potter, D. (2011). Parenting and academic achievement: Intergenerational transmission of educational advantage. *Sociology of Education, 84,* 299-321.

Rosenberg, B. (1982). Life span personality stability in sibling status. In M. Lamb, & B. Sutton-Smith (Eds.), *Sibling relationships: Their nature and significance across the lifespan* (pp. 167-224). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin, 86,* 638-641.

Rowe, D.C. (1983). A biometrical analysis of perceptions of family environment: A study of twin and singleton sibling kinships. *Child Development, 54,* 416-423.

Scarr, S., & McCartney, K. (1983). How people make their own environment: A theory of genotype-environment effects. *Child Development, 54,* 424-435.

Segal, N.L. (1997). Twin research perspective on human development. In N.L. Segal, G.E. Weisfeld, & C.C. Weisfeld (Eds.), *Uniting psychology and biology: Integrative perspectives on human development* (pp. 145-173). Washington, DC: American Psychological Association.

Segal, N.L. (1999). *Entwined lives: Twins and what they tell us about human behaviour.* New York, NY: Penguin Books.

Segal, N.L., & Ream, S.L. (1998). Decrease in grief intensity for deceased twin and non-twin relatives: An evolutionary perspective. *Personality and Individual Differences, 25,* 317-325.

Semmer, N.K., Grebner, S., & Elfering, A. (2003). Beyond self-report: Using observational, physiological, and situation-based measures in research on occupational stress. In P.L. Perrewe, & D.C. Ganster (Eds.), *Emotional and physiological processes and positive intervention strategies (Research in occupational stress and well-being: Vol. 3)* (pp. 205-263). New York, NY: Emerald Group Publishing Limited.

Shanahan, L., McHale, S.M., Crouter, A.C., & Osgood, D.W. (2008). Linkages between parents' differential treatment, youth depressive symptoms, and sibling relationships. *Journal of Marriage and Family, 70,* 480-494.

Shaver, P.R., Collins, N.L., & Clark, C.L. (1996). Attachment styles and internal working models of self and relationship partners. In G.J.O. Fletcher, & J. Fitness (Eds.), *Knowledge structures in close relationships: A social psychological approach* (pp. 25-61). Mahwah, NJ: Lawrence Erlbaum Associates.

Shonkoff, J.P, & Phillips, D.A. (2000). *From neurons to neighbourhoods: The science of early childhood development.* Washington, DC: National Academy Press.

Siegler, R., Eisenberg, N., DeLoache, J., & Saffran, J. (2014). *How children develop.* New York, NY: Worth Publishers.

Slomkowski, C., Rende, R., Conger, K., Simons, R., & Conger, R. (2001). Sisters, brothers, and delinquency: Evaluating social influence during early and middle adolescence. *Child Development, 72,* 271-283.

Smith, J., & Ross, H. (2007). Training parents to mediate sibling disputes affects children's negotiation and conflict understanding. *Child Development, 78,* 790-805.

Sroufe, L.A., & Fleeson, J. (1986). Attachment and the construction of relationships. In W. Hartup, & Z. Rubin (Eds.), *Relationships and development* (pp. 51-71). Hillsdale, NJ: Lawrence Erlbaum Associates.

Stocker, C., Dunn, J., & Plomin, R. (1989). Sibling relationships: Links with child temperament, maternal behavior, and family structure. *Child Development, 60,* 715-727.

Stocker, C., & Youngblade, L. (1999). Marital conflict and parental hostility: Links with children's sibling and peer relationships. *Journal of Family Psychology, 13,* 598-609.

Straus, M.A., Gelles, R.J., & Steinmetz, S.K. (1980). *Behind closed doors: Violence in the American family.* New York, NY: Transaction Publishers.

Tancredy, C.M., & Fraley, R.C. (2006). The nature of adult twin relationships: An attachment-theoretical perspective. *Journal of Personality and Social Psychology, 90,* 78-93.

Teti, D.M., & Ablard, K.E. (1989). Security of attachment and infant-sibling relationships: A laboratory study. *Child Development, 60,* 1519-1528.

Thomas, J.G. (1996). The early parenting of twins. *Military Medicine, 161,* 233-235.

Volling, B.L. (2003). Sibling relationships. In M.H. Bornstein, L. Davidson, C.L.M. Keyes, & K.A. Moore (Eds.), *Well-being: Positive development across the life span. Crosscurrents in contemporary psychology* (pp. 205-220). Mahwah, NJ: Lawrence Erlbaum Associates.

Volling, B.L., & Belsky, J. (1992). The contribution of mother-child and father-child relationships to the quality of sibling interaction: A longitudinal study. *Child Development, 63,* 1209-1222.

Wamboldt, F.S., O'Connor, S.L., Wamboldt, M.Z., Gavin, L.A., & Klinnert, M.D. (2000). The five minute speech sample in children with asthma: Deconstructing the construct of expressed emotion. *Journal of Child Psychology and Psychiatry, 41,* 887-898.

Whiteman, S.D., McHale, S.M., & Crouter, A.C. (2007). Competing processes of sibling influence: Observational learning and sibling deidentification. *Social Development, 16,* 642-661.

Whiteman, S.D., McHale, S.M., & Soli, A. (2011). Theoretical perspectives on sibling relationships. *Journal of Family Theory and Review, 3,* 124-139.

Woodward, J. (1998). *The lone twin: Understanding twin bereavement and loss.* London, England: Free Association Books.

Yelland, I., & Daley, D. (2009). Expressed emotion in children: Associations with sibling relationships. *Child: Care, Health and Development, 35,* 568-577.

Youngblade, L.M., Park, K.A., & Belsky, J. (1993). Measurement of young children's close friendship: A comparison of two independent assessment systems and their associations with attachment security. *International Journal of Behavioral Development, 16,* 563-587.

Yu, J.J., & Gamble, W.C. (2008). Pathways of influence: Marital relationships and their association with parenting styles and sibling relationship quality. *Journal of Child and Family Studies, 17,* 757-778.