UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL, HUMAN AND MATHEMATICAL SCIENCES

School of Psychology

The Impact of Same and Separate Classroom Placements on the Social Adjustment of Identical and Non-Identical Same-Sex Twins at School Entry

by

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Thesis for the degree of Doctor of Educational Psychology

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ABSTRACT

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THE IMPACT OF SAME AND SEPARATE CLASSROOM PLACEMENTS ON THE SOCIAL ADJUSTMENT OF IDENTICAL AND NON-IDENTICAL SAME-SEX TWINS AT SCHOOL ENTRY

Katherine Louise Goymour

Educators, parents and researchers continue to deliberate whether twins should be educated in the same classroom or placed in different classrooms when they start school (Alexander 2012; Segal & Russel, 1992). The twin relationship is one of the most intimate of interpersonal bonds (DiLalla & Mullineaux, 2008; Woodward 1998), more so than other sibling-relationships and is thus considered in the context of attachment theory (Tancredy & Fraley, 2006). Yet the nature of the twin bond serves as argument both for and against placing twins in the same classroom. At present, it appears that decisions regarding classroom placement are primarily based on viewpoints, rather than any evidence-base. A systematic review of the literature exploring the impact of classroom placement on behavioural and academic outcomes in young twins has highlighted inconsistent findings. However, no research to date has considered the importance of the twin relationship and the focus of empirical studies has been on behavioural and academic outcomes. No study has yet explored the associations between classroom placement, the quality of the twin relationship and the development of their social competence at school. This empirical paper therefore examines the impact of classroom placement on twins' social adjustment at school, taking into account the quality of their relationship prior to school entry. Results showed that there were no significant associations between these variables, although there was some evidence that the quality of twin relationship varied as a function of zygosity. However, conclusions were interpreted with significant caution due to the very small sample and lack of statistical power. Implications for future research, educational practitioners and parents are also considered.

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DECLARATION OF AUTHORSHIP

I, Katherine Louise Goymour, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

The Impact of Same and Separate Classroom Placements on the Adjustment of Identical and Non-Identical Same-Sex Twins at School Entry

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed:

Date: 22.10.2017

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Finally, I owe my family a huge amount of gratitude as they have helped to shape me into the person I am today and have always supported me every step of the way.

Definitions and Abbreviations

α	Cronbach's Alpha Statistic
ADHD	Attention Deficit Hyperactivity Disorder
β	Beta Statistic
BCa 95% CI	Bias Corrected Accelerated 95% Confidence Intervals
CASP	Critical Appraisal Skills Programme
CBCL	Child Behaviour Checklist
CITO	Dutch CITO-Elementary Test
d	Cohen's *d* Effect Size
DBRS	Disruptive Behaviour Rating Scale
df	Degrees of Freedom
DfE	Department for Education
DZ	Dizygotic/Non-Identical Twins
EAL	English as an Additional Language
F	F Statistic from ANOVA
IQ	Intelligence Quotient
M	Mean
MD	Mean Difference
Mdn	Median
MANOVA	Multiple Analysis of Variance
ML	Maximum Likelihood
MZ	Monozygotic/Identical Twins
N	Total Number of Participants
n	Sub-sample of Participants
NS	The 'Not Separated' group of twins

p	Probability Statistic
*p*β	Probability of Beta
r	Pearson's Correlation Coefficient
RGO	Research Governance Office
SAC	Social Attributions Checklist
SD	Standard Deviation
SDQ	Strengths and Difficulties Questionnaire
SE	The 'Separated Early' group of twins
SE*β*	Standard Error of Beta
SES	Socio-Economic Status
SL	The 'Separated Late' group of twins
t	T Test Statistic
TAMBA	Twins and Multiple Birth Association
TEDS	Twins' Early Development Study
TOWRE	Test of Word Reading Efficiency
TRF	Child Behaviour Checklist – Teacher Report Form
TRQ	Twin Relationship Questionnaire
TRQ-C	Twin Relationship Questionnaire – Child Version
TRQ-P	Twin Relationship Questionnaire – Parent Version
U	Mann-Whitney U Statistic
UK	United Kingdom
USA	United States of America
VIF	Variance Inflation Factor
WPPSI	Wechsler Pre-school and Primary Scale of Intelligence
χ^2	Chi-Squared Statistic
z	Z Score Statistic

Chapter 1: A Systematic Review of Same and Separate Classroom Placements on Twins' Adjustment at School

1.1 Introduction

The most recent birth characteristics in England and Wales indicated that 11,073 women experienced a multiple birth in 2015 (Office for National Statistics, 2016). 10,901 of these women gave birth to twins, 169 to triplets and three to quadruplets or more. This is 2,281 more women experiencing multiple births than in 2000. Indeed, since the 1980s, multiple maternity rates have continued to increase almost annually, particularly in women aged 45 and older. It is thought that such an increase has come about due to several different factors such as the availability and success of fertility treatments, women delaying pregnancy, and an increase in infant survival rates (Alexander, 2012). The focus for the rest of this literature review will be on twins, as they are the most typical type of multiples (Katz, 1998).

As a result of the general increase in multiple births, many educational settings are now experiencing a rapid rise in the number of twins that become enrolled with them (Beauchamp & Brooks, 2003) and the classroom placement of twins is a continuous source of discussion amongst educators, parents and researchers alike: whether twins should be educated in the same classroom or placed in different classrooms when they start school. There appear to be three inter-linking factors that fuel these on-going deliberations: the strong views held by educators and parents, the absence of a shared understanding in society about the exact nature and importance of the twin relationship, and a lack of empirical evidence upon which to draw solid conclusions. In this review, I will first discuss the theories and research that have explored the twin relationship.

Secondly, I will outline the arguments about the benefits and disadvantages of separating twins in school and consider them against the available evidence base. Thirdly, findings of relevant research on the impact of classroom placement on twins' adjustment at school will be assessed. This is followed by the consideration of methodological issues, wider implications of the research, and suggestions for future exploration.

1.1.1 The Significance of the Twin Relationship

Several researchers have proposed that the twin relationship is one of the most intimate of interpersonal bonds (e.g., Burlingham, 1945; DiLalla & Mullineaux, 2008; Koch, 1966; Woodward, 1998). Furthermore, it has been argued that this bond is closer between identical (monozygotic; MZ) twins than non-identical (dizygotic; DZ) twins (Koch, 1966; Segal, 1984; Segal & Hershberger, 1999). One possible explanation for this has been offered through a biological perspective of family relationships (Hamilton, 1964; Neyer & Lang, 2003). It is argued that people are predisposed to behave in pro-social ways towards those with whom they share their genes, to benefit one's inclusive fitness. According to this theory, it is therefore especially likely to be true for identical twins, given that they share 100% of their genes, in comparison with the 50% shared by non-identical twins.

Tancredy and Fraley (2006) propose that attachment theory provides an alternative framework for understanding the ways in which twins relate to each other. It is thought that, during the first few years of their lives, the twins' sole focus is on their primary caregiver (Leonard, 1961), and that this attention shifts to another readily accessible social partner, namely their co-twin, at around 36 months (Mahler, Pine, & Bergman, 1975). Accordingly, around three years of age may constitute an important time when

twins are becoming increasingly involved with one another (Ainslie, 1997) and begin to experience cooperation, reciprocity and trust through play (Ainsworth, 1991), all of which contribute to the development of a secure attachment relationship between them (Fraley & Davis, 1997). It is further argued that this relationship might be more prominent in twins than in other sibling-relationships, given that the twins are the same age and are likely to have had a greater proportion of shared experiences (Tancredy & Fraley, 2006). However, it is worth noting that Mahler et al.'s (1975) claim has been refuted through anecdotal evidence suggesting that twins share a fascination with each other as soon as they are able to manoeuvre into a position where they can maintain eye contact (A. Thomas, personal communication, March 21, 2017). As there are no recent empirical studies available to corroborate or refute these claims, this is an important area for future research and would help develop our understanding of the early development of twin relationships.

Whilst there is evidence to suggest that twins can develop close, interdependent relationships with each other, it is not clear to what extent such relationships could be classified as attachment. According to Ainsworth (1991), attachment relationships can be characterised by proximity seeking, separation distress, safety and assurance seeking and the use of another person as a safe base to enable exploration of the environment. Some researchers have therefore attempted to explore twin relationships in greater depth, using aspects of these characteristics as a guiding framework.

With regards to proximity seeking, Koch (1966) found that pre-school aged twins were more likely to play together and express a greater desire to be kept together than non-twin siblings. Furthermore, Segal (1999) highlighted that identical twins demonstrate greater physical closeness than non-identical twins. Other findings from twin studies

have included the intensity of loss that is felt by a twin when their co-twin dies (Segal, Wilson, Bouchard, & Gitlin, 1995; Woodward, 1998), the ability of twins to soothe each other when others cannot (Leonard, 1961), and the perception of a co-twin as a potential 'transitional object' during novel situations (Sandbank, 1999).

Tancredy and Fraley (2006) attempted to assess the presence of attachment features and functions in twin relationships in a more systematic way. Arguably, their study focussed on older twins, ranging from 14 to 61 years old. However, it has still offered more insight into the nature of the twin relationship. They asked twins and non-twins to rate the extent to which they felt their siblings fulfilled the four attachment-related characteristics. Overall, it was found that twins were more likely than non-twins to regard their sibling as an attachment figure. In their final conclusions, Tancredy and Fraley argue that placing twin studies within an attachment framework helps refine the lens through which we view these relationships.

Whilst an evolutionary approach and attachment theory have been presented as two different perspectives, they could in fact be considered complementary to each other and discussed within a unified framework. Tancredy and Fraley noted that their data showed that people were more likely to develop an attachment bond with someone with whom they shared a larger proportion of their genes. In addition, the sharing of genes is likely to impact and influence relationship dynamics between people, in a way that helps to foster the development of an attachment relationship.

Given the importance that research and theory has placed on the nature of the bond twins share, coupled with the fact that the number of twins being born in the United Kingdom (UK) continue to increase every year, the classroom placement of twins is therefore becoming a steadily more prominent issue faced by parents and educators

alike. The quality of the twin bond needs to be taken into consideration, along with the understanding that school entry falls at a critical stage of child development and could conceivably be the first time twins experience any form of separation from each other (Segal & Russell, 1992). This is possibly because parents reportedly find it difficult to provide the twins with separate experiences (Preedy, 1999). It is perhaps the nature of the twin relationship that becomes a sticking point as this has been used as part of the rationale for keeping twins together in the classroom and for separating them.

1.1.2 Classroom Placement Rationale: Same or Separate?

Advocates for educating twins in the same classroom provide arguments at three different levels: within the twin dyad, within the school organisation, and within the wider family context. At the twin-dyad level, Segal and Russell (1992) have argued that separation could cause distress and lead to a variety of emotional difficulties for some twins, particularly as they might otherwise have to adjust to separation from their parents, as well as separation from their co-twin (Segal, 2006). Secondly, it has been posited that twins can help support each other through academic and social difficulties in novel environments, such as a classroom setting (Alexander, 2012; Hay & Preedy, 2006). Thirdly, at a more systemic level, it has been argued that keeping twins in the same classroom helps to avoid some of the more practical issues around the twins having two different teachers, separate work requirements and separate parent-teacher interactions (Staton, Thorpe, Thompson, & Danby, 2012). It therefore arguably assures that the twins are receiving equal educational opportunities and experiences. Finally, at the family level, Alexander (2012) has emphasised the importance of giving due consideration to the emotional well-being of the twins' family unit before decisions about classroom

placements are made, particularly if they are already experiencing stress in relation to health or special educational needs.

However, these arguments appear to be primarily based on mothers' collated responses to school policy and classroom placement satisfaction surveys (e.g., Segal & Russell, 1992) rather than any empirical evidence, perhaps with the exception of the argument that separation could lead to emotional difficulties in twins. This was found to be the case in a study by Tully et al. (2004), which will later be explored in more detail as it has been included as one of the assessed studies in this systematic review.

For every argument supporting keeping twins together, there is a counter argument for separation. Indeed, most opinion pieces on the classroom placement of twins attempt to present a balance between the two stances, as argued by parents (e.g. Segal & Russell, 1992) and school staff (e.g., Jones & De Gioia, 2010; Nilsson, Leonard, Barazanji, & Simone, 2010), and as summarised by researchers (e.g., Alexander, 2012; Hay & Preedy, 2006). Firstly, it has been suggested that the closeness of the twin relationship actually obstructs the development of both twins' individuality and independence (Koch, 1966) and prevents the exploration of their own individual interests and abilities (Segal, 2005) and their own social networks (Hay & Preedy, 2006). At a wider level, Hay and Preedy have also presented the argument that classroom separation decreases the likelihood of adults making direct comparisons between the twins' abilities. Such a comparison can be particularly problematic if one twin is perceived as more able than the other and this has been found to impact on the self-esteem of the twin who feels they do not measure up to their co-twin in certain academic activities (Blevins, 2001).

At present, however, it appears that decisions regarding classroom placement are primarily based on viewpoints, rather than any evidence-base (Hay, 2004). Moreover, the

views upon which decisions are made appear to be based on explicit beliefs and ideologies that relate to multiple birth children as a homogenous group (Beauchamp & Brooks, 2003; Nilsson et al., 2010). This has been particularly reflected in specific schools and local authorities who have taken an organisational-level approach, whereby a generalised policy regarding twin separation at school is applied to all twin children within a specific population (Staton et al., 2012). Despite the lack of empirical evidence, the overwhelming message from the literature is that schools should adopt flexible placement policies, whereby the needs and experiences of each child within the twin pair are considered on a case-by-case basis (Segal, 2005; Tully et al., 2004), along with input from the parents (Katz, 1998; Segal 2005). There are therefore questions about how the literature marries up with the strong views held by educators and parents, and about how schools should operate with regards to their policies.

1.1.3 Aims and Scope of Literature Review

Despite the strong opinions held by many, the body of literature that is accessible to the public primarily comprises of opinion pieces about the different perceptions people have about educating twins together and apart. There is very little empirical evidence upon which these decisions and views are based. The picture is still not clear about the impact of different classroom placements on twins. This systematic literature review therefore aims to provide some clarity as it explores the available research that has been conducted within the last few decades.

An overview of the findings will be presented to understand in broad terms the impact of classroom placement on the adjustment of twins at school. Classroom placement refers to whether twins are educated in separate classrooms or are kept together. Based on the themes that emerged from the literature, adjustment is more

specifically explored in terms of twin behaviour and academic achievement at school. Furthermore, this review aims to assess whether the impact of classroom placement varies as a function of twin zygosity. The findings of this systematic review will therefore be framed around three different questions:

1. What is the impact of classroom placement on the behaviour of twins?
2. What is the impact of classroom placement on the academic achievement of twins?
3. Does the impact of classroom placement (if any) differ depending on zygosity?

1.2 Methodology

1.2.1 Data Sources and Literature Search Strategy

Searches were conducted in three different electronic data bases: PsycINFO (via EBSCO), Web of Science Core Collection (via Thomas Reuters) and ERIC (via ProQuest). These searches were conducted between September and December 2016. The terms that were used fell under three different categories: population, condition and outcome. For population, several different terms were used to capture the fact that the literature refers to twins in numerous ways. These terms included twin* OR “identical twin*” OR “non-identical twin*” OR co-twin* OR “monozygotic twin*” OR “dizygotic twin*” OR “multiple birth child*” OR “multiple birth*” OR multiple* OR triplet*. For the condition category, the search terms used were class* OR “classroom placement*” OR “school placement*” OR “classroom environment*” OR “learning environment*” OR “school environment*”. Finally, the outcome category aimed to capture the adjustment of twins in their different classroom placements. Many search terms were therefore used in order to reflect this broad term of ‘adjustment’. These terms included the following: “academic achievement” OR behav* OR “social well-being” OR “social skills” OR “social competence”

OR “social funct*” OR “emotional well-being” OR “emotional competence” OR “emotional funct*” OR “emotion regulation” OR adjustment OR “peer interaction*” OR “psychological well-being” OR “psychological competence” OR “psychological funct*” OR self-regulation OR self-concept OR self-efficacy OR “peer relationship*” OR identity.

In PsycINFO, the terms “academic achievement”, adjustment and self-concept were exploded to include additional terms that were related. In Web of Science Core Collection and ERIC, these additional terms were input by hand. The population, condition and outcome searches were then combined using the AND search. Appendix A shows an overview of the search terms and process. Once the electronic search was completed, the results were exported into Mendeley, an electronic reference manager, and were further assessed for their eligibility using inclusion criteria. The reference list of the papers that were included in the final review was manually searched to obtain additional articles. The electronic search retrieved 5,464 records, once duplicates across the databases were removed. Once the criteria for inclusion and exclusion was applied, titles and abstracts were scanned for relevance and a further 5,150 publications were excluded. Of the 315 papers remaining, only six met the pre-defined inclusion criteria for this literature review. Appendix B provides a flow diagram of this search process and Appendix C highlights the screening process of the final 315 papers.

1.2.2 Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were applied to all the studies produced through the systematic search (Table 1).

Table 1

Inclusion and Exclusion Criteria

Category	Inclusion Criteria	Exclusion Criteria
Participants	• 0-12 years old	• Older than 12 years old
Study Design	• Qualitative methodology • Quantitative methodology	
Variables	• Specific measures of the impact of classroom placement on twins	• No recorded measures of the impact of classroom placement on twins
Date	• 1990-2016	• Before 1990
Publication Requirement	• English language • Peer-reviewed journals	• Languages other than English • Books • Conference Papers • Unpublished works (e.g., dissertations, theses)

Participants. Studies were included if the participants were identified as twins who were attending school. As most research in this area has been done with younger twins, the 'childhood' (birth – 12 years) filter was applied in PsycINFO and any studies including 'Adult Education' or 'Adult Basic Education' were excluded in ERIC.

Study design. Studies were eligible for inclusion if they used a qualitative or quantitative methodology.

Variables. Studies were included if they specifically focused on the impact of classroom placements on twins. Studies that measured gene and environment interactions were excluded because it would not have been possible to separate the impact of classroom placement from other environmental factors. Furthermore, the qualitative studies were also excluded due to the fact that they focussed on the perceptions of school staff and parents about the initial decision-making process and the

factors to consider prior to the twins starting school, rather than on the impact of classroom placements on the twins once they had started school.

Date. Studies were only eligible for inclusion if they were published between the years 1990 and 2016. This is to reflect that fact that empirical studies in this area only began to emerge during the 90s. Prior to this point in time, the topic of classroom placement and twins was gaining publicity through opinion pieces, without any empirical evidence.

Publication Requirement. Studies were included if they were published in a peer-reviewed journal and were written in English. Any books, conference papers and unpublished work such as dissertations were therefore excluded.

1.2.3 Data Extraction

Six studies were included in the final, in-depth review. They were re-read, in order to extract relevant data information (see Table 2). For each study, details were provided about participant characteristics, design, countries, measures used and any findings.

1.2.4 Study Quality Assessment

All of the studies included adopted a longitudinal design. The quality of the studies included was therefore reviewed and assessed using a cohort study checklist from the Critical Appraisal Skills Programme's (CASP) website (http://www.casp-uk.net) and some of the key consideration points from an article by (Young & Solomon, 2009). Particular attention was given to the part of the article highlighting methodological points to consider during the appraisal of cohort studies.

Table 2

Data Extraction Table

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
Tully, Moffitt, Caspi, Taylor, Kiernan & Andreou (2004)	**Country:** UK **Design:** Longitudinal	Sample derived from same-sex twins who participated in the Twins Early Development Study (TEDS) and Environmental Risk (E-risk) Study, who were born in 1994 and 1995. **N:** 878 twin pairs *(1756 total)* **Gender:** 423 male twin pairs *(846 total)*, 455 female twin pairs *(910 total)* **Zygosity:** 484 monozygotic twin pairs *(968 total)*, 394 dizygotic twin pairs *(788 total)* **Age:** 5 and 7	**Behaviour:** Rutter Child Scales (Sclare, 1997); Diagnostic and Statistical Manual of Mental Disorders (DSM-IV); Child Behaviour Checklist Teacher Report Form (TRF; Achenbach,1991); Revised Rutter Scale for School-Age Children (Sclare, 1997); Strengths and Difficulties Questionnaire (Goodman, 1994) **Academic:** Teachers rated child's performance in relation to their peers along a 7-point scale; Test of	**Behaviour:** • MZ and DZ twins separated at age 5 showed more teacher-rated internalising problems than those never separated. • Internalising problems persisted over time for MZ twins. **Academic:** • MZ twins separated at 7 years had poorer reading abilities than non-separated twins. • DZ twins separated at 5 years were rated as working harder than non-separated DZ twins.

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
			Word Reading Efficiency (TOWRE; Torgesen et al., 1999)	
Van Leeuwen, van den Berg, van Beijstrveldt & Boomsma (2005)	**Country:** Netherlands **Design:** Longitudinal – short term and long term effects	Sample of twins from the Netherlands Twin Registry (NTR), who were born 1986-96. **N:** 6738 twin pairs (CBCL) and 5686 twin pairs (TRF) for short-term effects analysis. 284 twin pairs (TRF) and 843 twin pairs (CITO) for long-term effects analysis. **Zygosity:** MZ and DZ included depending on measures **Age:** 3, 5, 7 and 12	**SES:** Description of parental occupation classified using 5-point scale **Behaviour:** Child Behaviour Checklist (CBCL) and Teacher Report Form (TRF) **Academic:** Dutch national test of academic achievement (CITO)	**SES:** • Classroom separation at aged 5 was significantly associated with SES ($\chi^2(1) = 58.96$, $p < .01$) **Behaviour: Short term effects** • Classroom separation at aged 5 was significantly associated with externalising problems at aged 3 ($\chi^2(1) = 19.13$, $p < .01$) • Separated twins scored significantly higher on problem behaviour than non-separated twins, $F(2, 4854) = 7.53$, $p < .01$ • Significant main effect of separation for internalising, $F(1, 4855) = 14.77$, $p < .01$,

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
				and externalising problems, $F(1, 4855) = 35.50$, $p < .01$ • Significant interaction between age of separation and internalising scale $F(1, 4855) = 14.77$, $p < .01$, with a small effect size of 0.14 • No significant differences found between how MZ and DZ twins react to separation, $F(2, 4852) = 0.88$, $p = .42$ • Separated twins rated significantly higher by teacher on problem behaviour at age 7 than non-separated twins, $F(2, 1495) = 3.09$, $p = .05$ • Significant difference in internalising problems only, $F(1, 1496) = 6.00$, $p = .01$ • No interaction effect between zygosity and separation, $F(2, 1730) = 0.45$, $p = .64$ **Long term effects** • SES, problem behaviour at age 3 and within-twin pair differences in

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
				internalising problems did not predict separation at school; SES χ^2 (2) = 3.24, *p* = .20; internalising χ^2 (2) = .60, p = .74; externalising χ^2 (2) = 2.71, *p* = .26; within pair difference internalising χ^2 (2) = 3.46, *p* = .18 • Within-pair differences at age 3 in externalising problems predicted separation at school χ^2 (2) = 8.34, *p* = .02 **CBCL** • Twins in the partly separated group scored highest on the maternal ratings, followed by separated and then together • Significant effect of separation, *F*(4, 3294) = 5.92, *p* < .01, on maternal CBCL ratings for internalising *F*(2, 1647) = 10.11, *p* < .01, and externalising *F*(2, 1647) = 8.29, *p* < .01 scales

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
				• No significant interaction effect between age of testing and separation $F(4, 3294) = 1.17$, $p = .32$ **TRF** • Separated twins scored highest on the internalising and externalising scale, followed by together and then partly group. • Main effect of separation at school on TRF ratings at age 12, $F(4, 1646) = 4.25$, $p < .01$ for internalising, $F(2, 823) = 7.29$, $p < .01$ and externalising scales $F(2, 823) = 9.84$, p = .02 • Only significant difference, $p < .05$, between together and separated group • No interaction between zygosity and separation, $F(4, 1640) = 1.28$, $p = .28$ **Academic:** • Twins in partly separated group scored highest ($M = 541.6$, $SD = 5.83$), followed

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
				by together (*M* = 538.1, *SD* = 8.69) and separated groups (*M* = 537.8, *SD* = 8.95) • Separation had a significant effect on CITO scores *F*(2, 840) = 4.25, *p* = .02 between partly separated and together group, and partly and separated group. • No interaction between CITO ratings, zygosity and separation, *F*(2, 837) = 0.07, *p* = .93
Webbink, Hay & Visscher (2007)	**Country:** Netherlands **Design:** longitudinal	Data sought from longitudinal PRIMA survey from Netherlands Twin Registry (NTR) using first five waves of data (1994, 1996, 1998, 2000, 2002). **N:** 2878 twin pairs (5756 total) **Gender:** Used same-sex and opposite sex twins **Zygosity:** No info given **Age:** 6, 8, 10 and 12	**Cognitive:** IQ score (non-verbal intelligence), arithmetic tests, language tests and CITO	• Separated twins scored on average lower in language and arithmetic than those not separated. • Higher grades – no effect of classroom separation on cognitive ability.

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
DiLalla & Mullineaux (2007)	**Country:** UK **Design:** Longitudinal	Sample derived from twins who participated in the Twins Early Development Study (TEDS) 1994-96 **N:** 1935 MZ twin pairs (3870) **Age:** 4-7 Mean ages at assessment were 4.04 years (*SD* = 0.11) at age 4, 7.06 (*SD* = 0.25) for parent ratings at age 7 and 7.20 (*SD* = 0.28) for teacher ratings at age 7	**Behaviour:** Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) completed by parents and teachers – Emotional symptoms and anxiety, conduct problems, hyperactivity-inattention and peer problems. Prosocial scale was not used.	• No significant effect of being in the same or different class as the co-twin except for peer problems. • Small, but significant interaction effects for conduct disorder and peer problems. • Significant main effects for being in the same versus different classrooms as their co-twin for conduct disorder, peer problems, and total behavioural problems.
Coventry, Byrne, Coleman, Olson, Corley, Willcutt & Samuelsson (2009)	**Country:** Australia/USA **Design:** Longitudinal	Twins recruited from Australian Twin Registry and Colorado Birth Registry **N:** 1505 children who were either same-sex or triplets (50% MZ; 51% males)	**Behaviour:** The Disruptive Behaviour Rating Scale (DBRS; Barkley & Murphy, 1998) **Academic:** Composite measure of pre-school print knowledge using Letter recognition from names, sounds,	**Kindergarten:** • Regressions showed trend towards higher scores on reading for children in the same class, *t(*700) = 1.68, *p* = .094, with an effect size of Cohen's *d* = .12 (small). But not significant. • Disruptive behaviours significantly mediated the association between

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
		Age: pre-school (3-4), kindergarten (4-6), grade 1 (6-7) and grade 2 (7-8)	concepts about print (Clay, 1975) and a test of environmental print exposure, using common words like *stop* and *exit.* Test of Word Reading Efficiency (TOWRE; Torgesen et al., 1999)	classroom assignment and kindergarten reading (*z* score = 4.81, *p* < .001) • Print knowledge was also a significant mediator (*z* score = 2.69, *p* < .01) • Pre-school print knowledge and DBRS correlated -.281, *p* < .01 **Grade 1:** • Close-to-significant difference in TOWRE scores acorss three groups, *t*(471) = 1.96, p = .050, Cohen's *d* = .17 (small) with children in the same class scoring higher, as in kindergarten. **Grade 2:** • Means for children placed in either same or different class for three consecutive years showed less of a trend towards significance. • Regression yielded *t*(303) = 1.61, *p* = .108, Cohen's *d* = .18.

Author(s), Date	Study Characteristics	Participant Characteristics	Measures	Outcomes
Polderman, Bartels, Verhulst, Huizink, Beijsterveldt & Boomsma (2010)	**Country:** Netherlands **Design:** Longitudinal	Sample is from the Netherlands Twin Register (NTR) Using birth cohorts from 1986-93. **N:** 2003 twin pairs (4006 total) **Zygosity/Gender:** MZM 370 pairs, MZF 469 pairs, DZM 269 pairs DZF 302 pairs, DOS 593 pairs **Age:** data from when twins were aged 3, 5, 7, 10 and 12 was used	**Academic:** CITO	• After adjusting for confounding effects, there was no significant effect on CITO scores $F(2, 1653) = 1.99$, $p = .138$ with an effect size of 0.04. • No interaction between classroom separation and zygosity $F(8, 686) = 0.58$, $p = 0.798$.

1.3 Results

This systematic review aims to summarise the evidence from six longitudinal studies relating to the impact of classroom placement on twins' behaviour and academic achievement at school. The evidence is reviewed in two sections. Firstly, consideration is given to the methods used (e.g., the design of these studies, the characteristics of the samples, and the different measures used). Secondly, the findings on the impact of classroom placement on twins' behaviour, academic achievement and as a function of zygosity, are presented and critically discussed in relation to methodological strengths and limitations. Implications for future research and education practice are also considered. Table 2 summarises the key characteristics of the six studies included in this review.

1.3.1 Study Source

While the systematic search was confined to a publication period between 1990 and 2016, all the studies identified were published between 2004 and 2010. Four of the six studies were published in journals relating specifically to the development of multiple birth children: Twin Research (Tully et al., 2004) and Twin Research and Human Genetics (Coventry et al., 2009; van Leeuwen, van den Berg, van Beijsterveldt, & Boomsma, 2005; Webbink, Hay, & Visscher, 2007) . The other two studies were published in the Journal of School Psychology (DiLalla & Mullineaux, 2008) and the Journal of Epidemiological and Community Health (Polderman et al., 2010), which are concerned with practices relevant to psychological and behavioural processes in school settings and the study and improvement of communities all around the world, respectively.

1.3.2 Design

All six studies adopted a longitudinal design to investigate the impact of different classroom placements (i.e., together or separate) over different time scales. The shortest duration between the initial and follow-up assessment was two years (Tully et al., 2004). Other studies assessed the twin samples over a period of three years (DiLalla & Mullineaux, 2008), five years (Coventry et al., 2009), six years (Webbink et al., 2007), seven years (van Leeuwen et al., 2005) and nine years (Polderman et al., 2010).

1.3.3 Sample Characteristics

The synthesis table (Table 2) shows that the studies were conducted in the Netherlands, UK and USA/Australia. Cohorts of participants were selected from large population samples of twins who were on the birth registry for their country. It is worth noting that the studies conducted in the UK and the Netherlands used data from the same or overlapping cohorts. Researcher access to the birth registries permitted the use of large samples in all six studies. However, not all the studies reported on the zygosity (Webbink et al., 2007) or gender (DiLalla & Mullineaux, 2008; van Leeuwen et al., 2005) of the twins in their samples. Zygosity was primarily determined via DNA analyses and zygosity questionnaires. One study only included MZ twins in order to study the impact of the classroom environment on twins whilst holding genetic influence constant (DiLalla & Mullineaux, 2008). All six studies focused on twins who were between the ages of 3 and 12 years old.

1.3.4 Measures Used

As the studies all explored the impact of classroom placement on a variety of outcomes, a range of different measures have been used. These measures have been categorised as 'behavioural measures', 'academic measures' or 'other measures' and have also been included in the synthesis table.

Behavioural measures. The tools used to ascertain any observable change in internalising and externalising behaviour included variants of the Rutter Child Scales (Sclare, 1997; *n* = 1), the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; *n* = 2), the Disruptive Behaviour Rating Scale (DBRS; Barkley & Murphy, 1998; *n* = 1), and variants of the Child Behaviour Checklist, depending on the age of the twins (CBCL; Achenbach, 1991a, 1992) that were filled in by parents or teachers (*n* = 3). Teachers used the Teacher Report Form (TRF; Achenbach, 1991b). Some studies used more than one of these measures, whereas one did not measure behaviour at all (Webbink et al., 2007).

Academic measures. The three Dutch-based studies measured educational achievement using the Dutch CITO-elementary test. This tool assesses four different skills of language, mathematics, information processing and word orientation and is usually administered when children are approximately 12 years old. In addition to the CITO, Webbink et al. (2007) also used non-verbal components to measure IQ, in addition to tests of language and arithmetic that are used with children who are younger than 12 years old.

Coventry and colleagues (2009) measured pre-school print knowledge (Clay, 1975), which is thought to be a child's earliest introduction to reading and literacy (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003) and a Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999). The TOWRE was also used by Tully and colleagues (2004), along with a measurement of IQ using the Wechsler

Preschool and Primary Scale of Intelligence-Revised (WPPSI; Wechsler, 1990). Tully et al. (2004) also assessed twins' progress at school by asking teachers to rate each twin's performance in relation to their peers on a seven-point scale, where 1 was *much less* and 7 was *much more compared with other children in the classroom*. DiLalla and Mullineaux (2007) did not include any measures of academic achievement as their study focused on behaviour outcomes.

Other measures. Two of the Dutch-based studies also included measures of socio-economic status (SES; Polderman et al., 2010; van Leeuwen et al., 2005). SES was ascertained through full descriptions of the occupations of parents and classified on a five-point scale (Fengler, Joung, & Mackenbach, 1997), in accordance with normal practice in the Netherlands. Polderman et al. (2010) also considered whether urbanisation level was associated with classroom placement of twins. This was determined by linking participants' post codes to a scale (from very high to very low/none) that was pre-defined by Statistic Netherlands (Fengler et al., 1997).

1.3.5 What is the Impact of Classroom Placements on Twins' Adjustment at School?

This section will explore the research evidence, provided by the six identified longitudinal twin studies, to address three specific questions about the impact of different classroom placements on the adjustment of twins in school. The results from these studies have been grouped into themes to explore the impact on two different outcomes: behaviour and academic achievement. Consideration will then be given to whether the impact of classroom placement is different depending on the zygosity of the twins who took part.

1.3.6 What is the Impact of Classroom Placement on the Behaviour of Twins?

Tully et al.'s (2004) study was the very first of its kind to explore the impact of classroom placement on the behaviour of twins. Twins were followed over a period of approximately 18 months, from when they first started school at aged 5 in the UK. The twins in this study were categorised into three different groups: those who remained in the same classroom between the ages of 5 and 7 (Not Separated [NS] group), those who were kept in separate classes between the ages of 5 and 7 (Separated Early [SE] group) and those who were kept together at age 5 and separated by the age of 7 (Separated Late [SL] group). Findings demonstrated that the SE group showed more teacher-rated internalising problems at age 5 than the NS group, and that this was the case regardless of whether the twins were MZ or DZ. DZ twins in the SE group were also rated as showing more symptoms of attention deficit hyperactivity disorder (ADHD) than those in the NS group. However, Tully and colleagues did not control for any pre-existing factors prior to the start of the twins' schooling. Indeed, pre-existing symptoms of ADHD may have been a contributing factor when deciding where to place the twins.

Additionally, Tully et al. found that the MZ twins in the SE group also displayed more internalising problems at age 5 than MZ twins in the SL group. Interestingly, MZ twins in the SE group also continued to have a higher rating of internalising problems than the NS group 18 months later. This finding was also true for MZ twins in the SL group, in comparison with those in the NS group. Further comparison between the SL group and NS group highlighted that MZ twins in the NS group displayed significantly more prosocial behaviour than the SL group at 5 years old. Additionally, MZ twins in SL group demonstrated a significantly greater increase in internalising problems between 5 and 7 years old than the NS group. On the basis of these findings, the authors concluded that twins who were placed in separate classrooms at the start of school had more

internalising problems than those who were not separated and that these problems were still significantly noticeable in identical twins two years later.

Van Leeuwen and colleagues (2005) conducted a longitudinal study of Dutch twins. They collected data on twins from when they were 3 years old until the age of 12 and distinguished between short-term effects (i.e., after two years of schooling) and long-term effects (i.e., after seven years of schooling). With regards to the short-term effects, they found that twins who were separated at the age of 5 scored significantly higher on internalising (n = 1918) and externalising (n = 1951) problem behaviours at the age of 7 (as rated by mothers on the CBCL) than twins who were not separated (n = 3778 and n = 3835 for internalising and externalising problems respectively). However, this was a very small effect size for both (d = 0.1; Cohen, 1960). The data provided by teachers highlighted similar findings to the mother-reported results, in that twins who were separated aged 5 scored significantly higher on internalising (n = 686) and externalising (n = 719) problem behaviours at age 7 than those who were not separated (n = 1050 and n = 1076 for internalising and externalising problems respectively). These also had a very small effect size (Cohen's d = 0.1). Univariate tests highlighted a significant main effect of separation on maternal-rated internalising and externalising problems. Analysis of the teacher-rated results only highlighted a significant difference on internalising problems. Additionally, there was a significant interaction between age and separation for the internalising scale. Based on these findings, the authors concluded that differences in levels of internalising problems at age 7 were as a direct result of being separated from their co-twin, rather than any pre-existing differences at age 3.

With regards to the long-term effects, it was found that twins who were separated part way through their schooling (at age 7) scored higher on maternal ratings on the CBCL

than twins who either remained together or who were separated between the ages of 5 and 12. A higher score on the CBCL implies greater behavioural and emotional difficulties. A multivariate analysis of variance (MANOVA), with repeated measures, was carried out to identify whether the differences could be attributed to the separation or not. A significant effect of separation on maternal CBCL ratings was found. Univariate testing demonstrated a significant main effect for the internalising and externalising scales. However, unlike with the short-term effects, the authors did not find a significant interaction between age of testing and separation. This means that, once the authors controlled for pre-existing differences at age 3, the long-term effects on twins' internalising and externalising behaviours were not as a direct result of being in separate classrooms.

Unlike maternal ratings of child behaviour, teachers (TRF) rated twins who had been separated between the ages of 3 and 12 higher on the internalising and externalising scale than those who were together throughout and those who were separated part way through at aged 7. There was a main effect of separation on teacher ratings of internalising and externalising problems in twins at age 12. However, differences between groups were only significant for those who had only ever been together or apart throughout their time at school, between the ages of 5 and 12. This was not the case for the group of twins who experienced separation part way though their schooling at aged 7.

Taking these findings together, van Leeuwen et al. (2005) concluded that separating twins at age 5 leads to internalising problems at the age of 7, although this effect is small. However, it is worth noting that this effect had disappeared by the time the twins reached the age of 12 years old. Whilst the development of internalising problems

appears to support the findings by Tully et al. (2004), the latter finding suggests that separation does not have as much of an impact in the longer-term.

DiLalla and Mullineaux (2007) also sought to build on the findings by Tully et al. (2004), and used some of the same population to do so. Having assessed the twins' anxiety, hyperactivity, conduct disorder and peer problems through the SDQ, there was only one significant effect of classroom placement on peer problems. In other words, twins who were in a different classroom from their co-twin were rated by their teachers as having significantly more peer problems than those who were kept together.

In addition, DiLalla and Mullineaux found significant interaction effects for conduct disorder and peer problems, although this effect size was small. Twins (n = 1601) who were rated by their parents as having conduct problems at the age of 4 years old were also rated by their teachers as having more conduct problems if they had been placed in separate classrooms. In addition, some twins who were kept together at school were more likely to be rated as having conduct problems by their teachers, even though their parents had not identified these difficulties at the age of 4.

With respect to peer problems, twins were rated by their teachers as having difficulties at school if their parents had rated them as having peer problems at the age of 4 and if they had been placed in separate classrooms. In contrast, twins who were kept together and who did not experience peer difficulties at the age of 4, as rated by their parents, were also rated as having the fewest peer problems by their teachers. These findings were slightly different to teacher ratings of conduct problems, where classroom placement did not appear to make a difference to teacher ratings.

Furthermore, DiLalla and Mullineaux also found that, for all behaviour (anxiety, hyperactivity, conduct problems, peer problems and total behaviour problems), parents' ratings of twins aged 4 were significantly predictive of parental ratings when the twins were 7 years old. It was also found that parents were more likely to rate their twins as having behaviour difficulties if they had been separated from each other at school. Finally, there appeared to be a small, significant interaction effect between parental ratings of conduct problems in twins at age 4 and classroom placement: twins who were rated as having conduct problems at the age of 4 and had been separated continued to receive higher parental ratings of conduct problems at age 7 than twins who had been kept together at school. Based on these findings, DiLalla and Mullineaux concluded that being placed in the same classroom was more beneficial for the twins in their sample as they exhibited fewer behavioural problems.

1.3.7 What is the Impact of Classroom Placement on the Academic Achievement of Twins?

A greater number of studies explored the impact of separation on twins' academic progress and achievement at school and used a variety of different tools to do so. Three of the papers made use of a Dutch twin population (Polderman et al., 2010; van Leeuwen et al., 2005; Webbink et al., 2007) and measured educational achievement using the nationwide achievement test (CITO) that is usually taken when children reach the age of 12 years old. This consists of 240 multiple-choice items assessing four different intellectual skills: language, mathematics, information processing and world orientation. The four scales result in a standardised score that falls between 501 and 550, which is then used to advise parents about their children's secondary placements (Bartels, Rietveld, Van Baal, & Boomsma, 2002).

Van Leeuwen and colleagues (2005) compared the academic performance of three different groups of twins: *together, separated, and partly separated.* It was found that twins who were separated part way through their schooling, at 7 years old, scored the highest on the CITO scores at age 12 (*M* = 541.6, *SD* = 5.83), followed by those who were kept together between the ages of 5 and 12 years old (*M* = 538.1, *SD* = 8.69) and those who were separated between the ages of 5 and 12 (*M* = 537.8, *SD* = 8.95). The differences in CITO scores were only significant between the *partly separated* and *together* group, and the *partly separated* and *separated* groups of twins. In other words, the twins who were separated from the age of 5 and the twins who were kept together from the age of 5 did not differ in terms of their academic performance.

Webbink and colleagues (2007) assessed their school-based twin sample using four separate measures of cognitive ability: IQ tests, language tests, arithmetic tests and the CITO. As previously mentioned, the CITO is taken when the children are 12 years old. The language and arithmetic tests are taken when the children are aged 6, 8, 10 and 12 and the IQ tests are taken at the ages of 8, 10 and 12. Webbink et al. (2007) found that, by the time children reached the age of 12 years old, classroom placement did not appear to have an impact on CITO scores. They also found that twins (aged 5-6) who had remained with each other for a year of school, scored higher on the language and arithmetic tests than those who spent a year in separate classes. These differences appeared to be larger in same-sex twin pairs and were not significantly different for opposite-sex pairs. There were also no significant differences between the twins in higher grades. Based on these findings, the authors concluded that the presence of a co-twin was the most beneficial for same-sex pairs, but only during the first year of schooling. However, they did not collect data on the zygosity of these same-sex pairs. Therefore, it is not possible to know how this impact might have changed depending on whether the twins were MZ or DZ. Overall,

separation from a co-twin did not appear to significantly impact academic achievement in the higher grades.

Polderman et al. (2010) also used the CITO in their study. Without adjusting for confounding factors, such as socio-economic status, urbanisation level and pre-existing externalising problems at age 3, there appeared to be a significant association between classroom separation and CITO scores, with a very small effect size (*r*) of 0.08. However, this significant association disappeared when the authors adjusted for the confounding effects, thus indicating that being in separate classrooms did not have a significant impact on twins' CITO scores. The effect size (*r*) also decreased to 0.04. Thus, the authors concluded that there was no effect of classroom placement on cognitive abilities.

Two other studies also explored the impact of classroom placement on academic performance using other measures. Tully et al.'s (2004) UK-based study used the TOWRE (Torgesen et al., 1999) to examine the impact on twins' reading ability, in addition to asking teachers to rate, on a seven-point scale, how hard the twins were working and how much they were learning in comparison to the other children in their classes. It was found that teachers thought DZ twins who were separated at the age of 5 years old (*n* = 164) learned less in school than those who were not separated (*n* = 500). MZ twins who experienced separation by the age of 7 years old (*n* = 204) had lower standard reading scores at follow-up than MZ twins who had not experienced any separation (*n* = 604). Interestingly, for DZ twins, those who were separated by the age of 7 years old (*n* = 124) were rated by teachers as working harder from age 5 to follow-up in comparison to DZ twins who were not separated (*n* = 500). Tully et al. (2004) therefore concluded that there was some evidence to suggest that separated twins experience more academic problems than those who are not separated. However, this only appeared to be the case with MZ twins who were separated later on in their schooling. These results might have

also been impacted on by the uneven groups of MZ and DZ twins who were separated and kept together.

Coventry and colleagues (2009) used a composite measure of print knowledge in their study as this is thought to be the best proxy of reading in later years (Foulin, 2005) and correlates 0.56 and 0.45 with reading at kindergarten and Grade 1, respectively. They also included the TOWRE. Given that zygosity did not interact with class status in their analysis, Coventry and colleagues did not include specific information about this in their study. Regression analyses highlighted no significant differences between reading scores for twins kept in the same class and those who were separated in kindergarten (aged 4-6; *n* separated = 430, *n* together = 993), Grade 1 (aged 6-7; *n* separated = 793, *n* together = 565) and Grade 2 (aged 7-8; *n* separated = 708, *n* together = 322). Based on these findings, Coventry et al. concluded that, irrespective of the number of years the twins were separated for (e.g. 1, 2 or 3), the effects of classroom separation on reading are small at best as Cohen's *d* statistics remained comparable across all three years (*d* = 0.1, 0.2 and 0.2 respectively). Furthermore, when results were covaried on pre-school behaviour and pre-school print knowledge, any small differences between twins placed together versus those who were separated disappeared. In other words, the minimal effects on reading ability in this study could be explained by pre-existing differences prior to being separated, rather than as a direct result of being separated at school.

1.3.8 Does the Impact of Classroom Placement (if any) Differ Depending on Zygosity?

One of the studies indicated that impact of classroom placements may be different depending on whether the twins are identical or non-identical. In the research by Tully et al. (2004), it was found that MZ twins who were separated from the age of 5 years old

continued to experience higher internalising problems and had lower standard reading scores at age 7, in comparison with those who were never separated. Indeed, the authors also note in their discussion that MZ twins experienced an increase in the level of their internalising problems after the first year of being apart in school. Interestingly, a group of DZ twins who were separated after their first year of school demonstrated more favourable outcomes in that they were rated by teachers as harder workers than DZ twins who were not separated.

Although the study by Tully and colleagues (2004) was the first of its kind, no other studies in this review that incorporated zygosity in their analyses, found any differences between the way identical and non-identical twins experience classroom separation. Firstly, Polderman et al. (2010) found no interaction effect between zygosity (*n* MZ = 740, *n* DZ = 538) and classroom separation. This means that the association between classroom placement and CITO scores was the same, regardless of whether the twins were identical or not. Secondly, Coventry and colleagues (2009) found that zygosity did not interact with class status in any of their analyses. Thirdly, van Leeuwen et al. (2005) found no significant differences between levels of internalising and externalising behaviours (as reported by mothers and teachers) and academic performance for MZ and DZ twins as a result of classroom separation.

Taken together, it appears that studies conducted since Tully et al.'s (2004) have not found the same differences between MZ and DZ twins. Accordingly, the current evidence points more towards the notion that any possible impact of classroom placement on twins' adjustment to school is not further moderated by zygosity.

1.4 Discussion

The aim of this systematic review was to identify, summarise and evaluate a specific body of literature which explored the impact of classroom placement (same or separate) on the behaviour and academic achievement of twins at school. A further question explored was whether any impact of classroom placement on behaviour and academic achievement was different for identical and non-identical twins.

Overall, the findings from the six longitudinal studies included as part of this review appear somewhat inconsistent when it comes to evaluating the impact of classroom placement on the adjustment of twins at school. The only three studies exploring the impact on behaviour suggest that placing twins in separate classrooms when they first start school at the age of 5 could lead to an increase in behaviour problems (DiLalla & Mullineaux, 2007), particularly with regards to internalising behaviours by the age of 7 (Tully et al., 2004; van Leeuwen et al., 2005). However, whilst these behaviours seem more prominent after a year of separation, they do not appear to be present by the time the twins reach the end of their primary schooling at the age of 12 (van Leeuwen et al., 2005). That being said, it is worth noting that, despite the large samples used in these studies, the effect sizes were all small.

Five of the studies investigated the impact of classroom placement on academic achievement. Three of these studies found that separate classroom placements at the age of 5 did not make a difference to the academic achievement of twins in comparison to those who were kept together at the age of 5, especially when pre-existing differences were controlled for (Coventry et al., 2009; Polderman et al., 2010; van Leeuwen et al., 2005). One study concluded that it was more beneficial to the academic achievement of same-sex twin pairs if they were kept together early on in their schooling (Webbink et al.,

2007) and Tully et al. (2004) argued that separated twins would have more academic difficulties than twins who were kept together. However, they did not control for pre-existing differences in their study. It is therefore possible that, as with the other studies, these differences would disappear if they were accounted for in the analyses.

Finally, it is worth noting that only one of the six studies found reportable differences between MZ and DZ twins: separated MZ twins were noted to experience higher levels of internalising problems, which not only persisted but also increased following the first year of separation in comparrison to MZ twins who were not separated. In contrast, DZ twins appeared to benefit from a year of separation as they reportedly worked harder than the non-identical twins who were not separated. However, these findings were not replicated in the other three reviewed studies that incorporated zygosity in their analyses (Coventry et al., 2009; Polderman et al., 2010; van Leeuwen et al., 2005), thus suggesting that any possible impact of classroom placement on twins' adjustment to school is not further moderated by zygosity.

One important factor that appeared to shape the results was whether there were any noted pre-existing differences between the twins in the sample, prior to them starting school. However, only five out of the six included studies accounted for these differences. Externalising problems, or disruptive behaviours in 3-year-old twins, as rated by their mothers, were significantly associated with separation at the age of 5 years old (Coventry et al., 2009; Polderman et al., 2010; van Leeuwen et al., 2005) and there was also a greater liklihood of separation at school if twins had scored highly on measures of hyperactivity and conduct disorder at the age of 4 (DiLalla & Mullineaux, 2008). Furthermore, differences in pre-school reading ability and disruptive behaviours distinguished those who were subsequently separated at the age of 5 from those who

were kept together, as the twins with higher levels of disruptive behaviour and lower levels of reading abilty were more likely to be separated when they started kindergarten, aged 5 (Coventry et al., 2009).

All three of the Dutch studies accounted for differences in the twins' family background and found that these differences significantly influenced the decisions made by those families with regards to classroom placements. Webbink and colleagues (2007) found a higher proportion of ethnic minority twins in the separated group in comparison to those who were kept together. With regards to socio-economic status (SES), both Polderman et al. (2010) and van Leeuwen et al. (2005) found that this was significantly associated with classroom separation at the age of 5. In other words, twins who were from families with higher SES were more likely to be placed in separate classrooms when they started school.

1.4.1 Methodological Strengths of Studies Included

A particular strength of the studies is that they all adopted a longitudinal design, with large samples of twins. In doing so, researchers had a vast array of data to explore and could run a number of different analyses before formulating any conclusions on the impact of same or separate classroom placements on the adjustment of different sets of twins. Five out of the six included studies also accounted for pre-existing factors, such as behaviour, reading ability and family background, that may have influenced where the twins were placed when they started school (Coventry et al., 2009; DiLalla & Mullineaux, 2008; Polderman et al., 2010; van Leeuwen et al., 2005; Webbink et al., 2007). This prevented false or exaggerated conclusions about the impact of classroom placement on twins. In addition, all the samples were drawn from the national register in the country in

which the studies were based (i.e., UK, USA, Australia and the Netherlands). This means it is highly likely that the sub-sample of twins who took part were representative of the wider twin population. The researchers were also able to collate data using large samples (see Table 2), which means that they were unlikely to lack statistical power.

1.4.2 Methodological Limitations of Studies Included

It is worth noting that there was an overlap in the samples used in the studies by Tully et al. (2004) and DiLalla and Mullineux (2008). Both groups of researchers based their findings on some of the same sub-sample of twins from the wider Twins' Early Development Study (TEDS). This is only applicable for MZ twins as DiLalla and Mullineux did not conduct their study with DZ twins. This therefore means that a number of different conclusions are being drawn about the same population of twins and this may have led to an exaggeration of the significance of classroom separation on the behaviour of twins. Furthermore, Webbink, Hay and Visscher (2007) were unable to distinguish between MZ and DZ twins among the same-sex pairs in their study. Given the fact that zygosity differences were not identified in any study other than that by Tully et al. (2004), it is difficult to know whether this would have significantly changed the findings.

The measures used across the six studies only focused on behaviour (e.g., SDQ, CBCL, TRF and DBRS) and academic achievement (e.g., CITO, TOWRE and pre-school print knowledge). DiLalla and Mullineaux (2008) acknolwedged their lack of explicit assessment of the classroom environment in their study, and this can be extended to all the other research included in this review. It is therefore impossible to identify the precise ways in which the classroom environment had an impact on twin behaviour. This might be particularly pertinent if some of the classrooms were considered to be separate spaces but permited the children to move freely between them.

Furthermore, there was no detailed exploration of the twins' social development with their peers or co-twin in their classroom, nor indeed of the quality of the twins' relationship with each other. Considering that independent identity development is often given as one of the reasons for separating twins at school (e.g., Hay & Preedy, 2006; Koch, 1966; Segal, 2005), it is surprising that none of the studies considered the twins' relationship with each other and their dependence on each other. Indeed, the quality of the twin relationship may have been an additional factor that influenced decisions around classroom placements when the twins started school. Whilst some of the papers briefly make reference to some of the principles underlying attachment theory and importance of the twin relationship (DiLalla & Mullineaux, 2007; Polderman et al., 2010; Tully et al., 2004; van Leeuwen et al., 2005) none of the papers give any significant weighting to this.

The studies all made use of self-reported measures by teachers and parents, which typically do not correlate highly with each other (Achenbach & Rescorla, 2000). In DiLalla and Mullineaux's study, the primary predictor of teacher difference scores for the twin pairs was whether the twins were in the same classroom or not and, therefore, whether the twins were rated by the same teachers or not. In order to determine whether the same results would be obtained by a different rater, Di Lalla and Mullineaux repeated the regression analysis using parent ratings of the twins. This resulted in the twins who were more similar on all categories of the SDQ at age 4 being rated as more similar at age 7, regardless of whether they had been separated or not. There may therefore have been a teacher rating bias, that is dependant on the teachers' own perceptions of how twins function as a unit or as two individuals. An additional rater in the classrooms might therefore have helped to account for this potential bias, although it

is recognised that this is not always practical. It should also be noted that none of the six papers considered the views of the twins themselves.

Finally, it is difficult to know how generalisable the findings from these studies are, given that they were conducted in several different countries. There are already some obvious differences in terms of how educational progress is measured between the Netherlands and the other countries included in this review. Furthermore, there may also be some definitive differences in how different countries view separation at school and the policies that are implemented at the local or regional level. In America, for example, legislation in some of the states have only addressed whether parents should have a say in the classroom placement of their twins within the last 10 years. Indeed, in 2006 a bill was passed in the state of Minessota requiring twins and multiples be kept together if this is in line with parental wishes (as cited in DiLalla & Mullineaux, 2007).

Attitudes in Europe however, are someone different. With regards to the UK, the School Admissions Code (Department for Education and Skills, 2006) originally required local authorities to be explicit about their admissions policy for twins, whatever that may be. More recently, the Department for Education have removed any explicit references to twin placement (DfE, 2014). However, decisions about classroom placement appear to remain at the discression of each individual local authority. State education bodies in Australia have also directed schools to adopt individualised policies when it comes to the placement of twins (Hay, 2004). Whilst this is a more flexible approach to classroom placement than in the USA, it is still possible that schools who maintain the belief that classroom separation is ultimately best could adopt a blanket approach that is applied to all sets of twins. Indeed, in the Netherlands, the Dutch Society for Parents of Multiples believes separation stimulates the individualisation of the twins (Geluk & Hol, 2001),

although they advise parents to base the decision on what they think is best for their twins (Polderman et al., 2010; van Leeuwen et al., 2005).

It is therefore worth noting that, within each study included in this review, there are likely to be parents who have had the ability and choice to carefully select the school for their twins depending on their prior perceptions of the twin relationship, and understanding of school policies. Additionally, this decision may have been made by educators alone, without parental input, as has been highlighted in some research seeking parental views on the decision-making process (e.g., Beauchamp & Brooks, 2003; Ingalls, 2008; Preedy, 1999).

1.4.3 Review Limitations

It is worth noting that, whilst carefully documented measures were put in place to ensure the search was as systematic as possible, there is still a chance that some studies were missed as a result of refining the final search terms. There could also have been some studies as part of unpublished dissertations and doctoral theses that may have changed the nature of the overall findings, had they not been excluded. Furthermore, this review does not consider the impact of gender (i.e., female versus male twin pairs or different-sex twin pairs) on the overall findings relating to the classroom placement of twins. However, there are arguably still some important messages coming through the literature that was included, which could be used to inform educational practices in the future.

1.4.4 Implications for Future Research and Practice

It would appear that the discussion moving forward should not only focus on the impact of classroom separation on the adjustment of twins in school, but also on the factors that need to be taken into consideration during the decision-making process. As previously mentioned, five out of the six included studies accounted for pre-existing factors, such as behaviour, reading ability and family background (Coventry et al., 2009; DiLalla & Mullineaux, 2008; Polderman et al., 2010; van Leeuwen et al., 2005; Webbink et al., 2007). Pre-existing behavioural problems was arguably the greatest driving force behind the decision to separate the twins at school over any other factor (Coventry et al., 2009). This highlights the need for parents and teachers to discuss how these factors are displayed within the twin-pair and at the wider family level before a decision about classroom placement is made. Furthermore, it is important for parents and teachers to appreciate that twins can be offerred opportunities to develop their independence within the same classroom, such as through the use of different peer groupings for activities.

All the studies in this review were carried out in young children who started school at the age of 5. Whilst this was the specific focus of this review, it is recognised that it does not explore the impact of classroom placement at secondary school entry. Future research should therefore explore any possible impact of classroom placement on twins' social, behavioural and academic development during this transition period. Hay (1999) argued that there are additional factors to consider that might influence classroom placement at secondary school, such as subject choices and even school choices for twins. Such decisions might be particularly pertinent if they have spent their entire schooling together in the same classroom up until this point.

It is worth noting that only three of the six studies made reference to the relationship that is shared by twins. Polderman et al. (2010) refer to it as a unique and special relationship that is not available for singletons and Tully et al. (2004) refer to it as a close, social relationship. However, only DiLalla and Mullineaux (2007) explicitly mention that the twin bond can be considered in the context of attachment theory (as proposed by Tancredy & Fraley, 2006). Whilst these authors appear to acknowledge that the twin relationship has some special and important qualities that are not applicable to singletons and are not as prominent in non-twin sibling relationships, such a relationship is not further explored or accounted for in their studies. The twin relationship is arguably an important factor that parents and school staff need to consider when making decisions about classroom placement and therefore warrants further exploration. This is particularly pertinent as the inter-twin relationship has been found to impact on their ability to engage socially and academically (Staton et al., 2012). However, the quality of the twin relationship could also promote social exploration and serve as a protective factor in a novel and potentially anxiety-provoking environment (Sandbank, 1999).

Given the proposed biological and attachment-theoretical perspectives on the close bond that is shared between twins (Hamilton, 1964; Neyer & Lang, 2003; Tancredy & Fraley, 2006), it will be important moving forward to draw upon these ideas more explicitly in twin research. Given the lack of attention research has given to the importance of the quality of the twin relationship, further research is needed to better understand the impact that the quality of the twin relationship has on twins' adjustment at school. In addition, given that educators worry about the fact that the twins may not develop their own social independence if they are placed together, future research could

attempt to measure the development of twins' social skills as a result of being placed together or being put into separate classrooms.

An additional point to consider is the fact that two of the six selected studies included opposite-sex twin pairs in their sample of DZ twins (Polderman et al., 2010; Webbink et al., 2007). However, their findings were inconsistent. Polderman et al., (2010) found that the association between classroom separation and academic outcomes were the same, regardless of whether the DZ twin pairs were the same or opposite sex. In contrast, Webbink et al. (2007) indicated that there were differences in academic scores for same-sex pairs as a function of classroom placement, but found no differences between opposite-sex DZ pairs. More research is needed to explore the extent to which same-sex and opposite-sex twin pairs might experience classroom separation differently, and thus how this may impact differently on their school adjustment.

Finally, there is as distinct lack of twin voice in the research that is currently avaliable. One study found that teachers are far less likely to consider a twin's opinion when it comes to classroom placements (Gleeson, Hay, Johnston, & Theobald, 1990). However, it is imperitive that this changes, in line with UK government initiatives for professionals to incorporate pupil voice into their work (Department for Education & Department of Health, 2014).

1.4.5 Final Conclusions

Overall, the current systematic review suggests that there is no consistent evidence that classroom placement impacts on young twins' behavioural and academic development. However, current research does not permit ruling out any effects due to pre-existing differences in behaviour that may have influenced classroom placement in

the first place. It is therefore difficult to know to what extent classroom placements are having an impact on the overall development of twins in school. Research moving forward needs to take into account the progress that has been made in terms of our understanding of the nature of the close relationship twins share (e.g., Burlingham, 1952; DiLalla & Mullineux, 2008; Koch, 1966; Segal & Hershberger, 1999; Tancredy & Fraley, 2006), along with the knowledge that there is still much left to discover and explore about the numerous different contexts in which twins operate and function. This is particularly important given the rate at which women are experiencing multiple-births and therefore the steady increase of the numbers of twins who enter the school system each year. The issue of classroom placement will be one that parents, educators and researchers alike continue to grapple with. However, it is important that decisions are made in collaboration with the families and, most importantly, with the twins themselves.

Chapter 2: The Impact of Same and Separate Classroom Placements on the Social Adjustment of Identical and Non-Identical Same-Sex Twins at School Entry

2.1 Introduction

2.1.1 Twin Relationship Quality

Research on non-twin sibling relationships has highlighted that siblings are an important context for social and emotional development (Dunn, 2007). Children spend a greater length of time in the company of their siblings compared to time spent with their parents (McHale & Crouter, 1996). Moreover, sibling interactions are often emotionally loaded, due to the frequency with which they occur and the need for each separate sibling to compete for parental and material resources (Dunn, Stocker, & Plomin, 1990).

Twin relationships are a unique and intimate type of sibling relationship unlike any other interdependent relationship (Cassidy, 1999). Some researchers argue that the bond between twins can be appropriately placed within an attachment-theoretical perspective (DiLalla & Mullineaux, 2008; Fraley & Davis, 1997; Segal & Hershberger, 1999; Tancredy & Fraley, 2006). According to this perspective, twins are likely to experience a need to maintain proximity to their co-twin, and are likely to feel distressed when parted from them. They are also driven to seek assurance and safety from one another and will use each other as a secure base from which to explore the world around them. Research on the proximity-seeking of young twins at pre-school found that they were more likely to spend time together than non-twin siblings (Koch, 1966). Furthermore, MZ twins are more likely to remain physically close to each other than are DZ twins (Segal, 1999). Young twins have also been considered as 'transitional objects' for each other (Sandbank,

1999). In addition, Koch (1966) found that young twins who felt close to each other were more socially outgoing with those around them. This is particularly pertinent for when they first start school as this may not only be the first time they are away from their primary care-givers, but also the first time they are exposed to a busy, novel environment and surrounded by other children with whom they are expected to interact.

The specific nature of the twin relationship has been conceptualised in three different relational categories: 'mature dependents', 'closely coupled', and 'extreme individuals' (Hay and Preedy, 2006). Twins classified as mature dependent are likely to enjoy the company of each other and adequately function at both the pair and the individual level. Closely coupled twins are considered to be more reliant and dependent on each other and therefore are more likely to find it difficult to spend time apart. Extreme individuals are those who may go as far as actively rejecting the fact they are a twin and focus on trying to forge their own individual identities.

Informed by this conceptualization of the twin relationship and work on sibling relationships (e.g., Stocker, Dunn, & Plomin, 1989; Volling & Blandon, 2005), Fortuna, Goldner and Knafo (2010) developed a Twin Relationship Questionnaire (TRQ) which measured the twin relationships in terms of closeness, dependence, rivalry and conflict. Mothers of pre-school aged identical (N = 544) and non-identical (N = 2018) twin pairs and mothers of non-twin sibling pairs (N = 168) completed the TRQ. Mothers of MZ twins reported significantly higher levels of inter-twin closeness and dependence than the mothers of DZ twins. Mothers of DZ twins, in turn, reported higher levels of closeness and dependence than those of non-twin sibling pairs. There were no reported differences between the twins' levels of rivalry and conflict, thus suggesting that only closeness and dependence varied depending on the zygosity of the twins.

It is worth noting that, whilst the study made use of a large sample of twins, there was a distinct absence of twin voice in the data. In fact, there is a significant lack of twin views in any of the literature that has explored the relationship and genetic make-up of twins to date. Part of the reason for this could be due to the fact that the twins in the study by Fortuna et al. (2010) were very young and they therefore would not have been able to access the questionnaire in its current format.

2.1.2 Social Competence

Social competence encompasses constructs such as social skills, social communication, and interpersonal communication (Semrud-Clikeman, 2007). According to Spence and Donnovan (1998), social competence refers to the ability to interact with those around us in a way that facilitates a successful and positive outcome. Spence (1995) also argued that the development of social competence is thus reliant on an individual's ability to perform social skills adequately. Social competence is considered to be the foundation upon which children develop perceptions of their own behaviour towards others and learn from past social experiences, in order to better learn how to adapt to future social challenges (Semrund-Clikeman, 2007).

Given its social context, a great deal of importance has been placed on peer relationships as a means of enabling positive social development in children (Hartup, 1992). Furthermore, the development of social competence has been linked with attachment theory, in that some studies have found that children who experienced a secure attachment with their primary care-giver were able to develop positive and high quality peer relationships more easily than children who had experienced insecure attachments (Cohn, 1990; Kerns, Klepac, & Cole, 1996). An additional study found that both early and concurrent attachment security were associated with good social

functioning at school age, and that attachment security can therefore be considered a precursor of social competence (Bohlin, Hagekull, & Rydell, 2000).

However, the majority of research into the development of children's social competence has tended to focus on attachment security between the child and their parental primary care-giver. Given that it has only been more recently that research has used an attachment-theoretical perspective to further explore the relationship twins share, no research has thus explored the development of social competence in twins.

2.1.3 Research on Classroom Placement

With this perceived uniqueness of the twin relationship in mind, parents can find it difficult to know whether their twins should be educated together or apart at school. A systematic review of studies using quantitative methods assessing the impact of classroom placement (together/apart) on the twins' behaviour and academic adjustment was conducted in chapter 1. In brief, there was no consistent evidence to suggest that any particular classroom placement led to more favourable behavioural or academic outcomes. Furthermore, the review also highlighted pre-existing differences in the behaviour of twins that might have influenced where the twins were placed when they started school.

More recently, research using qualitative methods has focussed on gaining a better understanding of the views held by parents and educators about the impact of classroom placement on twins. Parents and educators alike appear to hold strong views about whether the twins should be placed in the same or separate classrooms and how such placements might impact on each individual twin's development and adjustment to school. Early research by Koch (1966) identified that the most common argument for separating twins at school was that the unique nature of the bond between twins could

be a potential barrier to the development of their individuality and independence. These views were later supported by other studies (Gleeson et al., 1990; Nilsson, Leonard, Barazanji & Simone, 2009; Segal & Russell, 1992). In contrast, some have argued that separation may cause distress for the twins, and their wider family, if the twins are not ready to be apart from one another (Alexander, 2012; Segal & Russell, 1992).

It is worth noting that, despite these different views and inconsistent body of evidence, some schools and local authorities continue to adopt placement policies that they apply to all twins, as if they are a homogenous group (Staton, Thorpe, Thompson & Danby, 2012). However, it has been argued that each twin pair starting school should be viewed in their own individual context and that parents and teachers should work collaboratively to monitor their ability to function dependently as a twin unit and independently without their twin (Lacina, 2010).

2.1.4 Research Rationale, Aims and Objectives

To date, research exploring the impact of classroom placement on twins' adjustment to school has not considered whether the type of relationship the twins have moderates behavioural and academic outcomes. Yet there is growing recognition that the twin relationship is a special and unique sibling relationship. Moreover, few studies, if any, have explored the link between the quality of the twin relationship and the twins' development of social competence. Given that children's social, emotional, academic and cognitive development are enhanced by frequent opportunities to develop their social competence during their childhood (Hartup, & Moore, 1990; Kinsey, 2000), this is an important area for further study. Accordingly, the present study sets out to test the theoretical model illustrated in Figure 1. In addition, the views of young twins are rarely

considered in the current literature. The present study will therefore include twin self-report to explore their views on their relationship.

Following the proposed associations in Figure 1, the present study examines the association between classroom placement (as characterised by being kept together in the same class or put into different classes) and twin social competence, whilst simultaneously taking into account the quality of the twin relationship (characterised by closeness, dependence, rivalry and conflict). In order to understand these associations better, a number of additional factors that may have influenced decisions around classroom placement from the outset are also assessed; twin zygosity and the quality of twin relationship prior to the start of school.

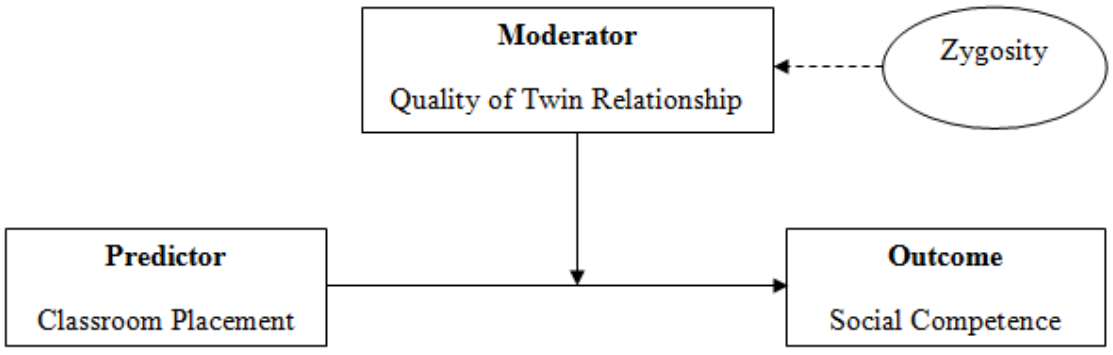


Figure 1. Diagram showing the proposed relationship between the different variables. It is thought that the quality of twin relationship might vary as a function of zygosity. Furthermore, it will be investigated whether the quality of twin relationship moderates the association between the twins' classroom placement and their social competence.

The overall objective of this piece of research is to use the data to inform, guide and shape current practice in schools in the UK when the classroom placement of twins is considered. The aim is to ensure that each twin-pair is kept at the centre of the decision-

making process, to better support their development and adjustment when they first start school at the age of 5 years old.

2.1.5 Research Questions

The primary aim of this research is to explore the effects of classroom placement and quality of twin relationship on the development of twins' levels of social competence. However, it is also important to ascertain whether there are pre-existing factors, such as twin zygosity or the quality of twin relationship prior to the start of school, that may have influenced the initial decision of where to place the twins. This thesis therefore aims to explore the following questions:

1. Does classroom placement impact on twins' levels of social competence over time?
2. Does the quality of twin relationship predict twins' social competence over time?
3. Does the quality of the twin relationship moderate the association between classroom placement and levels of social competence in twins?
4. Is zygosity an important factor that influences classroom placement decisions?
5. Is the quality of twin relationship prior to the start of school an important factor that influences classroom placement decisions?
6. In addition, does the quality of the twin relationship differ between identical and non-identical twins prior to school entry?

2.1.6 Hypotheses

Based on the aims and research questions of this thesis, it is hypothesised that:

1. Twins who have been in separate classrooms will have lower levels of social competence after a term than twins who have been kept together during a school term.
2. Twins who are closer to each other when they start school will have greater levels of social competence after a term at school. Twins who experience greater levels of dependence, rivalry and conflict with each other when they start school will have lower levels of social competence after a term at school.
3. The quality of the twins' relationship at school entry will moderate the association between classroom placement and their levels of social competence seen at school.
    a. Twins who reportedly have a close and moderately dependent relationship with each other will develop high levels of social competence if they are kept together at school.
    b. Twins who reportedly have a close and moderately dependent relationship with each other will have lower levels of social competence if they have been in separate classrooms.
    c. Twins who reportedly have higher levels of inter-twin conflict and rivalry will develop high levels of social competence if they have been in separate classrooms.
    d. Twins who reportedly have higher levels of inter-twin conflict and rivalry will have lower levels of social competence if they have been kept together at school.
4. Twin zygosity significantly influences decisions about classroom placement.
    a. MZ twins will more likely be kept in the same class.
    b. DZ twins will more likely be separated.

5. The quality of the twin relationship prior to school entry influences decisions about classroom placement.
    a. Twins with higher levels of closeness will be kept in the same class.
    b. Twins with higher levels of co-dependence, conflict and rivalry will be separated.
6. The quality of the twins' relationship will significantly differ depending on whether the twins are identical or not.
    a. MZ twins will have significantly higher levels of closeness and co-dependence and lower levels of rivalry and conflict than DZ twins.
    b. DZ twins will have significantly higher levels of rivalry and conflict and lower levels of closeness and co-dependence than MZ twins.

2.2 Methodology

2.2.1 Participants

Parents and their twins were recruited using adverts that were posted online by the Twins and Multiple Birth Association (TAMBA), a charity in the UK that supports parents with young twins and multiples. Parents were asked to provide details of the schools their twins were due to attend so that schools could also be contacted and invited to take part in the research. Fifty-six schools were approached (two parents did not want to supply this information and two parents had twins who were attended the same school) and 19 of those head teachers agreed to distribute information about the study to teachers who had the twins in their class.

Fifty-nine same-sex twin pairs (28 MZ and 31 DZ) took part in the study. It was felt that this sample should only include same-sex pairs due to the practicalities of

introducing an additional potential confounding variable in the analyses and due to the lack of consistency in previous research using opposite-sex twin pairs. For each separate twin, data was requested from parents, teachers and the twins themselves, at two different time points (i.e., before starting school and one term after starting school). Table 3 shows the number of participants who provided data on twin-pairs at time 1 and time 2. There was a substantial drop out in responses at time 2. The average age of the twin pairs at time 1 was 53.66 months (*SD* = 4.61*).*

Table 3

The Number of Participants at Time 1 and Time 2

Participants	Time 1	Time 2
Mothers	118	78
Twins	58	42
Teachers	35	34

In order to be included in the research, the twins had to be starting school in a UK mainstream Reception class in September 2016. For the purposes of this study, children were not permitted to take part if they had English as an additional language (EAL) or if they were attending a specialist educational provision. Nevertheless, it was recognised that a degree of special educational need may be present in the sample, particularly as it is considered to be common for twins to experience delays in their language development (Rutter & Redshaw, 1991).

2.2.2 Design

A correlational design was used to explore the associations between the quality of the twins' relationship, their social competence, classroom placement, and zygosity. All measures were assessed concurrently or over time, depending on the analysis.

2.2.3 Measures

Twin relationship questionnaire – parent version. The Twin Relationship Questionnaire (TRQ-P; Fortuna et al., 2010; Appendix D) was completed by mothers for each twin, in order to assess the quality of the twin relationship reflected in the behaviour and thoughts of one twin in relation to the other. The items were separated into four different subscales; closeness, dependence, rivalry and conflict. The questionnaire comprises a list of 17 statements rated on a 5-point scale reflecting the degree to which each one was characteristic of the twin (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). Mothers completed one TRQ for each twin. Higher values denoted higher levels of closeness, dependence, rivalry and conflict.

Exploratory factor analysis was used to explore the factor structure of the TRQ-P in this sample. In line with the methods adopted by Fortuna et al. (2010), principal component analysis with direct oblimin oblique rotation (delta = 0) was used, which assumes that factors are correlated (Field, 2013). Four factors were extracted and the final pattern matrix, indicated that the items measured four distinguishable concepts, which accounted for 67% of the variance and all had eigenvalues over 1. The four factors that emerged reflected the same constructs put forward by Fortuna et al., namely closeness, dependence, rivalry and conflict. Items were interpreted as good measures of a factor if they had loadings that were larger than 0.5 (Comrey & Lee, 1992). In the final matrix (see Appendix E) the item *'Is usually angry when the twins are separated'* had a loading of .48. However, the item was retained for conceptual reasons and because its inclusion resulted in an acceptable internal consistency coefficient for the relevant factor. One item that was originally included in the rivalry subscale ('*Is very competitive towards the other twin')* loaded better onto the conflict subscale in the final matrix. Furthermore,

it made theoretical sense so was subsequently incorporated into the conflict subscale before further data analysis. The subscales were computed by averaging the items within each factor. Internal consistency using Cronbach's alpha was either acceptable or good in this sample (closeness α = .76; dependence α = .86; rivalry α = .76; conflict α = .85). These values are consistent with those reported by Fortuna et al., (2010).

Twin relationship questionnaire – child version. For the purposes of this study, and due to the absence of twin voice in the previous research, a new child-friendly version of the Twin Relationship Questionnaire (TRQ-C) was created by re-phrasing the items from the mothers' version (Appendix F). A pilot study was carried out with ten reception-aged children (4-5 years old), to ascertain whether they understood the items once they had been read out. Given that all the children could say they understood the statements, this questionnaire was subsequently used in the study, and it was clearly outlined that parents needed to support their twins with its completion online. To simplify the ratings for each item, the original 5-point Likert scale was adapted to provide three possible choices (1 = no, 2 = sometimes, 3 = yes). Higher values denoted higher levels of closeness, dependence, rivalry and conflict.

As with the TRQ-P, exploratory factor analysis was used to assess the construct validity of the TRQ-C. Principal component analysis with direct oblimin oblique rotation (delta = 0) was conducted and four factors were extracted. Items were interpreted as good measures of a factor if they had loadings that were larger than 0.5 (Comrey & Lee, 1992). One item with a loading of .48 was retained. The final pattern matrix (Appendix G) indicated that the items measured four distinguishable concepts which were consistent with the conceptualization of closeness, dependence, rivalry and conflict. The four factors accounted for 65% of the variance and all had eigenvalues over 1. The item *'I*

know what my twin is thinking or feeling' was dropped from analyses because it did not load onto any of the four factors. Furthermore, it made theoretical sense to exclude this item as it appears to tap into theory of mind ability. Developmentally, theory of mind typically first emerges around the ages of 4 to 5 years (Rai & Mitchell, 2004) and so the twins in this study would have only started to develop these skills. Two further items were also excluded as they did not fit conceptually and did not load onto any of the four factors (*'If my twin is happy, I am happy too. If my twin is sad, I am sad too'* and *'I do not like it when my twin is ill'*). The subscales were computed by averaging the items that loaded primarily onto each of the four factors. The internal consistency of each of the subscales on the TRQ-C was acceptable (closeness α = .72; dependence α = .71; rivalry α = .75; conflict α = .73).

Social attributions checklist. The twins' social competence was measured using the Social Attributes Checklist (SAC; McClellan & Katz, 1992; Appendix H), which attempts to assess a child's social behaviour in relation to developmentally appropriate levels of social competence. The checklist included a list of 24 statements for teachers to rate on a 5-point scale reflecting the degree to which each one was characteristic of the twin, or twins, in their class (1= never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always). Teachers who had both twins in their class were asked to fill in separate checklists for each individual twin. Three of the items were reverse coded (as indicated in Appendix H). In line with previous research (McCellan & Katz, 1992) the sum of all item scores was used to produce an overall value of social competence, whereby a higher score reflected a higher level of social competence. The internal consistency of the SAC was found to be excellent (α = .90).

2.2.4 Procedure

Following ethical approval from the University of Southampton Ethics Committee and the Research Governance Office (RGO; ethics ID: 24666), all the questionnaires were set up online using www.isurvey.soton.ac.uk and the links for the TRQ-P and TRQ-C were sent to TAMBA for posting on their Facebook page and monthly e-newsletters. This strategy was adopted to try and reach as many families as possible. Mothers who visited the links were presented with initial online information and consent pages prior to starting the questionnaire (Appendix I), which detailed the purpose of the study and reminded them of their rights as research participants. Mothers were also asked to ensure that their twins were happy to take part (see child-friendly consent page, Appendix J) and to complete the TRQ-C with each twin separately, in order to try and prevent the twins from influencing each other with their answers. Mothers and their twins completed the first part of the study before the twins started school (Time 1; July-August 2016) and the second part of the study once the twins had been at school for a term (Time 2; February-March 2017).

Mothers were asked to provide the name of their twins' school so that teachers could be recruited to complete the SAC. Head teachers of 56 schools were contacted with information about the study that they could distribute to the appropriate members of staff (Appendix K). Teachers were asked to read an additional information sheet and consent online (Appendix L) before completing the SAC in the last week of September 2016 and again in the last week of January 2017. This particular time frame was chosen to reflect the fact that any behaviours noted at the very start of September might not be considered typical of the twins whilst they were settling in to a new environment. In addition, it was recognised that a few weeks may have been needed in order for the

teachers to be familiar enough with the twins in their class to provide information on the SAC.

All participants were provided with an online debriefing page (Appendix M). The twins were also provided with a mood-enhancing activity at both time 1 and time 2, which consisted of watching a Mr. Men YouTube clip and discussing it with their family. Completion of the questionnaires took about 10-15 minutes per twin.

2.2.5 Ethical Considerations

Participants were reminded of their right to withdraw at any time and told that their data would be kept confidential. This was particularly pertinent for mothers, who had been asked to provide identifiable information about each twin (such as their names, ages, gender, zygosity and the name of the school they would be attending, Appendix N). It was made clear to them that this process was necessary for the researcher to ensure that all data could be collated for the correct twin throughout the duration of the study. It was also hoped that this would allow the mothers and the teachers taking part to hold the correct twin in mind, and therefore provide more accurate answers. Participants were reassured that this information would be protected through isurvey (a secure university system) and that the identifiable information would only be seen and used by the researcher and their supervisor, in order to allocate participant ID numbers for later analysis. Furthermore, their questionnaire responses were kept separate from the information that identified the twins and was only accessed using a password-protected computer.

It was recognised that some parents and twins may have been feeling worried or anxious about the twins starting school, particularly if the twins had been separated

against the parents' wishes, or if they felt they had not been adequately consulted by the school setting when the decision was being made. The fact that participants were being recruited through TAMBA means that they would have access to various forms of support from TAMBA workers.

2.3 Results

2.3.1 Data Preparation

All data were prepared and analysed using IBM SPSS Statistics (version 24). Each twin participant was assigned a unique participant ID number to ensure anonymity. Two variables were created to address the fact that twin data consist of non-independent observations, as twins from the same family are more alike than twins from different families. These included (i) a variable specifying the family the twins belonged to (numbered 1-59) and (ii) a variable specifying the number of the individual twin within each family (1 or 2).

Prior to analysis, the data were inspected to check for normality. Histograms of the quality of twin relationship subscales and overall social competence were examined at time 1 and time 2 (Appendix O). All variables appeared to be approximately normally distributed, except for twin-reported closeness (at time 1 and 2) and twin-reported rivalry (at time 1 and 2). For analyses that required using these variables, either non-parametric tests (i.e., Mann-Whitney U) or bootstrapping, based on 1000 iterations, was used (Efron, & Tibshirani, 1994, as recommended by Field, 2013) depending on the type of analysis.

Scatterplots indicated that the assumption of linearity had been met (Appendix P). As it was difficult to detect outliers from the scatter plots, further inspections were made using boxplots. These indicated two possible outliers in the twin-reported data as the

points were greater than the upper quartile plus 1.5 times the inter-quartile range (Field, 2013). It was decided that these would be removed from any subsequent analyses, as the data was from a pair of identical twins whose mother had anecdotally informed the researcher that the twins had deliberately answered the statements negatively on the TRQ-C to seek a reaction from their co-twin.

2.3.2 Data Analytical Approach

The main focus of this research was whether classroom placement impacts twins' social competence over time. However, it is also important to test whether such an association is affected by pre-existing factors, such as zygosity or the quality of twin relationship prior to the start of school. Parents may have been more likely to opt for keeping identical twins together than non-identical twins. It may be that parents chose to separate twins if levels of conflict and rivalry were perceived to be high. Additionally, if twins were perceived to be particularly close or co-dependent, then separation could be potentially harmful to them and so parents may have chosen to keep these twins together. It is therefore important to understand the associations of these variables at the time the twins start school and how they might influence social competence over time.

All effect sizes were interpreted according to Cohen's (1992) conventions for *d* (small = 0.20, medium = 0.50, large = 0.80) and *r* (small = 0.10, medium = 0.30, large = 0.50).

2.3.3 Descriptive Statistics

Of the 118 twins who took part, 56 (52.5%) were identical and 62 (47.5%) were non-identical, 66 (55.9%) were male and 52 (44.1%) were female, and 86 (72.9%) were placed

in the same class and 32 (27.1%) were placed in separate classrooms. Importantly, of the 86 twins who were placed together, 40 attended schools that operated on a one-form entry system and therefore the possibility of separation was not applicable. The average age of the sample was 53.66 months (4.5 years old). Table 4 shows the number of male and female twins, both identical and non-identical, who were separated and kept together at school.

Table 4

Number of Male and Female MZ and DZ Twins Who Were in the Same or Separate Classrooms at School

Zygosity	Gender	Classroom Placement	*n* (Percentage)
MZ	Male	Same	12 (10%)
		Separate	10 (8%)
	Female	Same	26 (22%)
		Separate	8 (7%)
DZ	Male	Same	36 (31%)
		Separate	8 (7%)
	Female	Same	12 (10%)
		Separate	6 (5%)

Note. N = 118

Possible gender effects on the twins' relationship quality and social competence were explored. Only mother-reported levels of closeness were higher in female than in male twins. All other mother and child-reported twin relationship qualities did not differ between male and female twins. Teacher reports of twin social competence did not significantly differ as a function of gender. Furthermore, there was no gender bias on classroom placement or zygostiy. As the study's main focus was the impact of classroom placement on social competence, accounting for pre-existing differences in twin

relationship quality and zygosity, and there were no substantial gender effects on all the main variables of interest, gender was dropped from subsequent analyses.

Table 5 shows the means and standard deviations for twin-relationship quality and social competence measures at time 1 and time 2. In addition, twin reports of dependence, rivalry and conflict correlated significantly and positively within the twin pair. Levels of closeness were positively correlated within the twin pair but not significantly so. Mother-reported twin levels of closeness, dependence, rivalry and conflict significantly positively correlated with twin reports on these subscales (Appendix Q).

Table 5

Means, Standard Deviations and n for Each Variable Measured at Time 1 and Time 2

	Time 1		Time 2	
Variable	M *(SD)*	*n*	M *(SD)*	*n*
SAC - Social Competence	95.03 *(11.86)*	35	99.26 *(10.60)*	34
TRQ-P Closeness	4.20 *(0.48)*	118	4.14 *(0.52)*	78
TRQ-P Dependence	3.31 *(0.80)*	118	3.25 *(0.85)*	78
TRQ-P Rivalry	2.61 *(0.79)*	118	2.58 *(0.76)*	78
TRQ-P Conflict	2.96 *(0.75)*	118	2.99 *(0.73)*	78
TRQ-C Closeness	2.71 *(0.36)*	58	2.62 *(0.43)*	42
TRQ-C Dependence	2.21 *(0.63)*	58	2.14 *(0.55)*	42
TRQ-C Rivalry	1.93 *(0.80)*	58	1.69 *(0.75)*	42
TRQ-C Conflict	1.88 *(0.47)*	58	1.89 *0.44)*	42

2.3.4 Hypothesis One: Twins who have been in separate classrooms will have lower levels of social competence after a term than twins who have been kept together during a school term

A 2x2 mixed model ANOVA was run to examine whether classroom placement impacted on teacher-reported levels of social competence in twins over time. Table 6

presents the means and standard deviations of twins' social competence at both time points by placement. Results indicated there was no significant main effect of time on teacher-reported levels of twin social competence, $F(1, 29) = 0.20$, $p = .656$. The main effect of classroom placement was also non-significant, $F(1, 29) = 0.53$, $p = .473$. Furthermore, there was a non-significant interaction between time and classroom placement, $F(1, 29) = 1.25$, $p = .273$. These results suggest that there were no significant differences in teacher-reported levels of twin social competence over the course of a school term, regardless of whether they were kept together or separated.

Table 6

Mean and Standard Deviation Scores on SAC Over Time as a Function of Placement

	Same Class		Separate Classes	
Variable	M *(SD)*	*n*	M *(SD)*	*n*
SAC Time 1	95.62 *(12.20)*	26	95.00 *(13.69)*	5
SAC Time 2	99.85 *(9.09)*	26	93.20 *(17.96)*	5

2.3.5 Hypothesis Two: Twins who are closer to each other when they start school will have greater levels of social competence after a term at school. Twins who experience greater levels of dependence, rivalry and conflict with each other when they start school will have lower levels of social competence after a term at school.

Bivariate Pearson's correlations were conducted to assess the association between time 1 mother-reported and twin-reported levels of closeness, dependence, rivalry and conflict and the twins' social competence at time 2, as reported by their teachers. As twin-reported levels of rivalry and closeness were not normally distributed, bootstrapping (based on 1000 iterations) was used to obtain bias corrected accelerated (BCa) 95%

confidence intervals. Table 7 indicates that all subscales of the TRQ-P and TRQ-C positively correlated with teacher-reported twin social competence at time 2. However, surprisingly, only twin-reported levels of dependence was significant $r(11) = .56$, $p = .048$, 95 % BCa CI [0.08, 0.83]. This was a large effect size. These results suggest that twins who reported greater levels of co-dependence when they first started school were rated by teachers as having more social competence over time.

Table 7

Correlations Between Teacher-Reported Levels of Twin Social Competence at Time 2 With Quality of Twin Relationship at School Entry

Variable	*n*	*M (SD)*	*r*	*p*	BCa 95% CI
SAC – Social Competence	34	99.26 (10.60)	-	-	-
TRQ-P Closeness	34	4.01 (0.46)	.04	.835	-
TRQ-P Dependence	34	3.13 (0.68)	.01	.961	-
TRQ-P Rivalry	34	2.40 (0.72)	.10	.578	-
TRQ-P Conflict	34	3.03 (0.62)	.23	.195	-
TRQ-C Closeness	13	2.59 (0.41)	.10	.751	[-0.56, 0.72]
TRQ-C Dependence	13	1.62 (0.54)	.56*	.048	[0.08, 0.83]
TRQ-C Rivalry	13	1.73 (0.86)	.22	.474	[-0.33, 0.59]
TRQ-C Conflict	13	1.78 (0.29)	.05	.876	[-0.52, 0.44]

2.3.1 Hypothesis Three: The quality of the twins' relationship at school entry will moderate the association between classroom placement and their levels of social competence seen at school.

Prior to analysis, a new variable was computed that showed how much each twin's levels of social competence had changed over the course of a term, as reported by their teachers. Social competence at time 1 was subtracted from social competence at time 2 to produce a social competence change score for each twin. A positive score indicates

that the twins' social competence has increased over the course of a term, whereas a negative score indicates a decrease in social competence. Twins in the same class experienced an improvement in their social competence over the course of a term (*M* = 4.23, *SD* = 10.94*, n = 26*), whereas twins who were placed in separate classes appeared to experience a decrease in social competence over the course of a term (*M* = -1.89, *SD* = 11.71*, n* = 5*).*

Bivariate Pearson's correlations were conducted to assess the associations between the quality of the twins' relationship at school entry and change in the twins' social competence over time, as a function of classroom placement. Unfortunately, there were too few data on twin-relationship quality obtained from the children themselves, that also had data in change in social competence from teachers (*n* = 10 in same class and *n* = 1 in different class). For this reason, the analyses were focussed solely on the association for change in social competence with parental-reported twin-relationship quality. Table 8 shows that all aspects of the twin-relationship correlated positively with change in social competence over time for twins who were in separate classes. However, none of these values reached significance. Table 8 also indicates that twins who had higher levels of perceived dependence and rivalry prior to starting school, who were also placed in the same class, experienced a decrease in social competence over time at a level that reached significance. These were a medium and large effect size for dependence and rivalry respectively.

Table 8

Correlations Between Change in Social Competence Over a Term With Quality of Twin Relationship at School Entry

Placement	Variable	*n*	M *(SD)*	*r*	*p*
Same	TRQ-P Closeness	26	3.97 *(0.43)*	.08	.702
	TRQ-P Dependence	26	3.18 *(0.71)*	-.41*	.040
	TRQ-P Rivalry	26	2.42 *(0.68)*	-.54**	.004
	TRQ-P Conflict	26	3.06 *(0.63)*	-.13	.537
Separate	TRQ-P Closeness	5	4.20 *(0.65)*	.65	.232
	TRQ-P Dependence	5	2.75 *(0.43)*	.72	.175
	TRQ-P Rivalry	5	1.80 *(0.56)*	.28	.654
	TRQ-P Conflict	5	2.57 *(0.19)*	.22	.726

Note. * $p < .05$, ** $p < .01$

2.3.2 Hypothesis Four: Twin zygosity significantly influences decisions about classroom placement

A chi-square test was used to assess whether classroom placement (coded as 1 = same, 2 = separate) was associated with zygosity (coded as 1 = MZ, 2 = DZ). All expected cell frequencies were greater than five. The results of the chi-square test indicated no significant association between zygosity and classroom placement (χ^2 (1) = 1.36, p = .243, N = 118).

2.3.3 Hypothesis Five: The quality of the twin relationship prior to school entry influences decisions about classroom placement

Independent-samples t-tests were run to assess whether the quality of twin relationship prior to starting school, as reported by mothers and twins, influenced decisions about classroom placement. As the original distributions for twin-reported

closeness and twin-reported rivalry were not normal, Mann-Whitney U tests were run for these subscales. Levene's test for equality of variances showed there was homogeneity of variance between twins who were separated and those who were placed together across all subscales on the TRQ-P (closeness $p = .853$; dependence $p = .449$; rivalry $p = .346$; conflict $p = .415$) and the TRQ-C (closeness $p = .601$; dependence $p = .416$; rivalry $p = .281$; conflict $p = .565$). Table 9 presents the means and standard deviations of the twin relationship scales by placement. As indicated by table 10 and 11, there were no significant pre-existing differences in mother-reported and twin-reported relationship quality scores between twins who were placed together and those who were separated.

Table 9

Mean and Standard Deviation Scores on TRQ-P and TRQ-C at Time 1 by Placement

	Same Class		Separate Classes	
Variable	M *(SD)*	*n*	M *(SD)*	*n*
TRQ-P Closeness	4.18 *(0.48)*	86	4.26 *(0.49)*	32
TRQ-P Dependence	3.36 *(0.82)*	86	3.17 *(0.74)*	32
TRQ-P Rivalry	2.66 *(0.83)*	86	2.50 *(0.70)*	32
TRQ-P Conflict	3.01 *(0.78)*	86	2.85 *(0.67)*	32
TRQ-C Closeness	2.71 *(0.36)*	44	2.71 *(0.34)*	14
TRQ-C Dependence	2.20 *(0.60)*	44	2.26 *(0.73)*	14
TRQ-C Rivalry	1.86 *(0.77)*	44	2.14 *(0.89)*	14
TRQ-C Conflict	1.84 *(0.48)*	44	1.99 *(0.43)*	14

Table 10

Independent T-Tests Assessing Differences in Quality of Twin Relationship at Time 1 as a Function Of Placement

Variable	Mean Difference (MD)	*df*	*t*	*p*	95% CI
TRQ-P Closeness	0.08	116	-0.81	.422	[-0.28, 0.12]
TRQ-P Dependence	0.19	116	1.14	.257	[-0.14, 0.52]
TRQ-P Rivalry	0.16	116	0.94	.348	[-0.17, 0.48]
TRQ-P Conflict	0.15	116	0.98	.328	[-0.15, 0.46]
TRQ-C Dependence	0.06	56	-0.34	.739	[-0.45, 0.32]
TRQ-C Conflict	0.14	56	-0.97	.565	[-0.43, 0.15]

Note. N = 118 for TRQ-P; *n = 58* for TRQ-C

Table 11

Non-Parametric Tests Assessing Differences in Quality of Twin Relationship at Time 1 as a Function Of Placement

Variable	*U*	*z*	*p*
TRQ-C Closeness	302.50	-.11	.913
TRQ-C Rivalry	250.00	-1.09	.278

Note. n = 58

2.3.4 Hypothesis Six: The quality of the twins' relationship will significantly differ depending on whether the twins are identical or not

Table 12 presents the means and standard deviations of the twin relationship scales by zygosity. Independent-samples t-tests were run to assess whether the quality of the twins' relationship at time 1, as reported by mothers and by twins, varied as a function of zygosity. As the original distributions for twin-reported closeness and twin-reported rivalry were not normal, Mann-Whitney U tests were run for these subscales. Levene's test for equality of variances showed there was homogeneity of variance

between MZ and DZ twins across all subscales on the TRQ-P (closeness $p = .392$; dependence $p = .793$; rivalry $p = .550$; conflict $p = .842$) and the TRQ-C (closeness $p = .076$; dependence $p = .786$; rivalry $p = .844$; conflict $p = .411$).

Table 12

Mean and Standard Deviation Scores on TRQ-P and TRQ-C at Time 1 by Zygosity

	MZ		DZ	
Variable	M *(SD)*	*n*	M *(SD)*	*n*
TRQ-P Closeness	4.33 *(0.47)*	62	4.08 *(0.47)*	56
TRQ-P Dependence	3.27 *(0.81)*	62	3.35 *(0.80)*	56
TRQ-P Rivalry	2.76 *(0.71)*	62	2.82 *(0.78)*	56
TRQ-P Conflict	2.91 *(0.76)*	62	3.01 *(0.74)*	56
TRQ-C Closeness	2.76 *(0.31)*	32	2.65 *(0.41)*	26
TRQ-C Dependence	2.25 *(0.62)*	32	2.17 *(0.65)*	26
TRQ-C Rivalry	1.73 *(0.76)*	32	2.17 *(0.79)*	26
TRQ-C Conflict	1.89 *(0.45)*	32	1.88 *(0.49)*	26

Results indicated only two significant effects for zygosity; mothers reported greater levels of closeness between MZ twins ($n = 56$; $M = 4.33$, $SD = 0.47$) compared to DZ twins ($n = 62$; $M = 4.08$, $SD = 0.47$). This difference was statistically significant with a medium effect size ($MD = 0.25$, 95% CI [-0.41, -0.07], $t(116) = -2.79$, $p = .006$, $d = 0.51$). DZ twins reported more rivalry compared to MZ twins (Mdn = 2.25 and 1.50, respectively for DZ and MZ twins, $U = 290.50$, $z = -2.02$, $p = .040$, $d = 0.53$). This difference approached a medium effect size (see Table 13 for results from t-tests and Table 14 for non-parametric results). DZ and MZ twins did not differ on any other of the twin relationship quality measures.

Table 13

Independent T-Tests Assessing Differences in Quality of Twin Relationship at Time 1 as a Function Of Zygosity

Variable	Mean Difference (MD)	*df*	*t*	*p*	95% CI
TRQ-P Closeness	0.25**	116	-2.79	.006	[-0.41, -0.07]
TRQ-P Dependence	0.08	116	0.53	.595	[-0.21, 0.37]
TRQ-P Rivalry	0.07	116	0.46	.645	[-0.22, 0.36]
TRQ-P Conflict	0.10	116	0.70	.483	[-0.18, 0.37]
TRQ-C Dependence	0.08	56	-0.50	.619	[-0.42, 0.25]
TRQ-C Conflict	0.01	56	-0.06	.954	[-0.26, 0.24]

Note. N = 118 for TRQ-P; *n = 58* for TRQ-C; **p < .01

Table 14

Non-Parametric Tests Assessing Differences in Quality of Twin Relationship at Time 1 as a Function Of Zygosity

Variable	*U*	*z*	*p*
TRQ-C Closeness	364.50	-0.88	.380
TRQ-C Rivalry	290.50*	-2.02	.040

Note. n = 58; *p < .05

2.4 Discussion

The present study aimed to extend previous research by exploring the role of the twins' relationship with each other when studying the effects of classroom placement (either together or apart) on their social development. The objective was to generate data that can ultimately better inform parents and educators when making decisions about twins' classroom placements. The twins' zygosity was also considered in analysis. The current study further extends previous research by including measures that capture the perspective of the children themselves, specifically their perceptions of their

relationship with their co-twin. The study's sample was fairly small, especially when measures were considered across time and reporters. As a result, the study's statistical analyses were likely underpowered. The findings of the present study need to be interpreted with this in mind.

The study's main aim was to examine the impact of classroom placement on the twins' social competence over time. Preliminary analyses were carried out to account for any pre-existing differences in the twins' quality of relationship and zygosity prior to their start at school, as it was thought that these factors may have influenced the decisions parents made about the appropriate classroom placement in the first place. Firstly, it was hypothesised that twins who had been in separate classrooms would have significantly lower levels of teacher-reported social competence after a school term than twins who had been kept together. This was proposed with an attachment-theoretical perspective in mind; it was argued that twins would serve as secure bases for each other. Accordingly, if kept together in a new classroom, the presence of their co-twin would facilitate exploration of their environment and would help them to be more confident at developing their social circle. In contrast, those who had been separated from their twin may have experienced emotional distress at being separated (Alexander, 2012; Segal & Russell, 1992) and would therefore be less likely to explore the world around them and not have the confidence to initiate social interactions with new peers.

The findings of this study need to be interpreted with caution. According to table 6 twins who were in separate classrooms did in fact have lower levels of social competence after a term than the twins who were kept together. However, whilst these differences were notable, they were not significant. This might in part be due to the size of the final sample in this analysis (n = 31), as the teacher response rate was extremely low for this

study. Furthermore, it is important to note that the 31 twins included in this analysis were unevenly grouped, in that 26 were in the same class and only five were separated. It is possible that a much larger and more evenly spread sample would have yielded different results. As highlighted in Chapter 1, other studies investigating the impact of classroom placement have so far only focused on behavioural and academic outcomes in twins, and their findings have been inconsistent, even with much larger samples. Further exploration on the impact on social competence is therefore warranted with a much larger sample size, as with the previous longitudinal studies on twins. Indeed, more data is currently being gathered to address this question further.

Secondly, it was investigated whether the relationship quality between the twin pair impacted on their social competence. Informed by previous research (Bank, Patterson, & Reid, 1996; Tancredy & Fraley, 2006) it was hypothesised that twins who were reported to have higher levels of closeness, and lower levels of co-dependence, conflict and rivalry would demonstrate higher levels of social competence over time. Contrary to these predictions, it was found that twins who had higher levels of co-dependence (as indicated by self-report) were also significantly more likely to be rated by teachers as having higher levels of social competence after a term at school. Furthermore, whilst non-significant, both twin and mother reports indicated that twin rivalry and conflict were positively correlated with social competence.

The finding that twin-reported co-dependence was significantly, positively correlated with social competence was surprising. However, Koch (1966) found that the closeness between twins did not affect their ability to develop meaningful friendships with other children. Given that the concept of closeness and dependence are arguably interlinked, it is possible that moderate levels of dependence within the co-twin relationship provide a

unique context for experiencing the emotions of another person and may thus enhance a child's capacity to empathise with others (Zahn-Waxler, Robinson, & Emde, 1992).

Several explanations for the positive correlations between rivalry and conflict and social competence are possible; firstly, it has been argued that some level of conflict within sibling dyads can provide a healthy context for emotional expression, understanding the feelings of another person, and helping to resolve differences, as long as these levels of conflict are in moderation (Dunn, 1991, 2007). The particular intimate aspect of a sibling relationship has been described as a unique socializing context that promotes the development of understanding others' mental and emotion states (Howe & Recchia, 2014). Although this literature primarily focuses on non-twin sibling conflict, it is recognised that rivalry is an additional, and particularly salient, aspect of conflict in the twin-relationship, given the likelihood that the twins may be directly compared with each other and that they have to compete for resources (Hay & Preedy, 2006).

Secondly, it is possible that the co-existence of both conflict and closeness in twin relationships makes for a particularly powerful and intense emotional context that promotes social competence. Indeed, one study indicated that siblings who experienced moderate levels of conflict and warmth showed better social adjustment at school than those who experienced high levels of conflict and low levels of warmth (Stormshak, Bellanti, & Bierman, 1996). The present study did not consider the co-occurrence of different and contrasting emotional qualities in the twin relationship, but the average levels of closeness between twins across this sample were reported by both mothers and children to be very high, as indicated earlier in Table 3.

A third possibility is that children's behaviour within the twin dyad does not systematically generalize to other relationships, including those with other children at school. Indeed, frequent disagreements and arguments between siblings are common

even when they have a close and supportive relationship. However, this is less likely true for relationships with children at school (Cutting & Dunn, 2006). It is clear that future research needs to understand better the interplay between conflict, rivalry and warmth in twin relationships to better characterize how twin relationship experiences impact on other aspects of development.

This study also explored the association between quality of twin relationship at school entry and change in social competence over the course of a term, as a function of classroom placement. The findings suggest that twins who were perceived to be closer and more dependent on each other at school entry showed greater positive change in social competence over time if they were separated. Whilst non-significant, these correlations of .65 and .72 respectively show considerable strength, given that it is only based on a sample of 5 children. However, the small sample size means that this finding cannot be concluded with any certainty, nor can it be considered representative.

Furthermore, twins who were kept together and were perceived to have higher levels of dependence and rivalry before they started school had much lower change scores over time. This means that these twins were less likely to improve in social competence and, if anything, got worse over the course of a term. This is interesting to note, given that this study also found that twins with higher levels of co-dependence and rivalry were rated by teachers as having higher levels of social competence after a term at school. Taken together, these findings suggest that the quality of twin relationship is important to consider when making decisions about classroom placement, as those who were rated as higher in dependence and rivalry did not in fact experience a positive change in their social competence score if they were kept together.

Fourthly, it was hypothesised that zygosity would be an important influential factor in the decision-making process. Informed by previous research (Tully et al., 2004) it was

predicted that twins would more likely end up placed together if they were identical than non-identical. However, in this study there was no significant association between classroom placement and zygosity. Whilst this analysis drew on data from the entire participant sample (N = 118), this was still very small in comparison to other studies that have used twins, and therefore an association may have been found with a much larger sample.

Fifthly, it was hypothesised that the quality of the twin relationship prior to school entry would influence parental decisions about classroom placement; twins with higher perceived and reported levels of closeness would more likely be in the same class, whereas twins who had higher perceived and reported levels of co-dependence, rivalry and conflict would be separated. This is informed by previous research indicating that the most common reason for separation is to promote the twins' independence and individuality (e.g., Segal & Russell, 1992). Furthermore, it has been suggested that, due to their genetic similarities, twins may interact in such a way as to increase problem behaviours in each other (DiLalla & Mullineaux, 2007), and parents may therefore choose to separate them if they exhibit significant levels of conflict and rivalry with each other at home. Yet, having a co-twin present might serve as a protective factor for children who might feel anxious entering a novel and demanding environment (DiLalla & Mullineaux, 2007). However, in this study, there were no significant pre-existing differences in mother- and twin-reported relationship quality scores between twins who were placed together and those who were separated. Whilst not significant, the largest mean difference was found in mother-reports of the twins' co-dependence. With a greater sample size, this may have reached significance as dependency and reliance on a twin has

been rated by teachers and parents as the most important factor in the decision-making process (Gleeson et al., 1990).

Sixthly, this study examined whether the quality of the twins' relationship significantly differed as a function of zygosity. As expected, MZ twins were found to have significantly greater levels of closeness than DZ twins. However, this only applied to mothers' reports as the children's self-report indicated no significant differences in levels of closeness. Additionally, it was found that DZ twins reported higher levels of rivalry than MZ twins but this difference only reached significance for child reports. Therefore, while there was some support for the hypothesis that the quality of relationship between twins is associated with zygosity, this association did not hold consistently across different relationship dimensions and across reporters. The present findings are consistent with Fortuna et al.'s (2010) work who reported that MZ twins were rated by their mothers as closer with each other than DZ twins. This study has replicated that finding, even with a very small sample. However, in contrast to Fortuna et al. (2010), the present study also found that zygosity was associated with rivalry. Taken together, these findings suggest that there may be some differences in how mothers and twins view the same twin-relationship. Whilst this has not explicitly been researched within the twin literature, other studies in the social, emotional and mental health sector have highlighted discordance between parental and child reports (e.g., Chambers, Reid, Craig, McGrath, & Finley, 1998; Eiser & Varni, 2013; Holt, Kaufman Kantor, & Finkelhor, 2008; Jensen et al., 1999). This would therefore warrant further replication with a larger sample size.

There were some significant limitations to this thesis, which means that the findings must all be interpreted with extreme caution and cannot be generalised to the wider twin-population. The small sample size has already been mentioned. This will be

discussed further, along with additional limitations and potential strengths of the research.

2.4.1 Strengths and Limitations

This study was designed to explore changes in twin social competence over the course of a school term. Whilst this enabled the researcher to study the impact of classroom placement without the risk of unduly influencing the results, it is also possible that this was not a long enough time frame in order for any significant changes to be detected. Ideally, this process would have happened over an academic year, or even over the course of the twins' entire schooling. However, that was beyond the scope of this study.

A real strength of this research is the inclusion of twin views and it is the only study currently that has sought the views of twins at such a young age. A pilot study showed that the TRQ-C was appropriate for 4-5 year olds to understand and the internal consistency of the subscales were deemed to be acceptable. Furthermore, the TRQ-P and the SAC for teachers demonstrated good and excellent internal consistency respectively, thus indicating that they were appropriate measures to use for the purpose of this study. The results indicated that different aspects of the twin relationship correlated differently with social competence, thus highlighting the importance of exploring multiple aspects of the twin relationship in future research. This also supported the decision to keep the subscales on the twin relationship questionnaires separate, rather than computing an aggregate score of twin relationship quality.

That being said, there were a number of significant limitations of this study that mean the conclusions made from these findings are only tentative at best and must be

interpreted with extreme caution. The most significant impacting factor is arguably the small sample size. The present sample size is substantially smaller compared to the samples in other quantitative studies discussed in the systematic literature review (see Chapter 1). The reason for this is due to the fact that the researcher did not have access to a government database, where data on an entire twin population is likely to be stored. In 2012, when the majority of this study cohort would have been born, 11,228 women gave birth to twins in the UK (Office for National Statistics, 2013). It was therefore hoped that TAMBA would be able to reach out to a significant number of these families for recruitment purposes. However, despite the recruitment strategy that was adopted, the overall response rate from that cohort was still very low. Furthermore, not all mothers were able to help their twins complete their version of the questionnaire. This resulted in an even smaller twin-report sample, which was not able to be included in some of the analyses.

Another limitation is the reliance on mother's reports as to the zygosity of their twins. Previous UK studies have made use of DNA testing and a zygosity questionnaire (DiLalla & Mullineaux, 2007; Tully et al., 2004) which has been shown to be over 95% accurate when compared to DNA markers (Price, Freeman, Craig, & Petrill, 2000). However, the questionnaire was not used in this study and accessing twin DNA was outside the scope of this study. The differences that were found between identical and non-identical twins in this study can therefore not be concluded with certainty as it is possible that mothers have reported according to their perceptions of their twins being identical (and thus treated them so) rather than DNA testing, which is a costly process.

One difficulty with the use of twin-reported data is the fact that mothers may not have heeded the researcher's advice to help their twins fill in the questionnaire in the

absence of their co-twin. Indeed, the twin-reported data for one dyad was removed as the mother had anecdotally informed the researcher that the twins had been together and influenced each other's answers. There is no way to know the extent to which other mothers experienced this, and therefore how confounded the twin reports might be.

The response rates for schools were not only significantly low, but also inconsistent across both time points. The recruitment of teaching staff for this study was reliant on obtaining consent from head teachers. It is therefore possible that some heads may have taken the decision that their staff did not have capacity and therefore took the decision to participate away from the teachers themselves. Furthermore, staff may have felt that they did not have the time to commit to the research, despite reminders that the questionnaires would only take about 10 minutes to fill in. This might be because schools in the UK are currently under a phenomenal amount of pressure, given the introduction of a new national curriculum and the abandonment of national curriculum levels to assess pupil progress (Department for Education, 2015).

Finally, this study did not account for additional confounding variables, such as gender, ethnicity and socio-economic status. These might be significant factors to introduce in future research, given that other studies have shown that twins from lower socio-economic status are more likely to share a classroom (e.g., Polderman, Bartels, Verhulst, Huizink, Beijsterveldt & Boomsma, 2010). Studies have also accounted for pre-existing behavioural differences in twins (Coventry et al., 2009) that may have influenced the decision to separate them at school in the first place. This was not accounted for in the present study. It is also acknowledged that, for some of the twins, there was no option to separate as they attended small, one-form entry schools.

2.4.2 Implications for Future Research, Educational Practitioners and Parents

Given the number of limitations in this study, it will be important moving forward that attempts are made to replicate and build on this study at a broader level, in the hope that conclusions can be drawn more confidently. These findings would benefit from the addition of qualitative data on the twins' experiences of being together or apart from their twin, as this might serve to further fuel the argument that each twin dyad experiences subtle differences in the quality of their relationship, which may be why it is so difficult to demonstrate a range of significant findings.

Furthermore, there is currently no guidance or indication about the 'optimum' levels of twin closeness, co-dependence, rivalry and conflict that might help to facilitate positive social and emotional development and potentially buffer against being separated at school. It has been suggested that twins can vary from extreme closeness and supportiveness to extreme conflict and competition (Ainslie, 1985; Schave & Ciriello, 1983), and that this can lead to potential difficulties in terms of individual identity development (Hay & Preedy, 2006) and anti-social behaviours (Bank, Patterson, & Reid, 1996) respectively. However, the picture is not yet clear about what this would look like in moderation.

As an extension of this point, it would also be interesting to note whether twin relationships are likely to change over time, depending on the experiences of separation twins have at school. It would therefore be of benefit to study a large cohort of twins throughout their schooling. In line with this, a more in-depth exploration of within-dyad similarities and differences could be explored, to see which twin pairs report their relationship quality concordantly, and which twin pairs differ. This might be where zygosity has more weighting as research has indicated that MZ twins appear more dependent on each other in comparison to same-sex DZ twins (Penninkilampi-Kerola,

Moilanen, & Kaprio, 2005). It might be that MZ twins provide self-reports that are more concordant with each other than non-identical twins.

Furthermore, given the emphasis on an attachment-theoretical perspective in this thesis, it should be noted that research in the past has focussed on attachment relationships between an infant and their primary caregiver. The literature discussed as part of the systematic literature review in Chapter 1 has highlighted that twin relationships are unique and special (DiLalla & Mullineaux, 2007; Polderman et al., 2010; Tully et al., 2004). Whether and how attachment relationships between siblings, especially twins, form and develop are therefore important questions that warrant further exploration for the future development and application of attachment theory (Whiteman, McHale, & Soli, 2011).

The overall research objective stated in the introductory section of this chapter was that the findings from this study could be used to inform, guide and shape the practice of schools in the UK when considering the classroom placement of twins. Whilst they were not indicative of a significant impact of classroom separation on twins' social competence, there are still a number of important implications for educational professionals and parents to consider.

Taking the findings from this study into consideration with the pre-existing literature on the classroom placement of twins, there is an overwhelming sense that a one-size-fits-all approach to educating twins is inappropriate. There are a range of complex factors for parents and school staff to consider when deciding what is in the best interests of the twins, and it is vital that twins are not considered a homogenous group. It will therefore be important that schools work collaboratively with families of twins, and indeed other multiples, and consult with parents and twins about the precise nature of their relationship dyad. Whilst there were no apparent negative effects of separation on

the twin cohort in this study, it is still paramount that parents are consulted and that the twins are given a voice in the decision-making process.

Parents may be particularly interested in the suggestion that an appropriate level of rivalry can be considered helpful for the positive development of social competence in twins. Whilst this can potentially be difficult to manage at home, it might be important for parents to create or allow an environment at home whereby twins can safely work through any arguments or disagreements, in addition to modelling how this might be done effectively.

Educational Psychologists are well placed to promote the concept of attachment theory and the biological and environmental factors that are likely to impact on twins in school. They could also play a key role in promoting environments that enable twins to develop and thrive individually as well as together. According to Preedy (1999), parents are often not able to provide their twins with separate experiences. However, it is still possible to do this in an educational setting without placing them in separate classrooms. This might be particularly pertinent at pre-school, as this could be the first time the twins experience a significant period of time away from their parents. Educational Psychologists could encourage pre-schools to provide safe opportunities for twins to explore their environment, both with and without their co-twin.

In addition, Educational Psychologists could engage in a greater level of multi-agency working and foster stronger links with Portage workers, who might have worked with specific families before the twins get to pre-school. Portage workers would potentially have some understanding of the specific dynamics of a particular family of multiples and therefore families could be supported by other professionals to introduce opportunities for safe separation before the twins are of the age where they attend pre-school.

Given the lack of literature on whether and how attachment relationships develop between siblings, Educational Psychologists could perhaps contribute to this area by collating observations on co-twin interactions throughout their caseload. The knowledge held by EPs on attachment theory should also be shared with both parents and staff, so that those who live and work with twins have more of a shared understanding about the key concepts underpinning attachment theory, and how to support those twins who are finding it difficult to adjust to the novel demands of the school environment. This might also be pertinent when twins are transitioning to secondary schools and colleges, particularly if they have been kept together throughout their primary schooling.

Furthermore, this thesis has highlighted several areas of research for the future, some of which can be explored by Educational Psychologists already qualified or by those who are working through training courses. Indeed, additional data is already being collected for this particular project, in the hope that more firm conclusions can be drawn.

2.4.3 Final Conclusions

Quantitative research on the impact of different classroom placements on twins has previously focused on behavioural and academic outcomes (Coventry et al., 2009; DiLalla & Mullineaux, 2007; Polderman et al., 2010; Tully et al., 2004; van Leeuwen et al., 2005, Webbink et al., 2007). A growing body of research has also explored the specific nature of the twin relationship (Fortuna et al., 2010; Penninkilampi-Kerola et al., 2005) and placed it in the context of an attachment-theoretical perspective (Fraley & Davis, 1997; Tancredy & Fraley, 2006). The present study was the first to assess the association between classroom placement of twins, their relationship with each other, and their social adjustment at school. Furthermore, studies investigating the impact of classroom placement have not done so with regards to the social and emotional development of

twins. This is a particularly salient area that warrants further exploration, given the fact that the unique relationship twins share is provided as both a justification and an argument against separating twins at school (e.g., Alexander, 2012; Koch, 1966).

In summary, this present study suggested that twins who were kept in the same classroom had higher levels of social competence after a term than the twins who were separated, although this did not reach significance. They also improved in social competence over time, in comparison to the separated twins, who experienced a decrease in social competence after a term. However, when accounting for the quality of the twin relationship prior to starting school, it was found that the twins in the same class, who also had higher levels of perceived co-dependence and rivalry, experienced a decrease in social competence at a level that reached significance. This suggests that the quality of relationship the twins share is an important factor that needs to be explored and discussed with the twins and their families before decisions are made about classroom placements. Nonetheless, these conclusions need to be interpreted with significant caution due to the small sample and lack of statistical power and are only applicable for this sample at the time of the research. That being said, it is hoped that these findings will have paved the way for future research and further contribute to the ongoing debate faced by parents and schools about the issue of where to place twins in the class.

Appendices

Appendix A Search Terms and Limiters Applied for Systematic Literature Search

PsycINFO

PsycINFO was searched using the EBSCOhost Research Databases interface on 20/11/16 for the period 1990 to 2016. (Publication type: All Journals; Language: English; Document type: Journal Article)

1 twin* (16, 103)

2 “identical twin*” (981)

3 “non-identical twin*” (27)

4 co-twin* (787)

5 “monozygotic twin*” (2,472)

6 “dizygotic twin*” (1,418)

7 “multiple birth child*” (20)

8 “multiple birth*” (358)

9 multiple* (218,055)

10 triplet* (1,220)

11 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 (233,837)

12 class* (390,291)

13 “classroom placement*” (123)

14 “school placement*” (425)

15 “classroom environment*” (9,162)

16 “learning environment*” (14, 170)

17 “school environment*” (13,457)

18 12 OR 13 OR 14 OR 15 OR 16 OR 17 (407,290)

19 “academic achievement” *(EXPLODED – academic overachievement, academic underachievement, achievement gap, college academic achievement, mathematics achievement, reading achievement, science achievement)* (67,968)

20 behav* (1,401,021)

21 “social well-being” (1,250)

22 “social skills” (22,256)

23 “social competence” (6,800)

24 “social funct*” (19,654)

25 “emotional well-being” (3,341)

26 “emotional competence” (972)

27 “emotional funct*” (2,907)

28 “emotion regulation” (8,245)

29 adjustment *(EXPLODED emotional adjustment, occupational adjustment, school adjustment, social adjustment)* (53,101)

30 “peer interaction*” (2,466)

31 “psychological well-being” (10,899)

32 “psychological competence” (59)

33 “psychological funct*” (6,279)

34 self-regulation (14,848)

35 self-concept *(EXPLODED academic self-concept, entitlement, self-confidence, self-esteem)* (65,145)

36 self-efficacy (37,613)

37 “peer relationship*” (3,833)

38 identity (120,894)

39 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38 (1,644,237)

40 11 AND 18 AND 39 (6,885)

A further filter was applied to this final result: childhood (birth-12 years) to produce **2,084** articles.

Once duplicates removed: **2,080**

Web of Science

Web of Science Core Collection was searched using {Thomson reuters} interface on 02/12/16 for the period 1990 to 2016. (Publication type: All Journals; Language: English; Document type: Journal Article)

1 (TS=(twin* OR “identical twin*” OR “non-identical twin*” OR co-twin* OR “monozygotic twin*” OR “dizygotic twin*” OR “multiple birth child*” OR “multiple birth*” OR multiple* OR triplet*))

2 (TS=(class* OR “classroom placement*” OR “school placement*” OR “classroom environment*” OR “learning environment*” OR “school environment*”))

3 (TS=("academic achievement" OR "academic overachievement" OR "academic underachievement" OR "achievement gap" OR "college academic achievement" OR

"mathematics achievement" OR "reading achievement" OR "science achievement" OR behav* OR "social well-being" OR "social skills" OR "social competence" OR "social funct*" OR "emotional well-being" OR "emotional competence" OR "emotional funct*" OR "emotion regulation" OR adjustment OR "emotional adjustment" OR "occupational adjustment" OR "school adjustment" OR "social adjustment" OR "peer interaction*" OR "psychological well-being" OR "psychological competence" OR "psychological funct*" OR self-regulation OR self-concept OR "academic self-concept" OR entitlement OR self-confidence OR self-esteem OR self-efficacy OR "peer relationship*" OR identity)) *AND*

4 #3 AND #2 AND #1 (14,151)

5 #3 AND #2 AND #1
Refined by: **RESEARCH AREAS:** (PSYCHOLOGY OR EDUCATION EDUCATIONAL RESEARCH OR GENETICS HEREDITY)
Total Studies = 3,202

ERIC

ERIC was searched using the ProQuest interface on 02/12/16 for the period 1990 to 2016. (Publication type: All Journals; Language: English; Education Level: all EXCEPT Adult Education and Adult Basic Education)

(twin* OR “identical twin*” OR “non-identical twin*” OR co-twin* OR “monozygotic twin*” OR “dizygotic twin*” OR “multiple birth child*” OR “multiple birth*” OR multiple* OR triplet*)

AND

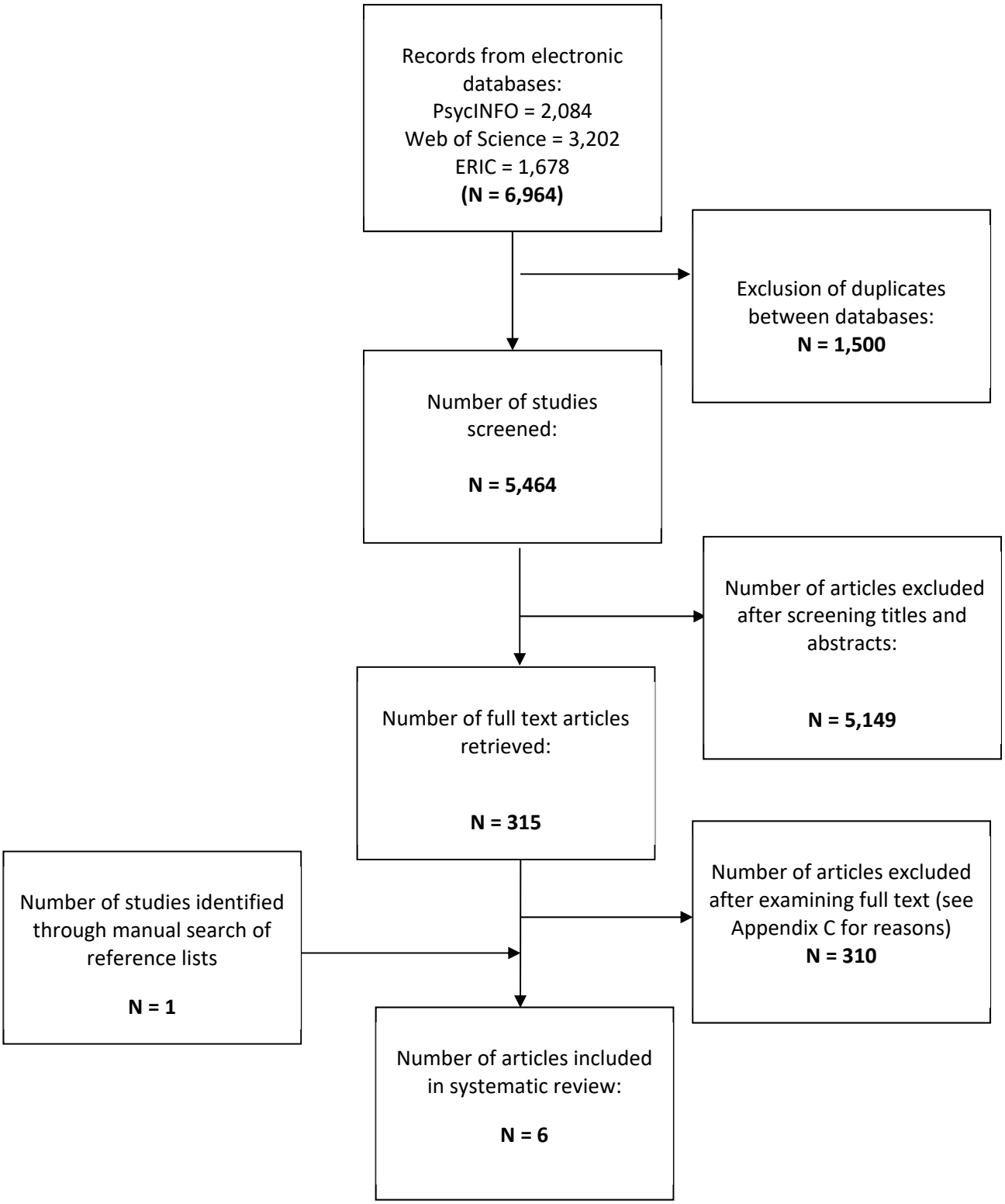
(class* OR “classroom placement*” OR “school placement*” OR “classroom environment*” OR “learning environment*” OR “school environment*”)

AND

("academic achievement" OR "academic overachievement" OR "academic underachievement" OR "achievement gap" OR "college academic achievement" OR "mathematics achievement" OR "reading achievement" OR "science achievement" OR behav* OR "social well-being" OR "social skills" OR "social competence" OR "social funct*" OR "emotional well-being" OR "emotional competence" OR "emotional funct*" OR "emotion regulation" OR adjustment OR "emotional adjustment" OR "occupational adjustment" OR "school adjustment" OR "social adjustment" OR "peer interaction*" OR "psychological well-being" OR "psychological competence" OR "psychological funct*" OR self-regulation OR self-concept OR "academic self-concept" OR entitlement OR self-confidence OR self-esteem OR self-efficacy OR "peer relationship*" OR identity)

Total Studies = 1,678

Appendix B Flow Chart Documenting the Inclusion and Exclusion of Studies From the Systematic Literature Search



Appendix C Reasons for Excluding Studies

All titles and abstracts of the papers identified from the electronic databases were screened. 315 were identified as relevant and retrieved in full text. One additional article was retrieved in full following a hand search, resulting in 316 full papers. 310 papers were excluded for the following reasons:

1. Studies did not look specifically at the classroom placement of twins (N = 306).
2. Studies focused on teacher, parental and twin perceptions of different classroom placements (N = 4). This was beyond the scope of this systematic review.

Appendix D Twin Relationship Questionnaire – Parent Version (Fortuna, Goldner & Knafo, 2010)

Please choose the response for each statement that best reflects your child's behaviour.

Closeness					
Understands their twin in the best possible way	Always	Often	Sometimes	Rarely	Never
Likes to be with their twin	Always	Often	Sometimes	Rarely	Never
Wants to play with their twin	Always	Often	Sometimes	Rarely	Never
Is interested in their twin	Always	Often	Sometimes	Rarely	Never
Dependence					
Is upset when parted from their twin	Always	Often	Sometimes	Rarely	Never
Their mood is affected by the mood of their twin	Always	Often	Sometimes	Rarely	Never
Is affected when their twin is sick or upset	Always	Often	Sometimes	Rarely	Never
Misses their twin when they are not there	Always	Often	Sometimes	Rarely	Never
Rivalry					
Is unhappy or jealous when you do things with their twin	Always	Often	Sometimes	Rarely	Never
Is unhappy or jealous when other adults do things with their twin	Always	Often	Sometimes	Rarely	Never
Is competitive towards their twin	Always	Often	Sometimes	Rarely	Never
Is angry when separated from their twin	Always	Often	Sometimes	Rarely	Never
Conflict					
Hurts their twin's feelings	Always	Often	Sometimes	Rarely	Never
Gets angry with their twin	Always	Often	Sometimes	Rarely	Never
Fights and argues with their twin	Always	Often	Sometimes	Rarely	Never
Blames their twin when something goes wrong	Always	Often	Sometimes	Rarely	Never
Has physical fights with their twin (not just for fun)	Always	Often	Sometimes	Rarely	Never

Appendix E Factor Loadings for Exploratory Factor Analysis with Direct Oblimin Oblique Rotation of TRQ-P Questionnaire Scales

TRQ-P Items	Closeness	Dependence	Rivalry	Conflict
Item 3: Wants to play with the other twin	.82			
Item 2: Likes to be with the other twin	.81			
Item 4: Is interested in the other twin	.74			
Item 1: Usually understands the other twin in the best possible way	.62			
Item 7: Is affected when the other twin is sick or upset		.88		
Item 6: Their mood is affected by the mood of the other twin		.78		
Item 8: Misses the other twin when they are not there		.77		
Item 5: Is upset when parted from the other twin		.76		
Item 9: Is unhappy or jealous when you do things with the other twin			.90	
Item 10: Is unhappy or jealous when the other parent does things with the other twin			.89	
Item 12 - Is usually angry when the twins are separated			.48	
Item 15: Fights and argues with the other twin				.88
Item 14: Gets very angry with the other twin				.86
Item 17: Has physical fights with the other twin (not just for fun)				.82
Item 13: Hurts the other twin's feelings				.73
Item 16: Blames the other twin when something goes wrong				.70
Item 11: Is very competitive towards the other twin				.61

Appendix F Twin Relationship Questionnaire – Child Version (adapted from Fortuna, Goldner & Knafo, 2010)

Please read the sentences with your Mum and tell me if you agree with them. Choose "Yes" if you agree, "No" if you do not agree and "Sometimes" if you only agree some of the time.

Closeness			
I know what my twin is thinking or feeling.	Yes	Sometimes	No
I like to be with my twin.	Yes	Sometimes	No
I want to play with my twin.	Yes	Sometimes	No
I like to see what my twin is doing.	Yes	Sometimes	No
Dependence			
I am sad when I am not with my twin.	Yes	Sometimes	No
If my twin is happy, I am happy too. If my twin is sad, I am sad too.	Yes	Sometimes	No
I do not like it when my twin is ill.	Yes	Sometimes	No
I miss my twin when they are not with me.	Yes	Sometimes	No
Rivalry			
I do not like it when Mum plays with my twin.	Yes	Sometimes	No
I do not like it when other grown-ups play with my twin.	Yes	Sometimes	No
I like to beat my twin at games.	Yes	Sometimes	No
I feel angry when my twin is moved away from me.	Yes	Sometimes	No
Conflict			
I make my twin sad.	Yes	Sometimes	No
I get angry with my twin	Yes	Sometimes	No
I argue with my twin	Yes	Sometimes	No
When something goes wrong I say it was my twin's fault.	Yes	Sometimes	No
I hit or kick my twin.	Yes	Sometimes	No

Appendix G Factor Loadings for Exploratory Factor Analysis with Direct Oblimin Oblique Rotation of TRQ-C Questionnaire Scales

TRQ-C Items	Closeness	Dependence	Rivalry	Conflict
Item 3: I want to play with my twin	.83			
Item 4: I like to see what my twin is doing	.78			
Item 2: I like to be with my twin	.69			
Item 12: I feel angry when my twin is moved away from me		.74		
Item 5: I am sad when I am not with my twin		.63		
Item 8: I miss my twin when they are not with me		.57		
Item 9: I do not like it when Mum plays with my twin			.81	
Item 10: I do not like it when other grown-ups play with my twin			.79	
Item 15: I argue with my twin				.78
Item 17: I hit or kick my twin				.77
Item 14: I get angry with my twin				.67
Item 13: I make my twin sad				.62
Item 16: When something goes wrong I say it was my twin's fault				.56
Item 11: I like to beat my twin at games				.48

Appendix H Social Attributes Checklist (McClellan & Katz, 1992)

Please choose one response for each statement about this twin's social behaviour.

Is in a positive mood	Always	Often	Sometimes	Rarely	Never
*Is dependent on adults	Always	Often	Sometimes	Rarely	Never
Comes to school willingly	Always	Often	Sometimes	Rarely	Never
Copes with disappointments adequately	Always	Often	Sometimes	Rarely	Never
Shows the capacity to empathise	Always	Often	Sometimes	Rarely	Never
Has positive relationships with one or two peers	Always	Often	Sometimes	Rarely	Never
Displays the capacity for humour	Always	Often	Sometimes	Rarely	Never
*Seems to be acutely lonely	Always	Often	Sometimes	Rarely	Never
Approaches others positively	Always	Often	Sometimes	Rarely	Never
Expresses wishes and preferences clearly	Always	Often	Sometimes	Rarely	Never
Asserts own rights and needs appropriately	Always	Often	Sometimes	Rarely	Never
*Is easily intimidated by bullies	Always	Often	Sometimes	Rarely	Never
Expresses frustration and anger effectively and without escalating disagreements or harming others	Always	Often	Sometimes	Rarely	Never
Gains access to ongoing groups at play and work	Always	Often	Sometimes	Rarely	Never
Enters ongoing discussions on a subject; makes relevant contributions to ongoing activities	Always	Often	Sometimes	Rarely	Never
Takes turns fairly easily	Always	Often	Sometimes	Rarely	Never
Shows interest in others; exchanges information from others appropriately	Always	Often	Sometimes	Rarely	Never
Negotiates and compromises with others appropriately	Always	Often	Sometimes	Rarely	Never
*Draws inappropriate attention to self	Always	Often	Sometimes	Rarely	Never
Accepts and enjoys peers and adults who are different to them	Always	Often	Sometimes	Rarely	Never
Interacts nonverbally with other children by smiling, waving, nodding etc.	Always	Often	Sometimes	Rarely	Never
Is accepted versus neglected or rejected by other children	Always	Often	Sometimes	Rarely	Never
Is invited by other children to join them in play, friendship and work	Always	Often	Sometimes	Rarely	Never
Is named by other children as someone they are friends with or like to play with	Always	Often	Sometimes	Rarely	Never

Note: *Items were reverse coded for analysis.

Appendix I Information Page Presented to Mothers Online

UNIVERSITY OF Southampton

Online Information Sheet and Consent – Parent Version

(03/01/17, V. 5)

Study Title: Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

Researcher: Katy Goymour

Study ID number: 24666

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to complete an online consent form.

What is the research about?

I am Katy Goymour, a Trainee Educational Psychologist at the University of Southampton. I am requesting the participation of you and your twins in an online study regarding the classroom placement of twins and the impact this has on the development of their social skills.

Why have I been chosen?

You have been chosen because you have either identical or non-identical twins of the same gender who are going to be starting school in September 2016.

What will happen to me if I take part?

I will be asking you to complete two online questionnaires about the quality of relationship your twins have with each other (one for each twin). This should take approximately 10 minutes per twin. Part of this research will also require you to help both of your twins fill out a child-friendly version of the same online questionnaire. This should take approximately 15 minutes per twin. As this is a staged piece of research, I will need your email address so I can contact you and ask you to repeat this same process in February 2017.

In addition, you will be asked to provide some other details about your twins' names, zygosity (i.e. identical or non-identical), age, the name and address of the school they are attending and whether they will be in the same class or different classes. For this study to work, it is important that this information is provided so that I can link all the different bits of data to the correct twins. I am also asking for the name and address of the twins' school placement so that I can get in touch with the right school to ask them to take part in my research as well. If you give me permission to contact them, I will be asking them to complete online questionnaires about your twins' social skills in September 2016 and again in January 2017. They will need to include the name of the twin they are completing the questionnaires for so that I can link their data to the correct twin. If you do not want

me to contact the school your twins will be attending then you I will not do so. This will not affect the participation of you or your twins in any way.

Are there any benefits in my taking part?

If you take part at both stages, you and your twins have the option to be entered into a prize draw for the chance to win £100 for yourself and £25 for each of your twins. In addition, your participation will also be invaluable for helping us understand more about the factors that need to be considered by schools when they are thinking about twin placements.

Are there any risks involved?

It is possible that you and your twins may be feeling worried or upset if they are not being placed together in school in September. Answering questions about the twins' relationship with each other could also lead to feelings of discomfort or upset. There will be a short, funny youtube clip for you to watch with your twins at the end of the study to make sure they finish the study in a positive way. In addition, as members of TAMBA, you will therefore have access to various forms of support from their organisation and can discuss any further concerns with them.

In addition, providing personal, identifiable information about you and your twins may concern you. Please read the next section for how I will ensure this is managed confidentially.

Will my participation be confidential?

Your participation will be kept confidential and the personal information you provide will not be released to or viewed by anyone other than myself and my Supervisor at the University of Southampton. Results of this study will not include your name or any other identifying characteristics of either yourself and your twins. Once you have provided this information, and the questionnaires have been completed, I will assign a code to your data and separate the identifiable information from your answers. This is also so I can monitor which pieces of data link to each twin in a confidential way. All the data will only be accessed on a password-protected computer and stored in a secure file.

What happens if I change my mind?

Nothing will happen to you if you decide you no longer want to take part in the study. This also applies to your twins. Your participation is voluntary and you may withdraw your participation at any time by contacting me at kg12g08@soton.ac.uk. I will then delete all data belonging to you and your twins.

What happens if something goes wrong?

Should you have any concerns about your rights as a participant in this research, or if you feel that you have been placed at risk, please contact the chair of the Ethics Committee, Psychology, University of Southampton, SO17 1BJ, UK. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Where can I get more information?

If you have any questions, please contact either myself on kg12g08@soton.ac.uk or my Supervisor, Dr. Jana Kreppner on J.Kreppner@soton.ac.uk.

I have read and understood the information about this study.

I consent to take part in this study and am happy for my and my children's data to be stored on a password-protected, secure file.

I agree for my twins to take part and will complete their questionnaires with them.

I am happy to provide the researcher with information about my twins' name, age, gender and zygosity so that the data can be linked to the right twin.

I am happy to provide the name and address of the school the twins are attending in September 2016 and will allow the researcher to contact them for the next part of the study.

I consent to the researcher using my email address to contact me reminding me about filling in these questionnaires again in February.

I am happy for my email address to be used to enter me and my twins into the prize draw.

In consenting, I understand that my legal rights are not affected, that data collected as part of this research will be kept confidential and that published results will maintain that confidentiality.

I understand that I or my twins may withdraw at any time by contacting the researcher and that our data will be deleted.

I understand that if I have any questions about my rights as a participant in this research, or if I feel that I have been placed at risk, I may contact the chair of the Ethics Committee, Psychology, University of Southampton, SO17 1BJ, UK. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Appendix J Information Page Presented to Twins Online

UNIVERSITY OF Southampton

Online Information Sheet and Consent – Twin Version

(03/01/17, V. 4, Ethics Reference: 24666)

Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

Note for Parents: Please read this information out loud to both twins before deciding whether they can take part in this research. By helping them tick the boxes at the bottom of this page and clicking 'Continue', you are consenting to your twins participating in this survey. If you have provided your email address when you filled in your questionnaires, I will contact you to ask if your twins would like to complete this again in February 2017.

For Twins: Hello. My name is Katy Goymour and I work at the University of Southampton. I would like to ask you to answer some questions about your twin as I am interested to know what it is like for you to have a twin. They will be very short and it will only take 15 minutes to do.

I would like you to type your name in so I know who you are and who you are talking about. But no one else will be able to know that you have taken part.

You do not have to do this if you do not want to. If you finish answering the questions and you change your mind at any time, your parents can send me a message and I will delete your answers. That is ok and nothing else will happen.

After you finish the questions there is a fun video for you to watch with your parents and to talk about together.

Would you like to take part?

Please read and tick the boxes below:

I understand what has been said to me and I would like to take part.

I know that I can change my mind at any time and that is ok

Appendix K Recruitment Email for Head Teachers to Distribute to Staff Detailing the Study

Recruitment email for Head Teachers and Teachers

(03/01/17, V.4, Ethics Reference: 24666)

Please note, this email will be sent to the Head Teacher of the school to gain permission before the Teachers are approached.

Dear [Head Teacher's name/Teacher's name],

My name is Katy Goymour and I am a trainee Educational Psychologist at the University of Southampton. I am currently working on my thesis project and am looking for reception teachers who have a twin/or both twins in their class to take part in a study. I am interested in the relationship twins share with each other and how classroom placements might influence the way their social skills develop at school. I believe that you have *[1 or 2 twin(s)]* due to start with you in September 2016. *[Name of twin(s) and Parent's name]* are aware of this part of the study and have agreed that it is ok for me to contact you to ask if you would be interested in taking part.

As part of the study, I will be asking *{the twin's teachers/ You]* to observe *[name of twin(s)]* and to fill in a very brief online questionnaire about [name of twin(s)] social skills that [*they/you]* have seen in school. The questionnaire can be found on www.isurvey.soton.ac.uk. It should take no more than *[10/20 minutes depending on whether they/you have 1 or 2 twins in their/your class]* to complete. I will be asking [*them/you*] to do this twice, once in September 2016 and again in January 2017.

(Added info for Head Teacher email: Please email me at kg12g08@soton.ac.uk to let me know that you have given permission for your staff to take part before they access the online link.)

(Added info for Teacher email: If you wish to take part, then please go to the website listed above. You will see a detailed information sheet which you will be able to read before you decide whether or not to take part.)

If you have any questions about this study, please feel free to email me at kg12g08@soton.ac.uk.

Best wishes

Katy Goymour, Trainee Educational Psychologist

Appendix L Information Page Presented to Teachers Online

UNIVERSITY OF Southampton

Online Information Sheet and Consent – Teacher Version

(03/01/17, V. 4)

Study Title: Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

Researcher: Katy Goymour

ERGO Study ID number: 24666

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to complete an online consent form.

What is the research about?

I am Katy Goymour, a Trainee Educational Psychologist at the University of Southampton. I am requesting your participation in an online study regarding the classroom placement of twins and the impact this has on the development of their social skills.

Why have I been chosen?

You have been chosen because you have either one twin or a set of twins in your class that have taken part in an earlier stage of this research, along with their parents. They have given me permission to approach you to ask you to take part in the next stage. The Head Teacher at your school has also given permission for me to approach you.

What will happen to me if I take part?

I will be asking you to complete an online questionnaire about the twin's social attributes. This should take 10 minutes to complete (or 20 minutes if you have both twins in your class). I will also need your email address to contact you and ask you to repeat this process again in January 2017.

Are there any benefits in my taking part?

If you take part at both stages, you have the option to be entered into a prize draw for the chance to win £100 for taking part. In addition, your participation will also help to contribute to our understanding of the factors that can impact on twins' development at school.

Are there any risks involved?

I will be asking you to provide the name of the twin you are filling out the questionnaire for. This is so I can link your information to the correct twin. Parents are aware that I will be asking you this information.

Will my participation be confidential?

Personal information will not be released to or viewed by anyone other than myself and my Supervisor. Results of this study will not include your name or any other identifying characteristics. Once you have completed the questionnaires, I will assign a code to your data and separate the children's names from your answers. This is also so I can monitor which pieces of

data link to each twin in a confidential way. All the data will only be accessed on a password-protected computer and stored in a secure file.

What happens if I change my mind?

Nothing will happen to you if you decide you no longer want to take part in the study. Your participation is voluntary and you may withdraw your participation at any time by contacting me at kg12g08@soton.ac.uk. I will then delete any data you have provided.

What happens if something goes wrong?

Should you have any concerns about your rights as a participant in this research, or if you feel that you have been placed at risk, please contact the chair of the Ethics Committee, Psychology, University of Southampton, SO17 1BJ, UK. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Where can I get more information?

If you have any questions, please contact either myself on kg12g08@soton.ac.uk or my Supervisor, Dr. Jana Kreppner on J.Kreppner@soton.ac.uk.

I have read and understood the information about this study.

I consent to take part in this study.

I consent to the researcher using my email address to contact me reminding me about filling in these questionnaires again in January.

I am happy for my email address to be used to enter me into the prize draw.

In consenting, I understand that my legal rights are not affected, that data collected as part of this research will be kept confidential and that published results will maintain that confidentiality.

I understand that I may withdraw at any time by contacting the researcher and that my data will be deleted.

I understand that if I have any questions about my rights as a participant in this research, or if I feel that I have been placed at risk, I may contact the chair of the Ethics Committee, Psychology, University of Southampton, SO17 1BJ, UK. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Appendix M Debriefing Statements Presented to Mothers, Twins and Teachers Online

UNIVERSITY OF Southampton

Debriefing Statement – Parent

(03/01/17, V.3, Ethics Reference: 24666)

Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

The aim of this research was to explore the relationship twins share with each other and how classroom placements can impact on this relationship and the development of social skills. It is expected that twins with a very close, dependent relationship will benefit from being kept together in school and will have higher levels of social skills compared to twins with a similar quality of relationship but who are separated. It is also expected that twins with a less dependent and close relationship will cope better with being separated in school compared to twins with a closer, more dependent relationship who are separated.

Your data will help our understanding of how important it is for the quality of twin relationships to be considered before classroom placements are decided by schools. Once again results of this study will not include your name or any other identifying characteristics. This research did not use deception. You may have a summary of research findings once the project has been completed.

If you have any further questions please contact me, Katy Goymour at kg12g08@soton.ac.uk , or my Supervisor, Dr. Jana Kreppner at J.Kreppner@soton.ac.uk .

Thank you for your participation in this research.

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

UNIVERSITY OF Southampton

Debriefing Statement – Twins

(03/01/17, V.3, Ethics Reference: 24666)

Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

Thank you for helping me with this project!

Your answers are very important and will help other families with twins as they get ready to start school.

If you are worried about anything or would like to ask me a question, please talk to your parents who can email me at kg12g08@soton.ac.uk.

Thank you again!

Katy Goymour

UNIVERSITY OF Southampton

Debriefing Statement – Teacher

(03/01/17, V.3, Ethics Reference: 24666)

Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

The aim of this research was to explore the relationship twins share with each other and how classroom placements can impact on this relationship and the development of social skills. It is expected that twins with a very close, dependent relationship will benefit from being kept together in school and will have higher levels of social skills compared to twins with a similar quality of relationship but who are separated. It is also expected that twins with a less dependent and close relationship will cope better with being separated in school compared to twins with a closer, more dependent relationship who are separated.

Your data will help our understanding of how important it is for the quality of twin relationships to be considered before classroom placements are decided. Once again results of this study will not include your name or any other identifying characteristics. This research did not use deception. You may have a summary of research findings once the project has been completed.

If you have any further questions please contact me, Katy Goymour at kg12g08@soton.ac.uk, or my Supervisor, Dr. Jana Kreppner at J.Kreppner@soton.ac.uk.

Thank you for your participation in this research.

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Appendix N Identifiable Information Provided by Mothers, Twins and School Staff as Part of the Study

UNIVERSITY OF Southampton

Questions asked that contain identifiable information

(03/01/17, V. 5, Ethics Reference: 24666)

Does Classroom Placement Moderate the Association Between Quality of Relationship and Social Competence in Twins in Reception?

Parents

- Name of Twin 1
- Name of Twin 2
- Age of Twins
- Zygosity of twins: Drop-down box *identical* or *non-identical*
- What is the name and address of the school they will be attending?
- Are they in the same class or different classes?: Drop down-box *same class* or *different classes*

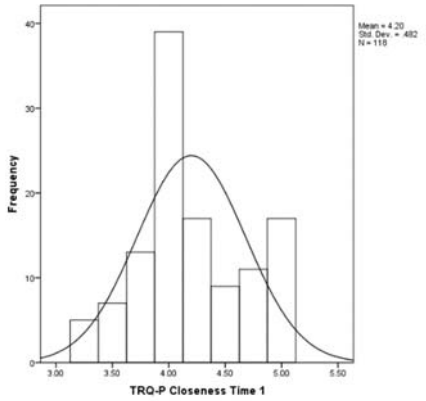
Twins

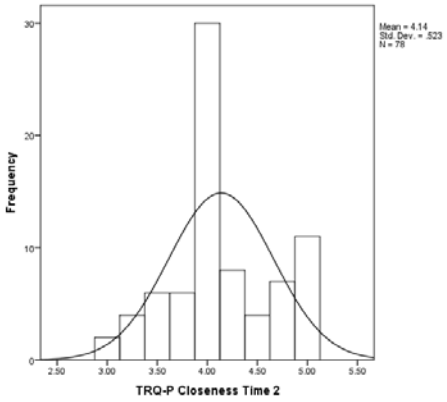
- Name

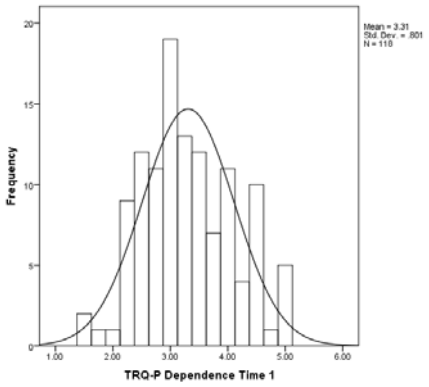
Teachers

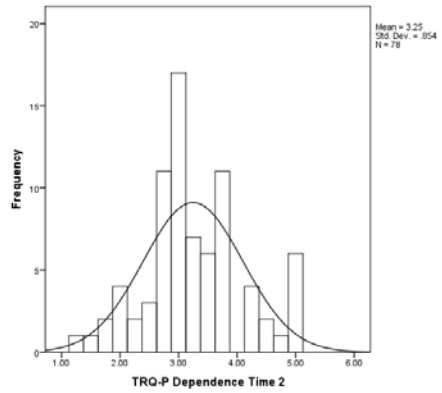
- Name of twin

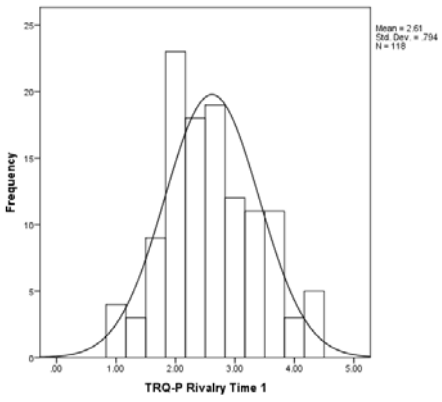
Appendix O Histograms of Scores for the Quality of Twin Relationship (Mother-reported and Twin-reported) and Social Competence (Teacher-reported)

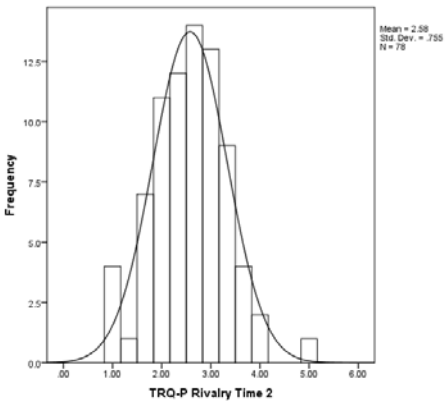


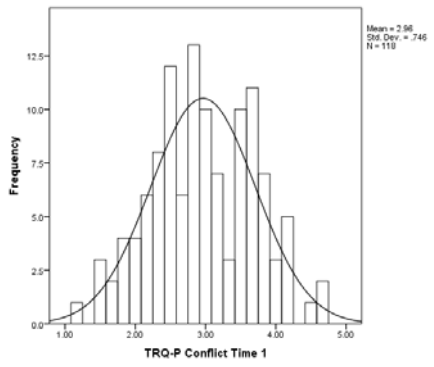


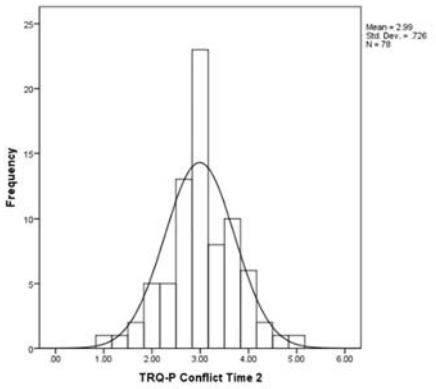


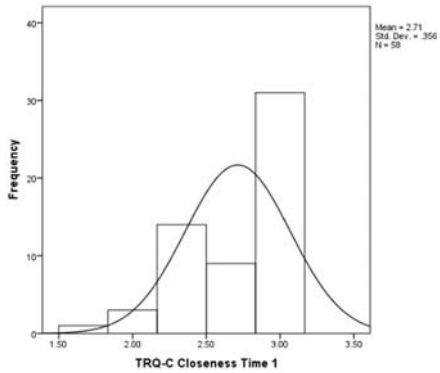


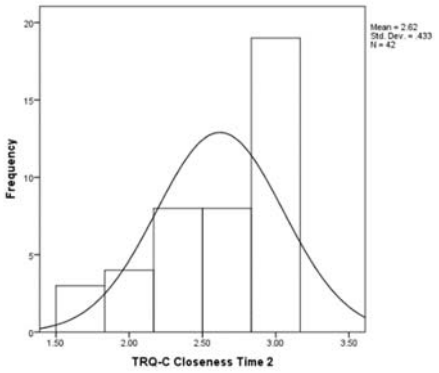


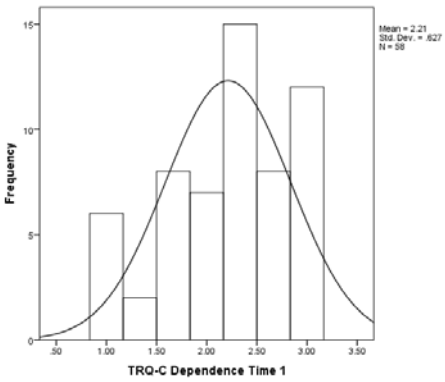


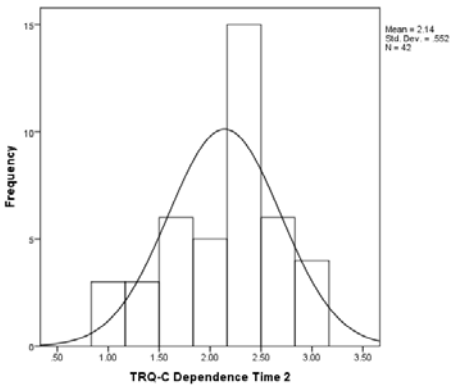

Mean = 2.96
Std. Dev. = .746
N = 119
Frequency
TRQ-P Conflict Time 1

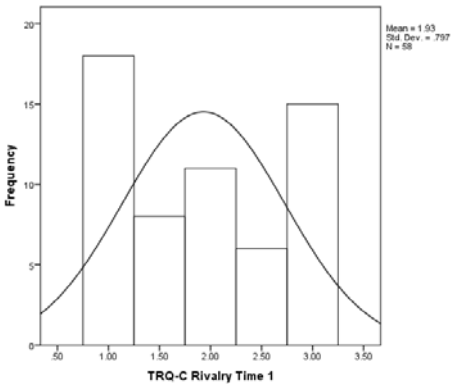

Mean = 2.99
Std. Dev. = .726
N = 78
Frequency
TRQ-P Conflict Time 2

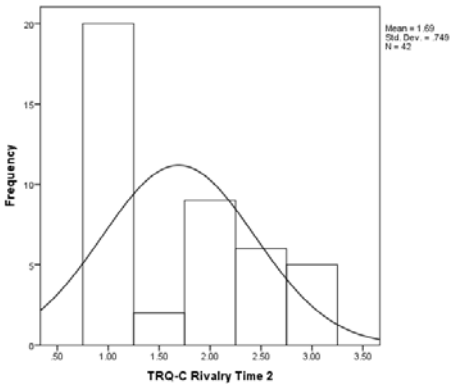

Mean = 2.71
Std. Dev. = .356
N = 58
Frequency
TRQ-C Closeness Time 1

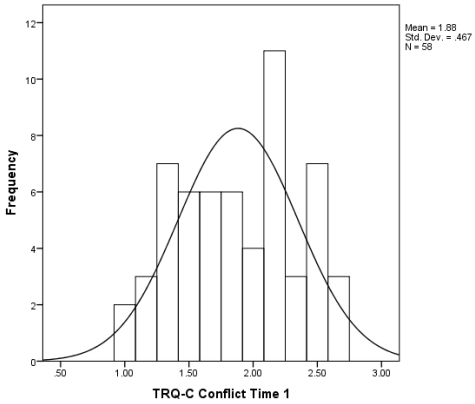

Mean = 2.62
Std. Dev. = .433
N = 42
Frequency
TRQ-C Closeness Time 2

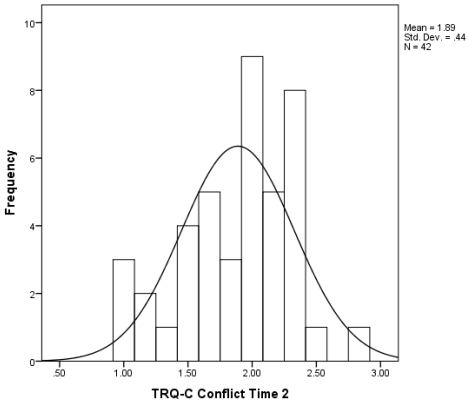

Mean = 2.21
Std. Dev. = .627
N = 58
Frequency
TRQ-C Dependence Time 1

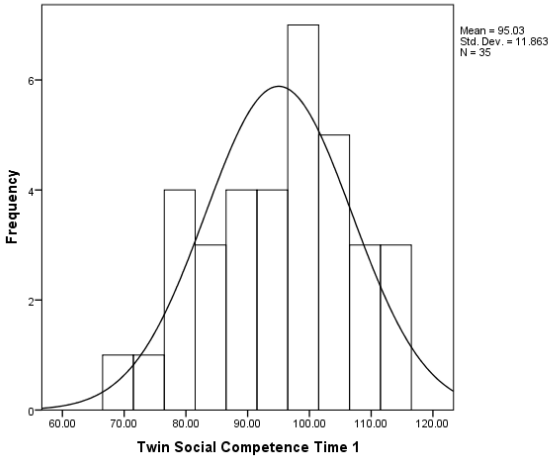

Mean = 2.14
Std. Dev. = .552
N = 42
Frequency
TRQ-C Dependence Time 2

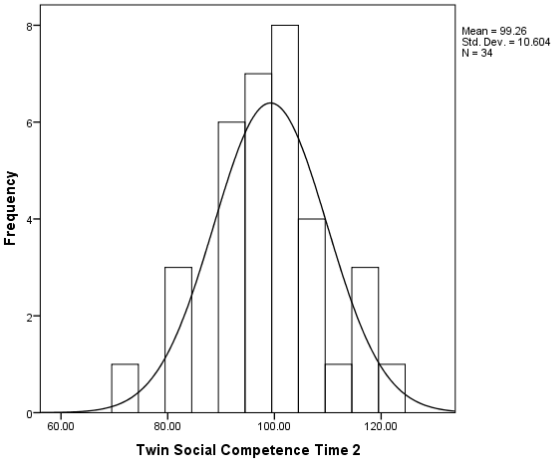

Mean = 1.93
Std. Dev. = .797
N = 58
Frequency
TRQ-C Rivalry Time 1


Mean = 1.69
Std. Dev. = .749
N = 42
Frequency
TRQ-C Rivalry Time 2

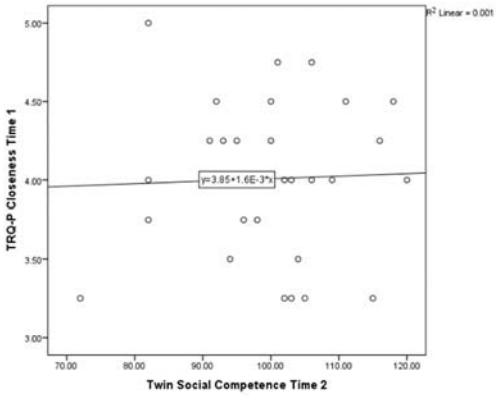

Mean = 1.88
Std. Dev. = .467
N = 58
Frequency
TRQ-C Conflict Time 1

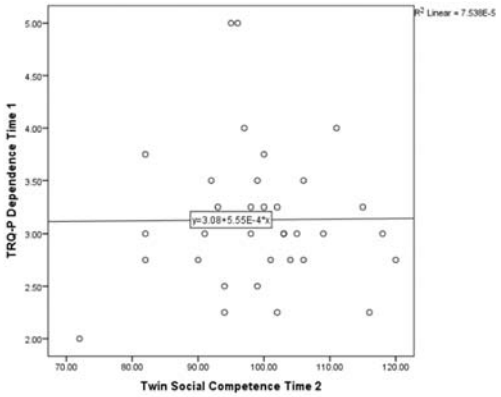

Mean = 1.89
Std. Dev. = .44
N = 42
Frequency
TRQ-C Conflict Time 2

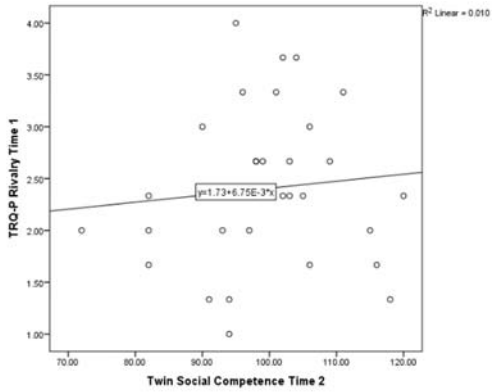

Mean = 95.03
Std. Dev. = 11.863
N = 35
Frequency
Twin Social Competence Time 1

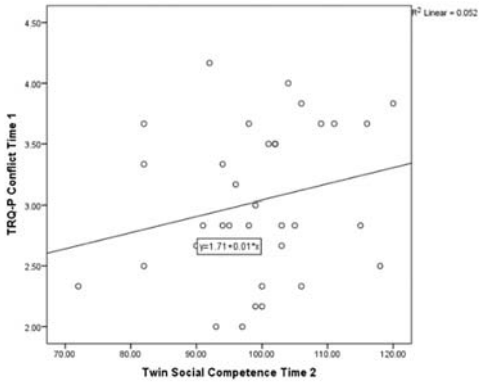

Mean = 99.26
Std. Dev. = 10.604
N = 34
Frequency
Twin Social Competence Time 2

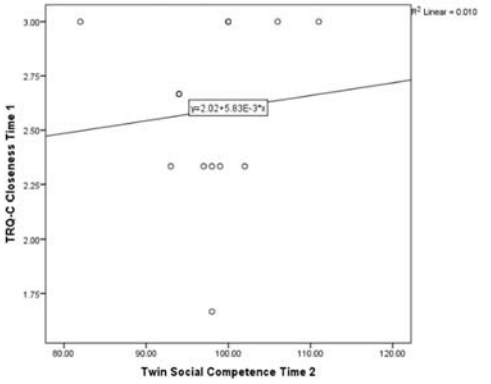
Appendix P Scatterplots of Scores for the Quality of Twin Relationship (Mother-reported and Twin-reported) at Time 1 Against Social Competence (Teacher-reported) at Time 2

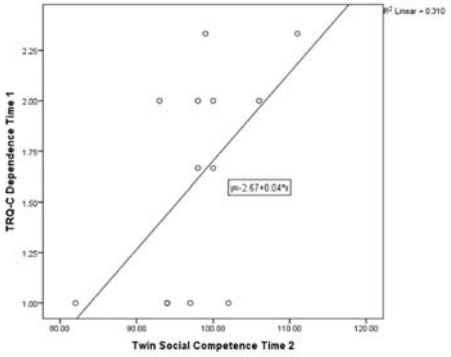


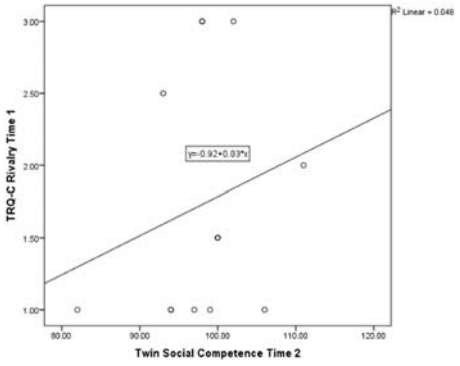


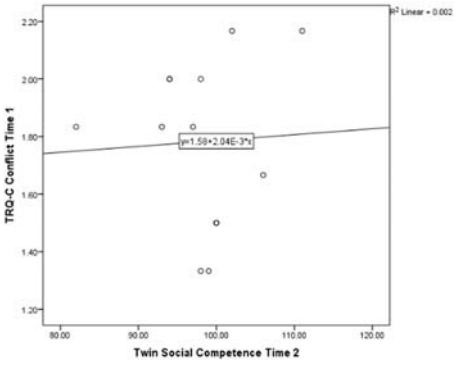












Appendix Q Correlation Matrix of Responses Between Twin-Pairs and Between Mothers and Twins at Time 1

	Twin 2 Closeness	Twin 2 Dependence	Twin 2 Rivalry	Twin 2 Conflict
Twin 1 Closeness	.14	.22	-.23	-.07
Twin 1 Dependence	.25	.41*	.24	.37*
Twin 1 Rivalry	-.05	.13	.66**	.41*
Twin 1 Conflict	-.18	-.02	.04	.50**

*Note. *p < .05, **p < .01, N = 29*

	TRQ-P Closeness	TRQ-P Dependence	TRQ-P Rivalry	TRQ-P Conflict
TRQ-C Closeness	.28*	.27*	.23	.12
TRQ-C Dependence	.19	.28*	.37**	.13
TRQ-C Rivalry	-.07	.26	.40**	.33*
TRQ-C Conflict	-.18	-.00	.12	.66**

*Note. *p < .05, **p < .01, N = 58*

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