

ATTACHMENT AND EXCEPTIONAL EXPERIENCES AMONG TWINS

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DECLARATION

I certify that the work contained in this thesis, or any part of it, has not been accepted in substance for any previous degree awarded to me or any other person, and is not concurrently being submitted for any other degree other than that of Doctor of Philosophy which has been studied at the University of Greenwich, London, UK.

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Abstract

The attachment between twins has for many years been known to be very strong, but has so far not been very much researched, and since it seems to relate to another under researched area, the deep empathic experiences reported by twins, generally called twin telepathy (including remote sensitivity to illness, and distant empathy, e. g. one twin sensing if the other twin is in an accident or has an injury), the aim for this thesis was to investigate if there is a connection between them. Do twins with a strong attachment report having more cases of so-called exceptional experiences?

Three experimental studies were carried out with UK twins on twin telepathy, where electrodermal activity for one twin was used as an indicator of twin telepathy, when the other twin in a distant room was exposed to a surprise event. The overall result for these three experimental studies was significant, justifying the method to be used in further research on twin telepathy with improved methodology, possibly also including testing if any kind of field is involved as a possible mechanism.

Attachment data was collected from more than 2000 UK twins in a web survey and was also related to the exceptional experiences they report having had. Two questionnaires for attachment were used and questions added about their exceptional experiences. Identical twins were found to report stronger attachment than non-identical twins, and female twins were found to report stronger attachment than male twins. For age, the attachment was found to be strong in early ages and then it slowly decreased. The attachment was very strong for the twins in this study, and for attachment-related anxiety and avoidance, it was stronger than the published norms. Many twins reported having had an exceptional experience with their twin, and some even with other than their cotwin, some of these having a genetical relationship. Twins reporting having had exceptional experiences with their twin reported a stronger and more positive attachment to their twin than those who did not.

CONTENTS

| | |
|---|----|
| INTRODUCTION: THESIS OVERVIEW AND THE IMPORTANCE OF STUDYING ATTACHMENT AND EXCEPTIONAL EXPERIENCES AMONG TWINS | 1 |
| Introduction | 2 |
| Outline of the Thesis | 12 |
| 1. ATTACHMENT RESEARCH, A LITERARY REVIEW | 17 |
| 1.1 Introduction | 18 |
| 1.2 Attachment theories | 18 |
| <i>1.2.1 What functions do attachment relationships have?</i> | 22 |
| 1.3 Attachment research | 25 |
| <i>1.3.1 The key findings of Bowlby and Ainsworth</i> | 25 |
| <i>1.3.1.1 Continuity of attachment in cultures, and with age</i> | 27 |
| <i>1.3.2 Attachment research between parents and child and between siblings</i> | 29 |
| <i>1.3.2.1 Infant-parent attachment and siblings' interaction</i> | 29 |
| <i>1.3.2.2 Adult attachment development – and questionnaires</i> | 30 |
| <i>1.3.2.3 Multiple attachment</i> | 35 |
| <i>1.3.2.4 The importance of genetics versus environment in attachment</i> | 36 |
| <i>1.3.2.4.1 The difference between shared and non-shared environment</i> | 40 |
| <i>1.3.2.4.2 Genes, environment, attachment and jealousy</i> | 41 |
| <i>1.3.3 Attachment research on and between twins</i> | 41 |
| <i>1.3.3.1 Studies comparing the attachment between twins and their caregiver(s)</i> | 42 |
| <i>1.3.3.2 Studies on the attachment between twins</i> | 43 |

| | |
|--|----|
| <i>1.3.3.3 Inclusive fitness, one aspect in twin attachment research</i> | 50 |
|--|----|

| | |
|------------------------------------|----|
| 1.4 Chapter Summary and Discussion | 51 |
|------------------------------------|----|

| | |
|--|----|
| 2. ATTACHMENT AMONG UK TWINS – A SURVEY | 54 |
| 2.1 Introduction | 55 |
| 2.2 Background | 55 |
| 2.2.1 <i>The features of an attachment bond</i> | 56 |
| 2.2.2 <i>Twin development and attachment</i> | 58 |
| 2.2.3 <i>Attachment between siblings, as compared to attachment between twins</i> | 59 |
| 2.3 Aims | 61 |
| 2.3.1 <i>Hypotheses</i> | 62 |
| 2.4 Methods | 63 |
| 2.4.1 <i>Materials</i> | 64 |
| 2.4.1.1 <i>Experiences in Twin Relationships (ETR)</i> | 64 |
| 2.4.1.2 <i>A modified version of the WHOTO and ANQ Questionnaires</i> | 66 |
| 2.4.2 <i>Participants</i> | 67 |
| 2.4.3 <i>Procedure</i> | 67 |
| 2.4.3.1 <i>Ethical approval</i> | 68 |
| 2.5 Results | 69 |
| 2.5.1 <i>Attachment scores – reliability evaluations</i> | 69 |
| 2.5.1.1 <i>ETR questionnaire evaluated</i> | 69 |
| 2.5.1.2 <i>WHOTO-ANQ questionnaire evaluated</i> | 69 |
| 2.5.1.3 <i>ETR and WHOTO-ANQ compared</i> | 70 |
| 2.5.1.4 <i>Do twins in each pair report about the same degree of attachment?</i> | 71 |
| 2.5.2 <i>The attachment for twins as a general group</i> | 72 |
| 2.5.3 <i>Do identical twins have a stronger and more positive attachment when compared to non-identical twins?</i> | 73 |
| 2.5.4 <i>Do female twins have a stronger and more positive attachment to their twin when compared to male twins?</i> | 75 |
| 2.5.5 <i>Do twins, reporting exceptional experiences <u>with their twin</u></i> | 77 |

| | |
|---|----|
| <i>have a more positive and strong attachment (when compared to those who do not)?</i> | |
| 2.5.6 <i>Does the twin in a pair with a more positive attachment, report more exceptional experiences (than the cotwin having a less positive attachment)?</i> | 79 |
| 2.5.7 <i>How does attachment change with age?</i> | 80 |
| 2.5.8 <i>Do twins report having had so-called exceptional experiences <u>with other than</u> their twin?</i> | 81 |
| 2.6 Discussion | 83 |
| 2.6.1 <i>General discussion</i> | 83 |
| 2.6.2 <i>Is there any difference in attachment between identical and non-identical twins?</i> | 84 |
| 2.6.3 <i>Do female twins have a stronger attachment than male twins?</i> | 85 |
| 2.6.4 <i>Do twins reporting exceptional experiences <u>with their twin</u>, have a stronger attachment (when compared to those who do not)?</i> | 86 |
| 2.6.5 <i>Does the twin in a pair with a stronger and more positive attachment report more exceptional experiences (than the cotwin having a weaker attachment)?</i> | 87 |
| 2.6.6 <i>Are the questionnaires ETR and WHOTO-ANQ reliable for twins (and their results corresponding to each other)?</i> | 88 |
| 2.6.7 <i>Does attachment change with age?</i> | 89 |
| 2.6.8 <i>Do twins report having had exceptional experiences <u>with other than</u> their twin?</i> | 90 |
| 2.7 Chapter Summary and Conclusions | 90 |

| | |
|--|-----------|
| 3. SPONTANEOUS PHENOMENA IN PARAPSYCHOLOGY - A LITERARY REVIEW | 94 |
| 3.1 Introduction | 95 |
| 3.2 Background – early surveys | 95 |
| 3.3 Conferences on spontaneous phenomena | 97 |
| 3.4 More recent surveys | 98 |
| 3.5 The term "exceptional human experiences" | 99 |
| 3.5.1 Metzinger's theory, a reality-model in the mind | 100 |
| 3.5.2 Anomalies in the model – external and internal and examples of phenomena | 102 |
| 3.5.3 Metzinger's model, why it was created, with an implicit assumption, partly questioned | 106 |
| 3.6 Chapter Summary and Conclusions | 109 |

| | |
|--|-----|
| 4. RESEARCH IN PARAPSYCHOLOGY, WITH FOCUS ON TELEPATHY AND THE USE OF EDA - A LITERARY REVIEW | 111 |
| 4.1 Introduction | 112 |
| 4.2 What is parapsychology – an introduction | 112 |
| 4.3 Telepathy research – an introduction | 114 |
| 4.4 Telepathy research with the Ganzfeld method | 115 |
| 4.5 Dream telepathy research | 117 |
| 4.6 Telepathy research using electrodermal activity | 119 |
| 4.6.1 <i>What is electrodermal activity?</i> | 120 |
| 4.6.2 <i>Telepathy research using EDA</i> | 121 |
| 4.6.2.1 <i>Twin telepathy research</i> | 127 |
| 4.6.2.2 <i>Possible connection between</i> <i>twin telepathy and quantum communication</i> | 131 |
| 4.6.2.3 <i>Discussions about how to use EDA</i> <i>in parapsychological research</i> | 134 |
| 4.7 Telepathy research with other technologies | 135 |
| 4.7.1 <i>Telepathy research with fMRI</i> | 136 |
| 4.7.2 <i>Telepathy research with EEG</i> | 138 |
| 4.8 Other use of EDA in parapsychology | 141 |
| 4.8.1 <i>EDA, DMILS, 'remote staring' and healing</i> | 141 |
| 4.8.2 <i>EDA and presentiment</i> | 144 |
| 4.9 Meta-analyses in parapsychology | 146 |
| 4.9.1 <i>Dream telepathy</i> | 146 |
| 4.9.2 <i>Ganzfeld telepathy</i> | 148 |
| 4.9.3 <i>DMILS</i> | 149 |
| 4.10 The criticism against parapsychology - and how to meet it | 149 |
| 4.11 Chapter Summary and Conclusions | 153 |

| | |
|--|------------|
| 5. THREE EXPERIMENTAL STUDIES OF PHYSIOLOGICAL CONNECTEDNESS AMONG TWINS IN RELATION TO ATTACHMENT | 156 |
| 5.1 Introduction | 157 |
| 5.2 Background | 157 |
| 5.3 Aims | 163 |
| 5.3.1 Hypotheses | 164 |
| 5.4 Methods | 165 |
| 5.4.1 Technical data in the measuring process | 165 |
| 5.4.2 The new questionnaire to measure twin attachment, ETR | 166 |
| 5.4.3 The Exceptional Experiences Questionnaire, EEQ | 167 |
| 5.4.4 Participants | 168 |
| 5.4.5 Procedure | 169 |
| 5.4.5.1 Ethical approval | 169 |
| 5.4.5.2 Design | 170 |
| 5.4.6 Applied stimuli | 174 |
| 5.4.7 The evaluation process | 175 |
| 5.5 Results | 178 |
| 5.5.1 The EDA data in relation to exposure of epochs | 178 |
| 5.5.1.1 The overall result | 185 |
| 5.5.2 Attachment data | 186 |
| 5.6 Discussion | 191 |
| 5.7 Chapter Summary and Conclusions | 197 |

| | |
|---|-----|
| 6. ATTACHMENT AND EXCEPTIONAL EXPERIENCES | 199 |
| AMONG TWINS: SUMMARY AND CONCLUSIONS | |
| 6.1 Chapter Overview | 200 |
| 6.2 Summary of Findings | 200 |
| 6.3. Evaluation of questionnaires | 205 |
| 6.3.1 <i>Psychometric properties explored - internally and towards each other</i> | 205 |
| 6.3.2 <i>Do twins in each pair report about the same degree of attachment?</i> | 206 |
| 6.4 Conclusions for attachment between twins | 207 |
| 6.5 Conclusions for twin telepathy | 208 |
| 6.6 Conclusions for the correlation between attachment between twins and twins having exceptional experiences | 209 |
| 6.7 Summary and Final Comments | 211 |

| | |
|------------|-----|
| REFERENCES | 214 |
|------------|-----|

| | |
|------------|-----|
| APPENDICES | 258 |
|------------|-----|

In chapter 2, attachment survey:

| | |
|---|-----|
| Appendix 1 - The questionnaire <i>Experiences in Close Relationships – Revised, ECR-R</i> | 259 |
|---|-----|

| | |
|---|-----|
| Appendix 2 - The questionnaire Experiences in Twin Relationships, ETR | 261 |
|---|-----|

| | |
|---|-----|
| Appendix 3 - Attachment Features and Functions Measure, WHOTO and ANQ | 263 |
|---|-----|

| | |
|--|-----|
| Appendix 4 - Two extra questions on exceptional experiences, for the survey attachment | 265 |
|--|-----|

| | |
|---|-----|
| Appendix 5 – Exceptional Experiences Questionnaire, EEQ | 266 |
|---|-----|

| | |
|--|-----|
| Appendix 6 - The distribution of answers to questions on the ETR | 272 |
|--|-----|

| | |
|--|-----|
| Appendix 7 - The distribution of answers to questions from WHOTO+ANQ | 275 |
|--|-----|

| | |
|---|-----|
| Appendix 8 – Figures with the distribution of differences between the twins in each pair, for all six attachment scores, two from ETR and four from WHOTO-ANQ | 276 |
|---|-----|

| | |
|---|-----|
| Appendix 9 – Published score norms for the subscales Attachment and Avoidance | 282 |
|---|-----|

In chapter 5, three experimental studies:

| | |
|---|-----|
| Appendix 10 – Technical data in the EDA measuring process | 283 |
|---|-----|

| | |
|--|-----|
| Appendix 11 - Examples of anecdotes on exceptional experiences reported by twins | 285 |
|--|-----|

In chapter 5, appendices 2, 5 and 9 are also mentioned.

INTRODUCTION

THESIS OVERVIEW AND THE IMPORTANCE OF STUDYING
ATTACHMENT AND EXCEPTIONAL EXPERIENCES AMONG TWINS

Introduction

The following thesis includes a body of research conducted to investigate if there is any connection between the attachment twins report having to each other, and to the “exceptional experiences” that twins often report, including telepathy, remote emotion, the remote sensing of the other twin having an injury, accident or being in a bad mood etc. Telepathy is a phenomenon in parapsychology, defined as direct mind-to-mind communication (and coined by Frederic Myers to refer to the paranormal acquisition of information concerning the thoughts, feelings or activity of another conscious being (Parapsychological Association, 2017). Parapsychology is still a controversial field of research, but it must be emphasized that it is now a legitimate research area - there are recent reviews of the psi hypothesis, psi being an umbrella term for all parapsychological phenomena, one of the recent reviews being Cardeña (2018) in the major journal *American Psychologist*. The experiences that twins report seem to be, not a direct mind-to-mind communication, but rather a direct communication between two organisms without recourse to the known senses. It can also be regarded as the other twin having the same reaction as the first twin, at the same time, and therefore being a synchronous reaction. Because of many claims about twins having a special connection with each other (Playfair, 2002/2009; Segal, 1997; Segal, 1999) and the author having an ongoing co-operation with the twin register in UK (The Department for Twin Research and Genetic Epidemiology, King’s College, London), and also that there is a substantial lack of research on both the attachment between twins and about twin telepathy, the connection between these topics seemed worthy of investigation.

Psychological research on twins has been nearly exclusively focused on behavioural genetics so there is virtually no work reported on how the attachment between the pairs of twins influence their subsequent development and identity (Neyer, 2002; Tancredy & Fraley, 2006). The research on this special connection between twins is regarded as being important, not only since it can provide new knowledge about attachment that even concerns developmental psychology in general, but also because it seems to relate to the deep empathic experiences reported by twins. These shared experiences concern remarkable synchronicities in life events, remote sensitivity to illness, and distance empathy (suggestive of identical cognitive processes or, in some cases, perhaps even of telepathy).

The term exceptional experience, which here will be used besides the term telepathy, is in this thesis used to cover a variety of anomalous experiences such as synchronistic illnesses, near identical life choices, thought concordances, and remote empathy, experiences that twins often claim to have (Brusewitz, Cherkas, Harris & Parker, 2013; Playfair, 1999/2009). The term exceptional experience (ExE) is chosen here partly because it is euphemistic, and it avoids the claims and counterclaims concerning the true nature of these experiences. It also avoids any pathologizing, and instead enables a focus on the psychological and physiological value of the experience. The term was coined by White (1990) to emphasize the experiential and subjective character of unusual and anomalous experiences that humans reported in contrast to the objective and experimental position of parapsychology in the debate on the veridicality of paranormal phenomena, as summarized by Belz and Fach (2015, p. 365) in a review on exceptional experiences and clinical psychology. There is however so far, they continue, no widely accepted definition of ExE. The term will be analysed in depth in chapter 3 on spontaneous phenomena.

The co-operation with the Department of Twin Research, DTR

The ongoing co-operation that the author and Professor Parker at the University of Gothenburg have with the Department of Twin Research and Genetic Epidemiology, King's College, London, has made us aware of the interest amongst twins for their so-called exceptional experiences (Brusewitz, Parker & Cherkas, 2010; Brusewitz *et al.*, 2013). A survey of the experiences of twins by this department at King's College found that when asked if they had the ability to know what was happening to their co-twin when the co-twin was not there, 46% said no, 39% maybe and 15% said yes with identical twins twice as likely as non-identical twins to report such experiences (Cherkas, 2004/2005). The area is also a neglected one that can potentially give insights into how synchronous mental and physiological reactions can arise in the non-twin population.

Twins often interpret these reactions as being telepathic events even though other explanations like "thought concordance" may sometimes appear more plausible. "Thought concordance" refers to similar associations and ways of thinking of a non-parapsychological nature, which as a concept hardly can be applied to explain empathic and synchronous bodily reactions to sickness that twins often report when being at a distance (Brusewitz *et al.*, 2010). This can indicate that identical cognitive processes occur between twins and other multiples sharing similar genetics and environment. Of particular interest, since these have a potential medical importance, are the claims amongst twins for a distant awareness of physical illness, mental distress and life-threatening events. Here, there is also a possible connection with what is called crisis-telepathy, where one of two persons who share an intense and emotional relationship has an exceptional phenomenon while the other undergoes a critical life-threatening event (Belz & Fach, 2015, p. 375),

cases that seem to reflect the closeness of the individuals, who react as parts of a whole system rather than as two independent individuals, even if they are locally separated. With this view, some cases of twin telepathy can be regarded as a new variant of crisis-telepathy – even if they are not life-threatening, twin telepathy cases often involve accidents or injury.

The similarity with crisis-telepathy, seeming to be a deep basic communication opens for another phenomenon, also possibly a basic deep communication that has caused some attention in popular media, but recently also in scientific circles. With a growing number of people having some kind of impaired language ability, there is now a slowly growing attention to primarily young children (but also adults) being autistic savants to also possess some kind of telepathy. Powell (2014) has reported some studies under controlled conditions with randomized words, letters, numbers and pictures, with astoundingly accurate answers, with result supporting the hypothesis that these savant children would possess telepathy. If these observations and preliminary results would turn out to be valid, it could indicate and mirror, Powell argues (2018) an increased motivation to find alternative means of communication when not being able of speech from early age, also supported by Darold Treffert (2018) with a paper about the Savant Syndrome, where some persons also were twins.

Theoretical influence

The aim of this thesis is to investigate if there is a connection between twin attachment and twin telepathy. One special possible connection between attachment and parapsychology that shortly could be mentioned is the one between paranormal beliefs and unresolved/disorganized trauma or loss, even if it seems to be of quite another kind than the possible connection with twins, being between the paranormal experiences they report

having with each other and the strong, positive bond they report. This other connection is proposed in a model by Irwin (2009), that paranormal belief may exist but remain inactive until some contextual stressor activates them. Main, van IJzendoorn and Hesse (1993) observed that adults with unresolved trauma, during interviews for the Adult Attachment Interview, conducted for attachment research, also tend to express paranormal beliefs (Cardeña *et al.*, 2015, p. 116), with a correlation replicated by Sagi *et al.* (2002). A moderate to strong relationship has also been found to traumatic life events in life stories of people reporting ExE (Belz & Fach, 2015, p. 368).

Besides this special, possible link, a more general question must be addressed: What are the reasons to use attachment, the emotional bond between people as predictor in telepathy research? Why should an emotional bond provide a basis for telepathy or non-local interaction or communication? Is there any support for a more general connection between attachment and telepathy? Some of the ideas here are rather speculative, but they are of importance to shortly review in this introduction. Even if the research on this possible connection is limited, this relationship has so far been found to be of great importance in parapsychology (e.g. Brusewitz *et al.*, 2013; Delanoy, 1989; Sannwald, 1963; Sheldrake, 2003; Sherwood *et al.*, 2000; Stevenson, 1970). The strong bond between persons experiencing telepathy has made some researchers to talk about persons being part of what we can call an “empathy field” (Dossey, 2013b; Lorimer, 1990), varying in strength and e.g. being very strong between identical twins, mothers and babies, and between dogs and their owners (Playfair, 2002, Sheldrake, 2003). In conventional physics, a field is a region of space in which there are physical properties that can be determined at any part of it, in physics we e.g. know of the magnetic field, electromagnetic field and gravitations fields. The question now is the obvious if there is any support for what could be called an empathy

field, and could there be any relationship with this field and telepathy or non-local interaction or communication?

EEG studies indicating a field

This is a bit of speculation, but there are many indications that there is a relationship with something that could be called a mental field. There are as a matter of fact quite a few studies using EEG on persons being on a distance, indicating correlations between the brains (Achterberg *et al.*, 2005; Grinberg-Zylberbaum & Ramos, 1987; Grinberg-Zylberbaum, Delaflor, Attie & Goswami, 1994; Hearne, 1977; Hinterberger *et al.*, 2008; Kelly & Lenz, 1975; Kittenis, Caryl, & Stevens, 2004), some of them with twins and therefore being relevant to my research as it essentially is a twin telepathy experiment much like mine but using EEG (e.g. Duane & Behrendt, 1965), also some mentioned among EEG-studies in chapter 4, most of them indicating some kind of field. Psychic researcher and twin telepathy author Playfair (2002/2009), influenced by many twin telepathy cases, finds support for an empathy field from one study by Grinberg-Zylberbaum *et al.* (1994), using EEG on persons being on a distance. He had in his study participants being close to each other and wired to EEG, measuring their brain waves. One person in each pair was stimulated by noises, flashes of light and short electric shocks, and it was found that besides the person being exposed showing blips on the chart, also the other person in this pair had blips on the chart, even if being far away and not knowing what was going on (also Broughton, 2015, p.142 ; Watt & Irwin, 2010, p. 55), valid for 25 per cent of the cases, and it worked for those pairs with the strongest empathic relationship. Playfair found this to support the existence of an empathic field, what Grinberg-Zylberbaum *et al.* (1994) called an “informational matrix”, a concept based on the ideas of physicist David Bohm (1980), an existence of another level of reality beyond our familiar one. It is almost like a resonance

phenomenon, and Lorimer (1990) even talk about “empathic resonance” for events between people who are emotionally close and links individuals across space and time (Dossey, 2013b, p. 148), getting support from psychiatrist Stevenson (Jackson, 1980, mentioned in Dossey, 2013b) who collected cases in which distant individuals experienced similar physical symptoms, very similar to the typical cases reported by twins (e.g. Bruswitz *et al.*, 2013). Biologist Sheldrake (2003) also proposes an idea of a field for telepathy-like phenomena. He calls them mental fields, extended mind and morphogenetic fields.

There are here even possible connections with entanglement in quantum physics, the strange connection between two particles that once were one and then separated. They remained entangled even when separated and fired off in opposite directions (Aspect *et al.*, 1982) – one particle would react to what was being done to the other. Entanglement would be an indication of non-local interaction or communication, which very much corresponds to telepathy, and reasons for a growing scientific field, comparing effects in quantum physics with psychic phenomena including telepathy, where e.g. leading quantum physicist Sir Roger Penrose claims that consciousness is an effect of quantum entanglement and has admitted that this might have implications to the twin bond (Playfair, 2002, p. 148).

The exceptional experiences that twins report are very similar to synchronicities, since the reaction for the “receiving twin” is like a synchronous reaction to the experience that the “sending twin” just had. The term ‘synchronicity’ was coined by psychologist C. G. Jung (1952/1969; 1955), with a definition “The occurrence of a *meaningful coincidence in time*” (Palmer, 2008), with the key words being *time* and *meaning*. These experiences for twins often have the effect of furthering the closeness of the relationship between the twins in a pair and in terms of developing internal models of relationships and the world around. The

expression exceptional experience is not ideal, since it is rather general and can be used for a variety of experiences, but it is useful by emphasizing that these experiences are often described by the individual as being transformative and transpersonal (i.e. the experiences that take us beyond the ordinary ego personality), as such they may influence the individual's working philosophical or religious belief. Previous work by the Department of Twin Research and Genetic Epidemiology, DTR (Cherkas, 2004/2005), and also work before this PhD started, connected to the University of Gothenburg (Brusewitz *et al.*, 2010; Brusewitz *et al.*, 2013) has shown that exceptional experiences are very common amongst twins and are as expected somewhat more frequently reported by monozygotic twins.

With the twins at a Twin Day 2009, arranged by the DTR, filling the Exceptional Experiences Questionnaire, a study was conducted that inspired this thesis (Brusewitz *et al.*, 2013, also Brusewitz *et al.*, 2010). In this study, it was found that there was a strong association between reporting having had exceptional experiences and the self-reports of positive attachment occurring between the twins. It was also found that monozygotic twins reported significantly more exceptional experiences when compared to dizygotic twins, and they also reported significantly stronger attachment. Most of the twins, 88 % reported having these experiences in a waking state, which is the opposite of other groups, where most exceptional experiences are in an altered state of consciousness (Sherwood & Roe, 2013). More than half of the twins participating in the study claimed to have sensed when the other twin had had an illness or pain, or had been in a bad mood, even at a distance. About every third twin amongst the twins claimed having sensed the other twin having an accident, also at a distance. Many female twins reported knowing when their sister gave birth to a child.

Even if it as present is rather much of a speculation if quantum entanglement theoretically can occur for twins, it must be clear, what different twins there can be, and for what kind of twins quantum entanglement would be possible. Genetic “identity” and physiological entanglement may naturally be much more complex than having 100% identical DNA. In embryological terms, there are two different types of fraternal twins and four different types of monozygotic twins depending on whether there occur separations of the amnion, chorion and placenta. A late initiation of the twinning process (10 days or more from the ovulation), leads to mono-chorionic pairs sharing the same placenta and intra-uterine environment. First, monozygotic twins show non-identical genetic developments since different genes are activated (Gilbert, 2006). Secondly, the zygote may divide into two embryos at different time points from approximately 0-11 days after conception (it happens within 8 days in most instances), affecting the amount of time the two future individuals have shared the same cell bodies.

Thirdly, there are physiological variations in the perinatal development, see figure 1. Most identical twins are monochorionic (one placenta) and diamnionic (two amnionic bags) (60-70%; Bomsel-Helmreich & Al Mufi, 2005). A smaller proportion are dichorionic as well as diamnionic (18-36 % is the figure given by Bomsel-Helmreich & Al Mufi, 2005; while 25% is given by Shulman & Vugt., 2006). Finally, very few are both monochorionic and monoamnionic (share the same placenta and the same amnionic bag of water) (estimated at 1-2% by Bomsel-Helmreich & Al Mufi, 2005). It is at present not known whether these conditions influence the perceived closeness of the pairs of identical twins. However, if any physiological influence should be present, it seems reasonable that the strongest physiological entanglement effects would be present in twins with the closest perinatal development, i.e. in monochorionic-monoamnionic (mo-mo) twins. A follow up of mono-

chorionic pairs of twins when at the age of 4-6.5 years, found these twins had a greater likeness in personality than those twins not sharing the same chorion (Sokol *et al*, 1995).

The idea was initially to do research on twin telepathy and twin attachment with both UK and Swedish twins, which also would give the possibility to compare experiences and attachment amongst twins in these countries. Having severe problems to reach twins in Sweden (the Swedish twin register didn't like to co-operate because of the topic of telepathy being too controversial and having a scientific value that they regarded was low when compared to other studies), the decision was to have all focus on UK twins.

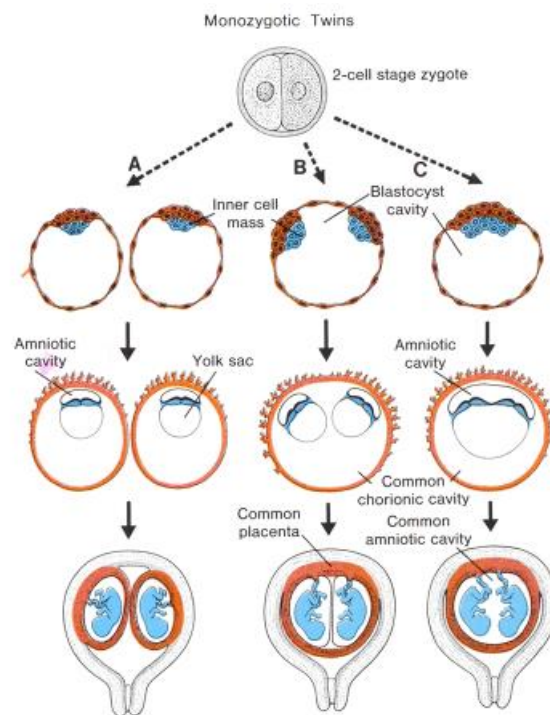


Figure 1. The development of different kinds of monozygotic twins.

Aims

The overall aim with this thesis is to investigate if there is a connection between twin telepathy and twin attachment. To reach this aim, three experimental studies have been carried out with UK twins, comparing the result in telepathy experiments with their reported degree of attachment. Besides that, a survey on attachment among UK twins has been carried out. The three experimental studies are presented in one chapter, being similar in aim and design.

Outline of thesis

Chapter One of this thesis comprises a review of the psychological literature on attachment, in particular research examining relationships between twins and those focused on related relationships. Attachment theory is described, being a basic theory in psychology, laying the foundations for modern developmental psychology, dealing with a basic affectional tie, a bond that one individual has to another individual, and in some form being of crucial importance between a child and its caregiver(s). The ethological theory, developed by Bowlby during the 1950s and 1960s is the most widely accepted theory for attachment. Other theories are also reviewed (Bowlby, 1979; Leman *et al.*, 2012), revealing the different views that exist, also indicating tensions and conflicts between attachment theorists and evolutionary psychologists. The criteria for a bond to be an affective bond and an attachment bond are described.

The development of attachment theory is described, first developed for children, and later also adapted for adults, especially in adult romantic relationships, and also for other relationships. The question when and how much attachment is influenced by genetics versus environment is discussed. For siblings, also individual factors can be different.

A few studies on the attachment between twins are described and a discussion is reviewed whether the bond between the twins in a pair can be regarded as an attachment relationship. The development of self-report questionnaires to measure adult attachment is described. The chapter closes with a short discussion whether attachment patterns are best assessed with a self-report instrument, or with interviews (e. g. Bartholomew & Shaver, 1998).

Chapter Two will give the result of a survey about attachment among UK twins and its relation to gender, age and kind of twin. The survey also included questions whether they had had any so-called exceptional experiences, including telepathy, with their twin or with any other person. Attachment data was collected from a questionnaire on Internet during one month from more than 2000 twins in UK, all through a co-operation with the Department of Twin Research and Genetic Epidemiology, King's College, London sending personalized links to 5060 twins. The two questionnaires are described, one according to the terminology of the pioneer Bowlby, the other, a questionnaire regarding attachment-related anxiety and avoidance.

The result of the analysis of the attachment data is given for all twins as one big group, with identical twins being compared with non-identical twins, and female twins compared to male twins. For age, there was a correlation found. Approximately three twins out of four reported having had a so-called exceptional experience with their twin, and approximately one twin out of four reported having had one with other than their twin, some but not all of them having a genetical factor in common with the twin. A correlation was found between twins report having had exceptional experiences with their twin and twins reporting a stronger and more positive attachment to their twin. The chapter ends with some ideas to extend and replicate this study, both for attachment and for its relationship with having had exceptional experiences.

Chapter Three will give a review of spontaneous phenomena in parapsychology, these phenomena in many cases being inspiration for research, as is also the case for this thesis. The present chapter gives examples of experiences (especially those reported by twins) and surveys, with their shortcomings, advantages and disadvantages. The term “exceptional experiences” is reviewed in depth, as is the connection between this term and the theory by Metzinger on mental representations, his idea of a reality-model in the mind, where exceptional experiences are found to be inconsistent with the basic elements in his model. Finally, the reason why the model was created is described, Metzinger being assumed to have an implicit assumption that the mind is created by the brain, the established view on this question, a view that now is challenged by e.g. research on near-death experiences but also some consciousness research, a quite separate topic.

Chapter Four will give a review of the research in parapsychology, with the focus on telepathy (especially between twins) and the use of electrodermal activity (EDA) in parapsychology, both as indicator of telepathy but also in other areas of parapsychology. Research with other technologies, e.g. fMRI (functional Magnetic Resonance Imaging) and EEG is described, as is the change of the view and the development of the field of parapsychology. Now, these phenomena are understood to be part of the big mystery of “mind” or consciousness and are at the borders of psychology. Early attempts in the beginning of the 20th century to study telepathy and related phenomena were in the 1960s followed by telepathy research with the ganzfeld-methodology and dream-telepathy. Electrodermal activity, EDA, being a mostly subconscious measure is described, as is research in parapsychology using EDA, being a possible indicator of telepathy, e.g. between twins, but can also be used as indicator for other phenomena in parapsychology.

A possible connection between exceptional experiences and the strange phenomena in quantum physics is described, both being very strange, both showing characteristics of so-called non-local effects or entanglement (Arndt, Juffman & Vedral, 2009). Quantum physics processes in other biological organisms are discussed, as well as in the human brain. Meta-analyses in parapsychology are reviewed and the chapter closes with some comments on both valid and invalid criticism.

Chapter Five will give the result of research from three experimental studies with twin telepathy amongst UK twins, studies using electrodermal activity and carried out in May 2014, April and October 2015, the first studies in parapsychology where attachment is measured for the participants and compared to their result in a telepathy study. Altogether 14 pairs of twins made telepathy tests, using electrodermal activity as indicator of telepathy and also filled questionnaires about their attachment to each other, some pairs participating twice. The twins were tested for synchronous responses that occurred in the physiological data of electrodermal activity from the receiver during the period when the other twin was exposed to a surprise stimulus (e. g., a bursting balloon or a hand put in ice water). Each of the five stimuli in a run was presented in random order, and with eight possible trial periods within each block. The choice of the trial periods, that is, the exact time placement of the surprise stimuli within the blocks, was determined randomly by a computer program. With no real variation in attachment data and a small sample, correlations were not possible to calculate between success in telepathy and attachment. For the telepathy data it was however possible. Out of 91 analysable graphs in all three studies, there were 18 correct, and with $MCE = 11.375$, the overall result was significant. Stimuli being most successful were a hand put in an ice bucket and a bursting balloon. Ideas on improved methodology in further studies are mentioned.

Finally, **Chapter Six** presents a summary of the thesis and draws together the discussions and findings from previous chapters in order to present an overview of the investigations about attachment and exceptional experiences amongst twins. Besides a summary of each chapter, there is a summary of the evaluation of the two questionnaires used for measuring attachment in this thesis. After that follows a summary of the conclusions for attachment between twins and for twin telepathy, and whether there is any correlation between twins having exceptional experiences with each other and the attachment between twins. Finally, also a conflict between two aims in the thesis is mentioned. To facilitate success in the telepathy experiments and comparing success in these experiments with degree of attachment, the former would need twins having had many exceptional experiences (which is presumed to facilitate success in the experiments) and therefore very often reporting a strong attachment, the other aim needing twins with a variety of attachment, not only twins with a strong attachment, but some twins also reporting a weak or even negative attachment.

CHAPTER ONE

ATTACHMENT RESEARCH, A LITERARY REVIEW

1.1 Introduction

In this chapter, theory and research on attachment will be discussed, and in particular research examining relationships between twins and those focused on related relationships, such as between siblings. The question of the importance of genetics is also touched upon. Various instruments to measure attachment, both interviews and self-report questionnaires, their uses, significance and reliability are reviewed.

1.2 Attachment theories

An “attachment bond” is an affectional tie, a bond that one individual has to another individual who according to Cassidy (2008) is perceived as stronger and wiser. It can also, according to Broberg, Risholm Mothander, Granqvist & Ivarsson (2009), emphasize the importance of something smaller connected to and depending on something bigger. In some cases, the tie can even be between equals. Attachment theory is a basic theory in psychology, laying the foundations for modern developmental psychology. The most widely accepted theory, the ethological, was developed by Bowlby and his collaborator Mary Ainsworth during the 1950s and 60s (Bowlby, 1969/1982; Broberg, Granqvist, Ivarsson & Risholm Mothander, 2006; Broberg *et al*, 2009, George, Kaplan & Main, 1984/1996). There are however also other theories to explain the development of attachment (Bowlby, 1979; Leman, Bremner, Parke & Gauvain, 2012), including psychoanalytic, learning theories and cognitive developmental approaches.

When psychologists are to understand attachment, they are likely to favour some form of learning theory if they are academically or experimentally oriented, while being clinically oriented they often prefer some form of psychoanalysis, Bowlby (1979, p. 25) found in his research. They have different assumptions about what is important for attachment to

develop and about the underlying processes. According to the psychoanalytic theory, social relations are being mediated by instincts which stem from biological roots and impel the individual to action (p. 25). This theory of attachment focuses on the infant's inner drive to obtain pleasure through sucking and other forms of oral stimulations.

Bowlby found that in the approach from learning theorists, there seemed to be very little space for human feeling or for motivation springing from unconscious and irrational depths. He noticed (1979, p. 26) that learning theorists are very critical of psychoanalysts, finding "the definitions of instinct to be notoriously unsatisfactory and are apt to degenerate into the allegorical". Being both a clinician and scientist, Bowlby was very aware of this conflict, finding Freud's approach the more rewarding, among other things because they had a series of concepts, invoking a dynamic unconscious, which has been a practically useful way of ordering the data, but as scientist he felt uneasy about the unreliable status of many of their observations, the obscurity of many of their hypotheses, and also the absence of any tradition for testing hypotheses. With this background, Bowlby was inspired by the approach from ethology, studying wild animals, with their instincts, conflicts and defence mechanisms. Even if he preferred the ethological approach, he didn't find it necessary to discard the learning theory. On the contrary, he continues, for understanding many of the processes of change, it is indispensable and therefore complementary to ethology.

The same is the case with various kinds of cognitive developmental approaches, including the work of Piaget (1937), which Bowlby (1979, p. 42) finds to be complementary to ethology in explaining attachment. The attempt from cognitive psychology is based (Leman *et al.*, 2012) on both the infant being able to differentiate between its mother and a stranger, but also that the infant must be aware that people exist independent of the infant's interaction with them, a capacity he believed that the child develops at the age of 7 or 8

months. In the second year, the child is developing the capacity for symbolic thinking. This cognitive development in a child means a change in how the attachment is expressed. When growing older, physical proximity to attachment figures becomes less important according to this theory. In understanding this change, Piaget's concepts seem likely to prove indispensable, Bowlby (1979, p. 42) continues. But even when an individual can utilize more complex perceptions, he or she is still influenced by more primitive stimuli. With this view, Bowlby regards cognitive approaches to attachment as complementary to ethology. Bowlby (1969/1982, p. 178) also mentions some other theories about the nature and origin of the child's tie to the first human relationship, one being the Secondary Drive, derived from Learning theory, the result of the mother's meeting the baby's physiological needs. He also mentions what he calls the theory of Object Sucking, and the theory of Primary Object Clinging.

Going back to the ethological theory of attachment, it was developed by Bowlby and Ainsworth, a theory that emphasizes that the attachment process involves two persons (Bowlby, 1969), it is reciprocal in nature. Bowlby was a trained psychoanalyst, but in shaping this theory he also established himself in other sciences like biology and general systems theory and thus was influenced both by evolutionary theory and studies where animals were observed. A good example of ethological approach was provided by Lorenz (1952) in his study of how ducklings were imprinted (Bowlby, 1979; Weidmann, 1956). Both newborn birds and the young of some other animals can develop an attachment to the first object they see at a very short critical period after their birth. Even a human being can be an attachment figure for a newborn bird. Bowlby's ideas are that attachment has its roots in a number of infant responses of an instinct nature, responses that are important when a species is to be protected and survive. The infant can respond with crying, smiling, sucking and clinging, and all these responses elicit the parent to take care and protect the baby and

also to promote contact between the child and the parent. The parent is signalling with sights, sounds and care, something the child is biologically prepared to respond to. In the same way, parents are prepared to respond to these behaviours from the baby. These reciprocal signalling and responses are being biological programmed according to this theory, making the attachment to develop between parent and the infant. When forming the attachment, the infant's early social signalling systems are important, but Bowlby also emphasizes that the attachment is mutual. Both partners become bonded to each other (Cassidy, 1999; Thompson, 2006a).

When Bowlby used evolutionary biology to explain how a close emotional bond is developed between the infant and its caretakers, it was not appreciated in psychoanalytic circles, and the suggestion by Bowlby that these early behaviours are biologically programmed is also very controversial (Leman *et al.*, 2012). There is for example considerable evidence that smiling has social as well as a biological origin. Bowlby's ideas were however appreciated by academic development psychologists. They were looking for a theory that could offer an alternative to both behaviourism and psychoanalytic developmental psychology. The theory, which has clinical and experimental support, emphasizes how important the first relationships are for future relationships, especially those that arise between the ages of 8 and 18 months. The first relationships are normally with the parents, but it is also discussed whether attachment relationships can be formed with others with whom the child has a relationship, for example family members, such as close family, including siblings and grand-parents (Ainsworth, 1989; Trinke & Bartholomew, 1997), but also friendships (Fraley & Davis, 1997) and even pets (Kurdek, 2009) and with God (Kirkpatrick, 1995; 2004). The research often talks about the primary caregiver(s), most often being the parents.

Bowlby (1956) and Ainsworth (1989) refer the attachment bond to be of a specific type of larger class of bonds, being “affectional bonds”. Throughout all life individuals form a variety of important affectional bonds that are not attachments. Cassidy (2008) mentions five criteria for a bond to be an affective bond and one additional criterion for a bond to be an attachment bond. The five criteria for an affective bond are 1) the bond is persistent, 2) it involves a specific person - a figure who is not interchangeable with anyone else, 3) the relationship is emotionally significant, 4) the individual wishes to maintain proximity to or contact with the person, 5) the individual feels distress at involuntary separation from the person. The additional criterion for a bond to be an attachment bond is for Cassidy (2008) that the individual seeks security and comfort in the relationship with the person (Ainsworth, 1989), and therefore the parents as well as the child feel distress when being involuntarily separated from each other. It is this final criterion that leads researchers in the field of attachment to refer to “parental bonds” to children and “child attachments” to parents (Cassidy, 2008), and making the relationship to be an attachment and not only a bond.

1.2.1 What functions do attachment relationships have?

There are (Tancredy & Fraley, 2006) four features or functions that characterize attachment relationships (Ainsworth, 1991; Hazan & Zeifman, 1994), and besides reviewing them, they will also be compared with the five criteria by Cassidy (2008) recently reviewed.

The first feature or function for attachment relationships according to Tancredy & Fraley (2006) is that an attachment figure is used to maintain proximity. Both infants and adults find pleasure in being close to their attachment figures and actively want to be close to them, when they accomplish something or when they feel worried. This feature does very much correspond to the fourth criterion for attachment bond according to Cassidy (2008)

being that the individual wishes to maintain proximity to the attachment figure. The second feature is that both infants and adults experience anxiety and worry when there is a break in the relationship. If they are separated from a person who is not an attachment figure, they in general do not feel distressed or make strong attempts to re-establish contact. This feature also does correspond to a specific criterion for an attachment bond according to Cassidy (2008), namely the fifth criterion, that the individual feels distress at involuntarily separation from the person. The third feature is that the attachment figure serves as a safe haven. If a child is having trouble, or is feeling anxious, he/she often seeks out the attachment figure for contact, assurance and safety. This feature partly corresponds to the additional criterion for Cassidy, where the individual seeks security and comfort.

The last feature is that attachment figures are used as a secure base from which the child can explore the world. If a young child would like to explore a strange new environment and have a secure attachment to the caregiver, they are very happy to do so if they know that the attachment figure is nearby and accessible if needed. This last feature for Tancredy and Fraley (2006) does not directly correspond to a specific criterion for Cassidy, but it is rather close to both the second and third criterion for Cassidy: for an attachment figure to be a secure base and someone the child always knows it can return to, this relationship must have been going on for a long time, i.e. being persistent, i.e. the person is not interchangeable, the second criterion, and also the relationship is emotional significant, the third criterion for Cassidy.

With Bowlby's interest in evolutionary biology, it is of interest to notice claims by Simpson (1999) that the state of evolutionary biology was stagnant when Bowlby started to formulate the attachment theory, and that this state could be the biggest impediment to Bowlby's understanding of evolution. The basic ideas in attachment theory were already

established when several new, important theories were introduced in the mid-1960s and early 1970s, theories addressing the major adaptive problems that humans probably confronted during different life stages throughout evolutionary history, theories Simpson calls “middle-level” theories of evolution. Other middle-level theories are according to Simpson reciprocal altruism, sexual selection, parent-offspring conflict and life history.

Therefore, Bowlby was not privy to much of what is now known as “modern” evolutionary perspective when he started formulating the major ideas in attachment theory (Simpson, 1999). Simpson tries to link the modern evolutionary theories to attachment theory and research, even claiming that Charles Darwin in fact may have been the first attachment theorist, even though he focused on “comrads” instead of attachment figures (and “society” instead of significant persons in an individual’s life). With the attachment theory, Bowlby tried to understand and explain how our ancestors successfully “solved” the first barrier to inclusive fitness – how to survive through the dangers and threats being an infant (Simpson, 1999).

As a contrast to attachment theory being a middle-level evolutionary theory, as argued by Simpson (1999), there has been some tension between attachment theorists and evolutionary psychologists (Kirkpatrick, 1998), a topic discussed by Tancredy and Fraley (2006). Evolutionary psychologists have a perspective that emphasizes the importance of shared genes for emotional bonding, which at first glance seems inconsistent with attachment theory, a theory that emphasizes how important people’s interpersonal histories are, rather than the genes they share. Tancredy and Fraley however claim that their research shows that these perspectives that seem to be quite different actually complement one another very well. Relationship processes can be the bridge between genetic similarity and the development of attachment, making it possible to discuss genes, interpersonal processes

and attachment within the same framework and can be regarded as parts of the same causal chain. Besides that, attachment theory needs to explain how evolutionary models of inclusive fitness connect with what is known about attachment processes.

1.3 Attachment research

From 1985 onwards, research on attachment has grown to an enormous literature, something a literature search on “attachment” will show, giving more than 10,000 entries since 1975 (Cassidy & Shaver, 2008) and they are all across physiological, clinical, developmental and social psychology journals, dealing with every stage of life from infancy to old age.

1.3.1 The key findings of Bowlby and Ainsworth

Attachment research along the ethological theory by Bowlby developed during the 1950s and 1960s. It emphasizes that it is an actively formed relationship between infant and caregiver (Bowlby, 1969). The development of attachment is an important aspect of emotional development. It is during the first year that this very intense bond between the child and one or more of its caregivers is a developmental milestone. Mary Ainsworth invented the so-called *Strange Situation*, where she could observe how a child behaves when being left and when being re-united with its caregiver, most often the mother. In studying children in the *Strange Situation*, she could draw conclusions about the quality of the attachment. She used the concept *secure base*, which many children had when they were confident enough in their relation to its caregiver and could explore the world and become more independent. For other children however, attachment seems less secure and more dependable. These variations along the scale *secure – insecure* show the differences in the quality of attachment.

Ainsworth's studies have been replicated many times and in many parts of the world. She made valuable observations of infant's attachment and exploratory behaviour at about one year of age (Ainsworth, 1973; Waters *et al.*, 1995) in the *Strange Situation*. These studies made it possible to assess the relationship between infant and mother and to classify them according to their nature and quality. Other research has both expanded her work and added a longitudinal feature and compared children's behaviour from infancy to young adults (Main *et al.*, 2005; Solomon & George, 1999; Sroufe *et al.*, 2005).

The observations of children in the *Strange Situation* in the age of 8 or 9 months, made it possible to predict how different infants and children later developed emotionally, socially and cognitively. For white middle-class children Ainsworth found 60-65% to have a secure attachment to their mother. Ainsworth classified the remaining children as *insecure* and being in one of three subgroups. Children exhibiting *insecure – avoidant* attachment typically showed little distress when the mother left in the *Strange Situation* and actively avoided her when she returned. Later researchers found (Leman *et al.*, 2012) that about 20% of American samples are characterized by this insecure pattern. The second subgroup of insecure attachment is called *insecure – resistant*. In this group, infants become extremely upset when the mother leaves, but are oddly ambivalent towards her when she returns. This kind of attachment is in the American sample found amongst about 10% to 15%.

The third insecure subgroup is by later researchers called *insecure – disorganized* (Solomon & George, 1999). Babies showing this attachment seem, when they are re-united with their mother in the *Strange Situation*, disorganized and disoriented. They seem apprehensive and fearful of their attachment figures and are unable to cope in a consistent and organized way with distress in the presence of the caregivers.

1.3.1.1 Continuity of attachment in cultures, and with age

When it comes to development of attachment, there is a considerable variation in different cultures, but the types of attachment are universal, and there is a consistency in how the parenting is expressed as compared with each of the kinds of attachment. Infants with a secure attachment to their mothers have a mother with a parenting style known as *sensitive care*, and if the attachment is insecure, the parenting style can vary, but include a lack of availability, rejection and abuse.

There is also a continuity over generations of attachment type (Leman *et al.*, 2012), shown for example in one study in Germany (Grossman, Grossmann & Kindler, 2005), in Israel (Scharf, 2001) and perhaps the most promising one by Fonagy, Steele and Steele (1991). There is also support for stability of attachment from one period of time to another. In a study by Solomon and George (1999) infants tested with their mother in the *Strange Situation* showed the same attachment patterns when they were 12 months and when they were 6 years of age. Change of the attachment pattern is however also possible as for example was shown in a study by Waters *et al.* (2000).

The relationship between caregivers and infant is important for later social development (Sroufe *et al.*, 2005; Thompson, 2006b). The importance of the early attachment for later social behaviour is illustrated in a longitudinal study in which children were traced from infancy to the age of 19 (Carlson *et al.*, 2004; Sroufe *et al.*, 2005). Contreras *et al.* (2000) and Schneider *et al.* (2001) found a link between the quality of early attachment and how they manage to get peers in later school age and also to friendship patterns.

Attachment develops in a series of steps (Leman *et al.*, 2012). A baby has a general preference for human beings and moves to inanimate objects to a child's real partnership

with its parents. In a study by Schaffer (1996), four phases are proposed in the development of attachment. In the first phase, which lasts for a month or two, the baby's social responses are relatively indiscriminate. Then, in the second phase, the baby can step by step learn to distinguish familiar from unfamiliar people. When the baby is about 7 months old, the third phase starts and the infant now actively seeks contact with certain regular caregivers, such as the mother, greeting them happily and when these people temporarily leave, the child often cries. When the child is two years old, the attachment relationship develops into the final phase, and owing to advances in cognitive development, children become aware of other people's feelings, goals and plans, the so-called goal-corrected partnership (Bowlby, 1969).

In the middle of the 1980s, attachment researchers began to explore in a more systematic way the idea that attachment systems may be operative in adulthood (Fraley & Tancredy, 2012). Hazan and Shaver (1987) began to study attachment in adulthood, especially in adult romantic relationships, Fraley and Davis (1997) continued with friendships, Ainsworth (1989) and Trinke and Bartholomew (1997) continued with family members such as siblings and grandparents, Kurdek (2009) studied relationships with pets and Kirkpatrick (1995, 2004) even studied the relationships with God. Other new applications for attachment theory was (Fraley, Waller & Brennan, 2000) to study the continuity of close-relationship patterns over time, with studies like Baldwin and Fehr (1995), Fraley (1999) and Scharfe and Bartholomew (1994). Also attachment organization has been studied when behaviour is regulated at support-seeking during stressful circumstances (e.g., Fraley & Shaver, 1998) and how children's security is influenced by parents' caregiving behaviour (van IJzendoorn, 1995).

1.3.2 Attachment research between parents and child and between siblings

The question of whether other relationships during childhood also can be attachment bonds is discussed by Marvin and Britner (2008). They mention siblings, specific teachers, adult members of the extended family and coaches. Since many of these relationships have a strong emotional component, some certainly qualify as bonds, even though many of them are relatively short-lived, they conclude.

Dunn (1993, cited in Broberg *et al.* (2009) discusses which cultural circumstances enable sibling relationships to be similar to attachment relationships. From observations of child survivors of a concentration camp, Freud and Dann found (1951, cited in Cassidy, 2008) that twins or siblings in unusual and stressful situations even can become attached to other infants when they did not have any parent alive, and by that close attachment could survive.

1.3.2.1 Infant-parent attachment and siblings' interaction

Sibling relationships are often people's longest lasting close relationships. They usually develop in the context of each sibling's attachment to the same set of parents. There are two studies that have examined the associations between infant-parent attachment and sibling-interaction (Berlin, Cassidy & Appleyard, 2008). One of them found that infant-mother, but not infant-father attachment security was associated with less sibling conflict observed in the home approximately 5 years later (Volling & Belsky, 1992). The other study found that infant-mother attachment security was related to positive treatment of and from an older sibling (Teti & Ablard, 1989).

In the 1990s, ideas from systems theory were applied to attachment theory to study the interplay between members within a family. The purpose was to impose some conceptual structure on what might otherwise be an exponentially complex set of interrelationships to understand and study (Cowan, 1997; Hinde, 1987; Martin & Stewart, 1990). This approach seems however to have fallen short of expectation due to two main reasons (Fearon, Bakermans-Kranenburg & van IJzendoorn, 2013a), one being the number of studies on families with more than one child being remarkably modest, the other reason may in fact be more significant even if being more subtle (Fearon *et al.*, 2013a). In systems theory, you meet a useful set of guiding principles for thinking about how complex self-organizing systems typically behave, but for attachment, it does not produce very clear or easily testable hypotheses. It is a framework rather than a theory, so there is a need for an account for the psychological and motivational processes that make attachment sensitive to events that happen in other relationships (Fearon *et al.*, 2013a).

1.3.2.2 Adult attachment development – and questionnaires

Attachment is most important during childhood, but even for adult's attachment is very important, but for other reasons, when a sexual partner comes to supersede parents in the hierarchy of attachment figures (Zeifman & Hazan, 2008). In adult attachment, there are two roles for the partners: each mate uses the other as an attachment figure and source of security, but they also serve as an attachment figure and source of security to the other, a reciprocal nature also emphasized by Crowell, Fraley and Shaver (2008). And since they also are sexual partners, the sexual mating system is involved, and so the adult attachment is qualitatively different from infant attachment. Another difference (Zeifman & Hazan, 2008) is the issue of genetic relatedness, a child and the adult have it, two mates do not.

While Bowlby identified four phases in the development of attachment between infant and caregiver, Hazan, Gur-Yaish and Campa (2004) proposed a corresponding four-phase model to integrate and explain the phenomenology of pair-bond development, adopting Bowlby's label for each of the phases and supplemented them with their hypothesized romantic relationship equivalents (Zeifman & Hazan, 1997, 2008, p. 448). According to Crowell *et al.* (2008, p. 601), current theory (and research) on adult attachment draw heavily on Bowlby's concept of "attachment representations" or "working models", importing ideas from cognitive psychology. Bowlby hypothesized that individuals develop representations of the functioning and significance of close relationships. These representations, or models, consist of a person's beliefs, and expectations about how attachment relationships operate. Patterns of attachment develop in the course of behavioural interactions between an infant/child and parents (Bowlby, 1980; Crowell *et al.*, 2008). Cognitive-affective structures develop that mirror the behavioural patterns, structures that are called "working models" or "representations" and are relatively stable and can operate automatically without the need for conscious appraisal. Including cognitive psychology and the concept of "working models" here seems to connect with the theories from contemporary philosophy of mind, mentioned in the Introduction of this thesis when it comes to the concept of "exceptional experiences", with Metzinger (2003) and his theory of mental representations, influenced by psychologist Johnson-Laird (1983) and his unified theory of mind, where Metzinger's *self-model* could contain Bowlby's "working models" of attachment.

There are here also reasons to shortly review how the questionnaires for attachment used in this thesis developed from and with adult attachment research, primarily ECR-R (Experiences in Close Relationships – Revised), but also the WHOTO (Hazan & Zeifman, 1994) and ANQ questionnaire (Trinke & Bartholomew, 1997). The development of

research and theories on adult attachment was carried out by personality and social psychologists who used self-report measures of a person's hierarchy of attachment figures and attachment "style" combined with various other measures and experimental research paradigms (Shaver & Mikulincer, 2002a, 2002b, Mikulincer & Shaver, 2008). Hazan and Shaver (1987, 1990, 1994) created the concept "adult attachment style" when they applied attachment theory to the study of adolescent and adult romantic and marital relationships (Mikulincer & Shaver, 2008). Bartholomew and Horowitz (1991) argued for a four-category typology of adult attachment styles, based on two dimensions suggested by Bowlby (1969/1982) analysis of internal working models of self and others. Inspired by this typology, Brennan, Clark and Shaver (1998) made a factor-analysis of all self-report items written up at that time (including the RQ (the Relationships Questionnaire, Bartholomew & Horowitz, 1991) and the RSQ (the Relationships Styles Questionnaire, Griffin & Bartholomew, 1994)) and created ECR (Experiences in Close Relationships). They found, as did Bartholomew & Horowitz (1991) that there are two major factors (anxiety and avoidance) underlying self-report measures of adult romantic attachment, anxiety being fear of rejection and abandonment, and avoidance, not being comfort with closeness and not being comfort being depending on others. The ECR-R (Experiences in Close Relationships – Revised) was developed by Fraley, Waller and Brennan (2000), derived from an item response theory (IRT) analysis of the 4 most commonly used self-report measures of adult romantic attachment (ECR scales (Brennan, Clark & Shaver, 1998), Adult Attachment scales (Collins & Read, 1990), Relationships Styles Questionnaire (Bartholomew & Horowitz, 1991; Griffin & Bartholomew, 1994), and Simpson's (1990) attachment scales). The analysis used data from 1,085 individuals and was conducted to determine whether existing attachment scales suffered from scaling problems, i.e. scored in ways that can lead to erroneous inferences about important

theoretical issues, such as the degree of continuity in attachment security and the differential stability of insecure attachment patterns (Brenner, Clark & Shaver, 1998; Fraley, Waller & Brennan, 2000). The authors found that commonly used attachment scales can be improved in several important ways, using IRT techniques, and thereby develop new attachment scales with desirable psychometric properties. The ECR-R is of special interest, since it is used in this thesis for twins, recommended by a leading Swedish expert on attachment research (Broberg, personal communication, 2010-12-22). It is currently one of the most used self-report questionnaires of adult attachment, aimed at emotionally intimate relationships. As such it has a focus on partner relationships rather than parental. To be used between twins, three questions were excluded, not being relevant for this group.

The other questionnaire used in this thesis, for the attachment survey, a modified version of the WHOTO Questionnaire and the Attachment Network Questionnaire, ANQ, was used, from now on called WHOTO-ANQ, suggested by an attachment expert at the University of Greenwich and being used by Tancredy and Fraley (2006) to assess how much siblings use one another as attachment figures, to assess functions and features that are related to attachment amongst siblings. The WHOTO Questionnaire (Hazan & Zeifman, 1994) identifies the people one turns to for proximity and support, for a safe haven and for a secure base (Mikulincer & Shaver, 2008, p. 508). The ANQ finally was developed to measure multiple adult attachment relationships and to examine the characteristics of attachment hierarchies.

A few comments can also be of interest comparing self-report questionnaires with interviews like AAI. Besides questionnaires having great advantages in terms of time and cost of efficiency (Slade, 2008), there is a debate (Crowell, Fraley & Shaver, 2008)

concerning whether attachment patterns are best assessed with a self-report instruments or interviews, and whether the two kinds of methods converge on the same phenomena (e.g., Bartholomew & Shaver, 1998; Crowell & Treboux, 1995, Roisman *et al.*, 2007; Shaver, Belsky & Brennan, 2000). Some authors have also questioned the validity of assessing adult attachment with self-report instruments (e.g., Crowell & Treboux, 1995; de Haas, Bakermans-Kranenburg & van IJzendoorn, 1994), notifying the difficulty of assessing unconscious or automatic processes with measures that tap people's conscious reports, a questioning that have caused a considerable tension between the AAI and self-report traditions within the field of adult attachment research (Crowell, Fraley & Shaver, 2008). Crowell, Fraley and Shaver (2008) however mention three reasons why self-report instruments are adequate to investigate individual differences in adult attachment. First, according to Bowlby, attachment plays an important role in people's emotional lives, and adults are able to provide valuable information about their emotional experiences and behaviour. Second, most adults have enough of experience in close relationships to recount how they behave in such relationships and the kinds of things that their partners have said to them about their behaviour, and three, conscious and unconscious processes typically operate in the same direction to achieve a goal (Bowlby, 1980; Jacoby, Toth, Lindsay & Debner, 1992). Mikulincer and Shaver (2007) have also conducted and reviewed numerous studies in which measures of unconscious processes (e.g., the TAT, the Rorschach, coded dreams and various kinds of inadvertent behaviour) were systematically and predictable related to self-report measures of adult attachment. Thus, Crowell, Fraley and Shaver (2008) conclude that the self-report measures obviously are tapping aspects of a person that are systematically associated with unconscious processes. These arguments support the suggestions from the attachment experts in this thesis to use self-report measures like ECR-R and WHOTO-ANQ to measure attachment between twins.

1.3.2.3 Multiple attachment

When it comes to multiple attachments, Cassidy (2008) also mentions two studies giving evidence that siblings can serve as attachment figures (Stewart & Marvin, 1984; Teti & Ablard, 1989) as well as day care providers (Ahnert, Pinquart & Lamb, 2006). She also argues that, although there usually is more than one attachment figure, there is a limit in how many attachment figures there can be (Bretherton, 1980). It is also important not to assume, Cassidy argues, that an infant treats all attachment figures as being equivalent, or that they are interchangeable. Instead (Tancredy & Fraley, 2006), an “attachment hierarchy” is thought to exist (Collins & Reed, 1994; Trinke & Bartholomew, 1997). This strong tendency for infants to prefer a special person as attachment figure for comfort and security is termed “monotropy” (Ainsworth, 1964, 1982; Bowlby, 1969/1982, Burlingham & Freud, 1944).

To assess attachment hierarchies, Trinke and Bartholomew (1997) developed a self-report measure and thereby extending the work of Hazan, Hutt, Sturgeon and Bricker (1991). They found that most young adults have multiple attachment figures, including family members, romantic partners, and friends (Tancredy & Fraley, 2006). In this hierarchy, mothers seem to be on the top, being the most important attachment figure. Next to come are romantic partners and best friends. Siblings were chosen still less often. Twins are not mentioned specifically in this report. While mothers seem to be on the top of the hierarchy, they are in fact not very often the exclusive caregiver. According to anthropologists (Harkness & Super, 2002; Weisner & Gallimore, 1977), mothers are exclusively caregivers in only about 3% of human societies (Leman *et al.*, 2012). In as many as 40% of societies, mothers are not even the major caregiver.

1.3.2.4 The importance of genetics versus environment in attachment

When discussing attachment, it is also necessary to include the question how important genetics is, how important a shared and non-shared environment is, and also the possible difference between shared and non-shared environment, topics discussed by Belsky and Fearon (2008). This knowledge about genetic contribution to variation in infant attachment organization has in recent years increased significantly. One line of evidence on this topic comes from studies of how rates on attachment security relates to each other for individuals who vary in their degree of biological relatedness (twins, siblings, unrelated infants). Belsky and Fearon mention three studies (Teti & Ablard, 1989; van IJzendoorn, Moran, Belsky, Pederson, Bakermans-Kranenburg & Kneppes, 2000; Ward, Vaughn & Robb, 1988). They also state that sibling concordances themselves cannot differentiate between similarities broadly attributable to common environmental factors and those associated with genetics. They mention four studies with infant-mother attachment assessments on samples on monozygotic (MZ) and dizygotic (DZ) twins and conclude that, despite the modest sample sizes of all these studies, the cumulative picture is quite consistent, suggesting a significant role for shared and non-shared environmental effects and apparently little role for genetics.

Studies that have compared how much attachment has been influenced by environment versus genetics have been on both infants, teenagers and young adults. One study with very small children was reported by Roisman and Fraley (2008), who had 485 same-sex twin pairs as participants and found evidence that the quality in being parent and the security in infant attachment as showed at the age of 24 months are a product of shared and non-shared environmental (but not genetic) variation among children. Genetic differences between infants did however play an important role in explaining observations of temperamental

dependency. They argue that there now is a perspective that has become conventional wisdom among many behaviour-genetic researchers (Bouchard, 2004; Harris, 1995; Rowe, 1994; Scarr, 1992; Türkheimer, 2000) that all psychological phenotypes can be inherited and that influences from the environment on how a child develops serve to make siblings dissimilar (Plomin & Daniels, 1987). During the past years however, several studies of infant attachment security have been published, studies that are sensitive to genetics and that challenge this wisdom (Roisman & Fraley, 2008). They also argue that in all relevant twin studies of infants and pre-schoolers (e.g., Bakermans-Kranenburg, van IJzendoorn, Bokhorst & Schuengel, 2004; Bokhorst *et al.*, 2003; Fearon *et al.*, 2006; O'Connor & Croft, 2001; Ricciuti, 1993), the effect from genetics on security has been estimated and it adds very little and is often close to zero. There was even evidence in each of these studies that the influence from shared and non-shared environment on the development of attachment security was quite substantial.

The attachment for twins to their caregiver(s) in early teenagers was inspected in a report by Fearon, Shmueli-Goetz, Viding, Fonagy and Plomin (2013b). They examined the relative importance of genetic and environmental influences on attachment in adolescence between each twin and the caregiver(s). Most twin studies indicate that during infancy, genetic factors only have a limited influence on attachment security. With this study they wanted to examine whether this remains the case in later development. They studied 551 same-sex twin pairs with an average age of 15 (the first study to examine the behavioural genetics of attachment for children being more than 3 years old), recruited from the larger Twin Early Development Study (TEDS). Attachment was assessed using a semi-structured interview, the Child Attachment Interview, CAI. It consists of 19 questions to show representation of current attachment relationships with primary caregivers. The purpose was to find children's perceptions of and experiences with their attachment figures. The

questions are focusing on times when it is possible that children call upon their attachment figures, when they for example are upset, ill or being separated. The result gave strong support to genetics playing an important role for attachment for adolescent twins while the influence from sharing environment is very limited. They conclude that their findings indicate that the characteristics that the child inherits have a big influence on attachment at this age. It is indicated, they argue, by the way the children represent and think about attachment relationships.

Donnellan, Burt, Levensky and Klump (2008) carried out a study with young adult twins on attachment to their caregiver, comparing influence from genetics and environment. They examined if there are any genetic influences on measures of anxiety and avoidance, related to attachment, including if genetic factors explain the phenotypic association between measures of the Big Five personality traits and dimensions of adult attachment. The participants were 134 MZ and 139 DZ pairs drawn from the Michigan State University Twins study of Behavioral Adjustment, the age being between 18 and 28. As method they used the NEO-Five Factors Inventory (NEO-FFI; Costa & McCrae, 1992) to measure the Big five personality dimensions, a self-report questionnaire with 60 items for the Five traits (neuroticism, extraversion, openness, agreeableness and conscientiousness) and for the dimensions of adult attachment, a modified version of the 18-item Adult Attachment Scale (AAS; Collins & Read, 1990) was used, assessing general attachment to romantic partners. They found that individual differences in anxiety and avoidance, related to attachment, are heritable, and that genetic factors account for much of the association between the relevant Big Five personality dimensions and attachment-related anxiety and avoidance.

Another study on attachment amongst young twin adults to their caregiver was carried out by Picardi, Fagnani, Nistico and Stazi (2011), who studied how much the individual

differences in attachment security in twins was influenced by genetics and by environmental influences. The Experiences in Close Relationships Questionnaire was used, and 677 twins participated, age 23-24 from the Italian Twin Register, with 244 complete pairs (46% MZ) and 189 unmatched pairs. Genetic effects could explain 45% and 36% of individual differences in attachment-related anxiety and avoidance, respectively. When comparing how much anxiety and avoidance varied with each other, it was found that the variation was mainly due to genetic factors. Unshared environmental factors were found to explain the remaining proportion of variance. They found the findings to suggest that both nature and nurture contribute to individual differences in adult attachment.

There is a clear view that attachment security comes from the quality from the care from the parents, a view that is very consistent with studies based on observation and behavioural genetic evidence in early development (Fearon *et al.*, 2013b). For adolescence, the picture is however clearly more complex, they argue. Among some speculations about possible mechanisms, they mention that genetic factors in the child may step by step have influences during phases of developmental reorganization and change of attachment between infancy and adolescence, it progressively biases the organization of the attachment. This result, Fearon *et al.* (2013b) claim, is in strong contrast to earlier studies using twin methodology (where both monozygotic and dizygotic twins are used to estimate heritability) with infants (Bokhorst *et al.*, 2003; O'Connor & Croft, 2001; Roisman & Fraley, 2008). These earlier studies indicate that attachment in early life is strongly, if not exclusively, influenced by the environment. With a sample being relatively large and with adolescent twins, the findings by Fearon *et al.* (2013b) suggest that the genes may be more important for attachment when the child grows older.

1.3.2.4.1 The difference between shared and non-shared environment

Some investigators have questioned that each twin in a pair experiences the same environmental conditions (Leman *et al.*, 2012). These investigators argue that identical twins with identical genes and dispositions that are inherited, are treated more similarly by their parents. They also argue that these twins get more similar responses from people outside the family, and also select more similar companions and activities compared to non-identical twins (Scarr, 1996; Scarr & McCartney, 1983). For this reason, these critics claim, identical twins have more shared environments than non-identical twins. Thus, any similarities in their traits must be attributed to both the environment and their genes (Rutter, 2006). This viewpoint stresses that people actively create their own environments. They do not just passively receive influences from the environment. There are in fact differences in people's experiences even within the same setting, differences that partly depend on how people are as individual.

Children living in the same family thus have both shared and non-shared experiences. Factors regarded as shared conditions are if they are living in a bad or good neighbourhood, whether the parents are employed or unemployed, and whether the parents are healthy, physically and mentally (Reiss *et al.*, 2000; Towers *et al.*, 2003). Factors that make the experiences not shared are in contrast related to how the individual child is, for example how the child is treated because of gender, temperament or physical and cognitive abilities, factors that can vary even for identical twins. Studies show that siblings, even twins, have many non-shared experiences that are important for their development (Plomin & Daniels, 1987; Plomin, 1995). It can even be the case that when siblings realize that their perceptions and their experiences are different, this can affect their behaviour whether or not these perceptions are accurate. Some even argue (Plomin *et al.*, 2001) that non-shared influences

are more important for understanding development than shared influences. To better evaluate how shared and non-shared environmental experiences influence development, studies are now designed in which two siblings in the same family are examined rather than single siblings from different families (McGuire, 2001; Rutter, 2006). Researchers can thus obviously no longer assume that the home environment is homogenous for all siblings.

1.3.2.4.2 Genes, environment, attachment and jealousy

Fearon *et al.* (2013a) explores the question how much genes and environment contribute to attachment security and insecurity, relatively seen. The findings of the research suggest that attachment amongst twins may be shaped by processes that reflect sibling competition, processes that may indeed be akin to jealousy.

Jealousy amongst siblings is also a topic discussed by Volling, Kennedy and Jackey (2013). Siblings, spending very much time together, may encounter frequent opportunities to experience and cope with sibling jealousy, which possibly influences the affective nature of the sibling relationship and, in turn, probably have significant consequences for the development and well-being for the child and in being an adult. The competition between siblings for love and attention from their caregiver(s) causes feelings of envy, jealousy, and competitiveness between brothers and sisters within the family, and even if sibling jealousy is very relevant, there is little research being done in the field (Volling *et al.*, 2013).

1.3.3 Attachment research on and between twins

Being a twin takes the relationship one step further from being a sibling. From the very beginning, twins spend extended periods of time together, share common experiences and environments, develop and share language, share support and also often have one another

as possible source of care during stressful or frightening moments (Fraley & Tancredy, 2012). Besides these social factors, Fraley and Tancredy (2012) argue that another dimension exists in the fact that monozygotic twins share 100 % of their genes and thus are identical genetically. This makes it unique to be a twin, and thus also the emotional bond is unique. To make the data on heritability for twins and also siblings more complete, while monozygotic twins have 100 % the same genes (they develop from one zygote which splits and form two embryos – a single cell is fertilized by a single sperm), dizygotic twins have 50 % the same genes (they developed from two separate embryos – two different eggs fertilized by two different sperms), and the same is the case for nontwin siblings, they share 50 % of the genes. These per cent measures were used for genetic relatedness in Tancredy and Fraley (2006) and were positively correlated with the extent to which people use their siblings as attachment figures (also foster and adoptive siblings were included, having 0 %, and step siblings, having 25 %). These findings, Tancredy and Fraley found, are compatible with the notion that genetic similarity may play a broad role in shaping the nature of the relationship that develops between siblings.

1.3.3.1 Studies comparing the attachment between twins and their caregiver(s)

According to Hesse (2008), there appear to be only two published reports on twin attachment to caregivers using the interview AAI (Adult Attachment Interview), and Brent Donnellan (personal communication, 2014-01-19) doesn't know of any more AAI studies. Both AAI studies concern whether the twins agree on their attachment to caregivers.

The two AAI studies have addressed the questions of genetics, shared and not-shared environment as contributors to AAI status. They both support the notion that pairs of monozygotic and dizygotic twins have highly concordant scores on a standard measure of the quality of their parental attachment. Constantino *et al.* (2006) used 33 pairs of identical

female twins, ages 13-26 and 14 of their non-twin siblings. Attachment classification were concordant for 13 of the 14 pairings of monozygotic twins and their non-twin siblings (who share on average 50% their genes) and was as strong as for the monozygotic pairs. Because these concordance rates were similar, the results were interpreted as providing preliminary evidence that similarity in AAI classifications occurs predominantly based on shared environmental inferences. Torgerson *et al* (2007) conducted a pilot study of attachment patterns in same-sex adult Norwegian twins. As in the Constantino study, the distribution of AAI patterns for twins was essentially the same as that established for singletons. Because of the small sample size (28 MZ and 14 DZ twins) it was not possible to carry out the most common forms of twin analysis or to present values that could provide differentiated information about environmental versus genetic influence (Hesse, 2008).

1.3.3.2 Studies on the attachment between twins

Despite the increase in twin births in industrial societies (primarily because the growing use of IVF, but also because of older age pregnancies), almost nothing is known about the attachment between the members of the pairs of twins and their claims to have this very special contact, as is confirmed by van IJzendoorn (personal communication, 2010-02-11). While there are numerous anecdotal accounts of the special bonding between twins and cases where the relationship seems to have had a survival value (such as in holocaust victims), the few published studies (Segal, 1999) concern shared aspects of their personality and cooperative skills.

With the questionnaire ECR-R, advised by a leading Swedish expert on attachment research to be used between twins (Broberg, personal communication, 2010-12-22), there have, according to Fraley (personal communication, 2013-12-20) been no studies on twin-twin attachment that have been published. There was one study with twins where Tancredy used

ECR-R (personal communication, 2014-01-21) from her dissertation, but it was not published due to a small sample size.

The question if the bond between the twins in a pair can be regarded as an attachment relationship is addressed by Tancredy and Fraley (2006) and in a follow-up study (Fraley & Tancredy, 2012). In the first report they argued that twin relationships could be easier to understand if attachment theory would be used as a framework. These relationships are often regarded to be one of the most unique relationships, with twins being very close to each other during many important years (e.g., Burlingham, 1952; Koch, 1966; Neyer, 2002; Segal, 1997, 1999; Woodward, 1998). Twins have some unique developmental circumstances, giving them the possibility to develop attachments to one another (Fraley and Tancredy, 2012). They are very much together, share many experiences, in school, in bedroom and kitchen, and also when being with friends (Neyer, 2002). Sharing a lot of time during the important early years, they also share support (Neyer, 2002; Neyer & Lang, 2003) and are part of each other's language development (Segal, 1999). They may also turn to each other when they are stressed or frightened. All these factors make it probable that twins more than just siblings use one another for attachment. Thus, these relationships do have many similarities with infant - caregiver relationships.

To assess how much siblings use one another as attachment figures, Tancredy and Fraley (2006) developed a 16-item questionnaire. They wanted to know what kinds of psychological and developmental factors are important when an attachment bond is developed with a sibling. In the study, 928 non-twin siblings and 62 twin siblings received the questionnaire. The participants, with an age ranging from 14 to 61 years were asked to report how old their siblings were and what relation they had to each sibling, data that also was used to determine how much of the genes they shared. They examined how age was

related to attachment to various persons (i.e., siblings, parents and romantic partners) and also depending on if they were twins or non-twin siblings. To assess functions and features that are related to attachment, a modified version of the WHOTO Questionnaire (Fraley & Davis, 1997; Hazan *et al.*, 1991) was used and the Attachment Network Questionnaire (ANQ; Trinke & Bartholomew, 1997), both being established attachment measures. The WHOTO questionnaire is used to measure functions that are related to attachment and to determine the people to whom the person sought proximity, which people the person used as a safe haven, and also which people the person used as a secure base (Fraley & Davis, 1997). To assess the degree to which a potential attachment figure served each of the four primary attachment functions (proximity maintenance, separation distress, safe haven and secure base), 16 items were used. Instead of nominating specific individuals or providing binary responses, participants were asked to rate how much various attributes in the attachment characterize their relationship with people being of interest. Also, the function of the attachment was asked for. The rating scale employed was from 1 to 7.

Because there were rather few twins in the sample ($n=62$) and because of a possible artefact of self-selection, the validity of their findings could be regarded as limited. They therefore continued and performed a large study (Fraley & Tancredy, 2012), with a sample obtained by Knowledge Networks at Menlo Park, California, maintaining a panel of individuals who were recruited using random digit dialling telephone selection methods. Once a panel member agreed to participate, he or she was given an interactive device to access the Internet and free Internet access in exchange for participating in online surveys approximately twice a month. Characteristics of the panel were found to closely match those of the U.S. census, and did represent all the nation with both twins and non-twin siblings, where the participants were not sampled, the sample being comparatively large, thus making it possible to address how zygosity may be associated with attachment. Panel

members received an email to alert them when they had a survey to complete. The survey was protected from nonpanel members. Both twins and non-twin siblings participated. They were not sampled with respect to their twinship status per se, so there was little reason, Fraley and Tancredy argue, to assume that people who participated were any more likely to be attached to their siblings than those who did not. With this, they continue, their sampling method essentially eliminated potential problems arising from self-selection biases.

Fraley and Tancredy used a questionnaire with three questions, the first being how many living siblings they had. If there were at least one, the participants were asked what biological relationship they had to the sibling that was closest to them in age. They were also asked how much they used that sibling for attachment. Altogether, 31487 people took part in the survey, 24172 reported having what they call full siblings, 2583 had half siblings, 278 were non-identical twins and 108 were identical. They also checked for step siblings, adoptive siblings and foster siblings.

Fraley and Tancredy (2012) could confirm the findings from Tancredy and Fraley (2006) and showed that, on average, twins were more likely than non-twins to use their siblings as attachment figures. They made predictions about mean attachment for non-twin siblings (NTS), non-identical twins (dizygotic, DZ) and identical twins (monozygotic, MZ). Analyses of these different kinds of twins showed (and without paying attention to whether environment is shared or non-shared), that people who share an average of 50% of their genetic variation with their siblings are less attached to their siblings when compared to people who share 100% of their genes with their siblings. They also found indications that non-twins were less likely to be attached to their siblings than twins were. Other analyses indicated that non-twins were less attached to their siblings than were non-identical twins,

who in turn were less attached to their siblings than were identical twins. They also found that older participants reported feeling less attached to their siblings. Twins reported feeling more attached to their siblings than non-twins did. Thus, twins and non-twin siblings differed in attachment when they got older: with growing age, it was more probable for twins to depend on their siblings. For non-twin siblings it was the opposite, they were less likely to depend on their siblings. Finally, siblings with many shared experiences were more likely to use one another as attachment figures when compared to siblings not having that many shared experiences.

Their conclusion was that there is something special about being a twin (e.g. shared environmental experiences of the variety often discussed in the behaviour genetic literature) that is relevant for understanding the nature of the bond that develops between twin siblings. These data are best explained, Fraley and Tancredy continue, by considering principles both in attachment and inclusive fitness.

Fraley and Tancredy also comment the question how environment influence attachment. They find their research to give rise to consequences for behaviour genetics. One idea in basic behaviour genetic models is that identical and non-identical twins experience similar environments on average. In cases there are differences between these environments, there is an assumption that they are not related to the important factor being in focus for the investigation (i.e., the *equal environment assumption* see Kendler, Neale, Kessler, Heath & Eaves, 1993). When the assumption is not valid, it leads to inflated estimates of heritability, they continue. The findings suggest, they argue, that both MZ and DZ twins experience their relationships in distinct ways (Fortuna, Goldner & Knafo, 2011; Penninkilampi-Kerola, Moilanen & Kaprio, 2005). Fraley and Tancredy suggest that when behaviour genetics research in the future will study personality, relationships or social behaviour,

areas where attachment is relevant, consideration should also be taken to the possibility that the environments twins experience may not be equal.

Fraley and Tancredy (2012) also mention some limitations to the present research on twins and siblings' attachment, one of them being that they have not included analyses of how attachment between siblings changes during different phases of life, i.e. how this attachment varies and changes with growing age. It would also have been valuable to assess whether siblings were of a common sex. Finally, attention should be paid to questions on how much older or younger the siblings are and what the effect of these differences are, and also how much contact you have with siblings and if you share any common interests.

Schwarz, Mustalic and Junker (2015) continued the efforts to understand attachment among siblings (and twins), comparing the attachment to the romantic partner with the attachment to the sibling as a function of the participant's sibling type among monozygotic twins (MZ), dizygotic twins (DZ) and non-twin siblings (NT). In their aim, twin attachment was not in focus, but two-folded: to compare attachment between different kinds of siblings (MZ, DZ, and NT), the same comparison as in Fraley and Tancredy (2012), and at the same time compare the attachment to the sibling and the romantic partner, as in Tancredy and Fraley (2006). With that approach they could compare the relative rank of the romantic partner with the rank of the sibling in the attachment hierarchy as a function of sibling type. A total of 515 participants took part in the study, and to avoid confounding effect of gender homogeneity and zygosity (non-MZ sibling pairs can be homogenous or heterogenous with respect to gender), the primary analyses were restricted to same-sex siblings, giving a total of 331 participants, who were either engaged in a close relationship, or married. Participants completed the questionnaire on the Internet, the link to the online questionnaire being spread primarily through an email distribution list of a twin agency. Attachment was

assessed with three different measures, the first one being the attachment functions (items from Tancredy & Fraley, 2006), the four main functions of attachment relationships, with 14 items. The second measure was the Inclusion of Other in the Self-scale (IOS, Aron, Aron & Smollan, 1992), measures the emotional closeness between the participant and the target persons, and finally, questions about attachment hierarchy, to make a ranking in which the four targets (sibling, mother, farther and romantic partner) were sorted according to the strength of emotional connectedness to these persons.

For the first question, whether the sibling or the romantic partner fulfil attachment functions, the analyses revealed that the sibling types differed significantly in the degree of their attachment, MZ twins being significantly more attached to their twin than non-twin siblings to their sibling, as was the case with DZ twins, thus confirming the first prediction. MZ twins were however only marginally significantly more attached to their twin than DZ twins, not fully confirming the second prediction. Neither the third prediction was supported, MZ twins were as equally attached to their sibling as to their romantic partner, and this was the case also for the fourth prediction: DZ twins were as equally attached to their sibling as to their romantic partner. The fifth prediction was however supported, non-twin siblings were significantly less attached to their sibling, compared to their romantic partner. Comparison were also conducted on emotionally closeness, where the first and second hypotheses were supported, as was the third, MZ twins reported to be emotionally closer to their sibling, compared to their romantic partner, and for DZ twins, they reported equal emotional closeness to their romantic partner as to their sibling. Altogether, the authors regard their predictions to be mostly confirmed, with the results for DZ twins to be mixed.

Schwarz, Mustalic and Junker regard their results to successfully complete and extend recent findings like those of Tancredy and Fraley (2006) and Fraley and Tancredy (2012). They at the end mention some limitations in their study, a) not having tested the mediational model between genetic relatedness, relational processes – shared experiences, separate lives, empathy, emotional closeness - and attachment to their sibling, a model proposed by Tancredy and Fraley (2006), b) their choice of sibling definition can be regarded to be a narrow one, c) all participating twins not completing the forced choice attachment hierarchy task, and finally d) using a very limited measurement of zygosity (Song *et al.*, 2019), as all participants indicated themselves as MZ, DZ or NT sibling.

1.3.3.3 Inclusive fitness, one aspect in twin attachment research

In its development, attachment theory was partly inspired by evolutionary biology (Simpson & Belsky, 2008). With that in mind, it is not that surprising that some researchers in the attachment field (Fraley & Tancredy, 2012) include another perspective that also is inspired from understanding biology. It is inclusive fitness, or kin selection theory that researchers from the beginning developed when they tried to understand why animals sometimes give up their own possibility to have children and instead give the possibility to others. More specifically, how genes that give rise to such altruistic behaviour are selected (Hamilton (1964). Fraley and Tancredy (2012) included this perspective since they also regard it to be able to give some clues on the nature of twin-twin relationship.

It is possible that twins take a special interest in one another (Neyer, 2002; Neyer & Lang, 2003; Segal & Ream, 1998) because of the special situation with sharing more of their genes with one another when compared to non-twin siblings. With this interest, Fraley and Tancredy (2012) continue, they should be more likely to behave altruistically toward one another and, for example spend more time with the children of their co-twins, and grieve

more if the twin dies as compared to if a non-twin sibling dies. There is in fact empirical research that supports these predictions (Segal, 1997, 1999). These two perspectives, however, do not exclude each other, Fraley and Tancredy (2012) claim. Even though attachment theory was inspired by evolutionary biology (Simpson & Belsky, 2008), most of the research and theories in attachment is focused on *proximate* mechanisms of behaviour. Inclusive fitness theory also offers proximate explanations for social behaviour, but it also tends to emphasize how behaviour patterns have developed during all years with evolution, what functions those behaviours may serve, i.e. distal or *ultimate* explanations. With these two theoretical perspectives, we seem to get different kinds of analyses, but they might together prove to be important to explain how much siblings use one another for getting attachment.

1.4 Chapter Summary and Discussion

Attachment is a basic theory in psychology, laying a foundation in modern developmental psychology, dealing with a basic affectional tie, a bond that one individual has to another individual, primarily being between a child and its caregiver(s). The different theories for attachment are described, the most widely being the ethological theory developed by Bowlby and Ainsworth during the 1950s and 1960s, the others being the psychoanalytical theory, learning theories and with cognitive developmental approaches, with different views and sometimes also causing tensions. The attachment bond is discussed, by pioneers Bowlby (1956) and Ainsworth (1989) regarded to be of a specific type of larger class of bonds, being “affectional bonds”. The criteria for a bond to be an affective bond and an attachment bond are discussed, as are the features or functions that attachment relationships have (e.g. Cassidy, 2008; Tancredy & Fraley, 2006).

The so-called *Strange Situation* is described, invented by Ainsworth, where she could make observations and develop certain concepts, showing the quality of attachment. Other researchers report about the stability of attachment from one period to another, how attachment develops during the 2-3 first years, and how it develops between generations and in different cultures.

The development of attachment theory is described, first being developed for children, but later adapted for adults, especially in adult romantic relationships and also for relationships between friends, family members, to pets and even with God. The so-called “attachment hierarchy” (Cassidy, 2008) is described where many children have more than one attachment figure, even though they have a strong tendency to prefer a special person as attachment figure. The question how much attachment is influenced by genetics versus environment is discussed, both shared and non-shared (Belsky & Fearon, 2008), especially for twins. Both shared and non-shared environmental effects seem to have a significant role for attachment between mother and monozygotic as well as dizygotic twins. Genetics apparently seem to have a little role (Donnelan *et al.*, 2008; Roisman & Fraley, 2008).

For siblings, and also twins, shared and non-shared environment is discussed, where even non-shared influences can be more important than the shared. It can be that the home environment is not homogenous for all siblings. Individual factors like gender, temperament and physical and cognitive abilities can be different between siblings in a family. For attachment between twins, there are very few studies reported. With a considerable increase in twin births, the necessity of attachment studies for twins seems obvious. With the ECR-R questionnaire, suggested to be used for attachment between twins, no studies have been published on twin-twin attachment. The question whether the bond between the twins in a pair can be regarded as an attachment relationship is discussed

by Tancredy and Fraley (2006), continuing in Fraley and Tancredy (2012) (and also in a later study by Schwarz, Mustalic and Junker, 2015). They also discuss inclusive fitness, or kin selection theory, and its possible influence and importance for twin-twin relationships. The development of various self-report measures is described (Crowell, Fraley & Shaver, 2008), including the questionnaires used in this thesis, ECR-R, WHOTO and ANQ. There is also a debate concerning whether attachment patterns are best assessed with a self-report instrument or interviews (the former regarded to give conscious assessments of their feelings and behaviour, the latter being a measure of unconscious aspects of defences and behaviour) and whether the two kinds of methods converge on the same phenomena (e.g., Bartholomew & Shaver, 1998; Shaver, Belsky & Brennan, 2000). Crowell, Fraley and Shaver (2008) however mention three reasons why self-report instruments are adequate to investigate individual differences in adult attachment. Finally, Mikulincer and Shaver (2007) found studies giving measures of unconscious processes to be systematically and predictably related to self-report measures of adult attachment.

CHAPTER TWO

ATTACHMENT AMONG UK TWINS – A SURVEY

2.1 Introduction

Twin relationships have for centuries been of public interest and also for science, being a relationship of a unique and intimate kind. Most studies on this unique relationship are however on biological topics, with questions if and how genetic factors influence the attachment, and very few are on psychological aspects. In this chapter, theory and research on twin attachment will be reviewed, and a survey among adult UK twins will be presented, using two questionnaires, with the scores from these also compared with whether the twins reported having had any so-called exceptional experiences with their co-twin or with a person other than their co-twin, exceptional experiences including such experiences as remote sensing the other twin's pain, injury, accident or state of mind.

2.2 Background

Twins relationships have captivated mankind for centuries. There are stories from classic literature all the way to modern media, showing this very unique and close bond (Burlingham, 1952; Koch, 1966; Neyer, 2002; Playfair, 2009; Segal, 1997, 1999; Woodward, 1998). Even if there are many studies with twin samples, just a few of them however address the nature of twin relationships, the very special bond between twins – in most studies in psychology with twins, they have served as a tool for behavioural genetic research (e.g. Bouchard, 2004; Tancredy & Fraley, 2006). Some twin researchers (e.g. Neyer, 2002, Segal, 1999) argue the twin relationship is worthy of investigation in its own right.

In an analysis of the twin relationship, Tancredy and Fraley (2006) argue that attachment theory (Bowlby, 1969; Hazan & Shaver, 1987) probably can offer a valuable framework to better understand the twin relationship in adulthood. According to their analysis and their

review of existing twin research, these relationships meet many of the criteria of attachment relationships, characterized by proximity seeking, separation distress, and the use of one another as a safe haven and secure base, the four features or functions of attachment relationships. Bowlby was from the beginning focused on understanding the nature of the relationship between caregiver and infant, but also believed that attachment characterized human experience through all the life, from the very beginning to the grave. It was however not until the middle of the 1980s that researchers began to take seriously that the attachment system may operate also in adulthood, especially in adult romantic relationships. Hazan and Shaver (1987) were among the first to explore Bowlby's ideas in the context of adulthood (Tancredy & Fraley, 2006).

2.2.1 The features of an attachment bond

There are (Tancredy & Fraley, 2006) four features or functions that characterize attachment relationships (Ainsworth, 1991; Hazan & Zeifman, 1994). The first feature or function for attachment relationships is that an attachment figure is used to maintain proximity. Both infants and adults find pleasure in being close to their attachment figures and actively want to be close to them, when they accomplish something or when they feel worried. The second feature is that both infants and adults experience anxiety and worry when there is a break in the relationship. If they are separated from a person who is not an attachment figure, they in general do not feel distressed or make strong attempts to re-establish contact. The third feature is that the attachment figure serves as a safe haven. If a child is having trouble, or is feeling anxious, he/she often seeks out the attachment figure for contact, assurance and safety. The last feature is that attachment figures are used as a secure base from which the child can explore the world. If a young child would like to explore a strange new

environment and have a secure attachment to the caregiver, they are very happy to do so if they know that the attachment figure is nearby and accessible if needed.

In their analysis of the relationship between twins (and whether the relationship between twins is an attachment relationship), Tancredy and Fraley (2006) also discuss the four features of attachment for twins. Regarding the first feature, proximity seeking, Koch (1966) found, in a study with preschool twins, that twins were more likely than non-twins to spend time together and share playmates, and Segal (1999) in a naturalistic observation study of twin pairs on a school playground found that identical twins showed greater physical closeness than fraternal twins. According to Tancredy and Fraley (2006), less is known for adult twins. In one of the few studies, Tambs, Sundet and Berg (1985) found that identical twins were psychologically closer to each other and they lived together longer than fraternal twins. Similar conclusions about adult twins come from Neyer (2002) and Ainslie (1997). For the second feature, separation distress, it is implied from these comments that some twins can easily be distressed when separated from one another, a distress that is particularly obvious when one twin dies, a process studied by Woodward (1998) and Segal with colleagues (e.g. Segal & Bouchard, 1993). Woodward (1998) even found twins reporting that seeing the twin die felt like experiencing their own death (Tancredy & Fraley, 2006).

When it comes to the third feature, if a twin can be a safe haven for their cotwin, Leonard (1961) found that twins sometimes are able to soothe each other even when others cannot, and Lassers and Nordan (1978) suggest that the twin relationship is an enduring attachment and that the twin naturally retreats to the twinship for safety and security (Tancredy & Fraley, 2006). For the fourth and last feature, being a secure base, there is according to Tancredy and Fraley (2006) very little research to determine the extent to which twins serve

as secure bases for each other across the life span. It seems likely that twins use their cotwin as a secure base when they are psychologically separated from the mother, as suggested by Sandbank (1999). This base does however not necessarily promote exploration, Tancredy and Fraley (2006) argue. Koch (1966) however suggests that exploration need not be inhibited by using one's twin as a secure base. This study found that children who reported feeling close to their cotwin, were less apprehensive socially. Finally, in a classic study of a set of Russian twins, Luria and Yudovitch (1959) noted that the preschool age twins were happy and energetic when they were together but were restrained and quite when apart (Tancredy & Fraley, 2006).

2.2.2 Twin development and attachment

Before addressing the question if the bond between twins is an attachment relationship, a short review is needed about the twin development during the first years. In seeking safety and security, twins get less individual attention from their mothers than singleton children (Lytton, 1977), a behaviour around the age of 6-8 months (Tancredy & Fraley, 2006). During the first couple of years, twins seem to be relatively uninterested in the presence of the cotwin, although this presence may have a soothing effect (Leonard, 1961). In the age of around 36 months, twins do however begin to interact with each other in a relationship-oriented manner, when the separation-individuation process is coming to an end (Mahler, Pine & Bergman, 1975). At around this time, the mother begins to be a secure base from which to explore the world and the environment, and in this process, the cotwin is a readily accessible object or partner (Tancredy & Fraley, 2006). It is during this important period of development that twins become increasingly involved in each other. From the very beginning, twins spend extended periods of time together, share common experiences and environments (e.g. with friends - Neyer, 2002 - school, bedroom and kitchen), develop and share language, share support (Neyer & Lang, 2003) and also often have one another as

possible source of care during stressful or frightening moments (Fraley & Tancredy, 2012). Besides these social factors, Fraley and Tancredy (2012) argue that another dimension exists in the fact that monozygotic twins share 100 % of their genes and thus are identical genetically. This makes it unique to be a twin, and thus also the emotional bond is unique.

Another aspect of the similarity between identical twins was reported in a recent study (Van Baak *et al*, 2018). Identical twins share, independent of their identical genes, an additional level of molecular similarity that influences their biological characteristics, a degree of similarity that could not be explained by the twins sharing the same DNA. To explain the extra level of similarity, the researchers propose an epigenetic mechanism, whereby environmental factors determine which genes will be turned on or off in different cell types. According to Waterland, one of the researchers in the study, epigenetics is the software that determines what the computer can do, if we would view one's DNA as the computer hardware. The phenomenon is called "epigenetic supersimilarity". Following an idea from Milne, another of the researchers, the markers will be the same in both twins if the epigenetic markers are established before the embryo splits into two. Thus, the researcher continues, both twins inherit an intimate molecular memory of their shared developmental legacy as a single individual. This is a very recent discovery and it remains to be established if there are any consequences for the attachment between identical twins, and also of course for the question of whether such a discovery could have any implication for twins having and reporting synchronous reactions, having so-called exceptional experiences.

2.2.3 Attachment between siblings, as compared to attachment between twins

Twins are also siblings, so besides looking at the question of twin attachment, there are reasons to look at the more general question of sibling attachment, i.e. if and how much

siblings use one another as attachment figures. Both are discussed by Tancredy and Fraley (2006), Fraley and Tancredy (2012) and Schwarz, Mustafic and Junker (2015), all three described in previous chapter. Because of the report from 2006 having a rather small sample and having a possible artefact of self-selection, Fraley and Tancredy found the validity of their findings to be limited and therefore continued and performed a large study (Fraley & Tancredy, 2012). The findings from Tancredy and Fraley (2006) could be confirmed: twins were found to, on average, more likely than non-twins to use their siblings as attachment figures. Analyses showed that people who share an average of 50% of their genetic variation with their siblings are less attached to their siblings when compared to people who share 100% of their genes with their siblings. They also found indications that non-twins were less likely to be attached to their siblings than twins were. Twins reported feeling more attached to their siblings than non-twins did. Twins and non-twin siblings differed in attachment when they got older: with growing age, it was more probable for twins to depend on their siblings. For non-twin siblings it was the opposite, they were less likely to depend on their siblings.

Schwarz, Mustalic and Junker (2015) continued the efforts to understand attachment among siblings (and twins), extending the findings like those of Tancredy and Fraley (2006) and Fraley and Tancredy (2012). They had the aim to compare attachment between different kinds of siblings (monozygotic twins, MZ, dizygotic twins, DZ and non-twin siblings, NT), the same comparison as in Fraley and Tancredy (2012), and at the same time compare the attachment to the sibling and the romantic partner, as in Tancredy and Fraley (2006). With that approach they could compare the relative rank of the romantic partner with the rank of the sibling in the attachment hierarchy as a function of sibling type. A total of 515 participants took part in the study. To avoid confounding effect of gender homogeneity and

zygosity, the primary analyses were restricted to same-sex siblings, giving a total of 331 participants, who were either engaged in a close relationship, or married. Participants completed the questionnaire on the Internet. Attachment was assessed with three different measures, the first one being the attachment functions (items from Tancredy & Fraley, 2006), the four main functions of attachment relationships, with 14 items. The second measure was on emotional closeness between the participant and the target persons, and finally, questions about attachment hierarchy, to make a ranking in which the four targets (sibling, mother, father and romantic partner) were sorted according to the strength of emotional connectedness to these persons.

The analyses revealed that the sibling types differed significantly in the degree of their attachment, MZ twins being significantly more attached to their twin than non-twin siblings to their sibling, as was the case with DZ twins. MZ twins were however only marginally significantly more attached to their twin than DZ twins, and they were found to be as equally attached to their sibling as to their romantic partner. For DZ twins, they were as equally attached to their sibling as to their romantic partner. Finally, non-twin siblings were significantly less attached to their sibling, compared to their romantic partner. Regarding emotional closeness, MZ twins reported to be emotionally closer to their sibling, compared to their romantic partner, and for DZ twins, they reported equal emotional closeness to their romantic partner as to their sibling.

2.3 Aims

A major interest with this study was to carry out a survey among UK twins on their attachment. The objective of this research is to assess the presence of attachment features and functions in twin relationships. This survey can partly be regarded as a replication of

the study by Tancredy and Fraley (2006), theirs conducted about attachment between twins and siblings in America using among other things a modified version of the WHOTO Questionnaire (Fraley & Davis, 1997; Hazan *et al.*, 1991) and the Attachment Network Questionnaire (ANQ; Trinke & Bartholomew, 1997), while the present study is with UK twins and uses two questionnaires, one of them being an instrument they used, a modified version of the WHOTO Questionnaire and the Attachment Network Questionnaire, from now on called WHOTO-ANQ, the other one a questionnaire for attachment-related anxiety and avoidance, a slightly modified version of ECR-R (see Appendix 1), modified to be used for twins and from here called ETR (*Experiences in Twin Relationships*, see Appendix 2). Formally, the aims for the study are: a) to find out what kinds of attachment twins in UK have to each other when it comes to attachment-related avoidance and anxiety as measured in the new questionnaire ETR, and also measuring four features or functions that characterize attachment relationships with the WHOTO-ANQ questionnaire, b) if there is any difference in attachment between identical and non-identical twins, and c) between female and male twins, d) if attachment changes with age, e) if twins reporting having had so-called exceptional experiences *with their twin* have a more positive and strong attachment to the twin when compared to twins who do not report having these experiences, f) if the twin with a more positive attachment in each pair is the twin that report having more exceptional experiences in the pair, g) if twins in UK have stronger and more positive attachment as compared to published norms for non-twins (there are no twin-data available), and finally h) if attachment data from the two questionnaires ETR and the modified version of the WHOTO and ANQ are correlating with each other.

2.3.1 Hypotheses:

- a) Identical twins have a stronger and more positive attachment when compared with non-identical twins.

- b) Female twins have a stronger and more positive attachment to their twin when compared with male twins, females in general being regarded as more sensitive and having closer relationships.
- c) Twins reporting having had so-called exceptional experiences *with their twin* have a more positive and strong attachment to the twin when compared with twins who do not report having these experiences.
- d) The twin in each pair with the most positive attachment to the cotwin reports having more exceptional experiences than the other twin being less positive
- e) The results in attachment from the two questionnaires ETR and WHOTO-ANQ are correlating with each other, i.e. having a strong attachment from ETR should correlate with having a strong attachment from WHOTO-ANQ.

Independent variables, IV: gender, kind of twin (identical and non-identical), age, reporting having had exceptional experiences. For the fourth hypothesis, for each twin, relevant data for the cotwin was added.

Dependent variables, DV: attachment scores from ETR and attachment scores from WHOTO-ANQ

Besides these hypotheses, one aim was to have a look at how attachment would change with growing age, and whether twins reported having had exceptional experiences with other than their twin.

2.4 Methods

In this study, two questionnaires were used to get scores on attachment for twins. The questionnaires were completed online, using the web tool Qualtrics. Invitations were sent

in personal emails to 5060 twins in the British twin register in co-operation with the DTR (Department of Twin Research and Genetic Epidemiology), King's College, London. Attachment between the twins in a pair was assessed by means of two self-report questionnaires, one of them being *Experiences in Twin Relationships*, *ETR*, a slightly modified version of ECR-R, modified following suggestions from those with expertise in developmental psychology, the other WHOTO-ANQ, a modified version of the WHOTO Questionnaire (Fraley & Davis, 1997; Hazan *et al.*, 1991) and the Attachment Network Questionnaire, ANQ, the latter being constructed and used in Tancredy and Fraley (2006). Besides these attachment questionnaires, two questions were added about having had so-called exceptional experiences.

2.4.1 Materials

2.4.1.1 *Experiences in Twin Relationships (ETR)*

This questionnaire is a slightly modified version of *Experiences in Close Relationships Revised (ECR-R)*, see Appendix 1), giving scores on attachment-related anxiety and avoidance, modified to be used for twins. The modification consisted of changing the word "partner" to "twin" and excluding three questions that were not relevant for twins, two for anxiety and one for avoidance. ECR-R is a 36-item self-report attachment measure, developed by Fraley, Waller and Brennan (2000). The 36 items were derived from an item response theory (IRT) analysis of the 4 most commonly used self-report measures of adult romantic attachment (*Experiences in Close Relationships Scales* (Brennan, Clark & Shaver, 1998), *Adult Attachment Scales* (Collins & Read, 1990), *Relationship Styles Questionnaire* (Griffin & Bartholomew, 1994), and J. Simpson's (1990) (unnamed) attachment scales). The ETR has thus in total 33 questions in the present study and is presented in Appendix 2. While the ECR-R is aimed at emotionally intimate, primarily romantic partner

relationships, ETR has the focus on twin relationships. Following recommendations by Fraley *et al.* (2000), the order in which the questions are presented to the twin was manually randomized, in order to mix the questions about anxiety and avoidance. Estimates of internal consistency of this questionnaire is .90 or higher for the two ECR-R scales (Fraley, 2015-03-25). The reliability and validity are also discussed in Sibley and Liu (2004).

The ECR-R questionnaire and with that also the ETR, yields scores on the two subscales: “avoidance“ (i.e. how much people are uncomfortable being close to others versus secure depending on others, e. g. “I prefer not to show my twin how I feel deep down”), and “anxiety“ (i.e. how much people are insecure versus secure about the availability and responsiveness of romantic partners, or another person, in this study the co-twin, e.g. “I often worry that my twin doesn’t really love me”). There are in the ETR 16 questions to score attachment-related anxiety (with two reversed questions), and 17 questions on attachment-related avoidance (with 11 reversed questions), all to be rated on a 7-point scale where 1 = strongly disagree and 7 = strongly agree – the reverse for the reversed questions). To obtain a score for anxiety, a mean score is calculated for the 16 questions concerning anxiety, the same procedure goes for a mean score for avoidance, in this study with 17 questions. The anxiety subscale is characterized by excessive need for approval and fear of rejection and abandonment. The avoidance subscale is in contrast characterized by an excessive need for independence, self-reliance and fear of dependence on others. A high score on these scales means greater anxiety/avoidance.

With the questionnaire ECR-R there have, according to Fraley (personal communication, 2013-12-20) been no studies published on attachment between twins. There was one study with twins where Tancredy used ECR-R (personal communication, 2014-01-21) from her dissertation, but it was not published due to a small sample size.

2.4.1.2 A modified version of the WHOTO and ANQ Questionnaire

To assess functions and features that are related to attachment, a modified version of the WHOTO Questionnaire (Fraley & Davis, 1997; Hazan *et al.*, 1991) and the Attachment Network Questionnaire (ANQ; Trinke & Bartholomew, 1997) was used, both being established attachment measures. This modified version was used by Tancredy and Fraley (2006) to assess functions and features that are related to attachment. It can be used to any potential attachment figure (sibling, mother, father, romantic partner, or friend). In the present study, it was used to assess the degree to which the cotwin served each of the four primary attachment functions (proximity maintenance, separation distress, safe haven and secure base). 16 items were used, see Appendix 3. Tancredy and Fraley (2006) constructed these scales based on attachment theory and research, choosing items that seemed to best represent these functions. Most items were taken from established attachment measures (e.g. the WHOTO and the ANQ (Tancredy & Fraley, 2006)). For example, *proximity maintenance* items included such statements as “I make an effort to stay in contact with my sibling.”, the *separation distress* items included such statements as “When I am away from my twin, I feel down”. The *safe haven* subscale, Tancredy and Fraley (2006) continue, included items such as “My twin is a person I count on for advice”. For the last subscale, the *secure base*, items such as “My twin is the person that I count on to always be there for me and care about me no matter what.” Participants were asked to rate the degree (from 1, *strongly disagree*, to 7, *strongly agree*) to which attachment features and functions characterize their relationships within this case the cotwin.

Besides these two questionnaires on attachment, one question was added (and in two versions), picked from the *Exceptional Experiences Questionnaire, EEQ* (see Appendix 5). It was the question if the twin has had any so-called exceptional experience with their twin

(and if so, how many), experiences that include telepathy-like experiences, shared physiological responses to illness or injury. Version 2 of the question concerned if the twin had had these experiences with other than cotwin (and in this case, also to specify with whom). Both extra questions are in Appendix 4. The questionnaire EEQ is developed at the DTR, King's College, London, and some questions added by Professor Adrian Parker (personal communication to Parker, 2010), based on his knowledge of the literature and his personal experiences in testing twins.

2.4.2 Participants

For this survey, 5060 twins in the British twin register received an individual email with a personalized link to the web survey with the web tool Qualtrics (in a co-operation with the DTR, King's College), inviting them to participate in the survey. Out of these 5060 twins, 2075 twins finished the questionnaire (and 215 participated but did not finish), giving a response rate of 41 %. Out of these 2075 twins, 1838 (89 %) were females and 224 (11 %) males (and 13 with missing info on gender), 1387 were identical twins, 660 were fraternal (and for 28 this information was missing). Participants ranged in age from 19 to 90 ($M = 56$, $SD = 15$, with 13 twins not having any information on age). Only one member of a twinship was needed to complete the study, for 630 twins, also the cotwin participated, and thus 815 single twins.

2.4.3 Procedure

The study took place on the Internet from November 7 to December 8, 2017. The participants were told in their individual email that the study was a part of a PhD project about twin attachment and exceptional experiences. They were told they could get more information (by email) by contacting the lead researcher Brusewitz or the project supervisor

Luke, and were asked to complete the survey by December 8, 2017, which should take approximately 10 – 20 minutes. After information about confidentiality, the survey itself started, with the ETR Questionnaire (*Experiences in Twin Relationships*) and specific instructions how to answer each of the 33 questions. This questionnaire was followed by the WHOTO-ANQ on attachment features and functions with 16 questions and specific instructions how to answer them. Then, questions followed whether they had experienced any so-called exceptional experience with each other or with another person (and in this case, also with who), and approximately how many times for both of these questions. After the survey, they were debriefed, reminded who to contact if they had questions, and they were given a thank you for having participated. The questionnaire was developed in cooperation with the author, the DTR and a post-graduate student of the supervisor. When the survey was completed (after one month), data from Qualtrics was downloaded into an SPSS-file, and personal data for each twin (e.g. kind of twin and age) was added.

2.4.3.1 Ethical approval

The study had obtained ethical approval from University of Greenwich as well as King's College. 100 % confidentiality was guaranteed for the responses from the twins, which were protected through a secure online set-up. The confidentiality included a) information that the lead researcher and his team will analyse information from the survey, b) no twin will be possible to identify from the presentation of the results – all answers are 100 % anonymous – a twin will not know the answers from the cotwin and can therefore be free to be honest - and identifiable data will not be passed on to any third parties, c) about consent d) possibility to withdraw from the study at any time, e) that data can be withdrawn from the study at any time, f) all questions must not be answered, and g) that possible intended studies at the University of Greenwich will not be affected if they would choose

to withdraw from the study. They were told that the research project had been approved by the University of Greenwich Research Ethics Committee (REC), and finally, they were told that by continuing with the survey, they gave their consent. After the survey, they were debriefed, reminded who to contact if they had questions, and they were given a thank you for having participated.

2.5 Results

2.5.1 Attachment scores – reliability evaluations

Using two different questionnaires on attachment (ETR giving negatively oriented scores in degree of anxiety and avoidance, and WHOTO-ANQ giving more positively oriented scores), their psychometric properties are first explored, both internally and towards each other.

2.5.1.1 ETR questionnaire evaluated

For questions from ETR, if not to be reversed, most of the scores should be on 1 and 2 if the attachment is strong and positive (more than approx. 50 % of the twins should choose 1, to totally agree, and then the numbers should slowly decrease), and for the reversed coded questions, most should be 6 or 7. Detailed statistics can be found in Appendix 6, including the distribution of the answers, and it is clear most scores for anxiety are maximum low (i.e. the attachment is very strong), and that is also almost the case for avoidance.

2.5.1.2 WHOTO-ANQ questionnaire evaluated

For WHOTO-ANQ questions, where no question was reversed, most answers should be on 6 or 7 for the attachment to be strong. For question 15, the distribution is skewed and even negatively correlated, and for question 14, the distribution is a little skewed. For all other

questions, most answers are on 7, strongly agree, and many also on 6. The distribution of these answers can be seen in a table in Appendix 7.

2.5.1.3 ETR and WHOTO-ANQ compared

Low scores (i.e. a strong attachment) on ETR should (if the ETR question is not reversed coded) correspond to high scores (i.e. a strong attachment) on WHOTO-ANQ. The correlations (between each of the two ETR scores to each of the four WHOTO-ANQ subscores) should be negative and significant, and they were all, $p < .001$. For the sub score anxiety (ETR), the correlation with the sub score proximity was $r = -.283$ (and more specified, $p = 2.7 * 10^{-39}$), the correlation with the “safe haven” scale was $r = -.223$ (and $p = 1.4 * 10^{-24}$), with the secure base scale $r = -.269$ ($p = 1.5 * 10^{-35}$), and with the separation distress scale $r = -.129$ (and $p = 4.1 * 10^{-9}$). For the sub score avoidance, the correlation was $r = -.663$ with the proximity scale (and $p = 2.1 * 10^{-260}$), with the safe haven scale $r = -.760$ (and $p = .000$), with the secure base scale $r = -.767$ (and $p = .000$), and with the separation distress scale $r = -.623$ (and $p = 3.8 * 10^{-221}$). The analyses supported the fifth hypothesis, that the results from the two questionnaires correlated with each other.

The scores from ETR and the scores from WHOTO-ANQ all show attachment, but in different terms, which is illustrated in the two-dimensional model in figure 1, where the axes show the degree of anxiety and of avoidance, and the four corners up-down/left-right show the four primary attachment functions (proximity maintenance, separation distress, safe haven and secure base), where the somehow similar “secure” is one feature in WHOTO-ANQ, in the upper left corner.

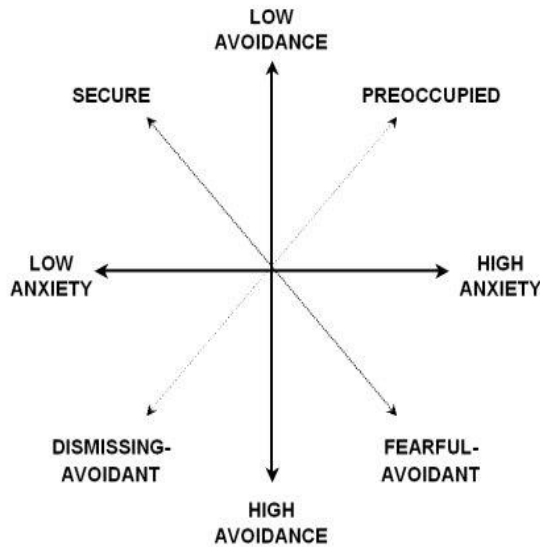


Figure 1. The two-dimensional model (Model of Self and Model of Others) of individual differences in attachment for infants and adults: The two dimensions of anxiety and avoidance, and their 45° rotations, underlying self-report instruments of adult attachment (Brennan, Clark & Shaver, 1998; Fraley & Waller, 1998; Griffin & Bartholomew, 1994).

2.5.1.4 Do twins in each pair report about the same degree of attachment?

For another aspect of reliability of these scores, twins in each pair should report about the same degree of attachment to each other. Creating a file with only pairs, being 1260 twins (and thus 630 pairs), a comparison was made between the scores for the twins in each pair (for the two sub scores anxiety and avoidance from the ETR questionnaire, and for the four sub scores from the WHOTO-ANQ questionnaire, proximity, safe haven, secure base and separation distress. Analyses were carried out for each of these six scores. If the twins in each pair report about the same degree of attachment towards each other for a specific sub score, the difference between these sub scores for the twins in each pair should be as low as possible, close to zero.

The statistics for each of these six analyses are presented in figures in Appendix 8. It is with some variation clear that the difference in scores between the twins in each pair, is zero or very close to zero for all six sub scores. To give an example, the statistics for the difference in scores for the proximity sub-scale is presented in figure 2.

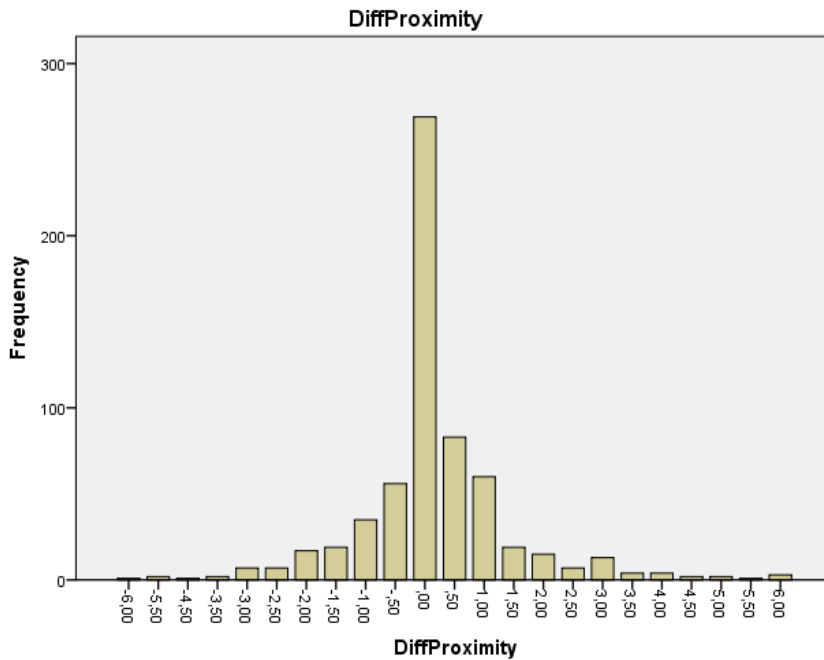


Figure 2. The difference in scores between the twins in each pair for the WHOTO-ANQ sub score proximity seeking.

The big focus on a difference being zero or very close to zero for these 6 scores between the twins in each pair, and a slowly decreasing number for bigger differences clearly indicate the scores were reliable between the twins, the twins in each pair reporting about the same degree of attachment to each other, which should be expected.

2.5.2 The attachment for twins as a general group

For the scores from ETR, the mean score for avoidance in this study was 2.54 (and the published norm is 2.92 (see Appendix 9), the mean score in this study being a third of an

SD lower). For anxiety the mean score was 2.23 in this study (and the published norm score is 3.56, the mean score in this study being a little more than one SD lower). For the scores for attachment from WHOTO-ANQ, the score for proximity maintenance was 5.99, for safe haven 4.92, for secure base 5.41, and for separation distress 5.21, as presented in table 3 and 4.

2.5.3 Do identical twins have a stronger and more positive attachment when compared to non-identical twins?

To determine whether there are differences in attachment between identical and non-identical twins, scores from the two questionnaires, four from the WHOTO-ANQ, and two from ETR were compared in an independent samples t-test. The scores with the means and standard deviations are presented in table 3 and 4. For the scores for attachment from WHOTO-ANQ, the difference for all four scores were significant, $p = .000$, 2-tailed (for proximity maintenance, $t(2040) = 4,527$, and p more specified = 0.000006 , for safe haven, $t(2042) = 8,042$, and p more specified = $1.5 * 10^{-15}$, for secure base, $t(2042) = 7,875$, and p more specified = $5.5 * 10^{-15}$ and for separation distress, $t(2039) = 6,337$, and p more specified $2.9 * 10^{-10}$).

For the scores from ETR, the mean score for avoidance was for identical twins 2.37 and for non-identical twins 2.88, both being low and with a difference being significant, $p = .000$, 2-tailed ($t(2028) = -8.376$, and p more specified = $1.0 * 10^{-16}$). The mean score for anxiety was for identical twins 2.22 and for non-identical twins 2.26, both being low, and with a difference not reaching significance, $p = .277$, 2-tailed ($t(2029) = -1,087$). Thus, for all but one score, the difference was significant, and the first hypothesis must be regarded to be supported.

When comparing the scores for anxiety and avoidance in this study for identical and non-identical twins with the published norms (see Appendix 9, Fraley, 2015-03-25), these ETR scores for both identical and non-identical twins were lower than these published norms (see table 4). For avoidance, the published mean norm score is 2.92, while the mean score in this study was 2.37 for identical twins (almost half of a SD lower), and 2.88 for non-identical twins (almost the same score as the published norm). The published mean norm score for anxiety is 3.56, as compared with the mean score in this study for identical twins 2.22 and for non-identical twins 2.26, both being a little more than one SD lower.

Table 3. Mean and standard deviation for scores from the WHOTO-ANQ questionnaire for all twins. Zygosity 1 = identical, 2 = non-identical twins. “Proximity” stands for proximity maintenance, “safe” stands for safe haven, “secure” stands for secure base, and “separate” stands for separation distress.

| | Zygosity | N | Mean | Std. Deviation |
|----------------|-----------|------|------|----------------|
| WHOTOproximity | 1 | 1382 | 6.10 | 1.35 |
| | 2 | 660 | 5.79 | 1.52 |
| | All twins | 2042 | 5.99 | 1.42 |
| WHOTOsafe | 1 | 1384 | 5.14 | 1.71 |
| | 2 | 660 | 4.46 | 1.90 |
| | All twins | 2044 | 4.92 | 1.80 |
| WHOTOsecure | 1 | 1384 | 5.60 | 1.50 |
| | 2 | 660 | 5.02 | 1.73 |
| | All twins | 2044 | 5.41 | 1.60 |
| WHOTOseparate | 1 | 1381 | 5.33 | 1.23 |
| | 2 | 660 | 4.95 | 1.35 |
| | All twins | 2041 | 5.21 | 1.28 |

Even though the norm scores are for partners in relationships, it is obvious that these norm scores, understood to be low for strong bonds and vice versa, indicate that the attachment

between the twins in this study is in general stronger than between partners in relationships. With this strong attachment between twins, and with the hypothesis that greater attachment leads to having more exceptional experiences, it gives a probable consequence, that twins indeed report having more exceptional experiences. Whether this strength depends on being a twin, or if it is due to having had many exceptional experiences is however currently impossible to say.

Table 4. Mean and standard deviation, SD for the two scores from the ETR questionnaire for identical (zygosity 1) and non-identical (zygosity 2) twins, and the published norm score.

| | Zygosity | N | Mean | Std. Deviation | Overall norm score |
|-----------|-----------|------|------|----------------|--------------------|
| Anxiety | 1 | 1373 | 2.22 | .87 | 3.56 |
| | 2 | 658 | 2.26 | .90 | |
| | All twins | | 2.23 | .88 | |
| Avoidance | 1 | 1372 | 2.37 | 1.23 | 2.92 |
| | 2 | 658 | 2.88 | 1.36 | |
| | All twins | | 2.54 | 1.30 | |

2.5.4 Do female twins have a stronger and more positive attachment to their twin when compared to male twins?

To determine whether there are differences in attachment between male and female twins, the scores from the two questionnaires were compared, four from the WHOTO-ANQ, and two from ETR, and an independent samples t-test is presented. For the scores from WHOTO-ANQ, the difference for all four scores was significant, $p = .000$, 2-tailed (for proximity seeking, $t(2055) = 9.856$ and p more specified = $2.0 * 10^{-22}$, for safe haven, $t(2057) = 11.576$ and p more specified = $4.6 * 10^{-30}$, for secure base, $t(2057) = 11.009$ and p more specified = $2.0 * 10^{-27}$, and for separation distress, $t(2054) = 10.595$, with p more specified = $1.4 * 10^{-25}$). The mean score for proximity was for female twins 6.10 (for male

twins 5.13), for safe haven for female twins 5.07 (male 3.64), for secure base 5.54 (male twins 4.32) and for separation distress 5.31(for male twins 4.37).

For the scores from ETR, the mean score for avoidance was for female twins 2.47 and for male twins 3.09, with a difference being significant, $p = .000$, 2-tailed ($t(2043) = -6.791$, and p more specified = $1.5 * 10^{-11}$). The mean score for anxiety was for female twins 2.23 and for male twins 2.20, not reaching significance, $p = .60$, 2-tailed ($t(2044) = .524$). Thus, for all but one score, the difference between sexes was significant. All data is summarized in table 5. We must however notice that it is a very heavily female skewed sample. This may very well affect the reliability of male data, making the comparison difficult to do, and the conclusion therefore being unsafe.

Table 5. The mean and the standard deviation, SD for all six attachment scores for female and male twins in this study, the norm score, and the t result of an independent samples t-test, comparing the means for each score.

| Kind of attachment | <i>t</i> | Mean score female | Mean score male | SD male twins | SD female twins | Norm score male | Norm score female |
|---------------------|----------|-------------------|-----------------|---------------|-----------------|-----------------|-------------------|
| WHOTO-ANQ: | | | | | | | |
| Proximity seeking | 9.856 | 6.10 | 5.13 | 1.61 | 1.35 | | |
| Safe haven | 11.576 | 5.07 | 3.64 | 1.83 | 1.74 | | |
| Secure base | 11.009 | 5.54 | 4.32 | 1.78 | 1.53 | | |
| Separation distress | 10.595 | 5.31 | 4.37 | 1.38 | 1.23 | | |
| ETR: | | | | | | | |
| Anxiety | .524 | 2.23 | 2.20 | .82 | .89 | 3.57 | 3.56 |
| Avoidance | -6.791 | 2.47 | 3.09 | 1.28 | 1.28 | 2.94 | 2.92 |

All scores from WHOTO-ANQ were higher for female twins, i.e. they reported having a stronger attachment when compared to male twins. The scores from ETR partly supported

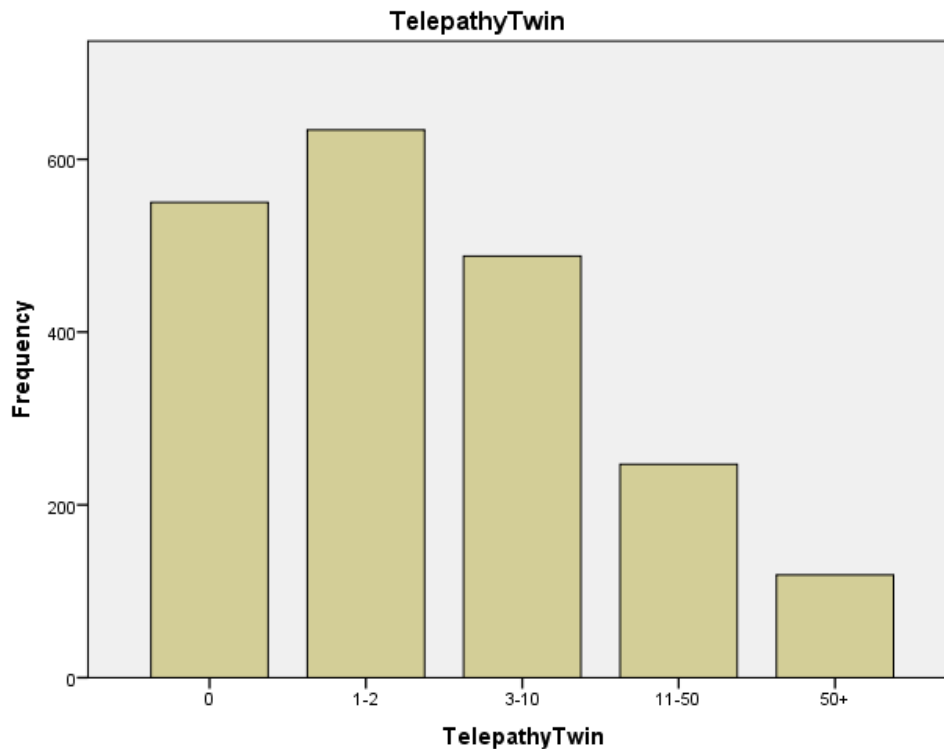
this conclusion with the avoidance score for female twins being lower than for male twins (and thus the attachment being stronger), and for anxiety, the scores were almost the same. With a difference for five scores out of six possible, the second hypothesis must be regarded to be supported, a conclusion however being unsafe with rather few males in the sample.

The published score norms for these scales are found in a table in Appendix 9 (Fraley, 2015-03-25). When compared to these published norms (for non-twins, there are no twin data available), all scores but one for the participants in this study are lower than these published norms (for avoidance, male have a little higher mean). For avoidance, the published mean norm score for male is 2.94 while the mean score for male twins in this study was 3.09 (just above the published norm). The published mean norm score for female was 2.92, and for female twins in this study, the mean score was 2.47, almost half an SD below the published norm score. The published mean norm score for anxiety is 3.57 for male while the mean score for male twins in this study was 2.20, a little more than one and a half SD lower the published norm. The published mean norm score for anxiety for female is 3.56, while the mean score for female twins in this study was 2.23, a little more than one and a half SD lower the published norm. These data are presented in table 5.

2.5.5 Do twins, reporting exceptional experiences with their twin have a more positive and strong attachment (when compared to those who do not)?

Of all participants in the study, 1488 twins (72 %) reported to some time have had an exceptional experience with their twin. From these, 634 (31 %) twins reported it to have happened only once or twice, for 488 (24 %) it happened between 3 and 10 times, 247 twins (12 %) reported it to have happened 11-50 times, while 119 (6 %) reported it to have happened more than 50 times. 550 twins (27 %) reported it never had happened. The statistics are presented in figure 3.

Figure 3. The number of exceptional experiences that twins report having had with each other. Mean = 1.39 (i.e. the mean of the five categories, not the mean number of ExEs – the scale is ordinal, not interval), Std. dev. 1.173, N = 2071.



There was for all twins a significant reversed correlation between attachment-related avoidance and reporting having many exceptional experiences with their twin, $r = -.141$ ($p = .000$, and more specified = $1.8 * 10^{-10}$), i.e. with lower score for avoidance (i.e. a stronger attachment), the more experiences the twin reported. For attachment-related anxiety, the correlation was also significant, but not reversed, $r = .045$ ($p = .042$): with higher scores for anxiety, i.e. with more anxiety reported to your twin, the more experiences the twin reported, which makes sense. For the WHOTO-ANQ scores, there were strong and significant correlations between all of the scores and reporting many exceptional experiences ($p = .000$): with the proximity scale $r = .146$ (and p more specified = $3.5 * 10^{-11}$), with the safe haven scale $r = .188$ (and $p = 1.0 * 10^{-17}$), with the secure base scale $r =$

.171 (and $p = 9.0 * 10^{-15}$), and with the separation distress scale $r = .212$ (and p more specified $4.9 * 10^{-22}$).

Thus, with more exceptional experiences reported by the twin, the higher the scores were from WHOTO-ANQ, i.e. the twin reported a stronger attachment. For five out of six sub-scores, there is a correlation - the third hypothesis must be regarded to be supported.

2.5.6 Does the twin in a pair with a more positive attachment, report more exceptional experiences (than the cotwin having a less positive attachment)?

It could be expected, that if one twin in a pair, here called A, has a more positive attachment than the cotwin, here called B, then twin A would report having had more exceptional experiences, i.e. there should be a correlation between the difference for a specific attachment code for the twins in each pair e.g. proximity, in this study “DiffProximity” and the difference between the number of experiences the twins report having had, in this study “DiffTelepathyTwin”. The difference for each sub score is calculated, e.g. $A_{prox} - B_{prox}$, and the difference for reporting exceptional experiences, $A_{telepathyTwin} - B_{telepathyTwin}$. In this case there should be a correlation between DiffProximity and DiffTelepathyTwin, i.e. the twin in each pair having more positive attachment than the cotwin is also to report more exceptional experiences (and with a bigger difference in degree of attachment, the bigger the difference should be in reporting number of exceptional experiences).

There was a significant Pearson correlation found between the difference in number of exceptional experiences that the twins reported having had with each other and the difference for one of the sub scores, separation distress, being $.089$, $p = .029$, 2-tailed. With the other sub scores, there was no significant correlation found (even if almost all

correlations were in the predicted direction). With the difference between the sub scores for “proximity”, the correlation was $r = -.006$ ($p = .89$), with the difference between the sub scores for safe haven, $r = .013$ ($p = .748$), with secure base, $r = .024$ ($p = .550$), with anxiety, $r = .026$ ($p = .523$), and with avoidance, $r = -.038$ ($p = .353$). The fourth hypothesis did not get full support in this study, but, as will be discussed later, there can be reasons why, and in short, the score for how many exceptional experiences they reported having had was not a precise number but rather an ascending ordinal scale for a group of numbers, i.e. not an interval scale, somewhat degrading the statistical power of calculation based upon reported ExEs in this survey.

Besides these hypotheses, also some other topics were investigated: how attachment changes with age, and whether twins report having exceptional experiences with other than their twin.

2.5.7 How does attachment change with age?

For the WHOTO-ANQ scores, there was a significant but negative correlation between age and all four scores, with the proximity scale $r = -0.53$ ($p = .017$), with the safe haven scale $r = -.110$ ($p = .000$, and more specified = $5.4 * 10^{-7}$), with the secure base scale $r = -.136$ ($p = .000$, and more specified $5.3 * 10^{-10}$), and with the separation distress scale $r = -.185$ ($p = .000$, and more specified $2.9 * 10^{-17}$), all 2-tailed.

For the ETR scores, there was a significant positive correlation between age and avoidance $r = .158$ ($p = .000$, and more specified = $5.8 * 10^{-13}$), but for anxiety the correlation was not significant $r = -.038$ ($p = .085$). Thus, for all but one score, there was a correlation (for anxiety it was just a very small relationship, not being significant). The result in table 6 shows the mean of the six scores at 5 different intervals of age. The scores from ETR were

Table 6. The mean of the six attachment scores at five different intervals of age.

| Interval of age /Scores | < 30 154 twins | 35-45 241 twins | 55-60 255 twins | 65-70 322 twins | 75- 158 twins |
|-------------------------|-------------------|--------------------|--------------------|--------------------|------------------|
| Proximity | 6.30 | 6.02 | 5.90 | 5.92 | 6.05 |
| Safe haven | 5.40 | 5.13 | 4.93 | 4.71 | 4.84 |
| Secure base | 5.93 | 5.63 | 5.37 | 5.25 | 5.29 |
| Separation distress | 5.79 | 5.42 | 5.23 | 5.00 | 5.03 |
| ETR: | | | | | |
| Anxiety | 2.48 | 2.17 | 2.27 | 2.20 | 2.31 |
| Avoidance | 2.31 | 2.22 | 2.54 | 2.62 | 2.88 |

low at early ages, i. e, the attachment was strong, and for avoidance they increased a little with growing age, i.e. the attachment was still strong, but a little weaker than in early ages.

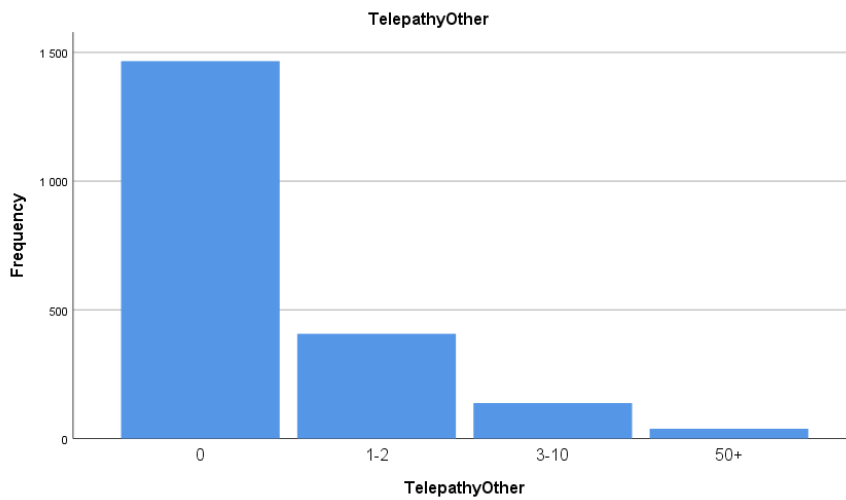
For anxiety, the attachment was almost on the same level, and in fact slowly decreasing. From WHOTO-ANQ, the scores were high at early ages, i.e. the attachment was strong, and with growing age, they slowly decreased.

2.5.8 Do twins report having had so-called exceptional experiences with other than their twin?

In this study, 583 twins (28 %) reported to at least once or twice having had an exceptional experience with some other person than their twin (1466 reporting no such experience), as illustrated by figure 4. From these, 407 twins (20 %) reported it to have happened only once or twice, 138 twins (7 %) reported it to have happened 3 to 10 times, while 38 (2 %) reported it to have happened more than 50 times. It can be noticed that no twin reported to have these experiences 11- 50 times.

The twins were also asked to specify what other person they have had these experiences with. There were five big groups, 1) children (daughter or son), 2) friend/s,

Figure 4. The number of exceptional experiences that twins report having had with other than their twin. Mean = .41, Std. dev.: .774, N = 2049.

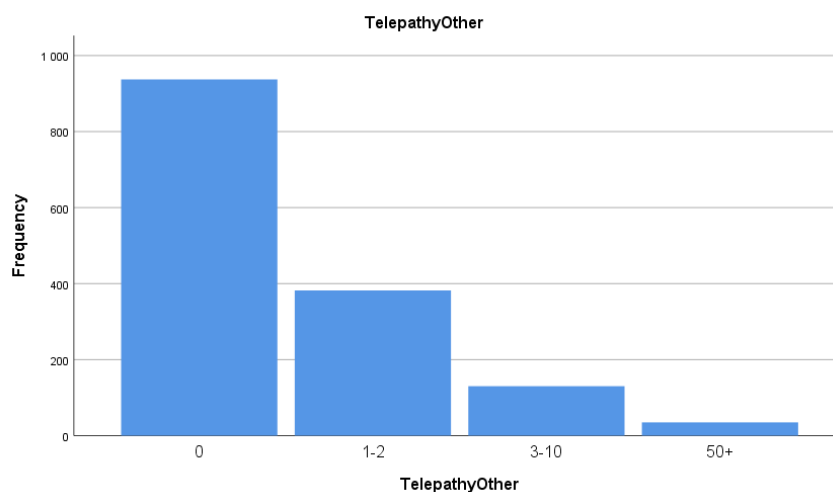


3) husband/wife/partner, 4) brother/sister/sibling and 5) parent/father/mother. 57 twins reported to have had some exceptional experience with one or more of the children, 195 twins reported to have had some exceptional experience with some friend, 123 with a husband/wife/partner, 56 with one or more brother/sister/sibling and 53 with a parent/father/mother. In all these groups, many twins reported to also have had exceptional experiences with persons from another of these groups. One twin even reported experiences with their dog. With these different groups, it seems that in twins reporting ExEs, not only a genetical factor is involved, but also an emotional, the genetic being involved in group 1, 4 and 5, group 2 and 3 not involving any genetic factor.

The major interest here are the two groups, a) twins reporting ExEs with their twin, and b) twins reporting ExEs with other than their twin. It can also be of interest to find out if there were any twins in a mix of these groups, e.g. not being in a), but being in b): are there twins not reporting any exceptional experience with their twin, but reporting having such experiences with someone else? Among 550 twins not having ExE with their twin, 32 twins

did report having had such an experience with other than their twin, so it did occur, but not for that many. In another mixed group, twins belonging to both group a and b, i.e. twins who did report having had an exceptional experience with their twin and also reporting having had such an experience with other than their twin, there were 547 twins in this group, with 382 twins reporting it to have occurred once or twice with other than their twin, and 35 more than 50 times (and 937 twins - no such experience). This analysis shows that some twins report having ExEs only with other than their twin, and some twins report having ExEs both with their twin and with other persons. The statistics from this last analysis is reported in figure 5.

Figure 5. For twins reporting having had exceptional experience with their twin, here are the number of exceptional experiences that these twins report having had with *other than their twin*. 382 twins reported it had occurred once or twice, and 35 (2.4 %) more than 50 times.



2.6 DISCUSSION

2.6.1 General discussion

This study with focus on attachment between twins is the fourth report in this PhD thesis, and continues the efforts to better understand the attachment between twins, and also the

relationship between twin attachment and the exceptional experiences that many twins report, beginning with the study by Brusewitz *et al.* (2013). The current study differs with the very big sample (more than 2000 twins, while the previous had 220 twins), and here having focus on attachment, while the previous study had its focus on twins' exceptional experiences.

The findings of the present study show that the attachment between twins as a general group is stronger than the published norm (in Appendix 9, based on over 17000 people, 73 % female, who have taken the ECR-R online, 21 % being married), when compared with the scores in this study for attachment-related anxiety and avoidance, the subscales from ETR. The scores from WHOTO-ANQ for attachment features and functions also supported the bond for twins as a general group to be strong.

2.6.2 Is there any difference in attachment between identical and non-identical twins?

The first hypothesis in this study was supported: there were significant differences in attachment between identical and non-identical twins. This was valid for all four scores from WHOTO-ANQ and for one from ETR. For the avoidance score from ETR, it was a significant difference, i.e. identical twins reported significantly less discomfort with closeness and depending on their twin (and excessive need for independence and self-reliance) when compared with non-identical twins. For anxiety, the difference was not significant, meaning both groups of twins reported about the same degree of anxiety with each other, i.e. fear of rejection and abandonment from their twin and the degree of excessive need for approval. For all four scores from WHOTO-ANQ, the difference was significant, meaning identical twins have a stronger attachment to each other as compared to non-identical twins for all four aspects of attachment features and functions.

Even though the norm scores are for partners in relationships, it is obvious that these norm scores, understood to be low for strong bonds and vice versa, indicate that the attachment between the twins in this study is in general stronger than between partners in relationships. However, whether this strength depends on being a twin, or if it is due to having had many exceptional experiences is currently impossible to say. What can be said here also is that from a survey by Brusewitz *et al.* (2013) among 220 UK twins, it was found that there was a significant relationship between reporting strong attachment and reporting many and more remarkable exceptional experiences.

2.6.3 Do female twins have a stronger attachment than male twins?

For the second hypothesis, it was found that female twins reported their attachment to be stronger and more positive when compared to male twins, supported by the significant difference for all four WHOTO-ANQ scores and for one of the ETR scores, the one for avoidance. The difference for avoidance means that female twins reported significantly less discomfort with closeness and depending on their twin (and excessive need for independence and self-reliance) when compared with male twins. As for the previous hypothesis, there was no significant difference in attachment-related anxiety between male and female twins: all twins reported about the same degree of anxiety, i.e. fear of rejection and abandonment from their twin and the degree of excessive need for approval. All four scores from WHOTO-ANQ supported the hypothesis that female twins report having a stronger bond than male twins. The difference in attachment between male and female twins can also be mirrored by the fact that the big majority of participants in this study are females, indicating they are motivated to participate by their strong attachment to their twin. There are however here also reasons to regard these conclusions as rather unsafe, given that very few males responded, making interpretations regarding sex differences unsafe.

2.6.4 *Do twins reporting exceptional experiences with their twin, have a stronger attachment (when compared to those who do not)?*

The third hypothesis was supported, one of the main ideas in the thesis: twins reporting having had exceptional experiences with their twin reported a stronger and more positive attachment to their twin than those who do not, with support from 5 out of 6 possible scores, and with the many participants, the support is to be regarded as strong. First however, there was another question in this hypothesis, whether twins reported having had so-called exceptional experiences with their twin. The result showed that 72 % in this study, 1488 twins, reported to at least once or twice having had exceptional experiences with their twin, including 8 % (119) who reported it to have happened more than 50 times. 550 twins, 27 % reported it never had happened.

For the hypothesis, there was a correlation for all four WHOTO-ANQ scores between the attachment the twins reported to their cotwin and having had more exceptional experiences with their cotwin, i.e. with more of these experiences you have stronger attachment. It is however not possible to draw any conclusions about a causal relationship: does a strong attachment opens for having exceptional experiences, or do these experiences occur between the twins and make the attachment to be strong?

For the ETR scores, there was a correlation for attachment-related *avoidance*, but reversed: with a lower score for avoidance, the more exceptional experiences the twin reported, i.e. the less the twin reported discomfort with closeness to your twin, the more exceptional experiences the twin reported, which seems quite logic. For attachment-related *anxiety*, there was also a correlation, but it was not reversed: with more reported anxiety in relation to your twin, i.e. with more fear of rejection and abandonment, the more exceptional experiences the twin reported. It is not clear how having exceptional experiences is related

to fear of rejection and abandonment. It can be because of fear of rejection, but such a conclusion may be too strong to draw.

2.6.5 Does the twin in a pair with a stronger and more positive attachment report more exceptional experiences (than other twins having a weaker attachment)?

The fourth hypothesis was supported for one kind of attachment: the score for the attachment “separation distress” for one twin in a pair was higher than for the other twin and the first twin was reporting having more experiences than the other twin. There was a significant correlation between the difference for this specific attachment for the twins in each pair and the difference between the number of experiences the twins report having had. This means that the twin in a pair reporting having had more exceptional experiences than the cotwin, reported stronger and more positive attachment when it comes to separation distress, i.e. that twin reported being less distressed when being separated.

From the other five attachment scores in this study, this hypothesis did not get full support. Of some interest here is however that almost all the correlations were in the predicted direction, even if not significant. This supports the following argument about a lack of statistical power. There were some problems with this analysis: the score for attachment was continuous, being all values between 1 and 7 (for WHOTO-ANQ 7 being strongest and also consisting of decimals, for ETR 1 being strongest), but the score for having had exceptional experiences was not continuous, but a code for having had 1) just one or two experiences, 2) between 3 and 10, 3) between 11 and 50, and 4) more than 50. Thus, the result was not easy to interpret and conclusions difficult to draw. There might be a correlation with a specific attachment, even if it is not significant, since both twins can report the same code, e.g. having had 3-10 experiences, and for one twin it can be 3

experiences, for the other it can be 10. Even with no correlation in this study for this hypothesis, a correlation cannot be excluded.

2.6.6 Are the questionnaires ETR and WHOTO-ANQ reliable for twins (and their results corresponding to each other)?

For the fifth hypothesis, that the results in attachment from ETR were in correspondence with those from WHOTO-ANQ, the results in this study in general supported the hypothesis. For all the group of the twins, the questionnaires showed the attachment to be strong and positive, the scores for both anxiety and avoidance were low, and the scores from WHOTO-ANQ were correspondingly high. When comparing identical and non-identical twins, there was a difference for all scores, for five of them being significant. The same was the case for the difference between the genders, and in both cases, it was not significant for anxiety. With age, both the scores for anxiety and avoidance had a correlation, one being reversed. The four scores from WHOTO-ANQ agreed to one of the ETR sub-scores. When comparing the two questionnaires, low scores from ETR were to correspond to high scores from WHOTO-ANQ if the attachment was to be strong and positive. The reliability evaluation showed that this was the case, with few exceptions.

Connected to the question if the questionnaires were correlated to each other, to be reliable, the attachment between the twins in each pair was expected to be about the same. The difference between the scores for the twins in each pair turned out to be very low, close to zero, i.e. the twins reported almost the same degree of attachment to each other for all six scores of attachment, which was expected, and supports the reliability.

Besides the hypotheses, analyses were carried out to find out how attachment change with change of age, and whether twins reported having had exceptional experiences with other than their twin.

2.6.7 Does attachment change with age?

For the question whether attachment change with age, it was found that there was a correlation between age and attachment for five of the six sub-scores. Attachment was strong in early ages, and then slowly decreasing. The scores from WHOTO-ANQ indicated a strong attachment in early years, and with higher age, it was slowly getting weaker, but still rather strong. This can indicate and be interpreted that the need for a good and strong attachment gets slightly lower. “Safe haven” seems to be less important (being lower at high age), followed by separation distress, as indicated by table 6. With attachment-related *avoidance* there was a significant correlation. Twins in early ages reported low avoidance, and with growing age, they reported higher degree, i.e. more discomfort with closeness and depending on their twin (and excessive need for independence and self-reliance). The depending on their twin was confirmed and commented by some twins in the study. Many twins when being adult live far away from each other, they get married and have children, meaning other persons, other relationships grow in importance and get even more important than their cotwin, and in many instances take the role that the twin earlier had – they are less depending on their twin – they feel more discomfort with being dependent. You get e.g. support from your partner instead of your twin. For the score for the *anxiety* aspect of attachment, there was no correlation with age. The analysis instead showed there was a low degree of anxiety in early ages and almost the same degree throughout the years, almost getting a little lower with higher age, i.e. the fear of rejection and abandonment from their twin was rather low through all life, the need for approval even gets slightly lower.

2.6.8 Do twins report having had exceptional experiences with other than their twin?

The analyses showed that 583 twins (28 %) reported to at least once or twice having had an exceptional experience with some other person than their twin. From these, 407 twins (20 %) reported it to have happened only once or twice, while 38 (2 %) reported it to have happened more than 50 times. According to the question “with what person/s the twins had had these experiences”, both children (57 cases), friend/s (195 cases), partner (123 cases), sibling (56 cases) and parent/s (53 cases) were mentioned. Many twins reported to have had these experiences with persons from more than one of these groups. For experiences with children, sibling and parent, a genetical factor can be involved, but for friend/s, and partner, some other factor must be involved, be it emotional or intellectual. A special analysis revealed that one group of twins report having had experiences with both their twin and with other persons (547 twins), one group reported having had experiences with only their twin (937 twins), one group with only other persons (32 twins), and some with no person at all (518 twins). It is thus clear that the biggest group is the one with only twin telepathy, then follows twins having had experiences with both their twin and some other person/s.

2.7 Chapter Summary and Conclusions

In this study, attachment data was collected from more than 2000 twins in UK, in the age from 19 to 90, both identical (1387) and non-identical (660) twins, with a majority of female twins, being 1838, the number of male twins being 224, all through a co-operation with the Department of Twin Research and Genetic Epidemiology, King’s College, London sending personalized links to 5060 twins, inviting them to participate in this survey on the web. The aim was to investigate what kinds of attachment that UK twins have. Two questionnaires were used, one, a modified version of WHOTO and ANQ with regard to attachment

features and functions according to the terminology of the pioneers Ainsworth and Bowlby (proximity maintenance, separation distress, safe haven and secure base), the other, the new ETR (*Experiences in Twin Relationships*, a modified ECR-R with regard to attachment-related anxiety and avoidance. Comparison was to be made between identical and non-identical twins, between male and females twins, and with age. Besides this, attachment was to be compared with whether the twins reported having had any so-called exceptional experience with their twin, or with any other person, not being their twin. Exceptional experiences in this study included telepathy-like experiences, shared physiological responses to illness, injury or accident, i.e. remote sensing the other twin's pain, accident or state of mind.

The four scores for attachment features and functions showed that the attachment between twins as one big group is strong, and for attachment-related anxiety and avoidance stronger than the published norms. The attachment between identical and non-identical twins was found to be significantly different, valid for all four scores from WHOTO-ANQ and for the avoidance score from ETR.

Female twins were found to report a stronger and more positive attachment when compared to male twins, supported by the significant difference for all four WHOTO-ANQ scores and for the ETR-score for avoidance. For age, there was a correlation found with one attachment sub-score from ETR and all four from WHOTO-ANQ: for five of the six sub-scores, the twins reported a strong attachment in early years, and with higher age, the attachment was slowly getting weaker.

The general question whether having had any so-called exceptional experience with their twin, 72 %, 1488 twins, reported it to have happened at least once or twice, including 8 %

(119) when it had happened more than 50 times. 550 twins, 27 % reported it never had happened. For twins reporting having had exceptional experiences with their twin, they reported a stronger and more positive attachment to their twin than those who do not, with support from 5 out of 6 possible attachment scores. This can be interpreted in two ways, either as getting a strong attachment when you share these experiences, or the case that having a strong attachment is necessary, or at least facilitates sharing these experiences. What is cause and what is effect is still to be decided.

Many twins, 28 % (583) also reported having had exceptional experiences with other than their twin at least once or twice. From these, 407 twins (20 %) reported it to have happened only once or twice, while 38 (2 %) reported it to have happened more than 50 times. This other person varied between children (57 cases), friend/s (195 cases), partner (123 cases), sibling (56 cases) and parent/s (53 cases), i.e. with persons both with and without a genetical factor in common. Many twins reported to have had these experiences with persons from more than one of these groups.

The reliability for the questionnaires were investigated, both internally and towards each other. When comparing the results from the two questionnaires, the results in general supported each other, giving about the same result, both in general and when comparing identical vs non-identical twins, male twins with females, and comparison with age. Attachment sub scores were compared between the twins in each pair, and as expected, the twins reported about the same degree of attachment for all six sub scores.

To find a possible mechanism and theory for these experiences, a further study would be needed to find out what kinds of experiences twins report a) with their twin (in case this can give some indication), and b) with other persons where a genetical factor can be

involved, and where it cannot be. It can also be of interest to know if the experience is psychophysiological (as seem twin telepathy to be) or if it in some cases is more mental. More experimental studies on twin telepathy are also required with twins reporting having had these experiences. The basic phenomenon twin telepathy still needs to be confirmed with more studies.

A few words are necessary about possible limitations in this study, and about my inferences. Regarding possible problems with self-report measures, the twin ship status (whether being identical or fraternal) and age was given by the DTR (Department of Twin Research and Genetic Epidemiology), King's College, a fact that should contribute to the study being certain. A clear limitation in the study is the response rate for male twins being very small, only 11 % in this sample, resulting in a big risk the male profile is not representative and the comparison between the sexes is unsafe. Positive aspects are clearly the large sample, for which we are thankful to the DTR for their co-operation, also serving us with the definitive twin identity. This makes most analyses in this study rather safe and reliable.

CHAPTER THREE

SPONTANEOUS PHENOMENA IN PARAPSYCHOLOGY - A LITERARY REVIEW

3.1 Introduction

Spontaneous reports from twins being the inspiration and impetus for this thesis is a reason to give a review on spontaneous cases in parapsychology during the years, and surveys on these, and compared with the cases that twins report. Besides having their strength, spontaneous reports and “anecdotal” accounts also have their shortcomings, disadvantages which however can be addressed in formal experiments. Both aspects are reviewed. While the review on experimental studies in the next chapter has a focus on telepathy (and the use of electrodermal activity in parapsychology), this chapter will also review some of the studies and surveys on other phenomena in parapsychology. Besides surveys, also case collections have been carried out, reviewed in Kelly and Tucker (2015). The term exceptional human experiences, to which these phenomena belong is also described, and the theory of Metzinger and his idea of a reality-model with mental representations in the mind, with which the spontaneous exceptional experiences are inconsistent, and regarded as deviations.

3.2 Background – early surveys

Spontaneous paranormal phenomena have been reported in practically all cultures and since time immemorial. They have however not been in focus in modern parapsychological research, which has been devoted to experimental methods. Occasionally there have however been surveys and analyses on spontaneous cases carried out, since they can give clues to the process underlying and producing the phenomena and also give ideas how to design methods to facilitate the phenomena to occur in experimental studies, a fact also emphasized by Roe (2019). We need to understand the conditions under which these phenomena occur naturally in the real world. When knowing that, we easier can design experiments where real phenomena are more probable to occur (the ‘process oriented’ approach), even if in fact rather few studies on spontaneous cases go beyond describing

them, emphasizing content over structure, description over synthesis (Roe, 2019). Roe points to various advantages as well as disadvantages with spontaneous case collections, one advantage being individual cases sometimes can be more convincing than statistical evidence, one disadvantage being spontaneous case material cannot provide persuasive evidence for psi (the ‘proof oriented’ approach) with the major argument being the incomplete nature of the descriptions produced. Other disadvantages, which can be addressed in formal experiments are the lack of control over circumstances, making it difficult to rule out fraud and deception, and even chance. There is also a lack of repeatability.

One of the first surveys was one published by Gurney, Myers and Podmore (1886), collecting and analysing cases of primarily telepathy and apparitions, analysing 702 cases that withstood the rigors of validation (Rhine, 1977), where there was a major division into two great families: (a) cases in which the impression was sensory and externalized, and (b) cases, in which it was not. The analysis was regarded to show beyond reasonable doubt that telepathy was a reality (Rhine, 1977). Cases suggesting precognition were collected and analysed by Sidgwick (1888-1889), and later by Dunne (1927), documenting and analysing his dreams, and also Besterman (1932-33). A study by Prince (1928) included cases from “noted witnesses”, being from scientists, clergymen, lawyers and statesmen, but curiously no well-known psychical researchers. Saltmarsh (1934) continued, finding 349 cases of precognition, dividing them into groups in several ways, including criteria of form and content. With respect to form, he found they occurred as dreams, borderline waking experiences, waking cases and hallucinations. The content or themes involved illness, and death, but also quite trivial incidents, to be compared with reports from twins, also involving illness (Brusewitz *et al.*, 2013). The preponderance of death coincidences was

quite large, with a proportion that was found to be statistically significant. Death being an emotionally charged topic, was found to dominate in hallucinatory experiences. Saltmarsh showed the same was true in precognitive situations too often to be explained by chance (Rhine, 1977), emotionally charged topics also being found in many telepathy experiences reported by twins (Brusewitz *et al*, 2013).

3.3 Conferences on spontaneous phenomena

Conferences on the topic of how to study spontaneous cases were held in Cambridge, England in 1955, and later in Paris (Rhine, 1977; Salter, 1960). The old traditional methods were advocated, and the objectives of further case studies were to have more focus on obtaining material on cultural anthropology and from psi in normal psychological activity etc. As a result of these conferences, a questionnaire was compiled and distributed, giving about 300 cases. Instead of rejecting all those that did not pass the “verification” test perfectly, Green (1960) graded them A, B, and C according to the level they reached (Rhine, 1977, also Heywood, 1960) and were then coded as type (telepathic, clairvoyant, precognitive, degree of conviction etc). Ian Stevenson (1970) returned to the old method of case collecting, finding 160 cases from older literature, cases that lack imagery and involve only simple impressions or intuitions about a distant person. His objective was to show that even these imageless experiences might be the result of ESP, and that if they were, they might contribute to an understanding of the process of extrasensory perception. He summarized their common features and characteristics: the relation of agent and percipient, and the variation in amount of information transmitted. For analysis, 35 new cases were presented and subjected to the four criteria that he set up (the 1st including telepathy but not clairvoyance, the 2nd, the statement of the percipient that the distant agent “needed” him or was in some “significant and unusual situation”, the 3rd excluded all but very short-

term precognitive cases, and the 4th concerned standard of authenticity) (Rhine, 1977, p. 75). The new cases were compared with old ones, and were found to have characteristics similar to these, some of them appearing to be precognitive or “variant” in other ways, so that only 23 fitted the model precisely. The “variants” however seemed to involve ESP just as convincingly as the others. For the author, the conclusion was that no individual case was found to provide *proof of* extrasensory perception, this seemed to be “the best available present interpretation” of such cases. The conclusion was that people may be linked to each other in hidden ways, even though this may be noticeable mostly between persons emotionally close, which very much also is the case in twin telepathy.

3.4 More recent surveys

Another study of spontaneous cases was reported by Palmer and Dennis (1975), carried out in an attempt to get a representative sample of psychic experiences in a general population and their frequency of occurrence (Rhine, 1977). They reached out to 700 persons in a single community in Virginia, Charlottesville, and 300 at the university there. Among results, more women than men reported experiences occurring when being awake, the percentage of persons reporting apparitional experiences were equally balanced with tactile and auditory ones (to be compared with twins in this thesis also reporting tactile sensations, see appendix 11). Some tendency was shown for the student group to have more than one kind of psychic experience, a fact very similar to twins (Brusewitz *et al.*, 2013). In Palmer (1979) this population in Charlottesville also reported déjà vu, contact with the dead, clairvoyance, poltergeists, out-of-body experiences, past-life memories and auras. There were 82 percent of the adult sample and 96 % of the student sample that reported having had these experiences (Kelly & Tucker, 2015, p. 67).

Looking at collated studies carried out during the past 90 years, dreams were found to be involved in somewhere between 33 and 68 percent of the cases (Van de Castle, 1977), and for only telepathic cases it was approximately 25 %, to be compared with twin telepathy cases where the majority report to be awake when having these experiences (Brusewitz *et al.*, 2013). As for all cases the past 90 years, women were found to outnumber men nearly two to one as percipients, and even more for twins. Close blood ties are involved in about 50 percent of the cases, as of course is the case for twins. For all cases, death looms as the most prominent theme in almost 50 percent of the experiences, with accidents and injuries next in order of prominence (Van de Castle, 1977, p. 481), also the case for twins (Brusewitz *et al.*, 2013).

The perhaps largest survey on psi-related experiences was Haraldsson (1985), comparing data from six surveys in Iceland, U.K., Sweden, the USA and 16 western European countries about beliefs as well as experiences. Different questions in different surveys made direct comparisons very difficult, but a striking finding was the wide variation in prevalence of the various types of experiences (Kelly & Tucker, 2015). In another large survey (Haraldsson & Houtkooper, 1991), there were three questions on telepathy, clairvoyance and contact with the dead used in all countries. Among more than 18000 respondents in USA and 13 western European countries, 60 percent in USA reported at least one such experience, and in Europe 46 %, the lowest 24 percent in Norway, up to 60 percent in Italy.

3.5 The term “exceptional human experiences”

With an interest to illustrate with more examples of spontaneous experiences and with them belonging to a group of experiences called exceptional human experiences, it is here reason to give a review on this term, its background and its connection with Metzinger (2003) and his theory of mental representations.

The use of the term and the kinds of experiences included, depend primarily on the belief system and worldview of the author. What is needed (Belz & Fach, 2015) is a definition that integrates what we know so far, but that do not judge, and also pays attention to the culture. For the person who has an ExE, the experience is so exceptional that it seems incompatible with their explanation of reality or with the worldview of their social environment. This can however differ very much. In South America for example, belief in spirits is a part of the culture and belief system, but experiences of spirits are regarded as exceptional in most parts of Europe as well as in North America. ExE can be regarded as an umbrella term for occurrences that are labelled as paranormal, psychic, spiritual, transcendental, supernatural, magical, etc. (Belz & Fach, 2015). ExE include poltergeist-phenomena, the feeling of being influenced by magical forces, telepathy, apparitions, precognition or phenomena that emerge in the context of occultism, spiritualism or alternative, esoteric practices (Belz, 2009, 2012; Belz-Merk, 2000). This definition is in line with the term anomalous experiences by Cardeña, Krippner and Lynn (2014), but is connected to a theoretical framework (Fach, 2011, 2014) originating from contemporary philosophy of mind and Metzinger (2003) and his theory of mental representations.

3.5.1 Metzinger's theory, a reality-model in the mind

According to this theory by Metzinger, the mental system of human beings creates a *reality-model* that consists of two fundamental components: a) the *world-model*, containing all representations that individuals have developed about states of the material world, including their physical body, and b) the *self-model*, containing all representations that individuals have developed about their internal states, such as sensations, cognitions, volitions, affects, motivations, and inner images. The difference between the two models is that the referents of the representations in the *world-model* are possible to observe for also

other individuals, while knowledge about the state in the *self-model* is private and can only be experienced by the person themselves.

Even if the domains are separated elements in the overall *reality-model*, they are experienced in strong mutual relationship. The dichotomy of self and world resembles the Cartesian dualism of mind and matter, but whereas Descartes distinction of both domains is ontologically conceived, Metzinger's view is explicitly epistemic (Belz & Fach, 2015). This approach, Belz and Fach continue, is strictly phenomenological and defines ExE as deviations in the reality-model of individuals and/or their social surrounding without any prior determination concerning the question of their ontological status - even if ExEs are mentioned by Belz and Fach to possibly be explained with a conceptual framework of dual-aspect monism where a fruitful version was developed by physicist Pauli and deep psychologist Jung (1952/1969), introducing the concept of synchronicity, to be mentioned later.

In our technological society, basic elements of such models are established epistemological concepts, such as cause-and-effect relations, and scientific principles and laws such as gravitation. Experiences that are inconsistent with these basic elements are regarded as exceptional and extraordinary. As a logical consequence of the reality-model with its dichotomy of self and world, four different classes of exceptional phenomena can be deduced. Deviations may occur as a) *internal phenomena* in the self-model, or b) *external phenomena* in the world-model and furthermore representations may form c) *coincidence phenomena* (connections of usually disconnected elements of self and world), or d) *dissociation phenomena* (disconnections of usually connected elements of self and world; Belz & Fach, 2015; Fach, 2011, 2014). Among exceptional experiences in this thesis,

telepathy, being a deviation in Metzinger's *reality-model*, is in this model regarded to belong to group c, coincidences of events without known causal connections, but related by some common meaning. Attachment, being an established phenomenon, belongs to the *self-model*.

ExE can, using Metzinger's theory of mental representations, be classified as subjectively experienced anomalies in the self-model or the world-model or in the relation of both (Fach, 2011). The phenomena that are included in ExE can appear extremely varied but can with a systematic classification fall into four basic categories of anomalies, based on Metzinger's model (Fach, 2011). There are first *internal* and *external* phenomena, dealing with anomalies in the self-model and in the world-model. Then, when an ExE concerns the relationship between these two models, in states of *psychophysical dissociation* a separation of normally well-integrated components of the self-model and the body-model (as part of the world-model) can be observed (Fach, 2011) and for *coincidence phenomena*, unusual links between representations in the self-model and/or world-model may be established. Fach (2011) finds these four categories of ExE to form two complementary pairs (Figure 1), one of them the localization ("external" vs. "internal") of representations, the other affects their relationship ("separated" vs. "linked").

3.5.2 Anomalies in the model – external and internal and examples of phenomena

External phenomena are perceived in the world-model and include e.g. anomalies that involve optical, acoustical, tactile, olfactory, and kinetic phenomena, and inexplicable changes of the body. *Internal phenomena* are perceived as anomalies in the self-model and include somatic sensations, unusual moods and feelings, thought invasions, hearing of voices, extraordinary images, and inner pictures.

Psychophysical dissociation

Anomalous separations of
elements belonging to the self
model and to the world model

| | |
|----------------------------------|--|
| Automatism & mediumism 7 % | External presence and nightmare 15 % |
|----------------------------------|--|

Internal phenomena

Anomalies in the self-model
Internal presence
and influence
38 %

External phenomena

Anomalies in the world model
Poltergeist
and apparitions
53 %

Coincidence phenomena

Anomalies linkages between
elements belonging to the self
model and/or the world model

| | |
|------------------------------------|------------------------------------|
| Extrasensory perception 41 % | Meaningful coincidences 10 % |
|------------------------------------|------------------------------------|

Figure 1. Fundamental anomalies in the reality-model, and patterns of categorial ExE (N = 1465) (a combination of figure 2, p. 236, and figure 4, p. 240 in Fach, 2011).

1. Poltergeist and apparitions (53%)
2. Extrasensory perception (41%)
3. Internal presence and influence (38%)
4. External presence and nightmare (15%)
5. Meaningful coincidence (10%)
6. Automatism and mediumism (7%)

Examples of ExE can be drawn from the accounts of the twins participating in the research in this thesis.

One example of an external phenomenon, a kinetic one, “couldn’t keep on walking“, was reported by two male twins, participating in the first and second study in this thesis:

“One of them taking a walk suddenly found he without any apparent reason couldn’t keep on walking, then after some minutes, he could continue. On meeting his brother some days later, he was told that his brother had had problems with his hip coming out of joint. They concluded that this incident occurred at the same moment that his brother just couldn’t walk.”

These twins also reported an internal phenomenon, a somatic sensation when

“one of them had meat stuck between the teeth, and the other one cried until it was removed.”

Finally for this pair, another example that is close to a kinetic phenomenon, when

“one of them as teenager had his appendix removed and the other lost rhythm and coordination when playing tennis until it recovered.”

For another pair of twins, female identical, there was another consequence when one of them had her appendix taken out, an internal phenomenon, a somatic sensation, when

“they were 17, one of them had her appendix taken out without the other twin knowing who woke up at about 2 am with severe feelings that her stomach was on fire (somatic) and couldn’t even touch it. She was later told that her sister had an emergency operation at 2 am.”

For the same twins, one of them reported an internal phenomenon, an unusual mood or feeling:

“At the age of 11, one of them was horse riding in an arena while the other was out on a trek. The twin who was indoors became concerned and agitated about the other twin. At that time her sister had fallen off her horse and been dragged causing concussion and an ambulance had been called.”

Another pair of female twins, participating in the first and second study, reported an internal ExE in the form of somatic sensations:

“They related how when aged 23, one of them was in London with her grandmother and happened to slip and cut her head and was taken to hospital. Meanwhile the other twin in Oxfordshire complained of head pains and both she and her mother were completely unaware of the accident for the other twin.”

This pair also reported what seems to be a somatic sensation, heart palpitations and perhaps also a taste or olfactory phenomenon, the taste or/and smell of coffee:

“When both of them were abstaining from caffeine, one of them took a few sips of coffee, and the other twin immediately called and asked her if she had had some coffee. She told her twin that she had suddenly had heart palpitations.”

One pair of twins, a female, identical pair in the first study, reported a rather strong case of what seems to be a somatic sensation or unusual feeling:

“The twins related how one of them knew when the other was engaged and pregnant before being told.”

Another case of somatic sensation comes from one pair of males, non-identical twins, reporting:

“paranormal experiences like injury and illness, when one of them cut his finger quite badly with a carving knife whilst his brother was away at university. Having no mobile phone he was unaware. But on the same day, the other twin’s finger went very red and very sore. The doctor didn’t know why his finger went red, but gave him a poultice to put it on. Later the other twin found out what had happened.”

One pair of females reported what primarily seems to be external phenomena, inexplicable changes of the body and/or perhaps tactile or kinetic, or an internal, a somatic sensation:

“when her sister was pregnant at the time, she herself felt the kicking inside even though she was not the one being pregnant. The other twin reports it is a bit of freaky at times, but quite interesting, and especially reports that it mainly happens with injuries.”

Finally, one pair of females reported about the same kind of mixed sensations, emphasizing somatic ones, but also unusual moods and feelings:

“where one of them reported to have sensed pain or illness, and a problem or state of mind.”

To summarize, most phenomena that twins in this PhD report, were a mix of external (kinetic) and internal (somatic sensations) phenomena, some also an unusual feeling or mood. Since many cases seem to be telepathy and/or synchronicities, it can be of interest to compare with the fundamental anomalies and patterns of categorial ExEs that the IGPP (Institut für Grenzgebiete der Psychologie und Psychohygiene, Freiburg) from 1966 to 2006 collected from 1,465 individuals, see figure 1, where six typical patterns of ExE can be identified, some individuals being assigned to more than one pattern.

3.5.3 Metzinger's model, why it was created, with an implicit assumption, partly questioned

Viewing exceptional experiences as anomalies to the self- and world-model that Metzinger developed is very fruitful, but some comments might be relevant to question the process how and why the model was developed, being to avoid the idea that consciousness was immaterial and outside the body. It was developed to better understand the out-of-body (OOB) experience Metzinger spontaneously had being a philosophy student. After his first out-of-body experience in the early 1980s, he was shocked, understanding the experience

could be an indication of consciousness being immaterial and being outside of the body (Rothma, 2018), very much in contrast with the established view among Anglophone philosophers (and in his Department at Johann Wolfgang Goethe-Universität) that the soul was made by the brain. He then came across a book by psychologist Johnson-Laird (1983), who offered a unified theory of the major properties of mind (comprehension, inference and consciousness). He regarded the mind as essentially being a model-building device and argued that deductive reasoning does not take place by tacitly applying the rules of logic, but by mentally manipulating models of the states of affairs, from which inferences are drawn. Metzinger also had a discussion with psychologist Susan Blackmore, a parapsychologist, first being openminded to parapsychology, but later changed to be a sceptic (Blackmore, 2017). She told Metzinger he probably had floated around his mental map in models of the world in his mind, and he was convinced.

With Metzinger, wanting to avoid the view that consciousness could exist outside the body, being supported by Johnson-Laird's ideas of models and Blackmore's support of these ideas, we approach very big ideas which go beyond the scope of this thesis and is a quite separate topic – what is consciousness and can it exist outside and even without the brain - but they must briefly be commented on. As long as OOB experiences are only inner experiences, with no objective verification (if someone else can observe you being outside your body – in whatever form it might be, or you yourself can observe (and report back) something that you couldn't do being inside the brain), the theory of models seems to be enough.

Having other research on OOB experiences (Fontana, 2005) and also research on near-death experiences, partly a parallel to out-of-body-experiences, indicating the possibility

something can leave the body, there are reasons to question the theory of models by Johnson-Laird and Metzinger to be enough, if this theory of models assumes the models are in the consciousness being inside and created by the brain. This is a quite separate research area, not possible to review here, but surveys by e.g. van Lommel (2010), Sabom (1982), Fenwick and Fenwick (1995), Baruss and Mossbridge (2017) and Dossey (2013b) clearly indicate that many persons have reported being out of their body and giving details from e.g. a surgery or resuscitation that they couldn't have observed being inside the body. These experiences question and challenge the theory of models from Metzinger, if these are assumed to be in the consciousness being inside the brain. They are still waiting to be explained. All more conventional explanations so far are not enough according to reviews by e.g. van Lommel (2010) and Fenwick and Fenwick (1995). The question whether you in an ExE operate within models in the mind is still a valid one, but the bigger question is where these models would be - are they in a mind or consciousness created by and in the brain, or are they in a consciousness that can exist outside the brain?

According to Metzinger, anomalies in the reality-model “violating the laws of cause and effect must be mental simulations having no equivalent in the real world”, assuming “all mental activity is reducible to the physical activity of the brain” (Fach, 2011), prerequisites he however not shares when classifying ExEs. This may be easy to understand since it is the established view of mental activities. When however discussing anomalies, he is confronted with the challenge of understanding the ontological status of ExEs, not just discussing them in general, and there he meets problems, just assuming ExEs are in the consciousness, that is in and created by the brain. New possibilities have emerged, partly supported by the new literature in previous section, but also a combination of old ideas and other new research. It is an approach “that allows to explain certain patterns of ExE, on the

basis of non-local correlations” (Fach, 2011). The approach is based on the concept of synchronicity, (Jung & Pauli, 1955), further developed by e.g. Atmanspacher, Primas and Wertenschlag-Birkhäuser (1995), Atmanspacher (1996), Lucadou (1995) and by Primas (1996), with ideas from standard quantum theory, where separated objects emerge in the process of measuring, but not being separated in a non-local reality before being measured. It may be a possibility (Fach, 2011) that non-local correlations are not restricted to the physical world but also can include mental systems, and therefore can be applied to Metzinger’s reality-model. While physical quantum theory is limited to the description of systems within the physical world, this theory is now expanded to a General Quantum Theory (GQT), also applicable to social groups and mental states (Atmanspacher, Römer, & Walach, 2002).

3.6 Chapter Summary and Conclusions

With spontaneous phenomena in many cases being inspiration for research, as is also the case for this thesis (the exceptional experiences twins report), the present chapter gives an orientation on spontaneous exceptional phenomena, with examples and surveys, with the value of them, and their shortcomings, advantages and disadvantages. With these phenomena belonging to a group called “exceptional human experiences”, this term is reviewed in depth, also giving examples of various phenomena, especially those experienced and reported by twins. The connection between the term exceptional experiences and the theory by Metzinger on mental representations is reviewed, his idea of a reality-model in the mind. With (spontaneous) exceptional experiences being inconsistent with the basic elements in this model, the classes of exceptional experiences are described. Finally, the reason why the model was created is described, being Metzinger wanting to avoid an explanation of his own out-of-body experiences that the soul, his mind would be

immaterial and being outside the body. He is assumed to have an implicit assumption that the mind is created by the brain, a quite separate topic.

CHAPTER FOUR

RESEARCH IN PARAPSYCHOLOGY, WITH FOCUS ON TELEPATHY AND THE USE OF ELECTRODERMAL ACTIVITY – A LITERARY REVIEW

4.1 Introduction

This chapter with a literary review on telepathy research and the use of electrodermal activity (EDA) in parapsychology will be on the basic research on telepathy, the main projects. Especially the research with twins and the use of electrodermal activity, EDA as a measure and indicator of telepathy will be reviewed, as will other research within parapsychology where EDA has been used. Finally, some criticism against this research will be commented.

4.2 What is parapsychology - an introduction

The term parapsychology suggests that these phenomena occur *beside* psychology, para meaning outside or beyond. This term was introduced in Germany (Bender, 1966; Ebon, 1974), since the phenomena didn't fit the view that science had of man in the 19th century. Now, the opinion is (Wolman, 1977) that these experiences are included in the big mystery of "mind" or consciousness and are at the borders of psychology, still very much non-researched. They are only a part of a big number of processes in a borderland where also the unconscious is to be found, as well as dreams, hypnosis and psychosomatic symptoms, and they must, according to Wolman (1977) be paid attention to in a broad perspective.

The phenomena that are included in parapsychology can be divided into three categories, all of them collectively called *psi*, the first letter in the Greek word "psyche", meaning "mind" or "soul": extrasensory perception (ESP), psychokinesis (PK) and phenomena indicating something surviving the bodily death. The first category, ESP refers to the supposed psychic ability to, so far in unknown ways, receive information. The second category, PK refers to the supposed psychic ability to influence matter – the energy or

information is going from the body, sometimes split up in micro and macro PK. Micro PK refers to the psychic ability to influence matter in the micro world, e. g., quantum physics or radioactive decay, while macro PK refers to psychically influencing objects in the macro world, e. g., furniture moving around or telephones flying about. The spontaneous form of PK has a special term, *poltergeist*, the spontaneous moving of often big objects, the word *geist* from German indicating one interpretation also is that the phenomenon is created by a ghost, indicating it can be regarded as a survival-phenomenon. When you influence some kind of biological organism, it is in the laboratory termed *DMILS*, Direct Mental Interaction with Living Systems, an analogue to *healing*.

The ways to receive information in parapsychology are *telepathy* (mind to mind communication, from the Greek roots *têle* or “distant”, and *pathe*, or “feeling”, “occurrence”) (Krippner, 1974). Next comes *clairvoyance*, having French origin and literally meaning “clear seeing” (Stanford, 1974). Other terms are remote viewing and stands for receiving information or images from hidden objects, even far away, meaning there is no “sender”. The third phenomenon in ESP is *precognition*, the claimed ability to get information about future events, about something that has not yet occurred, to see “into the future”, *pre* meaning “before”. A variant of precognition is *presentiment*, a term introduced rather late, meaning “feeling the future”, also called predictive anticipatory activity. If precognition is “knowing” the future, presentiment involves physiological changes before the future event occurs (Mossbridge, Tressoldi & Utts, 2012), and it can be changes in the cardiopulmonary, skin and/or the nervous systems. One term that also must be mentioned is *psychometry*, a term used in ordinary psychology, but also in parapsychology, where it however means something quite different. A better term could be object-association. It seems to be a form of clairvoyance and stands for the claimed ability

to get information via an object, that very well can be sealed, but still the person with this ability seems to get information, or images, about the history of the object or the owner of the object. The third category in parapsychology is various phenomena and experiences that suggest that there is something that seems to be able to survive the bodily death or exist outside the body. Examples of these phenomena are out-of-body experiences, near-death experiences, cases suggesting reincarnation or previous lives, electronic voices or messages (on tape, telephone, radio, tv or computer), hauntings, apparitions of the dead, mediumship and spirit photography.

Telepathy-like experiences have been reported by people in all societies and cultures, and at any point in history. There are examples in the Bible, in Taoist writings, the Hindu Vedas, Buddhist sutras, Judeo-Christian scripture, Greek and Roman records, and folk tales from American Indian and African cultures (Krippner, 1974). In the late 1800s, some scientists in Great Britain paid more than scant attention to some of these experiences and phenomena, and in 1882 started the *Society for Psychical Research (SPR)*.

4.3 Telepathy research – an introduction

Among early scientific investigations can be mentioned Charles Richet, the French psychologist and also Nobel Prize laureate who demonstrated telepathy and applying statistics to telepathy data (Krippner, 1974). Pierre Janet was another French investigator who induced hypnosis at a distance, probably through a telepathic signal. These kinds of experiments were also carried out in England by Gilbert Murray and by Henry Sidgwick, who also introduced statistical analysis to these types of data. Other early investigators were Sir William Barrett, Sir Oliver Lodge, René Warcollier, Upton Sinclair, Brugmans and Whatley Carington.

A big step was taken in 1930 when J B Rhine and his wife Louisa started studying telepathy, clairvoyance and related areas at Duke University (Krippner, 1974). They used 5 symbols in a deck of 25 cards., with each symbol 5 times, circles, square, stars, crosses and wavy lines, and used statistics to evaluate how much the result deviated from what could be obtained by coincidence, which is five times out of 25. During the following 3 or 4 decades, various effects were found in the experiments by Rhine and his colleagues (e. g. Soal and Price). Effects to be mentioned were the decline effect (a subject's score would decline as the experiment proceeded), the differential effect (experiments in which subjects tend to respond differentially to a dual situation without meaning to do so, e g responding to two different sets of targets in two different ways) and the sheep-goat effect (subjects with a more positive attitude to parapsychology, called sheep, tended to score better than subjects having a more negative attitude, called goat, not believing in psi). Another important conclusion that could be drawn (Krippner,1974) was that many experiences occur in an altered state of consciousness, ASC, e g dreams, so many methods were tried to induce this state, e g relaxation, hypnosis, sleep, meditation etc. When it comes to choose a good target, emotional targets have been found to be better than neutral, and film clips are more often used than just pictures.

4.4 Telepathy research with the Ganzfeld method

In the middle of the 1970s, three researchers, independent of each other developed what would later be called the Ganzfeld method, William Braud, Charles Honorton and Adrian Parker. This method is now an established and internationally used method in parapsychology to induce an altered state of consciousness. The goal is to reduce sensory input in the receiver, so he/she can have more attention on inner images, the word ganzfeld meaning “uniform” or “homogenous” and allude to the visual experience for the receiver.

Sensory input is reduced with half ping-pong balls on the eyes, a weak, red light is used directed to the face, and often also headphones are used. During the experiment, the receiver can freely report about impressions, and everything is recorded. For the sender, a film clip is chosen by random from a big pool, and in the final step, one out of five film clips is shown. Afterwards, the receiver, and also external judges, is to compare the five film clips with the mentation report from the receiver and evaluate which film clip does best correspond to the mentation report.

This method was used from the mid-1970s and in an early assessment by Honorton (1978), 23 out of 42 experiments conducted in 10 different laboratories had yielded significant ESP performance under ganzfeld conditions, with a success rate of 55 %, far beyond that expected by chance (Watt & Irwin, 2010). Since it was suggested that the result with this method came close to a replicable phenomenon, it became the focus of intense critical debate (Honorton, 1985; Hyman 1985) where the discussion was how to interpret the deviation from coincidence, whether being a sign of authentic extrasensory perception or some other kind of not understood anomaly. To agree on the method, Honorton and Hyman wrote a jointed paper on how to prepare and carry out a ganzfeld experiment (Hyman & Honorton, 1986).

A new method was applied to evaluate all experiments in a scientific field that were conducted with one method, so-called meta-analyses. Eight years after the first review, Bem and Honorton (1994) published a meta-analysis of 10 automated ganzfeld studies designed to meet these new more stringent standards, comprising 329 sessions in total, with p-value .002 and a hit rate of 32 percent (Baptista, Derakshani & Tressoldi, 2015, p. 193). This analysis had the aim to meet the Joint Communiqué and was promoted by the

authors as evidence that the ganzfeld psi effect was both robust and reproducible. Then, however, a new meta-analysis was published (Milton & Wiseman, 1999), conducted on all 30 studies from 1987 to 1997, showing there was no significant result ($ES = 0.013$, $p = .24$, hit rate = 27.5 percent). This null-result was however commented by other researchers (e.g. Bem, Palmer & Broughton, 2001; Schmeidler & Edge, 1999) to be due to the studies being included in their meta-analysis to be designed to explore ESP process variables, rather than being proof-oriented (Baptista *et al.*, 2015, p. 193; Watt & Irwin, 2010, p. 53). Another critical comment came in a new meta-analysis by Bem, Palmer and Broughton (2001) arguing that the studies being included were too heterogeneous with e. g. mixed studies, where also music was used as stimuli, besides pictures and film sequences. In this meta-analysis, 10 new studies were included, and now with altogether 40 studies, the hit rate was 30.1 percent, an $ES = 0.051$ and $p = .0048$ (Baptista *et al.*, 2015). Other meta-analyses supporting a significant effect were by Palmer and Broughton (2000) and Palmer (2003). To investigate whether the Milton & Wiseman meta-analysis included studies that varied too much, Bem made a special study to investigate how important it was to follow the guidelines by Hyman & Honorton (1986). The analysis showed that the studies that deviated much from the model did influence the Milton and Wiseman results in a negative way (Bem, Palmer & Broughton, 2001; Palmer, 2003; Palmer & Broughton, 2000). A more recent meta-analysis on ganzfeld telepathy in parapsychology is reviewed in section 2.9.

4.5 Dream telepathy research

As mentioned before, many telepathy experiences occur in dreams, so with the discovery that dreams are associated with rapid eye movement, REM, and with the technology to measure rapid eye movement, it was possible in the 1960s to carry out dream telepathy research, having the possibility to wake up a person in a REM period (when dreams were

expected to occur), or at the end of it. Psychiatrist Montague Ullman established the dream laboratory at the Maimonides Medical Center, Brooklyn in 1962 (Baptista *et al.*, 2015). With the colleagues Stanley Krippner and Alan Vaughan, he carried out the first major attempts to study the possibility of dream ESP, i.e. to study if it was possible to by telepathy influence dream content and imagery (Beloff, 1977) under controlled laboratory conditions (Ullman, Krippner & Vaughan, 2003). During the years 1962-1978, 11 formal studies were carried out on dream telepathy (and two for precognition, and three pilot studies for each of the phenomena clairvoyance, telepathy and precognition). The procedure for the studies was developed and improved over time, but in general, the receiver was attached to EEG-EOG monitoring equipment (EOG = electro-oculo grams, i.e. equipment to measure movement of the eyes) and slept in a sound-attenuated room in the laboratory. Once the person was asleep, a target was randomly selected from among a pool of targets (most often art prints) compiled on the basis of the images' emotional intensity, vividness, colour and simplicity. The target, in a sealed envelope, was given to the sender, who was then locked inside another sound-attenuated room in the building. The experimenter monitored the receiver's EEG-EOG throughout the night, and once this indicated that the receiver had entered the REM sleep, signalled the sender to open the target envelope and begin sending the target. At, or towards the end of the REM period, the experimenter awakened the receiver and asked him or her to describe any dream(s) they could recall. Responses throughout the night and in the morning were tape-recorded and later transcribed. After that, the receiver went back to sleep and the process was repeated for each REM period with the same target being sent each time. In the morning, the receiver guessed what the target might be, comparing with between eight and twelve pictures, where one was the target, and also gave a confidence rating for each picture and also placed them in rank order according to the correspondence with their dream mentation (Sherwood & Roe, 2003; Sherwood & Roe, 2013). Complete dream transcripts

and target sets were also sent to two or three independent judges, who made similar judgements.

In a meta-analytic review by Child (1985) (also by Krippner and Friedman (2010), Sherwood and Roe, 2003 and Ullman *et al.*, 2003) 450 trials were found with an overall hit rate of 63 percent (with MCE = 50 %) and odds against chance of around 75 million to 1 (Baptista *et al.*, 2015, p. 205; also Sherwood & Roe, 2013, p. 42 and Radin, 1997a, p. 71). 20 of the 25 sets of data analysed were above mean chance expectation. These strong results in combination with the highly stringent Maimonides protocol are the reasons for numerous replication attempts from 1977. More about these meta-analyses on dream telepathy in section 2.9.

4.6 Telepathy research using electrodermal activity

Electrodermal activity, EDA has been used in parapsychology as indicator of telepathy, but also remote influence and presentiment. Here, the research in telepathy will be reviewed. Beloff (1974) is accredited (Ramakers, Stevens & Morris, 2005) as being the first to suggest the use of a psychophysiological measure. Since most studies had used a conscious response measure, a study by Morris (1977) was probably the first in parapsychology that was carried out to use this psychophysiological measure. EDA was understood to be a (mostly subconscious) measure of a potentially psi-mediated response. Skin conductance has ever since been found to be a useful measure of unconscious psi (Delanoy & Sah, 1994; Schlitz & Braud, 1997; Schmidt, Schneider, Utts & Walach, 2004).

One major reason to use EDA in telepathy, as well as in other fields of parapsychology, is that telepathy in many cases is an unconscious process (Beloff, 1974; Rhine, 1967; Tyrrell, 1947). Using EDA, the receiver must not be aware of the process, must not be aware of images or emotions that he or she is expected to receive and report. The method makes it

possible to avoid cognitive bias (Cacioppo, Berntson, Larsen & Ito, 2004) since the inclusion of additional (potential) cognitive correlates may inhibit the psi process we are studying.

Besides images of various kinds, emotions have been used as “targets” in telepathy studies. Case reports in parapsychology indicate that emotions are important in apparently paranormal experiences (Delaney, 1989), but there is also experimental evidence (Dalkvist & Westerlund, 1998; Radin & Schlitz, 2005; Sherwood, Dalton, Steinkamp & Watt, 2000), the last study obtaining higher scores with emotionally negative targets than with positive or neutral video material (Watt & Irwin, 2010, p 51). The role of emotions is **however** not very well understood.

4.6.1 What is electrodermal activity?

The use of EDA has grown from neurology and physiology. EDA stands for ElectroDermal Activity, electric processes in the skin, which varies with the arousal, unconscious reactions in the body. Psychological factors were already in the 1880s observed to be related to electrical phenomena in the skin. Since then, arousal, physiological detection of emotions has been one of the most used bio signals in psychophysiology, even if not all details in the electrodermal phenomena are completely understood (Boucsein, 1992). The term EDA was introduced in 1966 by Johnson and Lubin (Boucsein,1992) as a general term for all electrical phenomena in the skin, both active and passive characteristics that can be connected to the skin and its appendages. EDA measures are, according to Boucsein (1992) highly applicable to emotions and stress research. To understand EDA, and how it is measured, it is necessary to both know the characteristics in the equipment measuring these currents, and it is an advantage to know more about the different layers in the skin and how

the current is created. The electric current is depending on sweating processes that very much influence the electrical processes.

There are two ways to measure the electric processes in the skin, endosomatic and exosomatic recording. For endosomatic recording, only potential differences coming from the skin are recorded, so there is no need for an external current to be applied. The methods with current are called exosomatic recording and use either direct current, DC or alternating current, AC. The current is measured 16 times per second, i. e. having the frequency of 16 Hz. A direct current, DC with 0.5 V is applied to the equipment measuring the current in the skin, a voltage that is normal standard. This function should have as low noise as possible and with a quite neglectable change of the temperature. A graph can consist of a maximum of 1 000 000 measuring-points.

In the concepts for EDA, the real signal, the skin conductance level (SCL) is called the level, L, and the skin conductance response (SCR) is the response, R. According to this, EDA is divided into tonic, persistent phenomena (level on the activity) and phasic phenomena (a response to electric activity in the skin, EDR) (Boucsein, 1992). Significant for the equipment used in this study is the very high resolution, which makes it possible to see small variations in the skin conductance. To make this possible, the amplifier has a very low noise itself and is very temperature stable. For maximum stability, the equipment is designed to get as few disturbances as possible and thus avoiding false signals, e.g. coming from static electricity from the participant. More details about the technical construction of the equipment used in this research are found in Appendix 9.

4.6.2 Telepathy research using EDA

There are in fact very few studies that have used EDA for investigating whether it is possible to detect the effect of emotions, originating from another distantly located person.

Tart (1963) used skin conductance as a measure when he administered electrical shocks to himself as sender (Ramakers, 2008). Tart used both skin conductance and plethysmographic measure and they showed higher activation in the receiver when the sender received an electric shock, but this also happened when the current instead was led into a resistor. Delanoy and Sah (1994) had the agent to recall happy memories and found that during this condition, receivers had higher EDA on average than in a control condition. There were overall significant psi-hitting, significant scoring for the sending of positive emotions and nearly significant scoring for neutral emotions. This study is also one of the few (also Targ & Puthoff, 1974; Tart, 1963) that was designed to explore whether conscious responses or unconscious responses (EDA) would elicit a larger ESP effect (Ramakers *et al.*, 2005). Ramakers *et al.* (2005) reported a study on the effect of remote emotion on receiver skin conductance. They found (Farrell, 2006) that the mean level of EDA for the receiver was highest with the negative targets, but not to a significant degree. Both kinds of emotional targets (both negative and positive) led to higher arousal than neutral targets. Inspired by Ramakers *et al.* (2005), Brusewitz (2008) tried to replicate this study and investigated if emotions could be transferred from a sender to a receiver being connected to the measuring of the mean level and the mean variance of the skin conductance. No significant result was obtained. Ramakers (2008) reported a study where he investigated if the receiver physiology could be an indicator of emotional ESP. Strong emotional targets, like pictures of mutilated bodies and erotic pictures were shown to the sender while the receiver's skin conductance was measured. The results showed no significant difference between the emotional and the neutral conditions and no effect of the combined emotional conditions on mean variance.

Parker began (Jensen & Parker, 2012) investigating a new methodology with telepathy research, applying psychophysiological methodology of electrodermal activity as an

indicator of the degree of connectedness (telepathy), an anomalous transfer of a synchronous reaction between the “sender” twin and the twin being “receiver” in the experiment, in this case between identical twins, also used in Parker and Jensen (2013). These two reports provided the model for the current research and were carried out as an attempt to develop a standard methodological design that would be easy to use in forthcoming studies. Being the model for the current work, they are described in more depth, making it clear why EDA is the most appropriate way of testing twin telepathy. Besides describing the design, some key design decisions in these studies are to be commented on, like choice of stimuli, schedule and number of trials.

When it comes to the choice of EDA to get indications of a possible physiological connectedness, the background is the relationship between twins being primarily emotional. Therefore the choice was to find a method indicating arousal and emotional connectedness, as is indicated in the background given in Jensen and Parker (2012) (and also in reviews in Irwin and Watt, 2007, Schouten, 1981 and 1982, and Watt and Irwin, 2010). They review some studies using EEG described later in this chapter and in the Introduction of this thesis, e.g. Duane and Behrendt (1965) (with analyses however not being blind and the study only being preliminary) and Grinberg-Zylberbaum *et al.* (1993) and also Grinberg-Zylberbaum *et al.* (1994), one of the most systematic series studies, and, partly with success replicated by Kittenis, Caryl and Stevens (2004). Positive findings were however reported in other similar studies, by Radin (2004b) and Standish *et al.* (2004). Besides these studies using EEG, there are also some studies using fMRI with conceptually similar findings (Achterberg *et al.*, 2005; Moulton and Kosslyn, 2008; Richards *et al.*, 2005). In summary, Jensen and Parker (2012) conclude that the findings are mixed, but with better results for related pairs. With these studies indicating connectedness especially

for related pairs (but more are of course needed to confirm them). With these studies and with the relationship between twins primarily being emotional, the choice was to find a method indicating arousal and emotional connectedness, and that method is electrodermal activity, an established method to measure unconscious bodily expressions of emotions, transmitted by the ANS, the autonomic nervous system.

In these two studies (Jensen & Parker, 2012; Parker & Jensen, 2013), each pair of twins participated in two runs, with four pairs of twins in each study (in the first study, four pairs were studied, but only three pairs produced analysable data), changing roles from sender to receiver or vice versa after the first run. In the study by Jensen and Parker (2012), running atomic clock on laptops in all rooms and camera recordings of these enabled the timing of the period to be precisely synchronized. A total recording lasted 15 minutes. The stimulus exposure period was predefined as the middle 12 minutes. This period was divided into 48 potential exposure period of 15 seconds, during which a stimulus could be presented. With this schedule, a twin was receiver in 25 minutes, then changing role and being sender for 25 minutes, giving 5 trials in each role, and altogether an experiment lasted 55 minutes to run, including change of roles and after that, filling a questionnaire on attachment. Extending to more trials would be difficult, since twins probably can't spend more than an hour for this experiment.

In the study by Parker and Jensen (2013), a design and schedule was developed, that in principle was used in the present work. There were in each run five 5-minute trials, each one with eight possible epochs, with the duration of 30 seconds, where one was randomly chosen for the exposure of the stimulus for the sender. The choice of stimulus epoch was performed by a random process (by use of a random integer generator,

<http://www.random.org>)). In this way, the authorized polygraph expert being with the receiving twin in a distant, separate room was kept blind as to the choice of epoch for the exposure to the stimuli. The participants were told that the sender would be exposed to some surprise stimuli and that the receiver would be wired to an equipment measuring the electric conductance in the skin, which if there were peaks on the graph could indicate telepathy in case the peak corresponded in time with a surprise stimulus for the sender. Both twins were asked to just relax during all the run. In the receiving room, the twin being 'receiver' was placed in an armchair and connected to the EDA equipment with the right hand. One difference between the first and second study was that atomic clocks were not available in the second study, so they instead had to rely to timing-stop clock programs on the Iphone and sending text-SMS indicating the start of the run. For the three studies in this thesis, a purpose-built equipment was used.

Finally, one of the elements in the key design in these two studies on twin telepathy is to be commented on, the choice of stimuli. When it comes to the choice of response type, more details about the measuring process are given below. The principle for the stimuli in Jensen and Parker (2012) (and also for Parker & Jensen, 2013) was to use both pleasant and unpleasant stimuli, to elicit some of the basic emotions, such as surprise, fear, joy and disgust. For the twins being 9 years of age in Jensen and Parker (2012), one foot suddenly placed in an ice bucket was used (1), as was lemon juice tasting (2), a jack-in-the-box device (3), popping a balloon behind the child's head (4) and (5) tickling all over the body. For the adult pairs, being 18 and 21 years of age, (1), (2) and (3) as above were used, as well as (6) the dropping of four porcelain plates suddenly behind the chair, and (7) a mild electric shock given to the hand with a joke pen. The stimuli that caused a "hit", i.e. a deviation in the graph identified by the polygraph expert were with stimuli 6, 1 and 7, but there were circumstances for the other stimuli that can explain why they were not successful.

In the second study (Parker & Jensen, 2013), there were difficulties in finding an appropriate positive stimulus. The most successful stimuli in Jensen and Parker (2012) were used, placing the subject's arm into an ice container, and the sound of porcelain plates crashing onto the floor. Besides these, a bursting balloon was used. Due to ethical reasons, the mild electric shock stimulus in previous study could not be used. Instead, a heat appliance on the arm was used, an appliance that could be turned off by the recipient at the experience of pain. As a final stimulus, eliciting of a knee reflex was used. Concerning successful stimuli in this study, i. e. giving a "hit", a hand in an ice container was among the most successful ones. Besides measuring the electrodermal activity, the heart rate, the blood pressure and the breathing rate was measured, as well as movement responses (via a cushion with movement sensors), making it possible to check if deviations on the graph for the electrodermal activity could depend on deviations in the breathing or the person moving on the chair.

Even if the overall results were non-significant in these two published studies, one pair out of three respectively four pairs gave independently significant results (with 3 hits out of 10, $p < .05$ in the first study, in Copenhagen). The result in the first of these two studies was reported to be non-significant, $p > .7$, using a formula for calculation of hit-probability (p) (Feller, 1968; Westein, 2011), utilising a hyper-geometric test for a given number of hits with a known sample size, a known number of possible hits and a specified number of drawings from the sample. For the second of these studies, the result was six hits out of 24 possible, and on a binomial test, marginally significant ($p = .07$, one-tailed), and with 24 periods under review and a one in eight chance to correct identifying each, mean chance expectancy MCE is $1/8 * 24 = 3$. The result from the study by Brusewitz *et al.* (2015) was with a binomial test not significant, but above chance, with $p = .21$ (and with a one sample t-test, $p = .385$, $df = 18$, $t = .89$).

4.6.2.1 Twin telepathy research

Twins is a group reporting having many paranormal experiences (Brusewitz, Cherkas, Harris & Parker, 2013; Playfair, 2002/2009) and it can depend on both that they are genetically identical (for identical twins) but also because they have a special, strong, emotional bond to each other, the latter reason getting support from Brusewitz *et al.* (2013). Studies of reported telepathy from everyday life (Feather & Schmicker, 2005; Persinger, 1974; Sannwald, 1963; Stevenson, 1970) concluded that telepathic experiences occur primarily between pairs who are connected genetically or emotionally (Roll & Williams, 2010). The same conclusion comes from some experimental studies (Alexander & Broughton, 2001; Broughton & Alexander, 1997; Rice & Townsend, 1962; Stuart, 1946).

Most studies on twin telepathy have used electrodermal activity as indicator of telepathy, but not all of them. They will however all be reviewed here. One recent study used fMRI and will therefore also be mentioned among fMRI studies. In a review by Parker (2010), eight attempts are reported to study telepathy amongst twins under controlled conditions (Barron & Mordkoff, 1968; Blackmore & Chamberlain, 1993; Charlesworth, 1975; Duane & Behrendt, 1965; Esser, Etter & Chamberlain, 1967; Kubis & Rouke, 1937; Rogers, 1960; Stuart, 1946). A ninth one is by Galton (1907) without mentioning the word “telepathy“ or “thought transference“, and another study (Rosambeau, 1987) is mentioned by Playfair (2017) - a survey among twins about sharing feelings, sensations and thoughts even when being distant away from each other, experiences that physician, author and MZ twin Larry Dossey calls *telesomatic events*, experiences where hundreds of cases have been reported over the years but have been largely ignored (Dossey, 2013a; Playfair, 2017). Rosambeau (1987) found that about 30 percent of the 600 twins they questioned, reported experiences suggesting such community of sensations. The experiences fell into six categories, where

four of them were of a simpler kind and could be explained by concordance, while two (“just knowing” that the other is in trouble, and sympathetic pain) are much harder to explain other than by telepathy, e.g. one twin has an accident in which an eye, nose or arm is wounded while the other feels a sudden pain in exactly the same part of the body, sometimes producing a bruise, burn or blister on the corresponding spot. These cases, Playfair (2017) finds, are visible evidence for macro-entanglement, rarely if ever reported by non-twins, as far as Playfair knows.

Galton (1907) reported that 11 of the 35 twins in his study showed a “similarity in the association of ideas“, which in contemporary terminology is called “thought concordance“ (Parker, 2010), a term twin telepathy author Guy Playfair (2017) specifies whereby genetically identical twins can be expected to share a number of likes, dislikes, preferences, and habits. Kelly and Tucker (2015, p.72) mentions a more recent report by Mann and Jaye (2007), about 20 pairs of twins report experiencing the other twin’s pain or other bodily sensations similar to those being experienced by the other twin. While a few of these results from twin telepathy studies seem to confirm the phenomenon, most of the studies show significant shortcomings, such as selecting twins irrespective of their claims to be psychic or not and selecting very few pairs of twins. For instance, one of the most cited studies (Blackmore & Chamberlain, 1993) attributed success of twins in a telepathic test to that of thought concordance. Three pairs of identical twins were tested under two conditions, one permitting thought concordance and the other telepathy. The results showed clear evidence for the thought concordance hypothesis and no evidence for genuine telepathy. The quoting of this experiment to justify the final rejection of the telepathy hypothesis in favour of that of thought concordance (Segal, 1999) is clearly unjustified based on tests involving just three pairs of twins. Besides, they were unselected (i.e., none of them had apparently reported any mutual psychic experiences). Finally, as Playfair (2002) points out, the testing

was carried out in what appears to have been non-psi-conducive ambience, namely the adolescents' school environment (Parker, 2010). In recent research, to be selected for participating in scientific studies in parapsychology, persons having a history of paranormal experiences are often preferred, since the probability for success is higher. Thus, the abundance of anecdotal reports indicates the need of further research and more carefully designed experiments.

Even if not being with twins, but with connected pairs, two studies by those in the review in Jensen and Parker (2012) can also be mentioned, since connected pairs and twins often have one thing in common, the one to have a strong connection, a strong bond. Both these studies focused on joint physiological recording of identical twins, with the goal to determine if the brains of connected pairs are correlated (Roll & Williams, 2010). In one of them (Duane & Behrendt, 1965), EEG was used and 14 pairs of twins were examined, and in two pairs it was found an increased alpha rhythm for one twin while inducing it in the other. The study however had weaknesses, Jensen and Parker (2012) commenting the analyses were not being blinded, and the authors emphasized that the study was only preliminary. Besides, the results were based only upon visual inspection of the EEG graphs, not on objective measurements (Radin & Pierce, 2010, p. 235). Besides this study, Roll and Williams (2010, p. 7) reviews five other EEG correlation studies (where two were genetically related and four were emotionally bonded), conducted by different experimenters, showing correlations between the brains of connected pairs, with the conclusion by William and Roll that telepathy may be relatively common between pairs who are genetically or emotionally connected.

One recently published report on twin telepathy or twin connectedness can also be mentioned, even if not using EDA but fMRI ("brain scanning") and will therefore also

shortly be mentioned below among studies using fMRI. In this study, that examines possible emotional connectedness in identical twins (Karavasilis *et al.*, 2017), one pair of male twins being 15 years of age were examined with fMRI to detect if there were any changes in brain activity for one of the twins, while the other twin in two sessions was exposed to visual and acoustic stimuli respectively, using a 25-inch monitor and earphones. Between the two experimental conditions, there was a 2 minutes break. The 260 seconds experimental condition for visual stimuli included seven “resting” periods and six “active” periods, where the subject watched randomly presented pictures, presenting basic emotions of anger, disgust, fear, sadness, surprise and happiness. A similar procedure was followed for the acoustic experimental condition, also lasting for 260 seconds. The sound was to cause fear. Each “active” condition lasted for 20 seconds and was followed by a “rest” period of 20 seconds, all delivered in a random order. After the experiment, both twins filled the *Temperament and Character Inventory-140* (Cloninger, 1999), with 136 questions related to temperament and character domains, as well as four response accuracy/validity items, the temperaments being novelty seeking, harm avoidance, reward dependence and persistence.

In the study, a clear correlation was found between the emotional stimuli that was exposed for one of the twins, and the fMRI response of the other. The psychometric assessment by the TCI-140 questionnaire verified a similar temperament and character profile for the participants. Significant brain activation was found in three regions: 1) left orbitofrontal gyrus (during visual condition), 2) left singulum, and 3) for the acoustic condition, left precentral gyrus. The orbitofrontal cortex is (Karavasilis *et al*, 2017) involved in the cognitive processing and is thought to be associated with emotional and reward aspects in decision making (Miller & Cummings, 2007). Activity in middle cingulum gyrus for the

emotions fear, sadness, and happiness has been found to be related to emotion (Vogt, Berger & Derbyshire, 2003). The Greek group acknowledge that fMRI is a relative measure and might not be the optimal method for individual analysis especially when studying higher mental functions, including emotional connectedness. Even if the study only involved one pair of twins and the result therefore cannot be generalized, they find that their findings denote emotional connectedness between a pair of monozygotic twins using fMRI. Further studies are needed, they conclude to investigate if this is a generalized and systematic phenomenon or an accidental finding.

It should also be made clear that while “normal” telepathy is *mental*, what twins report being able to do is to transfer *physical* or *psychophysiological* sensations, e.g. a black eye or burns when they have an accident, a fact Playfair (2017) emphasizes, as does Brusewitz *et al.* (2013). That is what makes twins and telepathy special, it is more physical. Besides these efforts to do twin telepathy research, other recent research in this field is reviewed in previous section, since all of these studies are carried out using the psychophysiological method with electrodermal activity (Brusewitz *et al.*, 2015; Jensen & Parker, 2012, Parker & Jensen, 2013).

4.6.2.2 Possible connection between twin telepathy and quantum communication

The search for some kind of explanation for the exceptional experiences that twins report has made many researchers in the field to compare these phenomena with the equally strange phenomena in quantum physics, both showing characteristics of so-called non-local effects or entanglement (Arndt, Juffman & Vedral, 2009). Even for the field of parapsychology in general, this comparison has increasingly often been suggested. There are according to Roll and Williams (2010) clear support for a possible connection from not

only quantum physics but also neurobiology. Whether the similarities with quantum physics are coincidences or not is hard to say. The exceptional phenomena between twins however indicate that it might be necessary to be open to the possibility that conventional genetic and cognitive models can be incomplete. Certain of these exceptional experiences (like “remote” empathy and synchronous events) cannot very easily be included in a cognitive model.

The phenomena in quantum physics that are similar to parapsychological phenomena are entanglement and superposition, phenomena that even Einstein had great difficulties with: when a fundamental particle is split into two, the two parts X and Y will remain correlated regardless of how far apart they are from each other. Experiments have shown (Aspect, Grainger, & Roger, 1981, 1982a, 1982b) that once X is measured, Y doesn’t have to be measured, it is also determined to be the same as X, regardless of separation in time and space (Roll & Williams, 2010), a characteristic called “spooky action at a distance”. [Nobel Laureate] Josephson and Pallikari-Viras (1991) emphasize the similarity that seems to exist between quantum processes and telepathy - this instantaneous action at a distance very much corresponds to telepathy (the direct connection of one mind with another), as does among others Radin (2006). From this perspective, Roll and Williams (2010) claim, quantum physics bridges parapsychology with mainline physical science. The physicists Stapp (2001) and Heisenberg (1958) also comment entanglement to make it easier to understand quantum physics and its relationship to parapsychology (Roll & Williams, 2010).

For many years, it was claimed that this spooky action could only occur on a macroscopic level, but Vedral (2008) stated that researchers now also have started to regard

entanglement to be an essential property of the macroscopic world, an idea that also gets support from other discoveries, reported in distinguished journals, the existence of “non-local” effects in biological tissue (Arndt, Juffman & Vedral, 2009; Engel *et al.*, 2007). The theory, seeing a parallel between synchronous events in behaviours and in processes in quantum choices, implies that quantum effects can occur in brain tissue, if a comparison is to be possible and meaningful (Hameroff, 2007). It is now accepted that birds can use quantum measurements in navigation, especially the robin (e.g. Al-Khalili & McFadden, 2015; Abbot, Davies & Pati, 2008) and that the process of photosynthesis and the identification of smell in the olfactory sense include quantum processes (Arndt, Juffman & Vedral, 2009), i. e. quantum effects in room temperature. There are even discoveries and theories suggestion that quantum effects can occur in the brain tissue (Hameroff, 2007), a discovery that he claims might explain consciousness and perhaps even telepathy. Hameroff has also, with Roger Penrose, developed a model that assumes that the human mind may exploit at least two conformations of microtubule as values of a quantum bit (Arndt *et al.*, 2009; Hameroff & Penrose, 1996).

There are still many problems to solve for this model, one of them being coherence is believed to be orders of magnitude too fast to make it relevant on physiological timescales (Eisert & Wiseman, 2007; Tegmark, 2000). For quantum physics to play a role in biology, Davies (2009) also reminds that effects like coherence, entanglement and superposition can be maintained only if the quantum system avoids decoherence caused by interactions with its environment. Electron spins in biological molecules are affected by the earth’s magnetic fields, even if the size of the effect is so small that it should be completely washed out by the thermal fluctuations. Some quantum systems can however be extremely sensitive to external magnetic fields (Davies, 2009). Therefore some scientists now believe that some birds can use quantum measurements in navigation, Davies concludes. Engel *et al.* (2007)

has shown that at physiological temperatures (277 K), coherence does survive for at least 300 fs, which is long enough to be biologically relevant (Panitchayangkoon, 2010). For the navigation for birds, especially the robin, it seems clear that quantum processes are involved (Arndt *et al.*, 2009; Lambert *et al.*, 2013) and also possibly for photosynthesis and the olfactory sense, i. e. quantum effects in room temperature (Arndt *et al.*, 2009; Lambert *et al.* (2013).

Finally, the possible connection between quantum physics and the specific phenomenon of twin telepathy is based on the fact that twin telepathy experiences might be explained by quantum entanglement at a biological and possibly even a neural level (Radin, 2006; Roll & Williams, 2010; Walker, 2000). It could be noted that identical twins originally were completely physically “entangled” in one cell (one string of DNA), and it can be speculated that even this form of entanglement might create a predisposition towards such experiences (Jensen & Parker, 2012). As identical twins were originally completely “entangled” (as one string of DNA), they might therefore be predisposed to such experiences. Since twin telepathy refers to *physical sensations*, twin telepathy author Playfair (2017) regard it as a compelling evidence for treating the pair of twins as a single macro-entangled system, as a sudden unexpected shock breaks through the barrier that enables them to live separate lives, reuniting them as the single entity that they were prior to division in the womb.

4.6.2.3 Discussion about how to use EDA in parapsychological research

There has been a discussion, but not very much, about how to use the technology of EDA in parapsychology as well as what statistical method to use. Stefan Schmidt *et al.* (2001) argue that the mean level of SC, the most widely used variable in EDA to detect remote effects is not the most appropriate variable to detect psi. They mention recording, processing, parameterization and evaluation of EDA data to be the crucial points in the

interpretation and studied EDA as a function of different methodological approaches. When comparing different EDA parameters (tonic and the fast-changing phasic), they found the effects to be similar in size, which they conclude indicate that the effect is more a global influence rather than a very specific one, and that this global physiological state reflects overall arousal, i. e. several physiological systems, as summarized by Brusewitz (2010b). They also found that their method of using the classical psychophysiological parameters outperformed the method traditionally applied in DMILS/remote staring research. The classical parameters are the numbers of SCR (Skin Conductance Responses), and the amplitudes of these.

Schmidt and Walach (2000) are also very critical to the use and reporting of EDA studies in other areas in parapsychology, to be reviewed later, dmils and remote staring. They compared a review of all published reports in these fields with the standards in psychophysiological journals, established in the 1970 and published in the beginning of the 1980 (Fowles *et al.*, 1981, Venables & Christie, 1980). Their conclusion was that there was not even one study conducted by parapsychologists that refers to psychophysiology's measurement standards published in 1981, indicating these studies do either contain artefacts, or do not detect the supposed effects. They conclude that there has not been enough effort to understand the results of EDA experiments or to address the origins of the irregularities in detail. Most of the reports do not use the required SC-technique (constant voltage method) or the appropriate electrode paste, and the scoring method remains unclear in more than half of the studies (Brusewitz, 2010a, 2010b; Schmidt & Walach, 2000).

4.7 Telepathy research with other technologies

Another physiological measure, cutaneous EGG (electrogastrography) was used in a study by Radin and Schlitz (2005) and summarized by Ramakers *et al.* (2005). They wanted to

study if gut feelings, commonly reported visceral sensations that are virtually synonymous with intuitive hunches, may involve information gained by non-ordinary means. Because of the close relationship between gut feelings and emotions, they especially tested whether a person's gut feelings might respond to the emotions of a distant person. Their result appears to support the hypothesis that one person's gut feelings can respond to a distant person's positive and sad emotions.

4.7.1 Telepathy research with fMRI

Using this new technique (fMRI, functional magnetic resonance imaging) has made it possible for neuroscientists to monitor brain activity and get impressions of neural activity (Roll & Williams, 2010). Many fMRI studies commonly use a technique called BOLD, based on blood oxygenation. This technique makes it possible to estimate the level of neural activity in a particular region during a specific behaviour, which indicates a functional correlate of the behaviour (Buxton, 2001).

The first study on telepathy using fMRI was carried out by Standish *et al.* (2003) who used BOLD fMRI to detect psi based correlated brain activity between bonded pairs (Broughton, 2015, p 143). In this study, the sender viewed a flashing display in the control room, while the receiver relaxed in the fMRI scanner. The study revealed changes in the receiver's visual cortex when the sender was stimulated, and in this study, the activity was increased. This study was followed up by the same team (Richards *et al.*, 2005), this time using both fMRI and EEG, two measures being independent of each other, with the pairs of participants from the first study (Standish *et al.*, 2003) who had shown significant EEG effects (Radin & Pierce, 2015). In this follow-up-study however, the cortical activity was found to be reduced. The male however, showed visual cortex activation during his first

fMRI, but no change during his second. Methodological weaknesses made it however difficult to evaluate (Roll & Williams, 2010, p 56 and p 134). An fMRI study at Harvard on ESP (extrasensory perception which includes telepathy) (Moulton & Kosslyn, 2008) caused media attention since Harvard University choosed to issue a press release about the study (Lavoie, 2008) when this study, that attempted to document the existence or nonexistence of ESP, gave a result that they interpreted as demonstrating that ESP does not exist. Because there were no neurobiological markers for matches between participants' guesses and a concealed target, the experimenters concluded that ESP was most likely illusory, a conclusion that was very much discussed and questioned (Roll & Williams, 2010, p. 135). It may even be the case that they explained away the only positive result they got (Neppe, 2010). The sixteenth pair of participants, the only pair that demonstrated above-chance ESP scores (16 pairs participated), yielded less activity in several brain areas with most reduction in the temporal lobe during correct ESP trials as compared with incorrect ESP trials (Neppe, 2010, p. 135) This result was explained away as "scanning artefact" and they found that the results were not relevant, but, as Neppe noticed, it could be the only positive result in this study.

As just mentioned, there recently was one study published on twin telepathy or twin connectedness, examining possible emotional connectedness in identical twins (Karavasilis *et al.*, 2017). In this study, one pair of male twins being 15 years of age was examined with fMRI to detect if there were any changes in brain activity for one of the twins, while the other twin in two sessions was exposed to visual and acoustic stimuli respectively. In the study, a clear correlation was found between the emotional stimuli that was exposed for one of the twins, and the fMRI response of the other.

4.7.2 *Telepathy research with EEG*

Electroencephalograph, EEG is used in parapsychology to find out what brain waves and states of mind that are related to telepathy (and also more general to extrasensory perception). Parapsychologists started to use this technique in the 1960s. They have looked at the neural correlates of performance on ESP tasks or they have used the EEG as a dependent measure of ESP performance (Watt & Irwin, 2010, p. 54). There are five types of brain waves, each type associated with a mental state and frequency in cycles per second, or hertz: gamma waves (30 – 80 Hz) appear when we process complex sensory information; beta waves (13-29 Hz) appear when we are alert and attentive; alpha waves (8-12 Hz) appear when we are relaxed and disengaged from thoughts as in meditation; theta waves (3.5 – 7.5 Hz) often appear in deeper meditative states, but also when falling asleep. Finally, the slowest wave cycle, delta waves during deep sleep (Roll & Williams, 2010).

In the results of laboratory-based studies that have sought EEG-parameters as correlates of ESP activity, the picture is inconsistent (Watt and Irwin, 2010, p. 54). A high amount or density of alpha waves (8 – 13 Hz) activity during a telepathy (or ESP) test is assumed to be a good predictor of performance, especially if the subject reports being in an altered state of consciousness at the time (Palmer, 1978). This is also emphasized by an overview of accounts from highly successful ESP percipients by White (1964), who found “a great deal of emphasis on achieving a state of deep mental and physical relaxation” (Roll & Williams, 2010, p. 1). Even if alpha waves are of first interest, also changes in other waves have however been of interest. For example, McDonough, Warren and Don (1989) found an association between “hits” in an ESP test and increased power in the delta (1-3 Hz) and theta (4-7Hz) EEG bands, suggesting a facilitatory effect of low cortical arouse (Watt and Irwin, 2010, p 54).

There are (Roll & Williams, 2010, p. 2) six studies (where also the studies gave evidence for ESP), that have shown a positive relationship between alpha and telepathy/clairvoyance (Cadoret, 1964; Honorton, 1969; Maher, 1986; Morris *et al.*, 1972; Stanford & Palmer, 1975; Stanford & Stevenson, 1972). With different experimenters in these studies and with the conclusion mentioned above (White, 1964), Roll and Williams (2010) find it improbable that this result would depend on the experimenter, the so-called experimenter-effect.

EEG have also been used (Roll and Williams, 2010, p. 55) to determine if the brains of connected pairs are correlated, studies that have been reviewed above (e.g. Duane & Behrendt, 1965; Kittenis, Caryl & Stevens, 2004; Persinger *et al.*, 2003; Radin, 2004b; Wackermann, Seiter, Keibel & Walach, 2003). Rebert and Turner (1974) reported a study where they recorded EEG from 6 people while distant senders were stimulated at random times with light flash flickering at 0, 6 or 16 Hz (Radin & Pierce, 2015, p. 235). There have more lately been several efforts to use brain waves to detect evidence of a telepathic “signal” from one person to another using the event-related potential (ERP), a measurable brain response to a specific stimulus (Broughton, 2015, p 142). Simply described, a researcher can stimulate one member of a pair, the two persons being in separate rooms, with a light flash which causes an ERP in the EEG record for one person, and then look for evidence of the ERP in the other non-stimulated participant’s EEG. If it would be a successful outcome, it could indicate a telepathic link (Broughton, 2015). Grinberg-Zylberbaum *et al.* (1994) made a study along this idea with seven pairs. In the result, there were significant correlations in two of the pairs in the “connected” condition (an effect they called “transferred potential” (Watt & Irwin, 2010, p. 55), however with questioned methodology (May, Spottiswoode & Faith, 2001) and also Wackermann *et al.* (2003) and

Watt and Irwin (2010, p. 55), but the result was sufficient to inspire replications. Sabell, Clarke and Fenwick (2001) tried to replicate, but failed.

Four studies have tested emotionally bonded pairs (Roll & Williams, 2010). In the first, Wackermann *et al* (2003) had participants to spend 20 minutes together to strengthen their empathic bond. Then, when the sender was stimulated, the receiver showed voltage changes that were not seen in the control receivers whose sender was either not stimulated, or there was no designated sender. In the second study, Standish *et al* (2004) used 30 pairs, stimulating one member with a reversing black and white checkerboard pattern comparing it with a static checkerboard (stimulus off) (Broughton, 2015, p. 142). They looked for evidence that the EEG pattern elicited by the two conditions in the stimulated person was replicated in that of the non-stimulated participant. An analysis of all 60 participants received highly significant results for the stimulus-on condition. Four of the five significant pairs were able to return for a replication study, and one pair was able to replicate their significant performance (Broughton, 2015; Roll & Williams, 2010, p. 7). In the third study, Radin (2004b) found very significant correlations in ensemble EEG variance between 13 pairs of friends when one was stimulated with the video image of the other – there were voltage changes between the emotionally bonded pairs (Roll & Williams, 2010, p. 7). In the fourth study Kittenis, Caryl and Stevens (2004) found significant differences in evoked-alpha global field power from non-stimulated participants in related pairs. The brain maps they created from the EEGs of each emotionally connected pair revealed that as the sender's brain became electrically active during the stimulation, the receiver's occipital-parietal region was also activated (Roll & Williams, 2010, p. 7).

In a replication, the same effect was found, and in the third study only related pairs failed to replicate the effect. So, in total, Kittenis' studies gave a mixed result (Watt and Irwin,

2010, p. 56). When summarizing ESP (telepathy) and EEG studies, the comments can differ. Watt and Irwin (2010, p. 56) find there are some positive results reported, but they lack consistency or replicability. Roll and Williams (2010, p. 7) are a little more positive and emphasize there are six EEG correlation studies, conducted by different experimenters, showing correlations between the brains of connected pairs. Two were genetically related pairs, and four were emotionally bonded. They find that these experiments are consistent with reports of telepathy experiences from everyday life.

4.8 Other use of EDA in parapsychology

Even if Beloff (1974) and Morris (1977) made the first steps, the standard design with electrodermal activity was established by William Braud and his colleagues during the 1970s and 1980s (Braud, 2003; Braud & Schlitz, 1991; Schlitz & Braud, 1997), and most studies in parapsychology using EDA have been carried out in order to study remote influence, in the DMILS protocol and remote staring, but also presentiment and healing.

4.8.1 EDA, DMILS, 'remote staring' and healing

The largest area in parapsychology to use electrodermal activity (EDA) is probably Direct Mental Interactions with Living Systems (DMILS) (Braud, 2003; Delanoy, 2001), an analogue of mentally induced healing. The standard design using EDA with DMILS was established by William Braud and his colleagues during the 1970s and 1980s (Braud, 2003; Braud & Schlitz, 1991; Schlitz & Braud, 1997). In this design one person systematically tries to influence a psychophysiological response of a receiver located in another room (Delanoy, 2001). The goal for the “sender” can be either to calm or activate the receiver’s EDA at different times during the experimental session. Of the 37 DMILS studies that Braud conducted from the late 1970s to the early 1990s, 21 gave a significant result (Braud,

2003; Braud & Schlitz, 1991; Delanoy, 2001; Schlitz & Braud, 1997), a strong support for an analogue of mentally induced healing in a laboratory setting. Attempts to replicate this initial work by Braud using EDA as a response system have been carried out at six different laboratories (Delanoy, 2001). The replications have used either the calm/activate approach or the remote staring protocol.

The area 'remote staring' is another application of EDA in parapsychology. These studies (e.g. Braud, Shafer & Andrews, 1993a & 1993b) are very similar in design to the calm/activate DMILS studies, except that the 'activate' period consists of the agent staring at the real-time image, shown on a monitor screen, of the receiver which is conveyed to the agent via a closed-circuit video camera system. The 'calm' periods become 'non-staring' periods where the agent does not view the image of the receiver. Delanoy (2001) concludes that the replications at other laboratories of Braud's work also have been overall successful. Of the 11 remote staring studies, seven or 67 % obtained an independently significant outcome.

There is according to Delanoy (2001) and Braud and Schlitz (1989, 1991) one main reason why DMILS research is successful. As mentioned before, using EDA makes it possible to avoid cognitive bias (Cacioppo, Berntson, Larsen & Ito, 2004) since the inclusion of additional (potential) cognitive correlates may inhibit the psi process that is studied. The underlying idea is that a physiological measure short-circuits the cognitive processes. Thus, autonomic responses might be subjected to less cognitive interference than other types of psi responses, especially when those are based on a conscious response. Another reason is that living targets, like the skin may have a greater lability than other systems, an ability to change in response to external influences.

Emotions have been mentioned earlier to be an interesting and important factor in parapsychology. There is also from DMILS research support for this idea. The DMILS protocol suggests (Braud & Schlitz, 1983, in Ramakers, 2008) that emotions might play a role in telepathy where people with greater emotion-related sympathetic nervous system activity (a greater “need” to be helped) showed a distant calming effect.

Since DMILS is connected to healing, being an analogue to it, a few words can be mentioned about it. Healing has been practiced and cases have been reported in many societies and cultures and at any point in history, the practice that mental influence can affect the health in other human beings, even when these are far away (Dossey, 2003). The tradition of healing is a natural part in many cultures, like Siberia (shaman tradition), Brazil, Papua New Guinea, Mexico, Senegal, Kalahari Desert and Japan (Schlitz & Braud, 2003, p. 210). Spontaneous cases of healing are reported from “faith healers” but also from certain sites, like Lourdes, where an international team of physicians gathered medical documentation and determined among other things the exact nature of the disease. 19 cases were judged “medically and scientifically inexplicable” during the years 1954 – 1984 (Dowling, 1984, p. 637; Kelly & Tucker, 2015, p. 72).

It was in the 1960s that researchers started using more formal scientific protocols to study healing in controlled studies, e.g. influencing hemolysis of red blood cells (Braud, 1990), plants (Grad, 1963) and mice (Watkins & Watkins, 1974) (Palmer, 2015, p. 60). The idea to use mice for healing was recently picked up by Bengston (2010) who infected mice with a well-known form of cancer. He found that among infected mice that regularly were treated with healing (laying-on-of-hands) significantly more mice did survive as compared to mice that were not treated with healing (Bengston & Kinsley, 2000) (Watkins, 2015, p. 79). He even found indications of a resonance effect in healing studies (Bengston & Moga, 2007).

A new research area has emerged during the last decades connecting healing with some kind of biological field, biofield science (e.g. Rubik, 2004; Rubik *et al.*, 2015), possibly connecting with research from the early 1900s by Burr and Northrop (1935), Gurwitsch (1922), Driesch (1968) and Weiss (1927) and among later names Becker (e.g. Becker & Selden, 1985) and Nordenström (1983) about a biological field, possibly explaining how a biological organism can be developed and controlled, one of the basic questions still remaining in biology.

4.8.2 EDA and Presentiment

The field of presentiment is rather new in parapsychology. The term presentiment refers to an unconscious precognitive response by the autonomic nervous system (Roll & Williams, 2010), meaning the person must not be aware of the response, it is physiological. The autonomic nervous system in the human body can respond to a stimuli 2-3 seconds before the stimuli is presented. The body is thus “knowing” an event before the event that causes the reaction has occurred. The first experiment with presentiment was published by Levin and Kennedy (1975) using a slow brainwave indicator of anticipation and the participants were to press a button if a green lamp was to be lit, but not for a red lamp. The difference was significant (Radin & Pierce, 2015, p. 232). Skin conductance (i.e. EDA) was for the first time used in parapsychology in an experiment by Zoltan Vassy (1978) in an experiment combining telepathy and presentiment. The result was significant in 6 out of 10 sessions (Radin & Pierce, 2015, p. 232). Almost twenty years later the next reports started to get published.

Radin (1997b) reported a study with double-blind experiments, showing that EDA was higher before emotional photos than before calm photos. The report suggested precognition

(the results were significant), and the phenomenon was dubbed “presentiment” (Radin & Pierce, 2015) of future events. Seven years later he reported a new study of presentiment (Radin, 2004a) with three double-blind experiments in an attempt to replicate the original studies using the same basic design. The study involved 109 participants and showed again higher EDA before emotional photos than before calm photos ($p=0.001$). Various alternative explanations were considered, including expectation, sensory cues, hardware or software artefacts, inappropriate analyses, and anticipatory strategies, but none of them were regarded to be able to systematically generate the observed results.

These four studies, supported by successful replications conducted by other investigators (Bierman & Radin, 1997, 1998; Spottiswoode & May, 2003; Wildey, 2001) as well as studies using functional magnetic resonance, fMRI (Bierman, 2000; Bierman & Scholte, 2002) and heart rate variability (McCraty, Atkinson & Bradley, 2004a, 2004b) is argued to demonstrate a small magnitude but statistically robust form of precognition in the human autonomic nervous system. The same conclusion comes from Eva Lobach (2008) at the University of Amsterdam. She emphasized that past and present research on presentiment has shown that emotionally arousing stimuli, visual or auditory, produce stronger effects than more neutral ones, and besides electrodermal activity (EDA), other important physiological measures used in presentiment studies are heart rate, peripheral blood flow, pupil dilation, brain blood oxygenation (Radin & Pierce, 2015, p. 232), EEG, and fMRI (BOLD signal). Since all these measures show evidence of presentiment, the whole body appears to be involved (Lobach, 2008).

One meta-analysis with presentiment research by Tressoldi (2011) and one by Mossbridge, Tressoldi and Utts (2012) very clearly showed it is a genuine, repeatable phenomenon

(Radin & Pierce, 2015, p. 233). Tressoldi (2011) included 37 experiments with a calculated combined fixed effect size of 0.26, in agreement with the average effect observed across a very broad range of ordinary human performance (Radin & Pierce, 2015, p. 233), presented in Richard, Bond & Stokes-Zoota, 2003). In Mossbridge *et al.* (2012), 49 published and unpublished studies were found, and 26 of these fulfilled the three criteria that were set up to be included in the meta-analysis.

4.9 Meta-analyses in parapsychology

Besides the early meta-analyses in ganzfeld telepathy, one more recent will here be mentioned, as well as some important, more recent meta-analyses from other fields in parapsychology.

4.9.1 Dream telepathy

The first meta-analytic review on dream telepathy at Maimonides was conducted by Child (1985), summarized above in section 2.5. This review was followed by Krippner and Friedman (2010), Sherwood and Roe (2003) and Ullman *et al.* (2003). They have all shown (Baptista *et al.*, 2015) that most of the criticism raised about the Maimonides methodology have been shown to be unfounded and those that are valid have been shown to not compromise the obtained overall results in any significant way.

Sherwood and Roe (SR, 2003) made the first meta-analytic review of the dream telepathy studies carried out after Maimonides, called post-Maimonides. They found 23 formal reports published before 2003, where 9 studies were on telepathy (and 13 for clairvoyance and 4 on precognition and some on a combination of these phenomena). 21 of these 23 studies reported sufficient information to obtain an outcome measure (Baptista *et al.*, 2015, p. 206). The effect size that SR calculated varied between -0.49 and 0.80 (giving a

combined effect size r of 0.11 (Sherwood & Roe, 2013, p. 66)), which strongly suggests a heterogeneous ES distribution. SR concluded that replications have been possible across laboratories and groups of researchers, the most successful being by Child, Kanthamani and Sweeney (1977; $ES = .58$ and $-.80$ respectively). SR also noted that a number of studies have found that the earth's magnetic field (GMF) (Krippner & Persinger, 1996; Persinger & Krippner, 1989; the most successful experiments were found to occur on geomagnetically quiet nights) and local sidereal time (LST) seem to correlate significantly with the success or failure of dream telepathy trials.

A dream study that was carried out rather recently is also worth mentioning here, even if it was not on telepathy but precognition (Baptista *et al.*, 2015). Watt (2014) used Twitter to do an online study with precognitive dreams, a somehow new approach. Participants were asked to take note of their dreams over 5 mornings, after which they were sent a questionnaire asking for an anonymous summary of their week's dreams. They later also watched the target clip on YouTube. They were then asked to evaluate how similar they felt their dream content, themes and emotional tone were to the target. Two independent judges, not knowing the participants, applied similar ratings between the dream summary contents and the clips and use the same ratings to rank-order the four clips for each of the dream summaries of the participants. In 200 trials, 64 direct hits were obtained for a 32 percent hit rate and $ES = 0.16$ (Baptista *et al.*, 2015). In a binomial test, this hit rate is significant ($z = 2.21$, $p = 0.015$, one-tailed) and the ES is almost identical to the unweighted mean of the other post-Maimonides study ever conducted and it produced a statistically significant hit rate (Baptista *et al.*, 2015).

4.9.2 Ganzfeld-telepathy

The most recent, big meta-analysis on ganzfeld telepathy studies is by Storm, Tressoldi and Di Risio (2010), a study that included not only ganzfeld but all free response ESP studies that had been conducted from 1997 to 2008 (Baptista *et al.*, 2015, p. 194). There were 30 ganzfeld studies, by 36 different investigators, comprising 1.648 trials. To be included in the review on ganzfeld telepathy, the criteria was that the study had more than two participants, used a random number generator or a random number table for target selection, and provided enough information to calculate direct hits (Baptista *et al.*, 2015, p. 194). Excluding an outlier (having an extremely high so-called *z* score), the result was a mean $ES = 0.142$, a hit rate on 32.2 % and $p < .001$ (with the outlier, ES was 0.152 and $p = 1.15 \times 10^{-10}$). In this data base of 29 ganzfeld studies, they also analysed a) comparison of the effectiveness of competing experimental conditions (i.e. 29 ganzfeld, 16 non-ganzfeld noise reduction studies (dream-psi, meditation, relaxation or hypnosis), and 14 standard-free response), b) an assessment of the performance of selected and unselected participants, c) a test of experimenter effects, and d) – e) file-drawer assessments.

For a, they found that the ganzfeld procedure still is the best developed of the free-response categories of studies, ganzfeld having the highest mean $ES = .142$ (and $p = 2.13 \times 10^{-8}$), followed by non-ganzfeld noise reduction $ES = .110$ (and $p = 2.08 \times 10^{-4}$) and the last group standard free-response $ES = .029$, showing that some kind of sensory isolation is best to elicit psychic functioning, i.e. an anomalous communication. For b, the hypothesis that selected participants performed better than unselected, a significant interaction was found, indicating that the difference could be attributed to participants in the ganzfeld only, where selected participants ($ES = 0.26$) had outperformed unselected ones ($ES = 0.05$) by half an order of magnitude, a statistically significant difference, $p = .002$ (Baptista *et al.*, 2015, p. 194), showing participant selection is a moderator variable of psi performance. For c, a test

of experimenter effects, no significant difference was found for effect size between different laboratories or experimenter groups (with at least two studies in each, Morris, Parker, Roe, Roney-Dougal, Tressoldi and Wezelman) ($p=.315$, two-tailed).

4.9.3 DMILS

In a recent review of EDA-DMILS (also remote staring studies are included) (Schmidt, 2015), all studies with EDA-DMILS completed by 2000 are included, with 40 single experiments. Three quality indices were computed, concerning safeguards, EDA-methodology and methodological quality. These were then integrated with different weights to an overall quality index (and four studies were excluded since they were not found to meet minimum methodological quality standards). The overall effect size was small but significant, for EDA-DMILS there were 36 studies, consisting of 1015 sessions, giving a mean effect size of 0.106 and a p -value of .001. For remote staring, there were 15 studies, consisting of 379 sessions, giving a mean effect size of 0.128 and a p -value on .013 (Schmidt, 2015), altogether a strong support for an analogue of mentally induced healing in a laboratory setting.

4.10 The criticism against parapsychology – and how to meet it

Being a controversial field, it is also natural to review some of the most common critique to parapsychology and add some comments how this critique is met, and what critique that is regarded to be valid. The research has during the years been very much criticized. Here, the critical comments will be reviewed on twin telepathy studies that have been carried out, and also a few relevant critical comments on other research on telepathy and with EDA, mentioned in recent reviews, including one in a mainstream journal (Cardeña, 2018).

For twin telepathy, as mentioned earlier, thought concordance was early mentioned as a more probable explanation in claimed cases of twin telepathy, as suggested by Blackmore and Chamberlain (1993) and again by Segal (1999). But, using only three pairs of twins, this study is far from enough to justify the final rejection of the telepathy hypothesis in favour of that of thought concordance. Besides, also as mentioned before, they were unselected (i.e., none of them had apparently reported any mutual psychic experiences). Thought concordance as a possible explanation for twin telepathy is also commented by twin telepathy author Playfair (2017) to hardly be an adequate explanation for one twin's reaction to an unpredictable event affecting the other one for which there is no genetic cause. Among the cases Playfair has received from twins, many of them directly from the source, there are twins who have reacted when their distant brothers or sisters have been in a car crash, fallen downstairs, broken a leg or a nose, been given a black eye, had a painful injection, got stuck in a car seat belt, burned an arm, begun to suffocate, given birth several weeks prematurely, committed suicide or been shot dead (Playfair, 2012). None of these cases can be explained away by thought concordance if you are to take them seriously, but would rather indicate the occurrence of twin telepathy and possibly support the hypothesis of the monozygotic twin relationship to be an example of nonlocal entanglement (Playfair, 2017). To explain them away as "thought concordance" suggests a lack of familiarity with the evidence, Playfair argues. For the more recent experimental studies with twin telepathy using EDA (the first ones by Jensen and Parker (2012) and Parker and Jensen (2013), there have so far not been published any criticism against methodology and conclusions. One criticism that is adequate is the small samples, but that weakness is already mentioned by the authors of the reports.

Critical comments in all the field of parapsychology are widely reviewed and discussed in a recent book by Cardeña, Palmer and Marcusson-Clavertz (e.g. Cardeña *et al.*, 2015; Tressoldi & Utts, 2015) and also in a recent paper in a mainstream journal (Cardeña, 2018), a review which however was criticized and dismissed by two leading sceptics, Reber and Alcock in the same leading journal *American Psychologist* (Reber & Alcock, 2019a) and in *Skeptical Inquirer* (Reber & Alcock, 2019b), in short claiming psychic phenomena are "impossible". Their dismissing comments were however in turn dismissed by parapsychologist Bryan J. Williams (2019), claiming their rebuttal isn't a sound one when it is examined carefully, their arguments being primarily personal opinions and unfounded assumptions (Williams, 2019).

One general critique that should be mentioned is related to the fact that the evidence for psi often is based on statistics, and here psi critics argue that they have explained away the statistical evidence for psi. This is one of the criticisms that Cardeña *et al.* (2015, p. 5) regard as invalid. In this case, the critic means that in principle a future argument could explain away the results that so far are positive and support the psi hypothesis (Hyman, 1995), in this case valid for research in remote viewing. This is undoubtedly true, but it is also valid for all single studies and theories in mainstream science. A sub-comment or follow-up to this criticism is that if Bayesian statistics would be used instead of frequentist statistical techniques, the results would evaporate (Cardeña *et al.*, 2015), a comment that is refuted by e.g. Baptista *et al.* (2015) and Tressoldi and Utts (2015).

Another often occurring criticism (Cardeña *et al.*, 2015, p. 5) is that psi requires exceptional evidence because it is an exceptional claim (e.g. French & Stone, 2014). This assertion was coined by the agnostic author Marcello Truzzi (1978) to declare that there is nothing unscientific about the psi hypothesis, but that "it is actually quite scientifically *proper if all*

ordinary explanations for an established extraordinary event have been found inadequate”.

In this argument, it is however unclear how to determine what constitute “exceptional claims”, and parallel to this, also what would constitute “exceptional evidence”, a concept so flexible that it could be used to either keep changing the evidential goalpost permanently, or to propose such levels of evidence that would make it practically impossible to have evidence for the psi hypothesis no matter how much of it accumulated, as summarized by Cardeña *et al.* (2015, p. 6). For the term “exceptional claims” it should be rather clear, that it changes with time: what we didn’t understand or even considered possible 100 years ago, e.g. electricity and flying airplane, now with more knowledge is far from being exceptional.

Besides that, creating an artificial law that the evidence for psi should follow some higher criteria than the own research of the critics is a particular example of a more general practice in which some critics use a double standard by not applying the same standards of evidence that they seek to impose on parapsychology to other areas (Zingrone, 2004). Palmer (1987) has shown that applying this version of the extraordinary proof criterion to publication of scientific research would lead to biases in the literature that would give an unfair advantage to ostensibly well-established theories, and it would greatly increase the likelihood of Type II errors (Fiedler, Kutzner & Krueger, 2012).

Another criticism regarded to be more valid (e.g. Cardeña *et al.*, 2015) is that parapsychology so far not has been able to develop a reliable indicator who is likely to perform consistently well in psi experiments (and therefore has had difficulties to enhance the small effect sizes found in psi research). An argument that also should be regarded as valid is that psi phenomena should be more integrated with more established disciplines, even if there so far have been attempts to discuss psi phenomena in relation to other larger disciplines (e.g. Cardeña, Lynn & Krippner, 2014 and Carpenter (2014) for psychology,

and Kaiser (2011) for physics (Cardena *et al.*, 2015), p. 7). Also, the terms used have been criticized. The term parapsychology very often elicits very negative reactions, but so far, all efforts to coin another term, theoretically more neutral, e.g. anomalistic, or anomalous psychology, have only partly been successful. Finally, these new ideas also meet reflections - many psi researchers don't regard psi phenomena as anomalous, but basic and fundamental (e.g. Sheldrake, 2015) and essential in the evolution (Broughton, 2015).

4.11 Chapter Summary and Conclusions

Research in parapsychology has been going on for a little more than a century, being the scientific study of phenomena that once were understood to occur *beside* psychology, para meaning outside or beyond. These phenomena didn't fit the view that science had of man in the 19th century. Now, they are among researchers in the field understood to be part of the big mystery of "mind" or consciousness and are at the borders of psychology. Parapsychology include the phenomena telepathy (mind-to-mind communication), clairvoyance or remote viewing ("seeing" hidden objects or places, i.e. with no "sender"), precognition (the claimed ability to get information about future events), presentiment ("feeling the future", an unconscious response by the autonomic nervous system resulting in physiological changes before the future event occurs), psychokinesis (the claimed ability to mentally influence matter) with the subarea healing, where the target is a living organism). In the field there are finally phenomena that indicate something survives the bodily death, e. g. near-death experiences. The chapter has its focus on research on telepathy and the use of electrodermal activity (EDA) in parapsychology, since this is the technology used as an indicator of telepathy in this thesis.

Systematic research with statistics did start in 1930 at Duke University, followed in the 1960s by telepathy research with the ganzfeld-methodology (a method to induce an altered state of consciousness) and with dream-telepathy, using the discovery of dreams being associated with rapid eye movement, REM, and a new technology to measure rapid eye movement.

Electrodermal activity has been used in parapsychology as indicator of telepathy, but also remote influence (healing) and presentiment, being a psychophysiological, mostly subconscious measure of among other things telepathy. Electrodermal activity has recently been used as a possible indicator of telepathy between twins in a few studies (Jensen & Parker, 2012; Parker & Jensen, 2012). Besides these two studies, there are rather few that have been conducted on twin telepathy, most of them with small samples.

Exceptional experiences and telepathy being very strange have been compared with the equally strange phenomena in quantum physics, both showing characteristics of so-called non-local effects or entanglement. Neurobiology is also claimed to support a possible connection with parapsychology and even opening for the question if there may be quantum processes also in man and also explaining consciousness.

Among other technologies, fMRI (functional magnetic resonance imaging) has been used in telepathy studies by neuroscientists to try to estimate the level of neural activity in a particular region of the brain. EEG (electroencephalograph) has been used in an effort to find out what brain waves and states of mind that are related to telepathy.

During the years, many meta-analyses have been carried out in parapsychology, meta-analysis being a statistical method to evaluate all experiments in a scientific field that were conducted with one method. It has been done for ganzfeld-telepathy studies, dream-

telepathy, presentiment and a protocol related to healing, most of them giving a significant result supporting the phenomena.

Being a controversial field of research, various criticism has been raised to parapsychology from the very time this research began. It is not very easy to comment or evaluate the criticism, since there very often are very assertive opinions about the field and the phenomena. With a very clear intention to be neutral, most of this criticism however seems to be invalid and more mirror the various attitudes and misunderstandings that occur in the field and debate. A continued open-minded and humble dialogue between proponents and critics is suggested on the various topics that are criticized, including the basic views on the phenomena, whether they are anomalous, basic and fundamental, or fraud and misunderstandings.

CHAPTER FIVE

THREE EXPERIMENTAL STUDIES OF PHYSIOLOGICAL CONNECTEDNESS AMONG TWINS IN RELATION TO ATTACHMENT

5.1 Introduction

Three scientific studies are described where the ostensible relationship between telepathy and attachment between twins is investigated, the bond between sender and receiver being suggested to be important from parapsychological research into distant interactions between individuals. By applying the concept of attachment from developmental psychology, these become the first studies to explore the degree of attachment between twins as a potential dependent variable relating to their apparent telepathic connection. Electrodermal activity was used as indicator of an anomalous transfer of a synchronous reaction between the twin being “sender” and the twin being “the receiver” in the experiments. The process to select the twins to participate is described, as is the test procedure and the evaluation process. The results are presented, discussed and some major improvements in the design are suggested.

5.2 Background

EDA has been used for many years in parapsychology, the biggest field being in the DMILS research (Direct Mental Interaction with Living Systems). The standard design using EDA with DMILS was established by William Braud and his colleagues during the 1970s and 1980s (Braud, 2003; Braud & Schlitz, 1991; Schlitz & Braud, 1997). In this design in the most used protocol EDA-DMILS, one person systematically tries to influence a psychophysiological response of a receiver located in another room (Delanoy, 2001; Schmidt & Walach, 2000). The goal for the sender can be either to calm or activate the receiver’s EDA at different times during the experimental session.

The second most prominent protocol using EDA in parapsychology is the area ‘remote staring’. These studies (e.g. Braud, Shafer & Andrews, 1993a & 1993b) are very similar in

design to the calm/activate DMILS studies, except that the 'activate' period consists of the agent staring at the real-time image of the receiver, shown on a monitor screen, which is conveyed to the agent via a closed-circuit video camera system. The 'calm' periods become 'non-staring' periods where the agent does not view the image of the receiver.

Of the 37 DMILS studies that Braud conducted from the late 1970s to the early 1990s, 21 gave a significant result (Braud, 2003; Braud & Schlitz, 1991; Delanoy, 2001; Schlitz & Braud, 1997). Attempts to replicate this initial work by Braud using EDA as a response system have been carried out at six different laboratories (Delanoy, 2001). The replications have used either the calm/activate approach or the remote staring protocol. Schlitz and Braud (1997) found, in a review of this literature 19 calm/activate and 11 remote staring EDA DMILS studies, and Delanoy (2001) found that seven of the 19 calm/activate studies had achieved independently significant outcomes. If all the 30 EDA DMILS studies are combined (i.e. both the calm/activate and remote staring studies), 14, or 47 % of the 30 studies obtained an independently significant outcome.

In a more recent review of EDA-DMILS and remote staring studies (Schmidt, 2015), all studies with EDA-DMILS completed by 2000 are included, with 40 single experiments (also Schmidt, Schneider, Utts & Walach, 2004). Three quality indices were computed, concerning safeguards, EDA-methodology and methodological quality. These were then integrated with different weights to an overall quality index. Inspecting the funnel plot visually and running a statistical test on publication bias found no indication of publication bias. Four of the studies were found not to meet minimum methodological quality due to inadequate randomization procedures. After removing these studies, 36 studies with 1015 single sessions remained for EDA-DMILS and passed a test for homogeneity. The overall effect size was small but significant, for EDA-DMILS giving a mean effect size of 0.106

and a p -value of .001. For remote staring, there were 15 studies, consisting of 379 sessions, giving a mean effect size of 0.128 and a p -value on .013 (Schmidt, 2015), altogether a strong support for an analogue of mentally induced healing in a laboratory setting.

When it comes to twins, there are actually very few studies that have been done with twins on telepathy (Playfair, 2002), even if reports have been accumulated with stories of remarkable incidents of apparently synchronous, and telepathic experiences between pairs of twins with strong bonds to each other. As is mentioned in the literary review in previous chapter, Parker (2010) mentions eight attempts that are reported to study telepathy amongst twins under controlled conditions (Barron & Mordkoff, 1968; Blackmore & Chamberlain, 1993; Charlesworth, 1975; Duane & Behrendt, 1965; Esser, Etter & Chamberlain, 1967; Kubis & Rouke, 1937; Rogers, 1960; Stuart, 1946). A ninth one is by Galton (1907) without mentioning the word “telepathy“ or “thought transference“, and another study (Rosambeau, 1987) is mentioned by Playfair (2017) – a survey among twins about sharing feelings, sensations and thoughts even when being distant away from each other, experiences that physician, author and MZ twin Larry Dossey calls *telesomatic events*, experiences where hundreds of cases have been reported over the years but have been largely ignored (Dossey, 2013; Playfair, 2017). Rosambeau (1987) found that about 30 percent of the 600 twins they questioned, reported experiences suggesting such community of sensations. The experiences fell into six categories, four of them being of a simpler kind and could be explained by thought concordance, while two (“just knowing” that the other is in trouble, and sympathetic pain) are much harder to explain other than by telepathy, e.g. one twin has an accident in which an eye, nose or arm is wounded while the other feels a sudden pain in exactly the same part of the body, sometimes producing a bruise, burn or blister on the corresponding spot. These cases, Playfair (2017) finds, are visible evidence for macro-entanglement, rarely if ever reported by non-twins, as far as Playfair knows.

Galton (1907) reported that 11 of the 35 twins in his study showed a “similarity in the association of ideas“, which in contemporary terminology is called “thought concordance“ (Parker, 2010), a term Playfair (2017) specifies whereby genetically identical twins can be expected to share a number of likes, dislikes, preferences, and habits. Kelly and Tucker (2015, p.72) mentions a more recent report by Mann and Jaye (2007), about 20 pairs of twins experiencing the other twin’s pain or other bodily sensations similar to those being experienced by the other twin.

While a few of these results seem to confirm the phenomena, most of the studies show significant shortcomings, such as selecting twins irrespective of their claims to be psychic or not, selecting very few pairs of twins, failing to adjust for multiple-analysis of data and the use of various complicated methodologies (Parker, 2010). In one of the most cited studies (Blackmore & Chamberlain, 1993), which attributed success of twins in a telepathic test to that of thought concordance, only three pairs of identical twins were tested under two conditions, one permitting thought concordance and the other telepathy. The results showed clear evidence for the thought concordance hypothesis and no evidence for genuine telepathy. The quoting of this experiment to justify the final rejection of the telepathy hypothesis in favour of that of thought concordance (Segal, 1999) is clearly unjustified based on tests involving just three pairs of twins. Besides, they were unselected (i.e., none of them had apparently reported any mutual psychic experiences). Finally, as Playfair (2002) points out, the testing was carried out in what appears to have been non psi-conducive ambience, namely the adolescents’ school environment (Parker, 2010). In recent research, to be selected for participating in scientific studies in parapsychology, persons having a history of paranormal experiences are often preferred, since the probability for success is higher. Thus, the abundance of anecdotal reports indicates the need of further research and more carefully designed experiments.

A psychophysiological methodology using electrodermal activity as an indicator of the degree of connectedness (telepathy) between identical twins was used in two recently reported studies (Jensen & Parker, 2012; Parker & Jensen, 2013), and since this methodology was the model for the current work, it is in detail described in previous chapter. The studies were carried out as an attempt to develop a standard methodological design that would be easy to use in forthcoming studies, electrodermal activity being used as indicator of an anomalous transfer of a synchronous reaction between the “sender” twin and the twin being “the receiver” in the experiment. In the second study, a design and schedule was developed, that in principle was used in the present work. There were in each run five 5-minute trials, the “sending” twin being exposed to a surprise during one out of eight possible time epochs, each one with the duration of 30 seconds, where one was randomly chosen for the exposure of the stimulus for the sender. The choice of stimulus epoch was performed by a random process (by use of a random integer generator, <http://www.random.org>). In this way, the authorized polygraph expert being with the receiving twin in a separate room, was kept blind as to the choice of epoch for the exposure to the stimuli. The participants were told that the sender would be exposed to some surprise stimuli and that the receiver would be wired to an equipment measuring the electric conductance in the skin, which if there were peaks on the graph could indicate telepathy in case the peak corresponded in time with a surprise stimulus for the sender. Both twins were asked to just relax during all the runs. In the receiving room, the twin being ‘receiver’ was placed in an armchair and connected to the EDA equipment with the right hand. As stimuli, a hand suddenly placed in an ice bucket was used, as was popping a balloon behind the head, eliciting of a knee reflex and also a hard bang on a cupboard.

Even if the overall results were non-significant in these two studies, one pair out of three and respectively four pairs gave independently significant results (with 3 hits out of 10 and a $p < .03$ in the first study). The result in the first of these two studies was reported to be non-significant, $p = 1.7$, using a formula for calculation of hit-probability (p) (Feller, 1968; Wesstein, 2011), a hyper-geometric test for a given number of hits with a known sample size, a known number of possible hits and a specified number of drawing from the sample. For the second of these studies, the result was six hits out of 24 possible, which was marginally significant ($p = .07$, one-tailed) using a binomial test, and with 24 periods under review and a one in eight chance to correct identifying each, mean chance expectancy MCE is $1/8 * 24 = 3$.

To document the experiences twins report, the Exceptional Experiences Questionnaire (EEQ) was developed and has been given to twins on two occasions, both being so-called Twin Days at King's College, one in 2009 and one in 2013. These surveys have provided a sample of more than 200 twins, from which to select twins for telepathy studies, including the three in this thesis. The most frequent kind of experience reported by identical twins concerns accidents and injury, sometimes also shared dreams. Identical (monozygotic) twins are reported to have significantly more of these experiences than non-identical (dizygotic) twins (Brusewitz, Cherkas, Harris & Parker, 2013; Cherkas, 2004/2005). The surveys indicate that approximately 60 % of twins report having these telepathy-like experiences, but only one out of ten report them on a regular basis. With these findings in mind, we have here adopted the term *exceptional experiences* to cover the two main categories of remarkable phenomena which twins report, namely telepathic experiences and remarkable coincidences. The twins are asked in the questionnaire if they have ever experienced telepathy with their twin – by which is meant “some form of communication

which *could not easily be explained* by prior knowledge, common experience or other normal means”, while the other kind of experience they are asked about is “remarkable coincidences in events or decision making”. In the EEQ they are also asked if they ever experienced shared dreams with their twin.

When it comes to attachment between twins, there are almost no studies carried out and reported, the three being found are reviewed in chapter 1. Tancredy and Fraley (2006) and Fraley and Tancredy (2012) included twins in investigations on attachment between siblings, when addressing the question if the bond between twins is to be regarded as an attachment bond. Schwarz, Mustalic and Junker (2015) continued these efforts with the aim to compare attachment between different kinds of siblings and at the same time compare the attachment to the sibling and the romantic partner. The analyses revealed that MZ twins were significantly more attached to their twin than non-twin siblings to their sibling, as was the case with DZ twins. MZ twins were however only marginally significantly more attached to their twin than DZ twins, and they were found to be as equally attached to their sibling as to their romantic partner. DZ twins were as equally attached to their sibling as to their romantic partner. Regarding emotional closeness, MZ twins reported to be emotionally closer to their sibling, compared to their romantic partner, and for DZ twins, they reported equal emotional closeness to their romantic partner as to their sibling.

5.3 Aims

A major interest with these studies concerned carrying out an attempt to replicate the findings of the two twin-telepathy studies mentioned above (Jensen & Parker, 2012; Parker & Jensen, 2013) with newly recruited pairs of twins, and to compare with scores for the attachment that the twins reported having to each other. Formally, the aims for the study

are: a) to investigate if twins reporting many previous exceptional experiences, can demonstrate having this contact with each other in a controlled experiment measuring synchronous reactions, b) to investigate the kind of attachment twins report who present synchronous reactions, c) to investigate if there is any difference in attachment (and attachment-related avoidance and anxiety) between twins who present synchronous reactions when compared to twins who do not, and d) investigate if the answers from the twins in each pair on the ETR questionnaire (the modified ECR-R questionnaire) are approximately the same as they should be expected to be.

5.3.1 Hypotheses:

- a) The twin being receiver will have corresponding physiological responses at the same time as the sender being shocked, significantly more often than would be expected by chance.
- b) There will be a positive relationship between the number of hits a twin receiver has in a telepathy experiment and their self-reported degree of attachment to their twin, from both childhood and adulthood.
- c) There will be a negative relationship between the number of hits a twin receiver has in a telepathy experiment and their scores for negative attachment (avoidance and anxiety).
- d) The scores on attachment from the twins in each pair on the new questionnaire ETR are approximately the same.

Independent variables, IV were: the reported degree of attachment, scores of attachment-related avoidance and anxiety

Dependent variables, DV were: the number of hits per participant in the telepathy experiment.

5.4 Methods

In these studies, the output of the psychophysiological equipment measuring electrodermal activity was used as an indication of potential (telepathic) connectedness. The attachment between the twins in each pair was assessed by means of a self-report questionnaire. A modified version of *Experiences in Close Relationships Revised (ECR-R)* (see Appendix 1) was used, following suggestions from those with expertise in developmental psychology, giving the new *Experiences in Twin Relationships (ETR)* (see Appendix 2). To select twins, the *Exceptional Experiences Questionnaire, EEQ*, was used, where each twin reports frequency of exceptional experiences (telepathy and striking coincidences), what they experienced in the telepathy from the other twin (injury, accident, mood etc) and examples of experiences, age, gender and whether being identical or non-identical.

5.4.1 Technical data in the measuring process

The equipment was built especially for this twin telepathy project by a professional electrical engineer and inventor. The principle for the measuring process in this equipment is identical to comparable equipments available for EDA research. The difference with other equipments is that technical improvements have been applied to this apparatus to provide a better signal to noise ratio. It has thus a very high resolution of the signal (making it possible to see small variations in the skin conductance) and making it possible to select and make use of highest possible resolution of the signal. It records the electric current in the skin, influenced by the sweating processes which varies with the arousal and non-conscious reactions in the body. For maximum stability, the equipment is

designed to get as few disturbances as possible and thus avoid false signals, for example coming from static electricity from the participant. The output is recorded and stored on a computer.

Understanding that technical details in this measuring process are often left out in reports (and can vary), causing much discussion and criticism (e.g., Schmidt & Walach, 2000), more precise technical details are given in Appendix 10.

5.4.2 The new questionnaire to measure twin attachment, ETR

This questionnaire, see Appendix 2, is a slightly modified version of Experiences in Close Relationships, Revised (ECR-R, see Appendix 1), giving scores on attachment-related anxiety and avoidance, modified to be used for twins. The modification consisted of changing the word "partner" to "twin" and excluding three questions that were not relevant for twins, two for anxiety and one for avoidance, see Appendix 2, giving 17 questions for avoidance and 16 for anxiety. The *Experiences in Close Relationships Revised* (ECR-R) questionnaire is a self-report attachment measure with 36 questions, developed by Fraley, Waller and Brennan (2000), yielding scores on the two subscales "avoidance" and "anxiety". The questions were derived from an item response theory analysis of the 4 most commonly used self-report measures of adult romantic attachment (ECR scales, Adult Attachment scales, Relationships Styles Questionnaire, and Simpson's attachment scales). Following recommendations by Fraley *et al.* (2000), the order in which the questions (in the attachment questionnaire ECR-R) were presented to the twin was manually randomized, in order to mix the questions about anxiety and avoidance. Estimates of internal consistency of this questionnaire is .90 or higher for the two ECR-R scales (Fraley, 2015). The reliability and validity are also discussed in Sibley and Liu (2004). While the ECR-R

questionnaire originally had a focus on emotionally intimate, primarily romantic partnerships, the ETR is to be used for focusing on emotionally relationships between twins, which is adequate since a big majority of twins in these studies on the EEQ questionnaire reported the bond to be emotional, strong and also positive, both from childhood and adulthood (see table 2).

The ETR questionnaire yields scores on the two subscales: “avoidance“ (i.e. how much people are uncomfortable being close to others versus secure depending on others, e. g. “I prefer not to show my twin how I feel deep down”), and “anxiety“ (i.e. how much people are insecure versus secure about the availability and responsiveness of romantic partners, or another person, in this study the co-twin, e.g. “I often worry that my twin doesn’t really love me”). There are in the original questionnaire 18 questions to score attachment-related anxiety (with two reversed questions) and 18 questions on attachment-related avoidance (with 11 reversed questions), all to be rated on a 7-point scale where 1 = strongly disagree and 7 = strongly agree). To obtain a score for anxiety a mean score is calculated for the 18 questions concerning anxiety, the same procedure goes for a score for avoidance. The anxiety subscale is characterized by excessive need for approval and fear of rejection and abandonment. The avoidance subscale is in contrast characterized by an excessive need for independence, self-reliance and fear of dependence on others. A high score on these scales means greater anxiety/avoidance.

5.4.3 The Exceptional Experiences Questionnaire, EEQ

The *Exceptional Experiences Questionnaire* was specifically designed to document paranormal experiences and the frequency of these experiences. The EEQ consists of 18 items concerning telepathy-like experiences, striking coincidences (synchronicities), shared

dreams and shared physiological responses to illness. It also included questions concerning the degree and intensity of attachment between pairs of twins, and if it was positive, negative or mixed. Each of the above topics also included a question that encouraged the respondents to give a brief account of their most striking experiences. The questionnaire is developed at the DTR (Department of Twin Research and Genetic Epidemiology), King's College, London, and some questions added by Adrian Parker (personal communication to Parker, 2010), based on his knowledge of the literature and his personal experiences in testing twins. The questionnaire is included in Appendix 4

5.4.4 Participants

The participants in the first study were four pairs of twins (all identical, in the age from 23 to 59, PW and JW males being 59, SH and JW females being 50, AC and HC, females being 23 and AH and JR, females being 54) selected from a little more than 100 twins attending the Twin Day in June 2013 at King's College, London. In the second study there were seven pairs, six pairs being identical, in the age from 23 to 65 (HC being female and 23, RS and AM, females being 35, SH and JW, females being 50, PW and JW, males being 59, RO and HT, females being 59, DF and JF, males being 61 and DC and SC being males, 65 and non-identical), including three pairs from the first study who were successful or enthusiastic and therefore re-invited (and in one pair only one twin acted as recipient, being the only twin in the pair picking up „events“ from her twin). In the third study, there were three pairs, all identical female twins in the ages from 28 to 61 (SH and DB being 44, KG and CA being 61, and GH and NO being 28). All twins had previously completed the EEQ and were selected based on their report of having had several exceptional experiences together, on being interested in participating in further telepathy studies, and also on their availability.

Some examples of the exceptional experiences that these selected participants reported are provided in Appendix 10.

5.4.5 Procedure

The first study took place between 27-28th May 2014 in Bronte Building, Department of Psychology and Counselling, the University of Greenwich, London, the second and third study took place in another location, at College for Psychic Studies, Kensington, London, easier to reach for twins coming travelling to London. The second study took place between 24-29th April 2015, the third 27-28th October 2015. Here, one room one stair down was used for the sender (and the SE, the sender experimenter), and for the receiver (and the RE, receiver experimenter) one room on the 3rd floor was used. They were thus separated with many floors and doors.

In the Bronte building in the first study, the two rooms used for sender and receiver were approximately 25 meters apart and were separated by seven walls in a direct line and five closed doors. The sender twin and SR were located in Psychology Lab A (Figure 1) and the receiver twin and receiver experimenter (RE) were located in Psychology Lab B. A third researcher (DL) was located in Bartlett with a view of the Psychology Lab A door and acted as additional security and possible go between should the experiment be halted. Furthermore, headphones were used for the receiver to attenuate sound.

5.4.5.1 Ethical approval

As for the questionnaires in the survey in chapter 2, all three experimental studies had obtained ethical approval from the University of Greenwich as well as from King's College. The approval primarily concerned the choice of stimuli in the experiments, the stimuli that

the sending twin was to be exposed to, given that real-life events such as injury or accidents could not be used. Approval was given for the choices that could be questioned, a bursting balloon and a hand in a bucket with ice-water, choices that could correspond to the surprise aspect in real-life events.

The ethical approval also included 100 % confidentiality being guaranteed for the responses with electrodermal activity from the twins possibly indicating telepathy. The confidentiality included a) information that the lead researcher and his team will analyse information from the experiments, b) no twin will be possible to identify from the presentation of the results, being 100 % anonymous – only initials, age and gender for the participants will be mentioned in reports - and identifiable data will not be passed on to any third parties, c) about consent d) possibility to withdraw from the study at any time, e) that data can be withdrawn from the study at any time, and f) that possible intended studies at the University of Greenwich will not be affected if they would choose to withdraw from the study. They were told that the research project had been approved by the University of Greenwich Research Ethics Committee (REC), and finally, they were told that by starting participating in the study, they gave their consent, but could still withdraw even after the study was carried out. After the experiment, they were debriefed, reminded who to contact if they had questions, and they were given a thank you for having participated.

5.4.5.2 Design

Each pair of twins participated in two runs, changing roles from sender to receiver or vice versa after the first run. In each run, there were five 4-minute trials (with a one-minute rest period between), each one with eight possible epochs, with the duration of 30 seconds,

where one was randomly chosen by the sender researcher (SR) (AP) for the exposure of the stimulus for the sender. The choice of stimulus epoch was performed by a random process (by use of the random number program “Research Randomizer”), initiated by the researcher

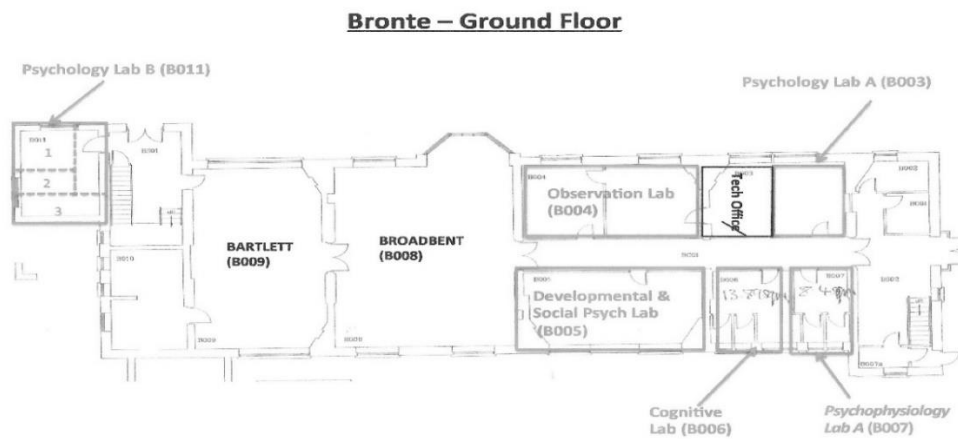


Figure 1. Plan of the building where the first twin telepathy study was carried out, using the rooms Psychology Lab A and psychology Lab B.

attending to sender (the sender experimenter, SE) once the twins had been split. In this way, the receiver experimenter (RE, whose initials were GB) and the twins were kept blind as to the choice of epoch for the exposure to the stimuli.

Even if the attachment between the twins in each pair was of importance, also the time the experimenters could spend with the twins before the experiment started can be of importance, creating inspiration, an enthusiastic atmosphere and openness that the twins could succeed showing their psychic connection in the experiment. Therefore, the plan and intention for the experimenters was to spend at least ten minutes with the twins before the

experiment started, and sometimes the interest among the twins for these phenomena made this introduction take even more time. So, with enthusiasm and interest for the experiences the twins reported having had, the participants were told that the study was about telepathy, that after one run they were to switch roles from sender to receiver and vice versa. They were told that the sender would be exposed to some surprise stimuli and that the receiver would be wired to equipment for measuring the electric conductance of the skin, which if there were peaks on the graph could indicate telepathy in case the peak corresponded in time with a surprise stimulus for the sender. Both twins were asked to just relax during all the run. If they wished they could close their eyes. After this short introduction to the twins, taking place in the Bartlett room in the first study, and in the second and third study, a room on the third floor, adjacent to the receiver room, the twins decided which one of them was to first take on the role of the sender. After that, the receiving twin went with the RE to the room decided for that twin (Psychology Lab B in the first study, the adjacent room on the third floor in the second and third study), while the sender twin went with the SE to their pre-decided room, Psychology Lab A in the first study, and in the second and third study, they used the elevator to go down to the room one stair down.

In the receiving room, the twin was placed in an armchair and connected to the EDA equipment with the right hand, electrodes prepared with paste were attached to the index finger and in the palm, close to the thumb. The receiving twin was asked to keep the hand being wired as still as possible to not disturb the measuring process. Assurance was made that there was a connection (the twin was asked to cough or the electrodes were touched and a verification was made on the graph that there was a reaction). At the point of the initiation of the trial, the RE met the SE outside the room with the sending twin, they started their stopwatches at the same time, and then both left to their respective rooms, where the

SE carried out the randomizations, five times using the program “Research Randomizer” in order to determine which of the 8 epochs for each of the five trials to be selected for the surprise exposure. At precisely the five-minute point following the synchronization of stop watches, the run started.

There was 30 seconds at the beginning of each trial to give a baseline, and also 30 seconds at the end, to give a minimum of one minute between two possible exposures, in case the last epoch in one trial and the first epoch in the next trial are selected for the stimulus (table 1). The exposure was to be at the midpoint in the epoch chosen by random. After the first run with five trials for the first twin in the pair, the twins changed roles (and rooms) without seeing each other during the change. After the second run, the twins separately filled the questionnaire on twin attachment ETR and were then able to discuss what had happened and were debriefed. This questionnaire was filled after the experiments in order to avoid that the questions might cause thoughts and reflections about their relationship that could influence and disturb the participant’s relaxation and the experiment. For each of the trials,

Table 1. A table showing after how many minutes and seconds the exposure was to take place, for each of the 8 possible epochs within the block for each of the five surprise exposures.

| Exposure Block | | | | | | | | |
|----------------|-------------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Stimulus | 30 sec. Potential exposure period 1 | 30 sec. Pot. exp. Period 2 | 30 sec. Pot. exp. period 3 | 30 sec. Pot. exp. Period 4 | 30 sec. Pot. exp. Period 5 | 30 sec. Pot. exp. period 6 | 30 sec. Pot. Exp. Period 7 | 30 sec. Pot. exp. period 8 |
| 1 | 0.45 | 1.15 | 1.45 | 2.15 | 2.45 | 3.15 | 3.45 | 4.15 |
| 2 | 5.45 | 6.15 | 6.45 | 7.15 | 7.45 | 8.15 | 8.45 | 9.15 |
| 3 | 10.45 | 11.15 | 11.45 | 12.15 | 12.45 | 13.15 | 13.45 | 14.15 |
| 4 | 15.45 | 16.15 | 16.45 | 17.15 | 17.45 | 18.15 | 18.45 | 19.15 |
| 5 | 20.45 | 21.15 | 21.45 | 22.15 | 22.45 | 23.15 | 23.45 | 24.15 |

a mark was made by RE on the event-channel on the equipment when the trial was finished. Using this time-mark, each trial and each epoch on the printouts of the graphs could be calculated, the middle-point in each epoch could be marked, as could the time when peaks occurred.

In the second study, it was also possible to measure EDA for the sender, with equipment that was available to borrow from the University of Greenwich. The same procedure to attach electrodes to the fingers for the sender was carried out. With this equipment it would be possible to determine if and exactly when there was a reaction for the sender when having the surprise stimulus, giving more safety in the comparison with a possible reaction for the receiver. Otherwise, the surprise for the sending twin is expected to cause a reaction in the electrodermal activity for the sending twin, a reaction that the receiving twin hopefully would sense and therefore be displayed in the graph for the receiving twin. With an extra equipment for the sending twin it could be possible to really find out if this expected change in the electrodermal activity took place. Unfortunately, for practical reasons, data from this extra equipment could not be analysed, the equipment being in London, and the person to do the analyses, the author, GB, was living in Stockholm.

5.4.6 Applied stimuli

The first idea for these studies was to have stimuli that were similar to the kinds of experiences that twins report, such as sudden pain or getting an injury (incidences that clearly give shocks to the body and thus would cause a clear change in the EDA). It would correspond to real-life spontaneous experiences. Since such stimuli could not be used for ethical reasons, the surprise aspect in these real-life experiences was used, in some way being similar to the kind of stimuli that twins reported having had. In the earlier studies (Jensen & Parker, 2012; Parker & Jensen, 2013), the most successful stimulus found had

been placing the participant's hand into an ice-water bucket. Earlier the crashing of plates has been used, but because of the possibility that the receiver might hear the resulting noise, this was in the fifth trial in the 1st and 3rd study substituted by a loud but lower frequency noise in the form of a singular, hard knock on a metal-cupboard. In the 1st and 3rd study, placement of the right hand put in an ice bucket was used twice (in trial 1 and 3), and also the sudden surprise a bursting balloon was used twice (in trial 2 and 4). In the 2nd study, an ice bucket was used in trial 1 and 5, a balloon in trial 4, a bang in trial 2, and a hairdryer turned on was used in trial 3, as is presented in table 3. Since the twins only participated once as receiver and nothing was mentioned about the order, the order of the stimuli was not judged to be of importance, and so the same order was used for all runs. Besides, the epochs to be used for the exposure were chosen randomly, and no stimulus was used in two trials following each other.

5.4.7 The evaluation process

The main pre-planned criterion to select the receiver's most volatile response epoch was that there should be a distinct peak in the middle of an epoch, +- 5 seconds from the middle-point, indicating arousal and a psychophysiological change, i.e. indicating a possible telepathic contact with the sending twin if it occurred in the same epoch as the sender was stimulated. A peak can also be regarded as the receiving twin showing a synchronous reaction with the sending twin who is expected to react with arousal when having the surprise. If there were peaks in more than one epoch fulfilling this basic criterion, the largest would be chosen. A further criterion was that the graphical output should be calm before the peak occurred. In any event a selection was made for every trial, based on the best data and if there anywhere was a distinct change in the graph (in a few there was not). An initial evaluation was made by Receiver Experimenter RE - evaluating where there were peaks

following these criteria. Then, the process differed between the studies. In the first study, an external expert was used, print-outs of the graphs were sent to this external expert for an independent evaluation, and also to DL (as an independent go-between the RE & the SE) and a preliminary summary of target epochs for each trial and run was made by the RE.

The external expert was the inventor and electronic engineer who built the equipment and had experience at analysing display graphs from this kind of equipment. Since it was rather clear in most trials which epoch had the obvious peak, a manual evaluation by RE was possible and sufficient. With considerably more recorded data, it would be possible to develop an automatic analysis in the evaluation through the development of a mathematical algorithm, including checking the sizes of the peaks, comparing with the basic level etc. This would be possible in future work. Since the RE recorded the electrodermal activity with the “receiving” twin, he was kept blind as to which moments the “sending” twin was exposed to the shock or surprise stimulus and had the task to identify which of the 8 possible epochs - each lasting 30 seconds - that might correspond to the exposure of the other twin to the stimulus.

In this first study, after having received comments from the external expert, a final decision was made by the RE as to which of the epochs was to be identified as the possible target epoch. There were only disagreements between RE and the external expert in the cases when the external expert suggested an epoch with a peak being either too early or too late in the epoch (starting 10 seconds or more before or after the midpoint, and this partly depending on the instructions to him being not clear enough). Therefore, when there were disagreements, they were not paid attention to by the RE, when making the final decision. With this result, the conclusion was drawn that an external expert was not found to be necessary in the second and third study.

For all three studies, after having triple-checked the graphs, watching them with different scales, the RE (GB) made the final decision which of the epochs were to be identified as the possible target epoch. Additionally, a confidence estimation was given to each trial (from 1 to 10) based upon how clear and distinct the peak was and the absence or presence of other smaller peaks, and also, the confidence decreased with increased displacement in time of the peak from the centre of the epoch.

Raw data, including epoch guesses and actual epoch for each trial in each of the three studies is included in table 2. Analyses were made for all the useable trials, 19 in the first study, 53 in the second study, and in the third 19. The questionnaires on attachment were analysed by the RE and mean scores were calculated for each twin for attachment-related avoidance and anxiety, each question possibly giving between 1 and 7.

In the first study, during two of the eight runs, the battery in the equipment measuring the skin conductance had not been fully recharged, and in two other runs, the graph was flat with no peaks or variations in the graphical record, probably due to the person for some reason belonging to the 10 % of the population being electrodermal nonresponders who do not show any reaction at all, perhaps due to personality type or type of skin (Schmidt, personal communication, 2015-11-20). The number of trials per run giving a graph with possible peaks was 4 in the first run (it was by mistake stopped too early), and 5 in runs 2, 3 and 4.

In the second study, from the original 65 possible trials, five trials were left out, since the participant AM was accompanied by her baby, being sleeping when AM was sender, but being awake when AM was the receiver. The run with her as receiver was thus not calm

enough to be analysed, since she all through her run was disturbed by her baby. Also, when this participant was sender, there was a risk the baby would wake up, so the bang stimulus was not used. Besides that, the hairdryer didn't work at one trial, and in five trials finally, one for each of five participants, there were no real changes in the graph, no deviation was big enough to be regarded as a peak. For these participants, there were only target windows decided for four trials, and in some instance three. The number of trials per run giving a graph with possible peaks was 5 in six runs, 4 trials in five runs and 3 trials in one run. Thus, altogether, analyses were made for the useable 53 trials.

In the third study, with 3 pairs, and 6 runs being carried out, in two of these runs (for receiver GH and DB), there was some recording error (giving no graph at all), and in one trial (for receiver CA), the stimulus failed. For these participants, there were only target windows decided for four trials. Altogether there were 19 trials being analysable, 5 trials in three runs and 4 trials in one run.

5.5 Results

5.5.1 The EDA data in relation to exposure epochs

The results will first be presented for each of the three studies, then the overall result. The hypotheses will be commented on for the overall result, not for each of the studies.

For the first study, there were 3 pairs on the first day, with 6 runs being carried out, one run for each twin as receiver, two of these were typical so-called 'zombies', giving just a flat graph on the level. It is not clear why this was the case. One possibility is the twins were very calm and did not react to any major stimulus, neither external nor internal. Boucsein (1992) discusses possible reasons, e. g., missing data that also takes into account zero reactions to stimuli e.g., in cases of advanced habituation, sometimes happening with

electrodermal nonresponders, electrodermal inactivity and lability, cases that partly can be connected to certain personality types. Schmidt, having written a review of EDA research in parapsychology (Schmidt, 2015), comments that it is not so unusual, quite a large percentage of people, perhaps 10% are a kind of EDA flat liners and do not show any reaction at all (personal communication, 2015-11-20). For the second day, the batteries were not fully re-charged, so the two runs this second day gave no graphs that could be analysed.

Table 2. Table showing, for each subject in the first study, the number of trials, in what epoch there was a peak for the receiver, the strength or confidence for that peak, in what epoch there was an exposure for the sender, which trial gave a hit, kind of stimuli in each trial (the same for all trials), and mean confidence for hits, misses and all.

| Subject | No of trials | Epoch guesses | Confidence strength | Actual epoch | Hits | Kind of stimuli |
|-----------------|--------------|---------------|---------------------|--------------|------|-----------------|
| 1A-PW | 5 | 5 | 7 | 5 | X | icebucket |
| | | 4 | 6 | 5 | | balloon |
| | | 3 | 7 | 2 | | icebucket |
| | | 7 | 7 | 7 | X | balloon |
| | | 5 | 7 | 5 | X | hard knock |
| | | | | | | |
| 1B-JW | 4 | 6 | 8 | 3 | | -, - |
| | | 5 | 8 | 6 | | |
| | | 3 | 6 | 3 | | |
| | | 3 | 6 | 7 | | |
| | | | | | | |
| 2A-HC | 5 | 3 | 7 | 2 | | -, - |
| | | 8 | 10 | 7 | | |
| | | 4 | 5 | 5 | | |
| | | 3 | 7 | 2 | | |
| | | 5 | 6 | 7 | | |
| | | | | | | |
| 3A-SH | 5 | 4 | 8 | 4 | x | -, - |
| | | 6 | 6 | 8 | | |
| | | 7 | 6 | 3 | | |
| | | 5 | 8 | 6 | | |
| | | 8 | 7 | 6 | | |
| Mean confidence | hits | | 7.25 | | | |
| | all | | 6.95 | | | |
| | misses | | 6.86 | | | |

Thus, in the first study, four runs gave analysable graphs, three runs with five trials, and one run with four trials (that run was unfortunately by mistake stopped too early), as presented in table 2, where also epoch guesses and actual epoch are included. Because there were 19 trials under review and mean chance expectancy (MCE) is one in eight, in total 19×0.125 , i. e., therefore 2.375 placements overall would be expected by chance. The result gave a total of four correct placements of the epoch, which is above chance, but not significant, $p = .1925$, one-tailed (a one-sample t-test, $t = .89$). With 6 hits, it would be significant. In this study, one twin, PW obtained as receiver 3 hits out of 5 and was therefore invited also to the second study. If his result is considered alone, it is significant at $p = .016$ (non-parametric test, binomial, but it is post hoc, and non-significant when corrected for multiple analyses. Figure 2 shows the graph when there is a small, but clear peak exactly when JW was shocked by the SE, and his brother PW being “receiver” seems to have picked it up.

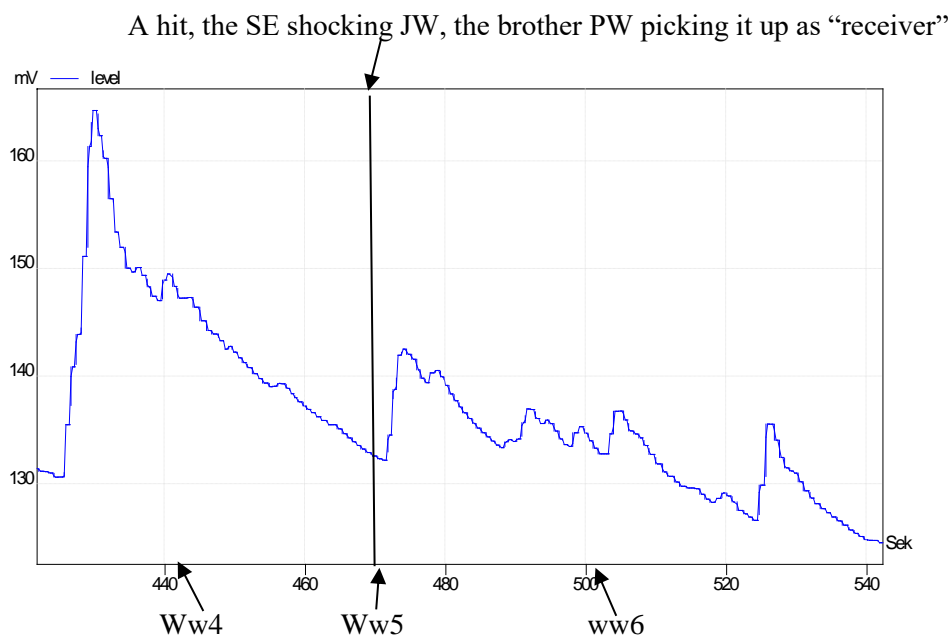


Figure 2. An example what the graph can look like for a peak, the chosen example is for the participant PW who had 3 hits. The peak occurs in the middle of epoch 5 (window 5, ww5), starting after 13 seconds. Window 5 starts at 457 seconds and ends at 487 seconds.

The 4 hits had the confidence ratings 7, 7, 7 and 8 (could be from 1 to 10) and had a higher mean (7.25) than the mean for the other group (6.87), though the difference was not significant. The stimuli that gave hits were for PW the ice-bucket, a balloon, and the metal cupboard, for SH it was the ice-bucket.

In the second study, there were seven pairs, with 13 runs being carried out, 1 run for each twin as receiver, and in each run there were five trials with the exceptions mentioned above. Out of 65 trials, 53 gave analysable graphs, 6 runs with five trials, 5 runs with four trials and 1 run with three trials, as presented in table 3, where also epoch guesses and actual epoch are included. Because there were 53 trials under review and mean chance expectancy (MCE) is one in eight, in total 53×0.125 , therefore 6.625 placements overall would be expected by chance. The result gave a total of 12 correct placements of the epoch, which is significant, $p = .043$, one-tailed (with a one sample t-test, $t = 1.747$). As stimuli, besides using an ice-bucket and a bursting balloon as in previous studies, a hairdryer and a bang on a cupboard were used.

The electrodermal activity in this study was also measured for the sending twin, to make it possible to see if and exactly when there was a reaction also for the sending twin. Unfortunately, due to technical and practical reasons, these data could not be analysed, the equipment being in London and the author to do the analyses is living in Stockholm, and it was not possible to send the data to Sweden.

In this study, some twins made results of some interest. One twin, HC obtained as receiver 3 hits out of 4 (which is significant with a one-sample t-test, $p = .044$, one-tailed, if

Table 3. Table showing, for each subject in the second study, the number of trials, in what epoch there was a peak for the receiver, the strength or confidence for that peak, in what epoch there was an exposure for the sender, which trial gave a hit and mean confidence for hits, misses and all.

| Subject | No of trials | Epoch guesses | Confidence strength | Actual epoch | Hits | Kind of stimuli |
|---------|--------------|---------------|---------------------|--------------|------|-----------------|
| 1A-SH | 5 | 8 | 8 | 2 | | Ice bucket |
| | | 4 | 9 | 4 | X | A bang |
| | | 5 | 8 | 3 | | Hair dryer |
| | | 8 | 9 | 3 | | balloon |
| | | 6 | 6 | 1 | | Ice bucket |
| 1B-JW | 5 | 6 | 6 | 3 | | |
| | | 7 | 7 | 8 | | |
| | | 8 | 8 | 2 | | |
| | | 7 | 6 | 1 | | |
| | | 4 | 8 | 5 | | |
| 2A-DF | 4 | 1 | 8 | 1 | X | Ice bucket |
| | | 5 | 10 | 2 | | |
| | | None | | | | Hair dryer |
| | | 1 | 8 | 3 | | |
| | | 8 | 8 | 8 | X | Ice bucket |
| 2B-JF | 4 | None | | | | Ice bucket |
| | | 6 | 8 | 1 | | |
| | | 4 | 7 | 3 | | |
| | | 5 | 6 | 6 | | |
| | | 4 | 6 | 4 | X | Ice bucket |
| 3A-RS | 3 | None | | | | Ice bucket |
| | | 7 | | None | | A bang |
| | | 6 | 6 | 1 | | |
| | | 8 | 7 | 8 | X | balloon |
| | | 5 | 7 | 5 | X | Ice bucket |
| 4A-HC | 4 | 5 | 10 | 5 | X | Ice bucket |
| | | None | | | | A bang |
| | | 4 | 7 | 4 | X | Hair dryer |
| | | 6 | 8 | 1 | | |
| | | 7 | 8 | 7 | X | Ice bucket |
| 5A-DC | 5 | 7 | 7 | 4 | | |
| | | 5 | 6 | 6 | | |
| | | 6 | 8 | 2 | | |
| | | 4 | 6 | 1 | | |
| | | 1 | 8 | 7 | | |
| 5B-SC | 4 | 2 | 6 | 7 | | |
| | | 5 | 7 | 6 | | |
| | | 7 | | None | | Hair dryer |

| | | | | | | |
|-------------------------|--------|------|------|---|---|------------|
| | | 7 | 7 | 5 | | |
| | | 5 | 7 | 2 | | |
| | | | | | | |
| 6A-PW | 4 | None | | 5 | | Ice bucket |
| | | 3 | 9 | 4 | | |
| | | 8 | 7 | 7 | | |
| | | 6 | 7 | 8 | | |
| | | 1 | 6 | 6 | | |
| | | | | | | |
| 6B-JW | 5 | 1 | 8 | 5 | | |
| | | 3 | 7 | 1 | | |
| | | 8 | 7 | 3 | | |
| | | 5 | 6 | 7 | | |
| | | 2 | 7 | 8 | | |
| | | | | | | |
| 7A-RO | 5 | 8 | 8 | 7 | | |
| | | 6 | 10 | 2 | | |
| | | 5 | 6 | 5 | X | Hair dryer |
| | | 5 | 10 | 4 | | |
| | | 3 | 7 | 1 | | |
| | | | | | | |
| 7B-HT | 5 | 3 | 8 | 8 | | |
| | | 7 | 8 | 1 | | |
| | | 2 | 9 | 2 | X | Har dryer |
| | | 4 | 8 | 4 | X | balloon |
| | | 2 | 8 | 3 | | |
| Mean confi- dence | hits | | 7.75 | | | |
| | all | | 7.49 | | | |
| | misses | | 7.41 | | | |

considered alone, but it is *post hoc*). HC also participated in the first study, was enthusiastic, but there she had no hits. Among the other twins having many hits, DF received 2 hits out of 4, RS received 2 hits out of 3, and finally HT received 2 hits out of 5. The 12 hits had the confidence ratings 9, 8, 8, 6, 7, 7, 10, 7, 8, 6, 9 and 8 (could be from 1 to 10) and had a higher mean (7.75) than the mean for the 41 trials being misses in the other group (7.41), though the difference was not significant.

In the third study, there were 3 pairs, and 6 runs being carried out with the exceptions mentioned above. Out of 30 trials, 19 gave analysable graphs, three runs with five trials and 1 run with 4 trials as presented in table 4, where also epoch guesses and actual epochs are included. Because there were 19 trials under review and mean chance expectancy (MCE)

Table 4. Table showing, for each subject in the third study, the number of sessions, in what epoch there was a peak for the receiver, the strength or confidence for that peak, in what epoch there was an exposure for the sender, which session gave a hit, kind of stimuli in each session (the same for all session), and mean confidence for hits, misses and all.

| Subject | No of trials | Epoch guesses | Confidence strength | Actual epoch | Hits | Kind of stimuli |
|-----------------|--------------|---------------|---------------------|--------------|------|-----------------|
| 1A-NO | 5 | 5 | 9 | 3 | | Icebucket |
| | | 3 | 6 | 3 | X | Balloon |
| | | 2 | 9 | 1 | | Icebucket |
| | | 8 | 8 | 6 | | Balloon |
| | | 1 | 7 | 5 | | hard knock |
| 2A-SH | 5 | 8 | 9 | 7 | | -,- |
| | | 7 | 9 | 7 | X | |
| | | 8 | 6 | 4 | | |
| | | 5 | 10 | 3 | | |
| | | 2 | 8 | 4 | | |
| 3A-KG | 5 | 6 | 6 | 5 | | |
| | | 3 | 7 | 7 | | |
| | | 8 | 9 | 3 | | |
| | | 7 | 7 | 1 | | |
| | | 4 | 6 | 1 | | |
| 3B-CA | 4 | 3 | 7 | 4 | | |
| | | 8 | 8 | - | | |
| | | 6 | 8 | 2 | | |
| | | 6 | 9 | 7 | | |
| | | 4 | 7 | 8 | | |
| Mean confidence | hits | | 7.50 | | | |
| | all | | 7.75 | | | |
| | misses | | 7.78 | | | |

is one in eight, in total 19×0.125 , i. e., therefore 2.38 placements overall would be expected by chance. In this study, there was 2 hits, i. e. almost by chance. The result gave a total of 2 correct placements of the epoch, which is not significant $p = .788$ (with a one sample t-test, $t = -.273$, two-tailed). In this study, an ice-bucket was used, as well as a bursting balloon, a hair dryer turned on and a bang on a cupboard.

The 2 hits had the confidence ratings 6 and 9 (could be from 1 to 10) and had almost the same mean (7.5) as the mean for the 17 misses in the other group (7.76), with a difference that was not significant.

5.5.1.1 *The overall result*

Having the same basic design, the results from all three studies could be summarized. With 4 hits out of 19 in the first study, 12 hits out of 53 in the second and 2 hits out of 19 in the third, there were overall 18 hits out of 91 (MCE = mean chance expectancy is one in eight, in total $91 \times 0.125 = 11.4$), which was significant $p = .043$, one-tailed ($t=1.734$), and with a binomial test, $p = .032$, 1-tailed. The first hypothesis was supported: the receiver did have corresponding physiological responses at the same time as the sender being shocked significantly more often than would be expected by chance. The results demonstrated anomalous synchronous receiver responses. At the hits, an ice-bucket was used eight times, a bursting balloon was used five times, a hair dryer three times and a bang on a cupboard was used twice. The number of twins and trials for each of the three studies, as well as the number of hits are presented in table 5.

Table 5. For each study in this thesis, the number of pairs of twins, number of trials carried out, number of useable trials, number of hits and mean chance expectancy.

| Study | Number of pair of twins | Number of trials | Number of useable trials | Number of hits | Mean chance expectancy, MCE |
|-------|-------------------------|------------------|--------------------------|----------------|-----------------------------|
| 1 | 4 | 39 | 19 | 4 | 2.4 |
| 2 | 7 | 65 | 53 | 12 | 6.6 |
| 3 | 3 | 29 | 19 | 2 | 2.4 |
| 1-2 | 11 | 104 | 72 | 16 | 9 |
| 1-3 | 14 | 133 | 91 | 18 | 11.4 |

5.5.2 Attachment data

The results of the attachment questionnaires from the three studies are summarized in each of the tables 6-8, where the mean scores are presented for anxiety and avoidance for each participant, even for the participants where the graphs were not tested for hits. They are compared with the attachment from childhood and adulthood that the twins reported in questionnaire EEQ, used as a selection criterion for these studies. The attachment scores from the EEQ were between 1 and 7, 1 being very weak, 7 being very strong.

Table 6. For each participant in the first study, the number of hits (as receiver) and degree of attachment, both self-reported from the EEQ questionnaire and the calculated from the ETR questionnaire giving mean scores for avoidance and anxiety. Along with the participant's initials are also identification which twins are in a pair, e.g., 1A and 1B.

| Participant, and gender (M/F) | No of hits | ETR Mean score anxiety 1-7, the maximum in colour | ETR Mean score avoidance 1-7, the maximum in colour | EEQ measure Attachment childhood 1-7 | EEQ measure Attachment adulthood 1-7 |
|--------------------------------------|------------|--|--|---|---|
| 1A-PW M | 3 | 1.94 | 1.53 | 7 | 6 |
| 1B-JW M | 0 | 1.56 | 1.41 | 7 | 6 |
| 2A-HC F | 0 | 1.5 | 1.18 | 7 | 6 |
| 3A-SH F | 1 | 2.25 | 1.29 | 7 | 5 |
| Mean | | 1.81 | 1.35 | 7 | 5.75 |
| Participants with graph not analysed | | | | | |
| 2B-AC F | - | 1.25 | 1.17 | 7 | 6 |
| 3B-JW F | - | 1.75 | 1.47 | 7 | 7 |
| 4A-JR F | - | 1.38 | 2.76 | 7 | 5 |
| 4B-AH F | - | 1.81 | 2.23 | 7 | 6 |
| Mean | | 1.55 | 1.91 | 7 | 6 |

In this study, the first, the range for the mean scores for all participants was for the anxiety subscale from 1.25 to 2.25, and for the avoidance subscale from 1.17 to 2.76.

Table 7. As in table 6, but here for the second study, for each participant, the attachment data and the number of hits (as receiver). Identification of which twins are paired is included, e.g. 1A, 1B.

| Participant and gender (M/F) | Mean no of hits per run | Mean score anxiety 1-7, the maximum in colour | Mean score avoidance 1-7, the maximum in colour | EEQ measure Attachment childhood 1-7 | EEQ measure Attachment adulthood 1-7 |
|--------------------------------------|-------------------------|---|---|--------------------------------------|--------------------------------------|
| 1A-SH F | .2 | 1.94 | 1.53 | 7 | 5 |
| 1B-JW F | 0 | 1.75 | 1.47 | 7 | 7 |
| 2A-DF M | .5 | 1.88 | 2.35 | 5 | 5 |
| 2B-JF M | .25 | 1.56 | 2.71 | 7 | 4 |
| 3A-RS F | .67 | 1.41 | 1.63 | 6 | 7 |
| 4A-HC F | .75 | 1.38 | 1.18 | 7 | 6 |
| 5A-DC M | 0 | 1.75 | 3.18 | 7 | 7 |
| 5B-SC M | 0 | 1 | 1.24 | 7 | 7 |
| 6A-PW M | 0 | 1.94 | 1.53 | 7 | 6 |
| 6B-JW M | 0 | 1.56 | 1.41 | 7 | 6 |
| 7A-RO F | .2 | 1.06 | 1.12 | 7 | 6 |
| 7B-HT F | .4 | 1.44 | 1.65 | 7 | 6 |
| Mean | | 1.44 | 1.75 | 6.75 | 6 |
| Participants with graph not analysed | | | | | |
| 3B-AM F | - | 1.75 | 1.47 | 7 | 7 |
| Mean | | 1.46 | 1.73 | | |

In this study, the second, the range for the mean scores for all participants on the anxiety subscale was from 1.0 to 1.94, and for the avoidance subscale the mean score was from 1.12 to 3.18.

Table 8. As in table 6, but here for the third study, for each participant, the attachment data and the number of hits (as receiver).

| Participant and gender (M/F) | No of hits/no of trials | Mean score anxiety 1-7, the maximum in colour | Mean score avoidance 1-7, the maximum in colour | EEQ measure Attachment childhood 1-7 | EEQ measure Attachment adulthood 1-7 |
|--|-------------------------|---|---|--------------------------------------|--------------------------------------|
| 1B-NO F | 1/5 | 1.0 | 1.38 | 7 | 7 |
| 2A-SH F | 1/5 | 1.75 | 3.13 | 5 | 5 |
| 3A-KG F | 0/5 | 1.75 | 1.5 | 3 | 7 |
| 3B-CA F | 0/4 | 2.81 | 2.75 | 3 | 7 |
| Mean | | 1.83 | 2.19 | 4.5 | 6.5 |
| Participants with graph not analysed (recording error) | | | | | |
| 1A-GH F | - | 2.25 | 1.5 | 7 | 7 |
| 2B-DB F | - | 3.25 | 4.31 | 5 | 5 |
| Mean | | 2.75 | 2.91 | 6 | 6 |

In this study, the third, the range for the mean scores for all participants was for the anxiety subscale from 1.0 to 3.25, and for the avoidance subscale the mean score was from 1.38 to 4.31.

The published norms for the anxiety and avoidance scales are found in Appendix 9 (Fraley, 2015), being 2.92 for avoidance, and 3.56 for anxiety. When compared to these published norms, it is clear that the scores for a majority of the participants in these studies are lower than these published norms (the maximum for avoidance in these three studies being 2.76, 3.18 and 4.31 respectively, all twins but three being under the norm, the maximum for anxiety in these studies being 2.25, 1.94 and 3.25 respectively, all being under the norm). Comparing for the genders, the published norm score for avoidance for males is 2.94 and for females 2.92, shows that all male participants but one in these studies had a score under the norm, and all female participants but two had a score under this norm. For anxiety, the published norm score for males is 3.57 and for females 3.56, and all participants in these studies, both males and females had a score under the norm for respectively gender.

The second hypothesis suggests a positive relationship between the number of hits a twin receiver has, and the attachment to their twin, i.e. a positive correlation with self-reported degree from childhood and adulthood (where 1 is weak and 7 strong). The correlation was found to be positive and weak with attachment from childhood, $r = .104$ ($p = .664$) and with the attachment in adulthood, the correlation was negative and weak, $r = -.224$ ($p = .342$), one being in the right direction, one in the wrong, but both being weak and neither of them significant.

For correlations in the third hypothesis, it was suspected that having many hits would predict lower scores on attachment-related anxiety and avoidance (where 1 is strong and 7 weak). The correlation between these scores and the number of hits as receiver was found to be negative and weak, for avoidance, $r = -.075$ ($p = .754$), and for anxiety the correlation was $r = -.138$ ($p = .561$). Both were in the right direction, but weak and not significant.

For both the second and third hypotheses, it is clear in table 6-8 that there is a lack of variance in both self-reported attachment (from childhood and adulthood) and calculated dysfunctional attachment (anxiety and avoidance) and with only 20 participants giving data, there is no real possibility to evaluate if the degree of attachment could predict success in these telepathy experiments. Even with twins in all three studies, the sample size is too small and makes it difficult to draw any conclusions, the lack in variance makes it unlikely to detect anything.

It is however clear, that all the twins report strong attachment to each other, especially from childhood. The mean score for anxiety was 1,73, for avoidance 1,85 (compared to the published norms 3,56 respectively 2,92), for childhood attachment 6,4, and for adulthood attachment 6,07. Thus, the degree of attachment was in general very strong. Partly as expected, a strong childhood attachment did correspond to a low degree of attachment-related anxiety, the correlation was $r = -.500$, $p = .025$. For avoidance the correlation was also rather clear, but not significant, $r = -.406$, $p = .075$.

Even though the norm scores are for partners in relationships, it is obvious that these norm scores, understood to be low for strong bonds and vice versa, indicate that the attachment between the twins in this study is in general stronger than between partners in relationships.

What however also must be clear is that it is impossible to say whether this strength depends on to be a twin, or if it is due to having had many exceptional experiences. What can also be said here is that from a survey by Brusewitz *et al.* (2013) among 220 UK twins, it was found that there was a significant relationship between reporting strong attachment and reporting many and more remarkable exceptional experiences.

The fourth hypothesis suggests the scores for attachment between the twins in each pair to be very close to each other, the differences should be very low. Looking at the differences between the scores, in table 9, this is verified, the difference for most pairs is very low, but, given the small sample size, even if the hypothesis is supported, the support is unsafe.

Table 9. For each participant in each study, the difference between the twins in each pair, for the scores for anxiety and avoidance, and for the degree of attachment from childhood and adulthood. In the fourth pair in the second study, only one twin served as receiver, only this twin filled the questionnaire.

| Pair | Difference score anxiety | Difference score avoidance | Difference Attachment childhood | Difference Attachment adulthood |
|-----------|--------------------------|----------------------------|---------------------------------|---------------------------------|
| 1st study | | | | |
| 1st pair | 0,38 | 0,12 | 0 | 0 |
| 2nd pair | 0,25 | 0,01 | 0 | 0 |
| 3rd pair | 0,5 | 0,18 | 0 | 1 |
| 4th pair | 0,43 | 0,53 | 0 | 1 |
| 2nd study | | | | |
| 1st pair | 0,19 | 0,06 | 0 | 2 |
| 2nd pair | 0,32 | 0,36 | 2 | 1 |
| 3rd pair | 0,34 | 0,16 | 1 | 0 |
| 4th pair | - | - | - | - |
| 5th pair | 0,75 | 1,94 | 0 | 0 |
| 6th pair | 0,38 | 0,12 | 0 | 0 |
| 7th pair | 0,38 | 0,53 | 0 | 0 |
| 3rd study | | | | |
| 1st pair | 1,25 | 0,12 | 0 | 0 |
| 2nd pair | 1,5 | 1,18 | 0 | 0 |
| 3rd pair | 1,06 | 1,25 | 0 | 0 |
| Mean | 0,59 | 0,50 | 0,23 | 0,38 |

5.6 Discussion

These three studies continue the development of objective methods for examining a possible anomalous physiological connectedness between twins, being physically isolated from each other, which was begun with two previous studies (Jensen & Parker, 2012; Parker & Jensen, 2013). All the pairs in these studies but one giving analysable graphs were deemed to be identical twins and as in these previous studies they were recruited because they report greater frequencies of such experiences in surveys (Brusewitz *et al.*, 2013; Cherkas, 2004/2005). The same basic procedure was used as the one in Parker and Jensen (2013), with the main difference being that in the present study, a new equipment was used, built especially for this research, eliminating as many false signals as possible, as described above. The same procedure as before was used: the stimuli that had been successful were again used, with a hand put in ice-water in a bucket and a bursting balloon (and some new stimuli were tested), randomized stimulus times, pre-defined objective hit-criteria, blind assessment by the experimenter and in the first study an external expert.

The result in these studies gave for the first hypothesis scores in the expected direction and was overall significant, but it is clear the statistical power is very low, and with the small sample size, the significant result can be due to chance effects. What can be made clear, however, is that, as in the two previous studies, some twins in two studies were especially successful (in the first study one twin having 3 hits out of 5, in the second study twins having 2 out of 4, 2 out of 3 and 3 out of 4) and if considered alone, these were significant. If this is a chance effect or a true effect is impossible to say. A possible way to proceed is to continue the strategy so far used, strict screening, interviews and questionnaires, with the result so far, that a few identical twins in laboratory testing show apparent significant signs of connectedness.

Even if the sample size in these three studies is very small, the result can however partly be compared with the result from the two previously published twin telepathy studies, also being very small, the p -value in the study by Jensen and Parker (2012) reported to be $p > .7$ (using a hypergeometric test (Feller, 1968; Wesstein, 2011) (but for one out of the four pairs of twins, it was $p < .03$), and for the study by Parker and Jensen (2013), also using four pairs of twins, the result was in a binomial test marginally significant, $p = .07$, one-tailed. The results from these five studies are mixed, all having very small samples, two (Jensen & Parker, 2012; Parker & Jensen, 2013) being non-significant but with one twin in each being successful, and the overall result from the three studies in this PhD being significant.

In other applications using EDA in parapsychology, the studies with DMILS research has the overall p -value .001 (Schmidt, 2015) and for “remote staring”, $p = .013$, results that of course cannot be compared to the result of this study, not being effect sizes. Even if the use of EDA in DMILS and “remote staring” have been successful so far, it is not possible to say if the use of EDA in twin telepathy also would be successful if there further on would be bigger sample sizes and improved methodology.

For the second hypothesis, it was found that all twins reported a high degree of attachment, both from childhood and adulthood. Even with twins from three studies, it is a small sample size and with the degree of attachment lacking variation (and for many twins being constant, 7 for childhood), the second hypothesis that having more hits would correspond to having a stronger bond could not be evaluated, neither for attachment from childhood nor adulthood. Both correlations were very weak and none of them significant. Thus, no real conclusion can be drawn. The reported degrees of attachment however being very high can

be an indication of a ceiling effect and that some more questions can be needed to specify this strength, more alternatives to choose between are needed, so that not all twins choose the maximum degree. It can however also be an indication that this questionnaire ETR, even if it is modified to be used for twin partnership is not the real right questionnaire for measuring attachment between twins in a pair. On the other hand, the very low scores on avoidance and anxiety indicate that the attachment really is strong, and ceiling and floor effects are inevitable with such a closely attached sample.

For the third hypothesis, that there would be a negative relationship between the number of hits and attachment-related anxiety and avoidance, the situation is the same as for the second hypothesis, it could not be evaluated, due to the very small sample size and also a lack of variation in attachment-related anxiety and avoidance. Both correlations were negative, but very weak and none of them significant. Thus, when it comes to this hypothesis, no real conclusions can be drawn.

For the fourth hypothesis, that the scores for attachment between the twins in each pair should be about the same, there is support for the hypothesis, with the difference in attachment scores from the twins in all pairs being very small, but the support must be regarded to be unsafe due to the small sample size.

The only clear result to notice regarding attachment in these studies was that the attachment was very high for all twins, both self-reported (from childhood and adulthood) and calculated from questions in a questionnaire (i.e. giving low scores for attachment-related anxiety and avoidance). The question about a possible relationship between attachment and being successful in telepathy studies still remains to be studied, with bigger sample sizes, both for twins and non-twins. Connected to the question of attachment, the question needs

also to be raised, if the questionnaire used, ETR, is the right questionnaire. From this study, it is not possible to give any final answer to that question. The scores for the twins in the two subscales anxiety and avoidance fall well in the boundaries what is adequate to the published norms in Appendix 9 and the scales seem valid in that identical twins who report a higher degree of empathy to each other tend to score more highly on the attachment measures than the published norms for partners in a relationship, as might be expected. More surveys need to be done on twins to find an answer.

When it comes to the psychometric measures in this thesis, i.e. the attachment data, the question should also be raised how it adds to the idea in the thesis, what impact do they have? This is the first attempt in a thesis to introduce attachment measures for twins and compare it with twin telepathy. With what already has been mentioned, very strong bonds between twins, also indicating possible ceiling and floor effects and with a lack of power (due to a small sample) in the experimental work, it must be clear there is a gap between the survey with many participants, and the experimental studies with a small sample size. It is thus difficult to, with safety, compare attachment data in the survey with attachment data in the experimental work, even if they both indicate the attachment is strong between twins reporting having exceptional experiences. The survey with many participants gives the strongest support for the idea in the thesis, just because of the big sample size, and many twins, 72 % reporting having had exceptional experiences with their twin. There is also support for the idea from the experimental work, but, all due to the small sample size, it is somehow unsafe, even if being in the same direction, with most twins reporting a strong bond to their twin.

To notice is that there are rather few pairs of twins in these studies, a fact that may need an explanation, the primary being most twins did not live in London. The procedure to arrange for a study starts some months before the study is to occur, with a decision when all three experimenters (Brusewitz, Parker and Puhle) were available and could be in London, and the place to be at is decided and also available. After that the twins were contacted. They were selected after having been at a Twin Day in London, to which twins from all UK came. To be able to come to London for an experiment during one day, they must live in the south parts of UK, not being able to be in London very early or late, since they need some hours to get to London, and also some hours to get back, having a maximum of two or three hours to travel. If a research assistant would be available, it could have been possible to have advertisements in local papers and also on Internet and in social media to reach out to twins living in the London area. This was not possible in this research project.

Another fact that can be noticed in these studies is that the twins coming and participating are identical twins with a strong attachment and thus possibly also with a strong empathy to each other. It seems difficult to have twins with a weaker attachment to participate and so compare twins with more variation in attachment. It would of course also be of interest with a wider study where also twins with a negative or more neutral bond could participate. Also twins with a more cognitive bond, like primarily sharing ideas and not emotions could be of interest to study.

Concerning methodology, sensory leakage as an explanation to the result in the telepathy part in these studies, the first hypothesis, can be regarded as quite implausible, given the distance between the two rooms for the twins, in the first study being more than approximately 25-m, and with four thick closed doors in between, in the second and third

study, the twins being on quite different floors and with closed doors. Moreover, one of the most silent stimuli was the most successful stimulus in this study, putting a hand in a bucket with ice-water, as was the case in the earlier studies. This stimulus is a surprise stimulus, the best one found so far to correspond to the real-life spontaneous experiences that twins report. The result can of course not be seen to exactly correspond to the real-life experiences that twins report, since due to ethical reasons it is not possible to use fear, pain or sickness in controlled experiments. Being a surprise and being rather physical it can however rather much correspond to the experiences that twins report in many anecdotes, being a little negative, and in some way also involving mild pain.

There are some obvious technical precautions that need to be implemented in future experiments, such as having the battery fully recharged after each day. Another suggestion is to record the electrodermal activity for the sender as well as the receiver which would give information whether the sender actually had a response when the surprise was exposed, and also the exact point in time and also the magnitude of it. Also, so far, the studies have relied on manually synchronizing stopwatches. It would of course be a more secure design if in the forthcoming studies, the two sets of equipment for measuring EDA could be linked automatically.

Another idea is to, after having had a few pilot studies, check if there is any specific stimulus that in all or most studies has been more successful than the other, and to use that for forthcoming studies. Also, a pool of possible stimuli can be made and in forthcoming studies, choice of stimuli can be done by randomly selecting one from this pool. It is also important to ensure that the hand that is placed in ice, is not later used for EDA recording.

There are in many trials also peaks in other epochs than the target epoch where the exposure occurred, and also peaks in the beginning or the end of an epoch. What these depend on is not clear, probably being some other reaction from the receiving participant. Even though the receiving twin is consciously calming down, there are still many processes that can cause these reactions. With more neutral measuring of the receiver, it could be more possible to check if these variations occur even if the receiving twin is kept neutral. An extended baseline (for measuring electrodermal activity of the receiving twin without any exposure of any surprise for the sending twin) may be advantageous, an improvement that is also suggested by the external expert, all to reduce the influence of chance.

5.7 Chapter Summary and Conclusions

Overall, the result from fourteen pairs of twins, some participating twice, was significant with altogether 18 out of 91 possible hits ($MCE = 11.4$). Having the same pattern as in the previous studies (Jensen & Parker, 2012; Parker & Jensen, 2013) with in general one successful pair of twins in each study getting significant results, this fact can be regarded to justify further research with in this way selected pairs of twins and with the improved methodology that has been suggested. Due to the three present studies having a small sample size, the relationship between the number of hits and degree of attachment could not be evaluated. The attachment between the twins in each pair was reported to be very strong, both self-reported and the one calculated from the questions in a special attachment questionnaire. The strong attachment scores partly correspond to the very low scores for avoidance and anxiety from the ETR questionnaire, modified from a questionnaire for romantic partnership to be used for twins after recommendation from a leading attachment expert. The difference in scores for attachment between the twins in each pair was found to be very low, almost zero, giving some support the scores being reliable, and the

questionnaires being able to be used for measuring attachment between twins. Whether these strong reported degrees of attachment are a ceiling effect or a genuine effect is however an open question, so the question must remain whether the modified ECR-R questionnaire is adequate to be used for attachment between twins. With many twins, 72 % reporting both a strong attachment to their twin and having had exceptional experiences with their twin, the idea in the thesis is getting support. Due to the small sample size in the experimental work in chapter 5, the support for the idea in the thesis is in the same direction, but somehow more unsafe.

CHAPTER SIX

ATTACHMENT AND EXCEPTIONAL EXPERIENCES AMONG TWINS: SUMMARY AND CONCLUSIONS

6.1 Chapter Overview

The present chapter presents a summary of the thesis and draws together all the discussions and findings from the previous chapters in order to present an overview of this investigation into exceptional experiences amongst twins, and the relationship to attachment. Conceptual and methodological issues that have arisen in the course of this research are outlined and the implications of this research are discussed along with recommendations for future research in this field. This chapter begins with a chapter-by-chapter summary of the thesis and then follows with a drawing together of the findings of these chapters under various subheadings.

6.2 Summary of Findings

The review of the literature on attachment research presented in Chapter One identified several areas of research that deserved addressing. Primarily, there exist hardly any research on attachment between twins, the closest being studies by Tancredy and Fraley (2006), Fraley and Tancredy (2012) and Schwarz, Mustalic and Junker (2015), all on siblings, but also including twins. It is obvious that more studies are needed to further explore the attachment between twins and e.g. compare non-identical and identical twins, but also to compare with non-twin siblings. The complex question how much and in what way, genetics and environment (both shared and non-shared) influences attachment also needs to be studied, with both twins and non-twin siblings. Also, how attachment develops with age, and depending on if and how far away the twins move from each other when being adult (and how frequent they are in touch in other ways, e. g. email and telephone), and if attachment changes if one or both twins get married (and another person comes very close to the twin and maybe replaces the twin).

Chapter Two gives the result of a web survey amongst UK twins on their attachment, and the attachment in relation to the exceptional experiences they report having had, both with their co-twin but also with other persons. Two questionnaires were used, the first being ETR (*Experiences in Twin Relationships*, a modified version of ECR-R, *Experiences in Close Relationships – Revised*), with regard to attachment-related anxiety and avoidance, the other a modified version of WHOTO and ANQ with regard to attachment features and functions according to the terminology of the pioneers Ainsworth and Bowlby (proximity maintenance, separation distress, safe haven and secure base). Attachment data was collected from more than 2000 twins in UK, in the age from 19 to 90, both identical and non-identical twins, with a majority of female twins, all through a co-operation with the Department of Twin Research and Genetic Epidemiology, King’s College, London, by email sending personalized links to 5060 twins, inviting them to participate in this survey on the web. The attachment was found to be stronger for identical twins when compared to non-identical twins (for all but one of the six attachment scores that were used). The same was the case when comparing female twins with male twins, female twins having stronger attachment. For age, there was a correlation, the attachment being strong when the twins were young and then it slowly decreased. Besides this, attachment was compared with whether the twins reported having had any so-called exceptional experience with their twin, or with any other person, not being their twin. For the twins in this study as one group, the attachment was very strong, and the attachment-related anxiety and avoidance were stronger than the published norms. Exceptional experiences in this study included telepathy-like experiences, shared physiological responses to illness, injury or accident, i.e. remote sensing the other twin’s pain, accident or state of mind.

Almost three out of four twins, 72 % reported to at least once or twice having had a so-called exceptional experience with their twin. For twins reporting having had exceptional experiences with their twin, they reported a stronger and more positive attachment to their twin than those who do not. Rather many twins, 28 % also reported to at least once or twice having had an exceptional experience with other than their twin. This other person varied between children, friend/s, partner, sibling and parent/s, i.e. with persons both with and without a genetical factor in common.

For attachment, more surveys are needed to in more depth study attachment between twins. For the exceptional experiences that twins report, more studies are required, both on telepathy in general and also between twins, since there so far are very few experimental studies. Ideas are mentioned how to find a possible mechanism and theory for them.

Chapter Three gives a review of spontaneous parapsychological phenomena, these phenomena in many cases being inspiration for research, as is also the case for this thesis (the exceptional experiences twins report). The chapter gives an orientation on spontaneous exceptional phenomena, with examples and surveys, with the value of them, and their shortcomings, advantages and disadvantages. With these phenomena belonging to a group called “exceptional human experiences”, this term is reviewed in depth, also giving examples of various phenomena, especially those experienced and reported by twins. The connection between the term exceptional experiences and the theory by Metzinger (2003) on mental representations is reviewed, his idea of a reality-model in the mind. With (spontaneous) exceptional experiences being inconsistent with the basic elements in this model (Belz & Fach, 2015), the classes of exceptional experiences are described (Fach, 2011) as is the reason why the model was created. He seems to have an implicit, natural assumption that the mind is created by the brain, the established view on this question, a

view that however now slowly has started to be questioned, by e.g. research on near-death experiences but also some consciousness research (that now also looks at the so-called “hard questions” in consciousness research), a quite separate topic.

The literary review in Chapter Four on research in parapsychology, with focus on telepathy and the use of electrodermal activity, EDA in parapsychology, in e. g. healing (remote influence on biological organisms) and presentiment shows that there during the years are rather few attempts to study telepathy between twins, just approximately ten, and they are conducted by different researchers during different decades and with different designs, using different methods. With twins reacting both emotional and physical in their connection with their twin, electrodermal activity being an established psychophysiological method in both biology and psychology, seems to be a possible indicator of the strong and strange connection that exist between twins (and was used in the two most recent studies before this PhD (Jensen & Parker, 2012; Parker & Jensen, 2013), detecting both conscious and unconscious reactions in the body with even small changes in the skin conductance. Therefore, more studies on twin telepathy are needed and suggested with this technology. Now that also other technologies during the last decades have been used in parapsychology, like EEG and fMRI, these also should be of interest to use, measuring the brain activities, as some telepathy studies mentioned earlier with EEG, indicating correlations between brains.

Chapter Five gives the result of three experimental studies on twin telepathy, the first carried out in May 2014 in Bronte Building, Department of Psychology and Counselling, The University of Greenwich, London, the second and third in April and October 2015 at the College for Psychic Studies, London. One twin in each pair was exposed to a surprise

at a random time epoch, the other twin was shielded in another distant room, wired to an equipment measuring the electrodermal activity. If there was a peak on the graph, corresponding in time with the surprise, it was a hit and regarded as an indication of telepathy between the twins in this pair. There were for each pair two runs, the twins changing roles as sender and receiver after the first run, each run consisting of 5 trials, and each trial consisting of 8 possible time epochs of 30 seconds, the surprise being exposed for the twin in the mid-point of the time epoch randomly chosen. In the first study, four pairs of twins participated, in the second seven pairs, and in the third, there were three pairs. The overall result for the twin telepathy part was significant, with 18 hits of 91 (with MCE = 11.4), a fact that can be regarded to justify further research with in this way selected pairs of twins and with the improved methodology that has been suggested.

In the first and second study, one participant showed significant result in the telepathy study, and in the second even more (one twin having 2 of 4 hits, one twin having 2 of 3 and one having 3 of 4). Due to all three studies having a very small sample size, even together (with 4 + 7 + 3 pairs), the relationship between the number of hits and degree of attachment could not be evaluated. In the attachment part of the study, the attachment between the twins in each pair was reported to be very strong, both self-reported and the one calculated from the questions in a special attachment questionnaire. A possible ceiling effect is discussed.

In the second study, there was one important improvement in the design, with an extra equipment being used to measure the electrodermal activity for the sender, to know if and when there was a reaction for the sender when being exposed to the surprise. Due to technical and practical problems (the equipment being in London and the author living in

Stockholm), the analysis of the data from this extra equipment for the sender could unfortunately not be fulfilled.

6.3 Evaluation of questionnaires

The psychometric properties for both questionnaires were explored (ETR and WHOTO-ANQ), both internally and towards each other, and besides that, there should be another aspect of reliability – the twins in each pair should report about the same degree of attachment to each other, so they were compared, expected to be almost the same.

6.3.1 Psychometric properties explored – internally and towards each other

For the questions in ETR (giving degree of anxiety and avoidance), if not to be reversed, the majority of the scores should be on 1 and 2 if the attachment is strong and positive (more than approximately 50 % of the twins should choose 1, to totally agree, and then the numbers should slowly decrease), and for the reversed questions, most should be 6 or 7. This turned out to be the case for both items for anxiety (for 10 questions out of 16, more than 60 % of the twins reported to totally agree, giving score 1), and almost the same result for the questions on avoidance, both for items that were not to be reversed (for two questions more than 60 % of the twins reported to totally agree, giving score 1. For another two questions, between 50 and 60 % totally agreed), and for the questions that were to be reversed (e.g. 7 giving a 1), for two questions, between 45 and 55 % totally disagreed and for six questions, between 35 and 45 % reported to totally disagree. In total, the questionnaire ETR seems to be internal valid and reliable in this analysis.

For WHOTO-ANQ questions, where no question was reversed, most answers should be on 6 or 7 (and then the numbers should slowly decrease for lower scores), and this was the case for almost all questions. Most answers were on 7, strongly agree, and many also on 6. The correlations for these four scales (proximity maintenance, safe haven, secure base and separation distress) were significant, ranking from .716 to .904. The four scales were highly correlated (on average .775). The high magnitude of these associations indicates that there was a single source of variation underlying the attachment function ratings, i.e. the four scales can also be regarded as one, as do also Tancredy and Fraley (2006). Thus, for this questionnaire, the answers seem to be reliable.

Finally, the questionnaires should give about the same result, i.e. high scores on ETR should correspond to low scores on WHOTO-ANQ, and this was also the case. Correlations between scores from ETR and scores from WHOTO-ANQ showed that with higher scores from ETR (and the attachment therefore more negative and weaker) twins report lower scores from WHOTO-ANQ (and therefore more negative), all correlations being significant, $p = .000$ (being .000 between avoidance and safe haven, and between avoidance and secure base; for the other correlations, the p-values varied between $1 * 10^{-260}$ for the correlation between avoidance and proximity down to $1 * 10^{-9}$ for the correlation between anxiety and separation distress), all thus being extremely low.

6.3.2 Do twins in each pair report about the same degree of attachment?

For another aspect of reliability of these scores, twins in each pair should report about the same degree of attachment to each other. A comparison was made between the scores for the twins in each of the 630 pairs (for anxiety and avoidance from the ETR questionnaire, and proximity, safe haven, secure base and separation distress from the WHOTO-ANQ

questionnaire). If the twins in each pair report about the same degree of attachment towards each other for a specific sub score, the difference between these sub scores for the twins in each pair should be as low as possible, close to zero. This turned out to be the case, the difference between the scores being zero or almost zero for all 6 sub scores, the four scores from WHOTO-ANQ and both from ETR. This analysis clearly indicated the scores were reliable between the twins, the twins in each pair reporting about the same degree of attachment to each other, which should be expected.

Summarizing the evaluation of the questionnaires (psychometric properties – internally and externally and comparing twins in each pair), all these tests supported both questionnaires to be reliable and possible to be used for twins.

6.4 Conclusions for attachment between twins

The mean score for attachment-related avoidance in the big attachment survey in this thesis was far lower than the published norm, and this was also the case for anxiety. For the sub scores from the WHOTO-ANQ questionnaire, there are no published norms published.

Identical twins were in the big survey found to have a more positive attachment when compared to non-identical twins, being valid for all four scores from the questionnaire WHOTO-ANQ, and with a significant difference for the ETR score for avoidance, but not for anxiety. Thus, for all but one score, the difference was significant.

Female twins were found to have a more positive attachment to their twin when compared to male twins, being valid for all four scores from the questionnaire WHOTO-ANQ, and for the ETR score for avoidance, but not for anxiety. Thus, for all but one score, the

difference was significant. The conclusion is however very unsafe, because of the small sample of male twins, only 11 %.

For age, there was a significant but reversed correlation with the four WHOTO-ANQ scores. With the ETR scores, there was a significant correlation with avoidance, but not for anxiety. Thus, for all but one score in this study, there was a correlation, i.e. the attachment was strong at early ages, and slowly getting weaker with growing age.

6.5 Conclusions for twin telepathy

From the three experimental studies on twin telepathy in this thesis, the overall result was significant, with 18 hits out of 91 possible (with MCE = 11.4). With the sample however being very small (with altogether 14 pairs of twins, some participating in two studies, with 133 trials, 91 being useful), there are two conclusions to be drawn, 1) the result can justify that the method used is possible to use in further research on twin telepathy, with electrodermal activity as indicator of telepathy, and 2) the overall result from the three studies being significant can be regarded to justify further research with selected pairs of twins and with the improved methodology, a pool of targets to be the surprise for the sending twin, and an equipment to also measure the electrodermal activity for the sender, and of course, this equipment synchronized with the equipment for the receiver. For the evaluation, also a quantified analysis would be massively beneficial too, rather than just subjective ocular judgements of the graphs around the epoch time that were evaluated to be enough in these three small studies. Quantifiable analysis of the data could explore when spikes occur in the epochs, their sizes etc.

In the big attachment survey (with more than 2000 responses), 72 % reported to some times have had an exceptional experience with their twin. From these, 30 % reported it to have happened only once or twice, 247 twins (12 %) reported it to have happened 11-50 times, while 119 (8 %) reported it to have happened more than 50 times. 550 twins (27 %) reported it never had happened.

There were also twins that reported having had so-called exceptional experiences with other than their twin. 583 twins (28 %) reported to at least once or twice having had an exceptional experience with some other person, not their twin. From these, 407 twins reported it to have happened only once or twice, while 38 (2 %) reported it to have happened more than 50 times. This other person varied between four main groups, 1) children, 2) friend/s, 3) husband/wife/partner, 4) sibling, and 5) parent. With these different groups, it seems obvious it is not only a genetic factor, but also an emotional, the genetic being involved in group 1, 4 and 5, group 2 and 3 not involving any genetic factor.

Among twins who did not report having had any exceptional experience with their twin (550 twins), 32 did report having had such an experience with other than their twin. Among twins who did report having had an exceptional experience with their twin (1488 twins), 547 (37%) also reported having had such an experience with other than their twin, with 382 twins reporting it to have occurred once or twice, and 35 more than 50 times.

6.6 Conclusions for the correlation between attachment between twins and twins having exceptional experiences

In the three experimental studies, the samples were too small to make any evaluation possible whether there was any correlation between having success in telepathy experiments and the degree of attachment between the twins.

In the big survey on attachment, for the WHOTO-ANQ scores, there were strong and significant correlations for all four scores with reporting having had many exceptional experiences with their twin. For attachment-related avoidance there was a significant reversed correlation with reporting having had many exceptional experiences with their twin: with lower scores on the avoidance scale, i.e. reporting a strong attachment, the more exceptional experiences the twin reported. For attachment-related anxiety, there was also a correlation, but not reversed: with higher scores on the anxiety scale (i.e. more reported anxiety to your twin), the twin reported having had more exceptional experiences. Thus, for five scores, if a twin reported having had more exceptional experiences with the co-twin, the twin reported a stronger attachment, or vice versa. There was a correlation, but it was not clear what was cause and what was effect.

With the many participants in the survey, many twins reporting a strong attachment to their twin and 72 % reporting having had exceptional experiences with their twin, the idea in the thesis of a correlation between attachment and reporting exceptional experiences is getting support. The support for the idea is somehow more unsafe from the experimental work in chapter 5, all due to the small sample size, even if the support for the idea is in the same direction.

Correlated with this question is one, whether the twin in a pair who reported having more exceptional experiences than the co-twin also reported stronger attachment to the cotwin than the cotwin did. It could be expected that that is the case. In a special analysis, it was found that there for one of the WHOTO-ANQ sub-scores, separation distress, was a significant correlation found between the difference in this sub-score between the twins and the difference in numbers of exceptional experiences that the twins reported having had

with each other, i.e. the twin in a pair reporting being less distressed when separated, that twin reported having more exceptional experiences. With the other sub-scores from WHOTO-ANQ and with the sub-scores from ETR, there were no significant correlations. There are here however also reasons to have the attention to the fact that the number of exceptional experiences the twin reported was a group code, (one code for having had 1 – 2 experiences, one code for having had 3 - 10 experiences, one code for having had 11 – 50 experiences and one for having had more than 50 experiences – and of course one code for having had no experiences), so this question needs to be addressed in more surveys with more specified information how many exceptional experiences the twin report having had. Here, it is also clear there is a conflict between two main goals in this thesis: a) to facilitate success in the telepathy experiments, twins were preferred reporting having had many exceptional experiences (since it is assumed that reporting many exceptional experiences makes it more probable to be successful in telepathy experiments), and b) to facilitate comparing twins with strong and weak attachment when it comes to success in the telepathy experiments, twins with a variety in degree and kind of attachment could be preferred (some having a strong attachment, others having a weak or negative attachment). The reason why twins reporting having had many exceptional experiences were preferred in this thesis was partly because they were assumed to be more interested in coming to London for experiments.

6.7 Summary and Final Comments

It has been demonstrated in the present chapter, especially in the attachment survey, that the attachment between twins in pairs in general is very strong, that many twins report having had exceptional experiences with each other, and also that there is a strong

correlation between twins having a strong attachment and twins having exceptional experiences of various kinds.

The findings of the three experimental studies, although in need of independent replication, provide further evidence for twins being able to demonstrate that twin telepathy seems to exist, even in controlled laboratory settings. Some pairs of twins have what it seems a physiological connectedness, giving a possibility to sense each other's pain, injury etc. Being a small sample, it is however not possible to draw any final conclusions about the existence of twin telepathy. Conclusions that can be drawn from these three studies are a) the result can justify electrodermal activity to be possible to use in further research on telepathy between twins, and b) the result overall being significant in these three studies justifies further studies with twin telepathy with the improvements that have been suggested.

Finally, there are reasons to compare with the EEG studies in the Introduction (e.g. Grinberg-Zylberbaum *et al.*, 1994) as well as with studies with EEG reviewed in chapter 4.6.2.1 and 4.7.2 and with fMRI in chapter 4.6.2.1 and 4.7.1, indicating an empathy field between persons being on a distance. These studies indicate that the brains for the persons being in this study somehow seemed correlated, with a field Grinberg-Zylberbaum called an "informational matrix". With these studies these are reasons to have the idea of an empathy field in mind when investigating a correlation and connection between attachment and telepathy, attachment being an empathic and emotional relationship and telepathy possibly being a correlation between two brains/individuals.

Comparison can also be made with other “fields” in this thesis, Sheldrake (2003) calling them mental fields and extended mind, Lorimer (1990) calling the connection a resonance phenomenon, “empathic resonance” for events between people who are emotionally close, and links individual across space and time (Dossey, 2013b, Stevenson, mentioned by Jackson, 1980), and we can here also compare with the ideas of a resonance phenomenon in healing research that Bengston and Moga (2007) mention. The attachment between twins (and probably between all persons) could very well be connected to this “field”, whether being called an empathy field or mental field, and be part of the explanation to the immediate contact between individuals being close to each other, as it seems happen in telepathy and synchronous reactions. Further studies with electrodermal activity to possibly confirm twin telepathy should be completed with EEG and also fMRI studies to investigate if there is support for a field, whether being called empathy of mental field.

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APPENDICES

Appendix 1. The questionnaire *Experiences in Close Relationships – Revised, ECR-R*

The questionnaire has 18 questions about attachment-related anxiety and 18 questions about attachment-related avoidance, arranged in random order, some with reversed questions.

Note. Items 1, 4, 5, 7, 9, 11, 13, 15, 17, 20, 22, 24, 26, 28, 30, 32, 34 and 35 are indicators of anxiety,

2, 3, 6, 8, 10, 12, 14, 16, 18, 19, 21, 23, 25, 27, 29, 31, 33 and 36 are indicators for avoidance.

Items that are to be reversed are for anxiety question 11 and 30, for avoidance, question 3, 6, 10, 14, 19, 23, 25, 27, 29, 31, 33 and 36.

For confidentiality reasons, the twins in each pair filled one questionnaire each, separately, and handed it over to the RE, receiver experimenter.

The statements below concern how you generally feel in your relationship with your twin. We are interested in how you generally experience this relationship, not just in what is happening in the current relationship.

Each item is rated on a 7-point scale where 1 = strongly disagree and 7 = strongly agree.

Respond to each statement by inserting a number (from 1 to 7) within the brackets to indicate how much you agree or disagree with the statement.

1. I worry that my partner won't care about me as much as I care about her/him. []
2. I find it difficult to allow myself to depend on my partner. []
3. I usually discuss my problems and concerns with my partner. []
4. I'm afraid that I will lose my partner's love. []
5. My desire to be very close sometimes scares people away. []
6. I talk things over with my partner. []
7. I often worry that my partner doesn't really love me. []
8. I prefer not to be too close to my partner. []
9. My partner makes me doubt myself. []
10. I feel comfortable depending on my partner. []
11. I do not often worry about being abandoned. []
12. I prefer not to show my partner how I feel deep down. []
13. I worry that I won't measure up to other people. []
14. It helps to turn to my partner in times of need. []
15. I worry a lot about my relationships. []

Appendix 1 (continued) - The questionnaire *Experiences in Close Relationships – Revised, ECR-R*

16. I am nervous when my partner gets too close to me. []
17. When I show my feelings for my partner, I'm afraid they will not feel the same about me. []
18. I get uncomfortable when my partner wants to be very close. []
19. I tell my partner just about everything. []
20. Sometimes my partner changes her/his feelings about me for no apparent reason. []
21. I don't feel comfortable opening up to my partner. []
22. I often wish that my partner's feelings for me were as strong as my feelings for him or her. []
23. It's not difficult for me to get close to my partner. []
24. It makes me mad that I don't get the affection and support I need from my partner. []
25. My partner really understands me and my needs. []
26. My partner only seems to notice me when I'm angry. []
27. I find it relatively easy to get close to my partner. []
28. I find that my partner doesn't want to get as close as I would like. []
29. I find it easy to depend on my partner. []
30. I rarely worry about my partner leaving me. []
31. I feel comfortable sharing my private thoughts and feelings with my partner. []
32. I often worry that my partner will not want to stay with me. []
33. I am very comfortable being close to my partner. []
34. When my partner is out of sight, I worry that he or she might become interested in someone else. []
35. I'm afraid that once a romantic partner gets to know me, he or she won't like who I really am. []
36. It's easy for me to be affectionate with my partner. []

The last three questions were excluded creating the ETR Questionnaire

Thank you for completing this questionnaire.

Appendix 2. The questionnaire *Experiences in Twin Relationships, ETR*

The questionnaire has 16 questions about attachment-related anxiety and 17 questions about attachment-related avoidance, arranged in random order, some with reversed questions.

Compared to ECR-R in Appendix 1, three questions have been excluded (two for anxiety and one for avoidance), being regarded as not adequate for twins. These are presented at the end of appendix 1.

Note. Items 1, 4, 5, 7, 9, 11, 13, 15, 17, 20, 22, 24, 26, 28, 30 and 32 are indicators of anxiety,

2, 3, 6, 8, 10, 12, 14, 16, 18, 19, 21, 23, 25, 27, 29, 31 and 33 are indicators for avoidance. For anxiety, question 11 and 30 are reversed, for avoidance, question 3, 6, 10, 14, 19, 23, 25, 27, 29, 31 and 33 are reversed.

For confidentiality reasons, the twins in each pair filled one questionnaire each, separately, and handed it over to the RE, receiver experimenter.

The statements below concern how you *generally* feel in your relationship with your twin.

We are interested in how you *generally* experience this relationship, not just in what is happening in the current relationship.

Each item is rated on a 7-point scale where 1 = strongly disagree and 7 = strongly agree.

Respond to each statement by inserting a number (from 1 to 7) within the brackets to indicate

how much you agree or disagree with the statement.

1. I worry that my twin won't care about me as much as I care about her/him. []
2. I find it difficult to allow myself to depend on my twin. []
3. I usually discuss my problems and concerns with my twin. []
4. I'm afraid that I will lose my twin's love. []
5. My desire to be very close sometimes scares people away. []
6. I talk things over with my twin. []
7. I often worry that my twin doesn't really love me. []
8. I prefer not to be too close to my twin. []
9. My twin makes me doubt myself. []
10. I feel comfortable depending on my twin. []

Appendix 2 (continued) - The questionnaire *Experiences in Twin Relationships, ETR*

11. I do not often worry about being abandoned. []
12. I prefer not to show my twin how I feel deep down. []
13. I worry that I won't measure up to other people. []
14. It helps to turn to my twin in times of need. []
15. I worry a lot about my relationships. []
16. I am nervous when my twin gets too close to me. []
17. When I show my feelings for my twin, I'm afraid they will not feel the same about me. []
18. I get uncomfortable when my twin wants to be very close. []
19. I tell my twin just about everything. []
20. Sometimes my twin changes her/his feelings about me for no apparent reason. []
21. I don't feel comfortable opening up to my twin. []
22. I often wish that my twin's feelings for me were as strong as my feelings for him or her. []
23. It's not difficult for me to get close to my twin. []
24. It makes me mad that I don't get the affection and support I need from my twin. []
25. My twin really understands me and my needs. []
26. My twin only seems to notice me when I'm angry. []
27. I find it relatively easy to get close to my twin. []
28. I find that my twin doesn't want to get as close as I would like. []
29. I find it easy to depend on my twin. []
30. I rarely worry about my twin leaving me. []
31. I feel comfortable sharing my private thoughts and feelings with my twin. []
32. I often worry that my twin will not want to stay with me. []
33. I am very comfortable being close to my twin. []

Thank you for completing this questionnaire.

Appendix 3 - Attachment Features and Functions Measure, WHOTO and ANQ

Instructions: Please take a moment to reflect on your CURRENT relationship with your twin.

If you had a relationship with this individual, but he or she is now deceased or no longer in your life. Please respond to each statement by selecting a number from 1 (=strongly disagree) to 7 (=strongly agree) to indicate how much you agree or disagree with the statement.

1. My _____ is the person that I would want to go to, to help me feel better when something bad happens to me or I feel upset.
2. I make an effort to stay in contact with my _____
3. If I achieved something good, my _____ is the person that I would tell first.
4. My _____ is the person that I would like to be able to count onto always be there for me and care about me no matter what.
5. My life would be severely disrupted if my _____ twin was no longer a part of it.
6. My _____ is a person whom I count on for advice.
7. My _____ is the first person that I think of when I have a problem.
8. My _____ is the person that I would actually go to, to help me feel better when something bad happens to me or I feel upset.
9. It is important to me to see or talk with _____ regularly.
10. My _____ is a person whom I do not like to be away from.
11. My _____ is the first person that I would turn to if I had a problem.
12. My _____'s death would have a great impact on me.
13. If my _____ was no longer accessible to me, I would feel greatly distressed.

Appendix 3 (continued) - Attachment Features and Functions Measure, WHOTO and ANQ

14. My _____ is my primary source of emotional support.

15. When I am away from my _____, I feel down.

16. My _____ is the person that I would actually count on to always be there for me and care about me no matter what.

Note. Items 2 and 9 are indicators of proximity seeking. Items 1, 7, 8, 11, and 14 are indicators of safe haven.

Items 3, 4, 6, and 16 are indicators of secure base. Items 5, 10, 12, 13, and 15 are items of separation distress.

Appendix 4 - Two questions, picked from the *Exceptional Experiences Questionnaire, EEQ*.

Q5 - Many twins with a strong bond to each other report having some form of communication with each other, which could not easily be explained by prior knowledge, common experience, or other normal means (e.g. telepathy-like experiences, synchronous events, remote sensing of pain or illness, an accident or injury or a problem or state of mind).

Have you experienced any such experience with your twin?

| Never not answer | Only once or twice | Between 3 and 10 times | Between 11 and 50 times | Over 50 times | Prefer to |
|---------------------------------|-------------------------------|-----------------------------------|------------------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Q6. Have you experienced any such experience with another person (except your twin)?

Q7. With whom did you have this experience? (other sibling, parent, other relative, friend,...)

APPENDIX 5 - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

Please mark your answer with an 'X' within the correct bracket

1. Are you an (1) identical or (2) non-identical twin (please circle). If unknown, please tick here [].

2. Do you think you have ever experienced telepathy between you and your twin - by which we mean some form of communication which *could not easily be explained* by prior knowledge, common experiences, or other normal means? (0) [] No ⇒ **Go to Q8** (1) [] Yes ⇒ **Go to Q3**

3. **In total**, about how many times have you experienced telepathy with your twin?
(1) [] Only once or twice (2) [] Between 3 and 10 times
(3) [] Between ten and fifty times (4) [] Over fifty times

4. During telepathy, there is usually one person sending the message - 'the sender' and the other person receiving the message - 'the receiver'. During your telepathic experience(s), who were you? (Please mark one option)
(1) [] Always 'the sender' of the information? **If yes, ⇒ Go to Q6**
(2) [] Always 'the receiver' of the information? **If yes, ⇒ Go to Q5**
(3) [] In some cases the sender and in others the receiver? **If yes, ⇒ Go to Q5**

5. During the time(s) that you were the 'receiver' of the information, did you experience telepathy during:

APPENDIX 5 (CONTINUED) - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

a) a waking state

(0) [] No (1) [] Yes

b) a dream state

(0) [] No (1) [] Yes

c) another kind of altered state

(0) [] No (1) [] Yes

6. Have you successfully received or sent what seemed to be a form of telepathy about:

(a) pain or illness (0) [] No (1) [] Yes

(b) an accident or injury (0) [] No (1) [] Yes

(c) a problem or state of mind (such as depression or anxiety)

(0) [] No (1) [] Yes

(d) a pleasant experience of any kind

(0) [] No (1) [] Yes

(e) other, please specify

7. In a few lines, please tell us more about your telepathic experience(s).....

8. Have you and your twin ever experienced any remarkable coincidences in events or decision making? (0) [] No ⇒ Go to Q11 on next page

(1) [] Yes ⇒ Go to Q9 on next page

APPENDIX 5 (CONTINUED) - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

9. **In total**, about how many times have you experienced remarkable coincidences with your twin?

- (1) Only once or twice (2) Between 3 and 10 times
(3) Between ten and fifty times (4) Over fifty times

10. In a few lines, please tell us more about these remarkable coincidences.....

11. Have you ever experienced **shared** dreams with your twin?

- (0) No ⇒ Go to Q14 (1) Yes ⇒ Go to Q12

12. **In total**, about how many times have you experienced shared dreams with your twin?

- (1) Only once or twice (2) Between 3 and 10 times
(3) Between ten and fifty times (4) Over fifty times

13. In a few lines, please tell us more about these shared dreams.....

14. For how many years were you and your twin in the **same school**? ..

15. For how many years were you and your twin in the **same class**? ..

APPENDIX 5 (CONTINUED) - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

16. How would you describe your relationship with your twin a) during childhood and b) during adulthood?

a) childhood (1) Positive (2) Negative (3) Mixed

b) adulthood (1) Positive (2) Negative (3) Mixed

17. How strongly attached are/ were you to your twin. By attachment we mean the extent to which you turn/ed to your twin in times of need; discuss/ed your problems/concerns with him/her; talk/ed things over with him/her; find/found it easy to depend on him/her; feel/felt comfortable opening up to him/her. Please insert the number (from 1 to 7) within the brackets that reflects your degree of attachment, where 1= weak attachment and 7= strong attachment.

a) Attachment during childhood []

Weak attachment 1 2 3 4 5 6 7 Strong attachment

b) Attachment during adulthood []

Weak attachment 1 2 3 4 5 6 7 Strong attachment

18. As far as you are aware, during childhood, did you and your twin communicate in your own private words that no-one else understood?

(0) No (1) Yes (2) Don't know

19. Were you and your twin separated after birth (but before the age of 16)?

(0) No ⇒ Go to Q23

(1) Yes

APPENDIX 5 (CONTINUED) - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

20. At about what age were you separated? ..

21. Were you able to see or speak to each other during your separation?

(0) No (1) Yes (2) Don't know

22. At about what age were you and your twin re-united? ..

23. Would you be interested in participating in **future research** about exceptional experiences?

(0) No ⇒

(1) Yes ⇒ **You may be contacted by postgraduate student Göran Brusewitz, Greenwich University, email g.brusewitz@gre.ac.uk.**

24. Would you be interested in participating in **a survey about attachment** between twins?

(0) No ⇒ **Thank you for your participation!**

(1) Yes ⇒ **You may be contacted by postgraduate student Göran Brusewitz, Greenwich University, email g.brusewitz@gre.ac.uk. Tel: +46 8 466 98 58.**

In case you have answered Yes in question 23 or 24, please complete your details below so that he can contact you:

APPENDIX 5 (CONTINUED) - EXCEPTIONAL EXPERIENCES QUESTIONNAIRE, EEQ

First Name: Last Name:

.....

Date of Birth (dd/mm/yyyy): Age: _ _ Sex: M / F (please circle)

E-mail: Telephone
number.....

Address:

.....

.....

Thank you for completing this questionnaire.

Appendix 6 - The distribution of answers to questions on the ETR

For the questions on anxiety that are not to be reversed, for 10 questions, more than 60 % of the twins reported to totally agree, giving score 1. For another two questions, between 50 – 60 % of the twins reported to totally agree.

Items that are to be reversed are for anxiety question 11 and 30, for avoidance, question 3, 6, 10, 14, 19, 23, 25, 27, 29, 31 and 33.

For the questions on avoidance that were not to be reversed, for two questions (Q 16 and 18), more than 60 % of the twins reported to totally agree, giving score 1. For another two questions (Q8 and 21), between 50 and 60 % totally agreed. For the questions that were to be reversed (e.g. 7 giving a 1), for three questions (Q14, 30 and 33), between 45 and 55 % totally disagreed and for six questions (Q3, 6, 11, 23, 27 and 29), between 35 and 45 % reported to totally disagree.

Some deviations from the expected trend can be seen. Q11 and 30, which are reversed coded, have a small tendency to be bipolar, as is also the case, even if not that clear, for Q10 and 19. In total, with these few exceptions, the questionnaire ETR seems to be internal valid and reliable.

Instructions:

Select a number from 1 (=strongly disagree) to 7 (=strongly agree) to indicate how much you agree or disagree with the statement.

| Question number | Strongly disagree | | | | | | | Strongly agree | | Total |
|-----------------|--------------------------|----------------|----------------|----------------|---------------|---------------|---------------|----------------|--|-------|
| | 1 Number (Percent) | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| 1 | 1.280 (59.1 %) | 309 (14.3%) | 119 (5.5%) | 204 (9.4%) | 120 (5.5%) | 68 (3.1%) | 66 (3.1%) | 2.166 | | |
| 2 | 872 (40.4%) | 385 (17.8%) | 245 (11.4%) | 278 (12.9%) | 148 (6.9%) | 115 (5.3%) | 115 (5.3%) | 2.158 | | |

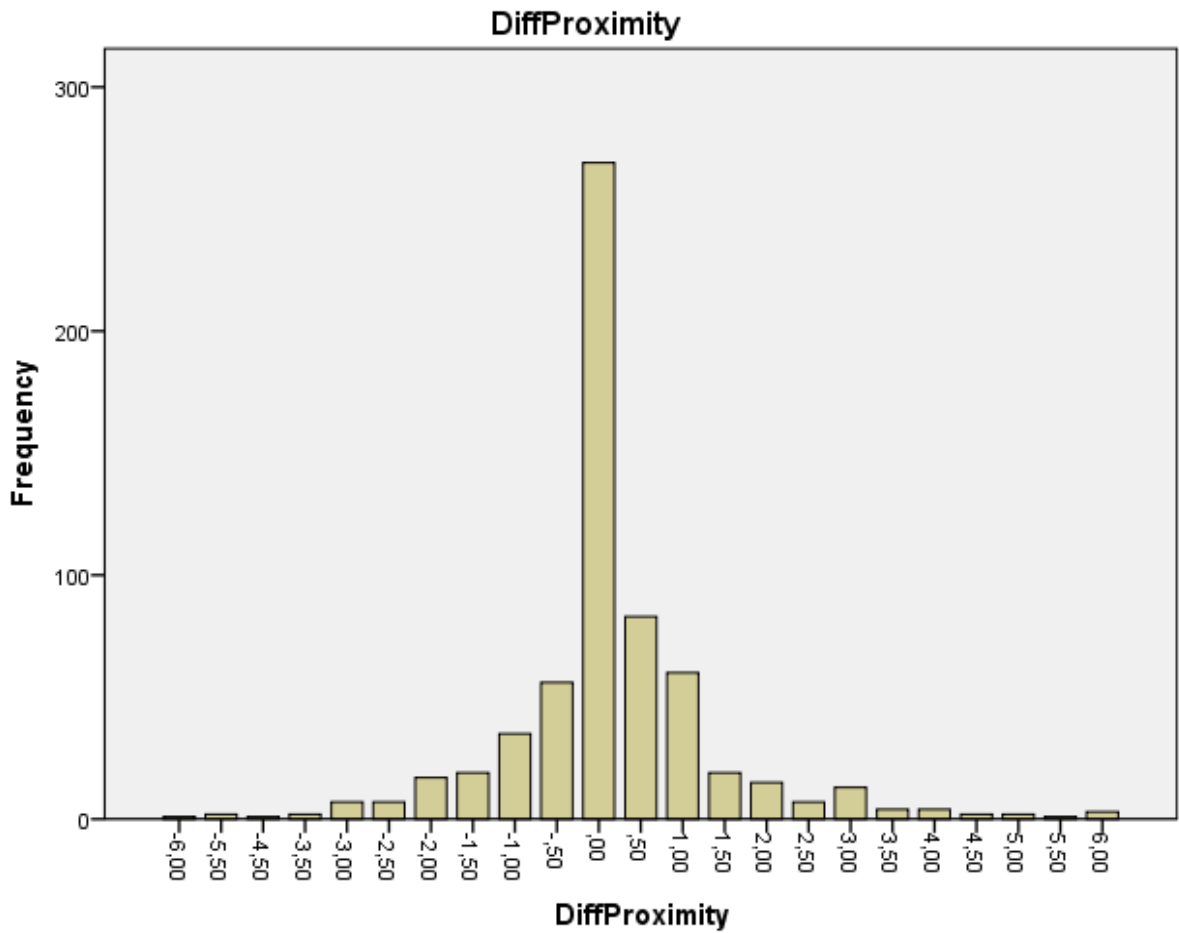
| | | | | | | | | |
|----|------------------|----------------|---------------|----------------|----------------|----------------|------------------|-------|
| 3 | 156 (7.2%) | 189 (8.7%) | 150 (6.9%) | 221 (10.2%) | 252 (11.6%) | 413 (19.1%) | 784 (36.2%) | 2.165 |
| 4 | 1.533 (70.8%) | 271 (12.5%) | 91 (4.2%) | 91 (4.2%) | 59 (2.7%) | 53 (2.5%) | 67 (3.1%) | 2.165 |
| 5 | 1.616 (74.8%) | 234 (16.8%) | 80 (3.7%) | 86 (4.0%) | 37 (1.7%) | 30 (1.4%) | 78 (3.6%) | 2.161 |
| 6 | 150 (6.9%) | 142 (6.6%) | 143 (6.6%) | 228 (10.5%) | 243 (11.2%) | 381 (17.6%) | 877 (40.5%) | 2.164 |
| 7 | 1.689 (78.1%) | 191 (8.8%) | 72 (3.3%) | 73 (3.3%) | 44 (2.0%) | 26 (1.2%) | 67 (3.1%) | 2.161 |
| 8 | 1.253 (58.0%) | 291 (13.5%) | 154 (7.1%) | 185 (8.6%) | 118 (5.5%) | 65 (3.0%) | 96 (4.4%) | 2.162 |
| 9 | 1.384 (64.0%) | 284 (13.1%) | 121 (5.6%) | 135 (6.3%) | 100 (4.6%) | 72 (3.3%) | 65 (3.0%) | 2.161 |
| 10 | 254 (11.8%) | 183 (8.5%) | 178 (8.3%) | 360 (16.7%) | 254 (11.8%) | 328 (15.2%) | 601 (27.9%) | 2.158 |
| 11 | 391 (18.1%) | 109 (5.1%) | 96 (4.5%) | 139 (6.5%) | 132 (6.1%) | 325 (15.1%) | 964 (44.7%) | 2.156 |
| 12 | 906 (41.9%) | 364 (16.9%) | 194 (9.0%) | 241 (11.2%) | 211 (9.8%) | 141 (6.5%) | 103 (4.8%) | 2.160 |
| 13 | 1.268 (58.7%) | 327 (15.1%) | 116 (5.4%) | 179 (8.3%) | 105 (4.9%) | 77 (3.6%) | 88 (4.1%) | 2.160 |
| 14 | 147 (6.8%) | 96 (4.4%) | 109 (5.1%) | 177 (8.2%) | 252 (11.7%) | 359 (16.6%) | 1.020 (47.2%) | 2.160 |
| 15 | 934 (43.2%) | 426 (19.7%) | 189 (8.8%) | 269 (12.5%) | 168 (7.8%) | 94 (4.4%) | 80 (3.7%) | 2.160 |
| 16 | 1.570 (72.7%) | 261 (12.1%) | 84 (3.9%) | 98 (4.5%) | 42 (1.9%) | 37 (1.7%) | 69 (3.2%) | 2.161 |
| 17 | 1.512 (70.0%) | 289 (13.4%) | 90 (4.2%) | 115 (5.3%) | 50 (2.3%) | 41 (1.9%) | 63 (2.9%) | 2.160 |
| 18 | 1.449 (67.1%) | 292 (13.5%) | 98 (4.5%) | 131 (6.1%) | 60 (2.8%) | 52 (2.4%) | 77 (3.6%) | 2.159 |
| 19 | 205 (9.6%) | 178 (8.4%) | 165 (7.8%) | 183 (8.6%) | 287 (13.5%) | 472 (22.2%) | 638 (30.0%) | 2.128 |
| 20 | 1.382 (64.9%) | 299 (14.0%) | 97 (4.6%) | 134 (6.3%) | 90 (4.2%) | 60 (2.8%) | 68 (3.2%) | 2.130 |
| 21 | 1.191 (55.9%) | 360 (16.9%) | 152 (7.1%) | 131 (6.2%) | 109 (5.1%) | 100 (4.7%) | 87 (4.1%) | 2.130 |
| 22 | 1.405 (66.1%) | 274 (12.9%) | 116 (5.5%) | 172 (8.1%) | 63 (3.0%) | 39 (1.8%) | 57 (2.7%) | 2.126 |
| 23 | 176 (8.3%) | 101 (4.7%) | 145 (6.8%) | 177 (8.3%) | 214 (10.1%) | 411 (19.3%) | 905 (42.5%) | 2.129 |
| 24 | 1.482 (69.7%) | 278 (13.1%) | 86 (4.1%) | 117 (5.5%) | 64 (3.0%) | 38 (1.8%) | 60 (2.8%) | 2.125 |
| 25 | 149 (7.0%) | 140 (6.6%) | 169 (8.0%) | 222 (10.4%) | 282 (13.3%) | 436 (20.5%) | 729 (34.3%) | 2.127 |
| 26 | 1.582 (74.4%) | 239 (11.2%) | 87 (4.1%) | 99 (4.7%) | 42 (2.0%) | 23 (1.1%) | 55 (2.6%) | 2.127 |
| 27 | 103 (4.8%) | 98 (4.6%) | 147 (6.9%) | 181 (8.5%) | 227 (10.7%) | 449 (21.1%) | 923 (43.4%) | 2.128 |
| 28 | 1.268 (59.6%) | 345 (16.2%) | 132 (6.2%) | 176 (8.3%) | 76 (3.6%) | 74 (3.5%) | 55 (2.6%) | 2.126 |
| 29 | 186 (8.8%) | 137 (6.5%) | 143 (6.7%) | 265 (12.5%) | 256 (12.1%) | 369 (17.4%) | 768 (36.2%) | 2.124 |
| 30 | 266 (12.5%) | 96 (4.5%) | 73 (3.4%) | 136 (6.4%) | 116 (5.5%) | 373 (17.5%) | 1.067 (50.2%) | 2.127 |
| 31 | 117 (5.5%) | 128 (6.0%) | 152 (7.1%) | 191 (9.0%) | 253 (11.9%) | 464 (21.8%) | 823 (38.7%) | 2.128 |
| 32 | 1.483 | 309 | 88 | 117 | 45 | 28 | 55 | 2.125 |

| | | | | | | | | |
|----|---------------|--------------|--------------|---------------|---------------|----------------|------------------|-------|
| | (69.8%) | (14.5%) | (4.1%) | (5.5%) | (2.1%) | (1.3%) | (2.6%) | |
| 33 | 104 (4.9%) | 76 (3.6%) | 89 (4.2%) | 186 (8.7%) | 188 (8.8%) | 344 (16.2%) | 1.142 (53.6%) | 2.129 |

Appendix 7 - The distribution of answers to questions from WHOTO+ANQ.

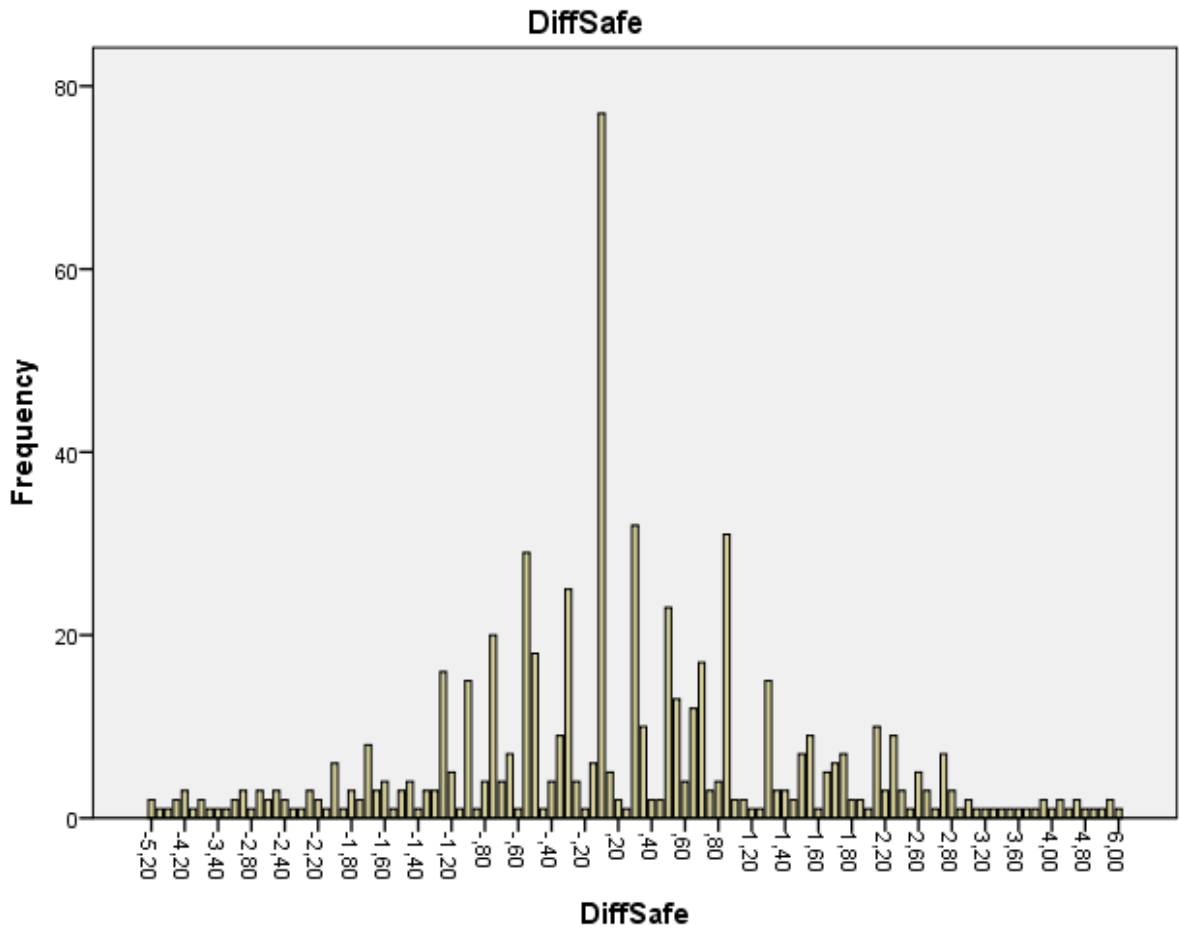
| Question number | Strongly disagree | | | | | | Strongly agree | | Total |
|-----------------|--------------------------|----------------|----------------|----------------|----------------|----------------|-----------------------|-------|-------|
| | 1 Number (Percent) | 2 | 3 | 4 | 5 | 6 | 7 | | |
| 1 | 116 (5.5%) | 125 (5.9%) | 117 (5.5%) | 206 (9.7%) | 253 (12.0%) | 399 (18.9%) | 899 (42.5%) | 2.115 | |
| 2 | 59 (2.8%) | 38 (1.8%) | 46 (2.2%) | 100 (4.7%) | 194 (9.2%) | 370 (17.5%) | 1.306 (61.8%) | 2.113 | |
| 3 | 140 (8.6%) | 118 (5.6%) | 136 (6.4%) | 188 (8.9%) | 303 (14.3%) | 488 (23.1%) | 742 (35.1%) | 2.115 | |
| 4 | 75 (3.6%) | 75 (3.6%) | 73 (3.5%) | 181 (8.6%) | 221 (10.5%) | 392 (18.5%) | 1.098 (51.9%) | 2.115 | |
| 5 | 118 (5.6%) | 97 (4.6%) | 81 (3.8%) | 126 (6.0%) | 162 (7.7%) | 290 (13.7%) | 1.241 (58.7%) | 2.115 | |
| 6 | 130 (6.2%) | 128 (6.1%) | 109 (5.2%) | 250 (11.8%) | 301 (14.2%) | 433 (20.5%) | 764 (36.1%) | 2.115 | |
| 7 | 183 (8.7%) | 166 (7.9%) | 189 (8.9%) | 252 (11.9%) | 305 (14.4%) | 460 (21.8%) | 559 (26.4%) | 2.114 | |
| 8 | 164 (7.8%) | 177 (8.4%) | 172 (8.1%) | 205 (9.7%) | 304 (14.4%) | 422 (20.0%) | 669 (31.7%) | 2.113 | |
| 9 | 74 (3.5%) | 84 (4.0%) | 86 (4.1%) | 153 (7.2%) | 230 (10.9%) | 341 (16.1%) | 1.145 (54.2%) | 2.113 | |
| 10 | 220 (10.4%) | 225 (10.7%) | 215 (10.2%) | 408 (19.3%) | 327 (15.5%) | 263 (12.5%) | 453 (21.5%) | 2.111 | |
| 11 | 175 (8.3%) | 189 (8.9%) | 161 (7.6%) | 268 (12.7%) | 307 (14.5%) | 478 (22.6%) | 536 (25.4%) | 2.114 | |
| 12 | 42 (2.0%) | 19 (0.9%) | 15 (0.7%) | 26 (1.2%) | 63 (3.0%) | 121 (5.7%) | 1.827 (86.5%) | 2.113 | |
| 13 | 79 (3.7%) | 50 (2.4%) | 54 (2.6%) | 119 (5.6%) | 208 (9.9%) | 295 (14.0%) | 1.308 (61.9%) | 2.113 | |
| 14 | 282 (13.3%) | 224 (10.6%) | 186 (8.8%) | 255 (12.1%) | 369 (17.5%) | 386 (18.3%) | 412 (19.5%) | 2.114 | |
| 15 | 602 (28.5%) | 410 (19.4%) | 234 (11.1%) | 345 (16.3%) | 246 (11.6%) | 141 (6.7%) | 136 (6.4%) | 2.114 | |
| 16 | 154 (7.3%) | 141 (6.7%) | 130 (6.2%) | 215 (10.2%) | 257 (12.2%) | 365 (17.3%) | 851 (40.3%) | 2.113 | |

Appendix 8 - Tables showing the distribution of the differences between the twins in each pair, for all six attachment scores, 2 from ETR and 4 from WHOTO-ANQ.



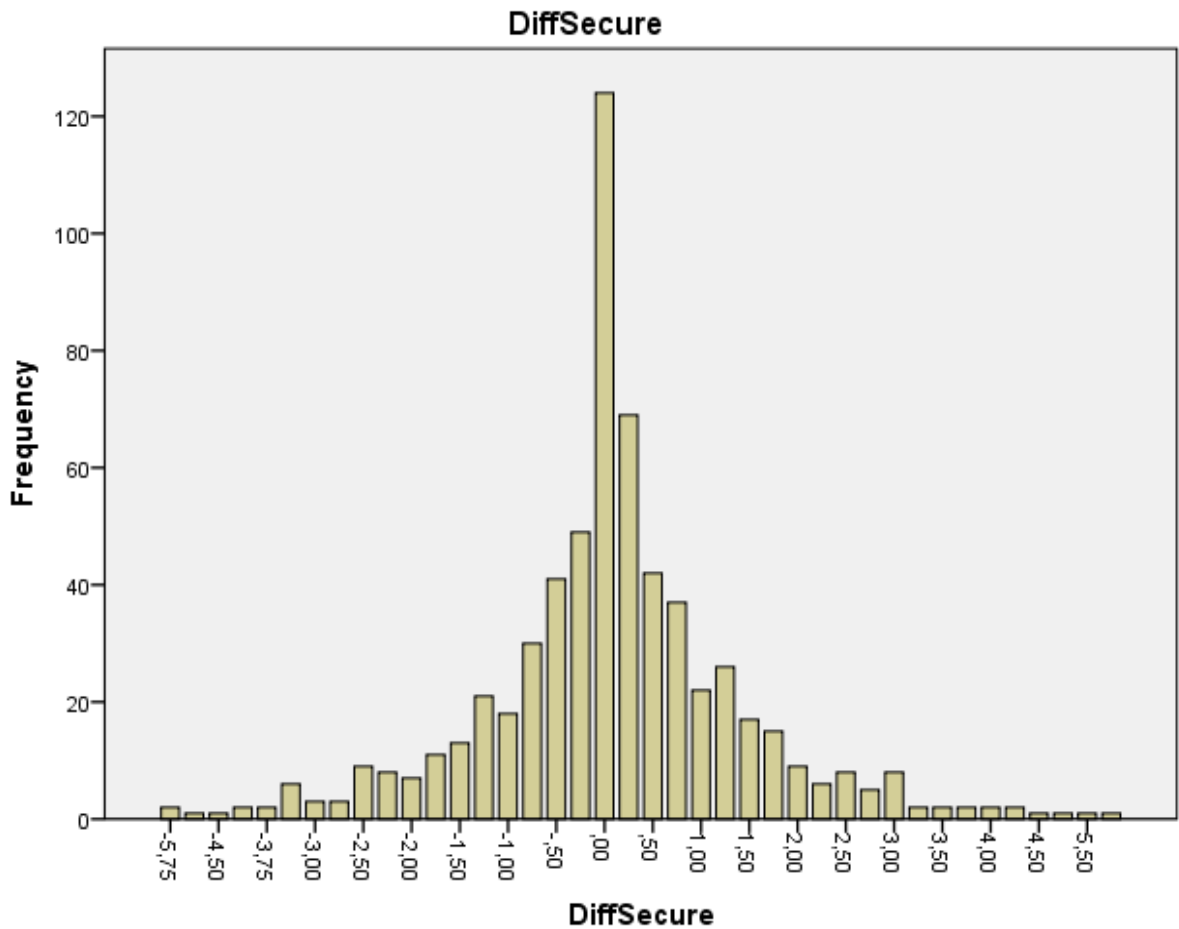
Almost half of the pairs of twins, 42 %, 269 pairs out of 629, had for “proximity” from the WHOTO-ANQ questionnaire no difference at all, and then a slowly decreasing number for bigger differences, 304 having a difference between 0.5 and 2.00, and 56 having more than 2 in difference, a quite normal distribution and with a focus on small differences, indicating the twins in each pair very often having almost the same score for “proximity maintenance”.

Appendix 8 (continued) - Differences between the twins in each pair, for all six attachment scores



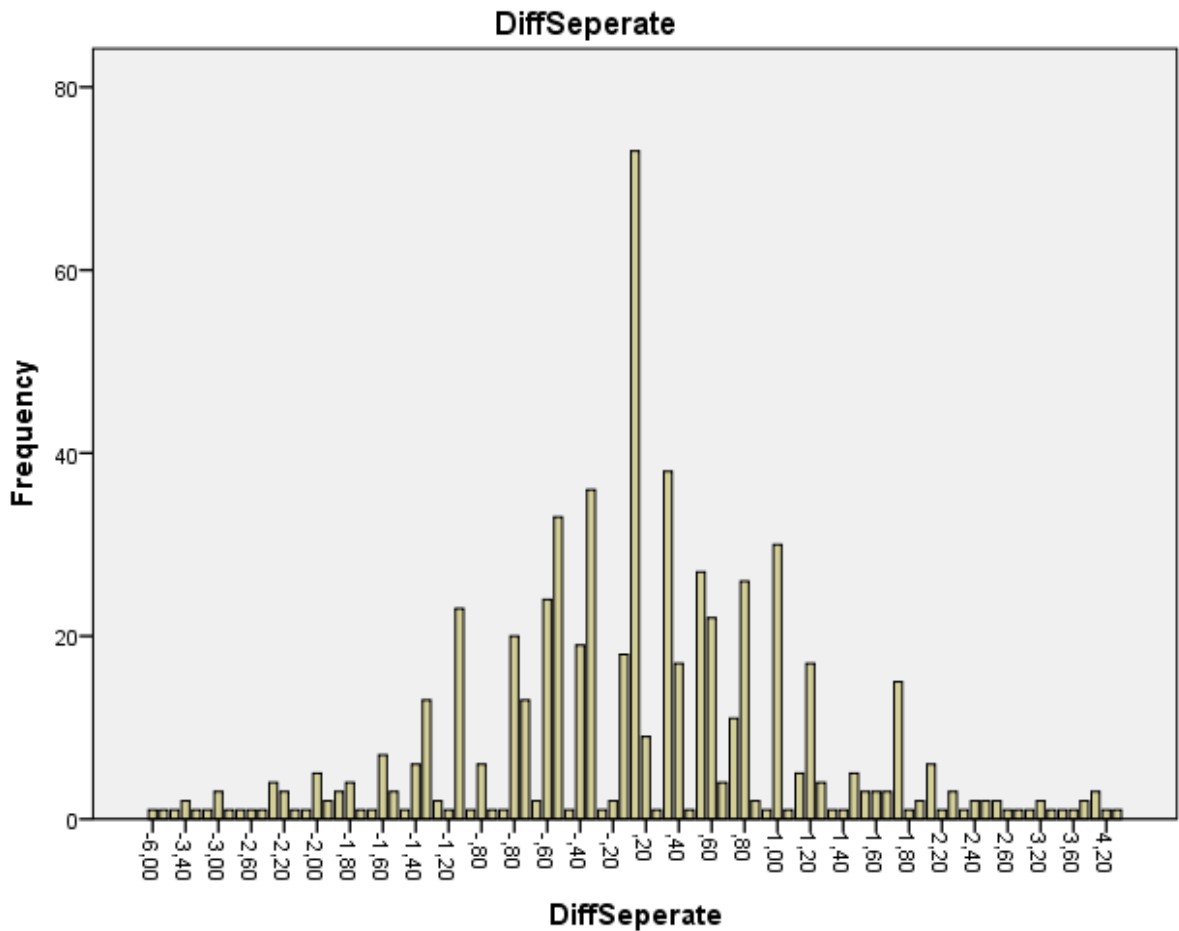
For “safe haven”, there is also a big peak, 77 pairs out of 629, 12 % having no difference at all, and then a slowly decreasing number for bigger differences. 353 pairs, 56 % have a difference between 0.20 and 1.20, and 198 pairs, 31 % have a difference between 1.20 with the biggest difference 5.8, also a quite normal distribution, indicating the twins in each pair very often having almost the same score for “safe haven”.

Appendix 8 (continued) - Differences between the twins in each pair, for all six attachment scores



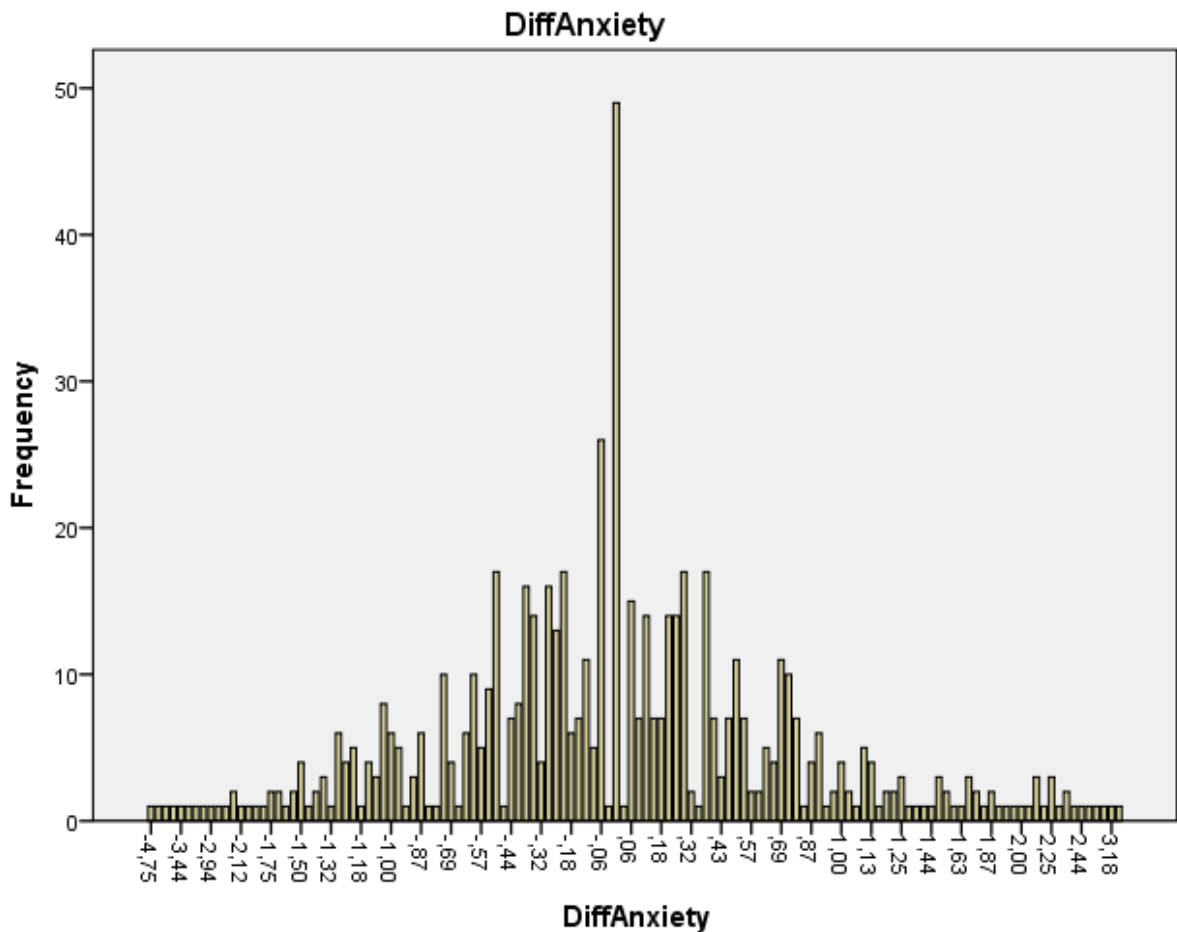
For “secure base”, there is also a pattern like the other scores have, with a big peak of 242 pairs out of 629, 38 % having no difference at all or 0.25 (and 124 pairs having no difference), and then a slowly decreasing number for bigger differences. 332 pairs, 53 % have a difference more than 0.25 and less than 2.75, and only 55 pairs have a difference more than 2.25 and less than 6.0, also a quite normal distribution, indicating the twins in each pair very often having almost the same score for “secure base”.

Appendix 8 (continued) - Differences between the twins in each pair, for all six attachment scores



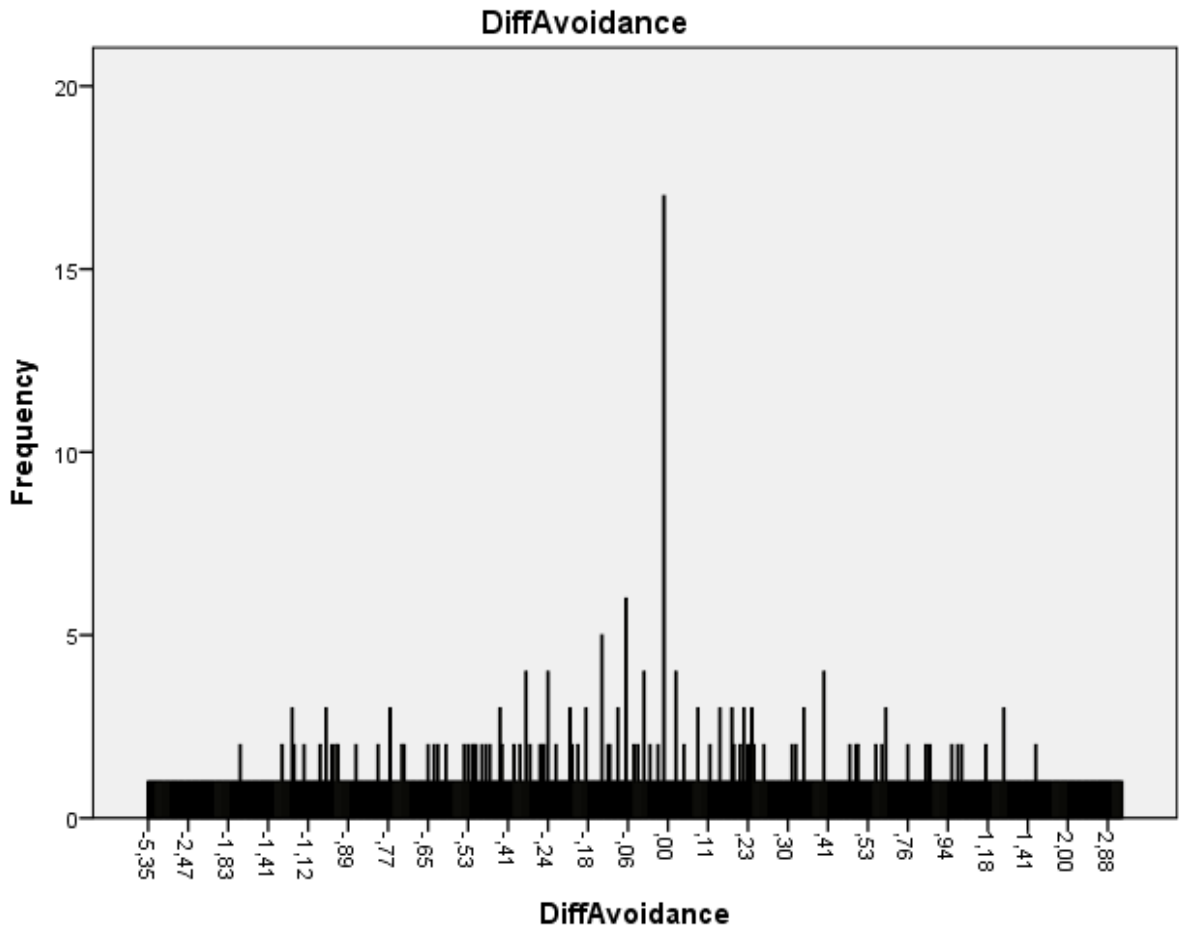
The fourth score from WHOTO and ANQ, “separation distress”, also has a clear pattern, with a big peak of 73 pairs out of 629, 12 % having no difference at all and then again, a slowly decreasing number for bigger differences. 493 pairs, 78 % having a difference between 0.2 and 1.8 and only 62 pairs having a difference between 1.8 and the biggest difference 6.0, also a quite normal distribution, indicating the twins in each pair very often having almost the same score for separation distress.

Appendix 8 (continued) - Differences between the twins in each pair, for all six attachment scores



For the ETR scores, the distribution of the difference is also characteristic, slightly different, but still very clear. For “anxiety” (the score being a mean from 16 questions), there is also a big peak, 49 pairs of twins, 8 % having no difference. 474 pairs, 75 % have less than 1.15 in difference, another 67 pairs, 10 % have between 1.15 and 2.0, and only 33 pairs have more than 2.0 in difference, with a maximum being 5.35.

Appendix 8 (continued) - Differences between the twins in each pair, for all six attachment scores



The difference for the “avoidance” score finally (the score being a mean from 17 questions), is even more clear: 38 pairs, 6 % have no difference at all, another 408 pairs, 65 % have less than one in difference, and finally 175 pairs, 28 % have between 1 and the biggest difference 5.35.

APPENDIX 9 - SCORE NORMS FOR THE SUBSCALES ATTACHMENT-RELATED ANXIETY AND AVOIDANCE (FRALEY, 2015-03-25).

There are some ECR-R norms available based on people who have taken the ECR-R online. The following statistics are based on a sample of over 17,000 people (73% female) with an average age of 27 (SD = 10). Twenty-one percent of the sample was married.

Here are some of the summary statistics:

| | Avoidance | Anxiety |
|-----------------------|-----------------------------------|-----------------------------------|
| Overall (full sample) | <i>M</i> = 2.92, <i>SD</i> = 1.19 | <i>M</i> = 3.56, <i>SD</i> = 1.12 |
| Sex | | |
| Male | <i>M</i> = 2.94, <i>SD</i> = 1.13 | <i>M</i> = 3.57, <i>SD</i> = 1.10 |
| Female | <i>M</i> = 2.92, <i>SD</i> = 1.21 | <i>M</i> = 3.56, <i>SD</i> = 1.13 |
| Marital status | | |
| Married | <i>M</i> = 2.86, <i>SD</i> = 1.26 | <i>M</i> = 3.26, <i>SD</i> = 1.15 |
| Single | <i>M</i> = 2.94, <i>SD</i> = 1.17 | <i>M</i> = 3.64, <i>SD</i> = 1.10 |
| Age | | |
| 20 | 2.88 | 3.59 |
| 30 | 2.96 | 3.55 |
| 40 | 3.04 | 3.51 |
| 50 | 3.12 | 3.47 |
| 60 | 3.20 | 3.43 |

Note. The values for age represent the predicted values for variable ages based on a regression model that models avoidance and anxiety as a function of age in years. The equation for avoidance is $2.72 + .008*AGE$. The equation for anxiety is $3.67 - .004*AGE$.

APPENDIX 10 - Technical data in the EDA measuring process

The equipment records the electric current in the skin, influenced via the sweating processes which varies with the arousal and non-conscious reactions in the body. In this study, the so-called maximum sampling is 16 per second or 16 Hz. A direct current, DC with 0.5 V is applied to the equipment measuring the current in the skin. This function is improved with a very low noise and taking precautions that the temperature will not be changed too much, something that otherwise could have influenced the measuring process.

Significant for this equipment is the very high resolution on so-called 20-bit, which corresponds to the scale-area being divided into 2^{20} levels = ca 1,000,000 levels, which makes it possible to see small variations in the skin conductance. To make this possible, the amplifier has a very low noise itself and is very temperature stable. For maximum stability, the equipment is designed to get as few disturbances as possible and thus avoid false signals, e.g., coming from static electricity from the participant with the use of cables to the electrodes that are isolated and earthed with so-called ESD-protection.

Concerning artefacts, there is one frequency in the surrounding electrical field that is known to be able to disturb the equipment, a frequency of 50 Hz. This frequency can also be picked up by the participant acting as an antenna. To avoid this, the equipment has a standard built-in filter, a low pass (LP) filter, for the frequency-area DC -> 5 Hz, but also blocking out all signals with frequencies over a certain limit (20 Hz). This filter prevents fast signals passing through (e. g., external disturbances). There is also an extra notch filter to attenuate for 50 Hz, making it possible to select and make use of highest possible resolution of the signal. In this way, higher frequencies are attenuated, moderating all

APPENDIX 10 (CONTINUED) - Technical data in the EDA measuring process

interferences from the surrounding electrical net. Therefore the frequency-range is optimized from DC 0 – 20 Hz.

A high pass (HP) filter is also used, permitting only frequencies over a certain limit (0.05 Hz) to pass. This will block out very slow variations in the signal and quite static signals. Thus, the HP filter is said to have the frequency area of 0.05 – 20 Hz. Excluding the very slow changes in the baseline, the graph is given an appearance more like a straight line rather than big oscillations up and down, which facilitates the interpretation of the graphs.

As regards data output, one graph depicts the skin conductance level (SCL) and another one shows skin conductance responses (SCR).

The level graph is the real signal being measured, with a frequency area for the DC being 0 -> 5 Hz. For the response-graph, the frequency area is limited to 0.05 -> 5 Hz, which is achieved by introducing the HP filter. On the Response graph, slow variations of the signal are all excluded, and the baseline is set as straight. It can be noted that 0.05 Hz corresponds to a time of $1/0.05 = 20$ seconds. That is why peaks will appear much clearer towards a straight baseline, as compared to if also the baseline is varying all the time.

The frequency range for a filter has a damping effect so that when the response graph for instance set between 0.05 -> 5 Hz, both lower and higher frequencies will pass, but they become very much attenuated. In this study, frequencies up to 8 Hz are represented, but frequencies between 5 – 8 Hz are not represented linearly and become therefore successively more attenuated. On the response graph, the signal is amplified with a factor * 2 when compared to the level graph, and the amplitude depends on the frequency of the signal.

APPENDIX 11 - Examples of anecdotes and exceptional experiences reported by twins in these three studies.

Study 1:

One pair of male twins, aged 59 years, PW and JW, described how JW suddenly found he without any apparent reason couldn't keep on walking, then after some minutes, he could continue. On meeting his brother some days later, he was told that his brother had had problems with his hip coming out of joint. They concluded that this incident occurred at the same moment that his brother just couldn't walk.

At another occasion, one of them had meat stuck between the teeth, and the other one cried until it was removed. Finally, as teenagers, JW had his appendix removed and PW lost rhythm and co-ordination when playing tennis until it recovered.

One pair of female identical twins, aged 50, SH and JW, told how when they were 17, one of them had her appendix taken out without the other twin knowing who woke up at about 2 am with severe feelings that her stomach was on fire and couldn't even touch it. She was later told that her sister had an emergency operation at 2 am. On another occasion, one of the same twins at the age of 11 was horse riding in an arena while the other was out on a trek. The twin who was indoors became concerned and agitated about the other twin. At that time her sister had fallen off her horse and been dragged causing concussion and an ambulance had been called.

Another pair of female twins AC and HC, related how when aged 23, one of them was in London with her grandmother and happened to slip and cut her head and was taken to hospital. Meanwhile the other twin in Oxfordshire complained of head pains and both she and her mother were completely unaware of the accident for the other twin. On another

APPENDIX 11 (CONTINUED) - Examples of anecdotes and exceptional experiences reported by twins in these three studies.

occasion, when both of them were abstaining from caffeine, one of them took a few sips of coffee, and the other twin immediately called and asked her if she had had some coffee. She told her twin that she had suddenly had heart palpitations.

The last remaining pair of female, identical twins, aged 54, AH and JR, related how one of them, AH knew when the other was engaged and pregnant before being told.

Study 2:

Examples of anecdotes the twins in this study reported.

One pair of twins, aged 59 years, PW and JW, was one of the pairs who also participated in the first study, where PW had 3 hits out of 5.

One pair of female, identical twins, aged 50, SH and JW, also participated in the first study, where SH had one hit out of 5.

Another pair of twins, AC and HC, also participated in the first study and there reporting HC was being the receiver in their daily life. Therefore, in this study, only HC participated as receiver. They were both enthusiastic so even if none of them were successful in the first study, they were invited again.

One pair of males, DF and JF, aged 61, belongs to the group who could not recall any previous paranormal experiences, but were interested in participating in further experimental studies, and were also available.

APPENDIX 11 (CONTINUED) - Examples of anecdotes and exceptional experiences reported by twins in these three studies.

One pair of females, RS and AM, identical twins, aged 35, reported having paranormal experiences in situations with distress, appendix, miscarriage and pregnancy.

One pair of males, SC and DC, non-identical twins, aged 65, reported paranormal experiences like injury and illness, when for example SC cut his finger quite badly with a carving knife whilst his brother was away at university. Having no mobile phone he was unaware. But on the same day, DCs finger went very red and very sore. The doctor didn't know why his finger went red but gave him a poultice to put it on. Later DC found out what had happened.

Finally, the last remaining pair of females, HT and RO, identical twins, aged 59, told how HT was in England and suddenly felt very excited for no reason. Later she found out that her sister, being in Africa, met a mutual friend at the airport there at that very moment. as receiver. They were both enthusiastic so even if none of them were successful in the first study, they were invited again.

Study 3:

One pair of females, DB and SH, age 44, where DB reported to once having known „something bad had happened“.

One pair of females, KG and CA, age 61, where KG reported to have sensed pain or illness, and a problem or state of mind, and sometimes being ringing at the same time, while CA reports the same thing.

APPENDIX 11 (CONTINUED) - Examples of anecdotes and exceptional experiences reported by twins in these three studies.

One pair of females, NO and GH, age 28, where NO reported that when her sister was pregnant at the time, and she herself felt the kicking inside even though she was not the one being pregnant. GH reports it is a bit of freaky at times, but quite interesting, and especially reports that it mainly happens with injuries.

Other twins:

For some other pairs who wanted to participate, but couldn't, one pair of females, RS and AM, identical twins, aged 35, reported having paranormal experiences in situations with distress, appendix, miscarriage and pregnancy.

One pair of males, SC and DC, non-identical twins, aged 65, reported paranormal experiences like injury and illness, when for example SC cut his finger quite badly with a carving knife whilst his brother was away at university. Having no mobile phone he was unaware. But on the same day, DC's finger went very red and very sore. The doctor didn't know why his finger went red but gave him a poultice to put it on. Later DC found out what had happened.

Finally, the last pair of females, HT and RO, identical twins, aged 59, told how HT was in England and suddenly felt very excited for no reason. Later she found out that her sister, being in Africa, met a mutual friend at the airport there at that very moment.