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Tuulikki Trias

INTER-TWIN AND PARENT-TWIN RELATIONSHIPS AND MENTAL HEALTH

A STUDY OF TWINS FROM ADOLESCENCE TO YOUNG ADULTHOOD

FACULTY OF MEDICINE,
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CLINIC OF CHILD PSYCHIATRY,
OULU UNIVERSITY HOSPITAL

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INTER-TWIN AND PARENT-TWIN RELATIONSHIPS AND MENTAL HEALTH

A study of twins from adolescence to young adulthood

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Abstract

The sample consisted of 419 twins, born in 1965–1973, from Northern Finland who had been followed at ten-year intervals, at 2–10 years, 12–20 years and at 22–30 years of age. Data on psychosomatic symptoms, parent-twin and inter-twin relationships were elicited, and twins completed the Children's Depression Inventory modified for age.

Middle adolescence appeared to be the most difficult phase of puberty for twins as far as depressive and psychosomatic/somatic symptoms were concerned. When different twin pairs were evaluated separately, the males of opposite-sex twin pairs seemed to be in the most favourable position, particularly in late adolescence, as they reported least depressive symptoms.

Depressive and psychosomatic symptoms were evaluated in relation to parental preference among young adult twins. Parental preference was evaluated in two directions: which one of the parents was reported to feel as being closer to the twin – *experienced parental preference* evaluated by the twin, and which one of the parents the twin felt closer to – *twin's own preference*. Those males who were equally close to both parents (experienced parental preference) had least total depressiveness, while females in intermediate situation had the highest self-confidence and least anhedonia and nervousness. According to twins' own preference, twins who felt equally close to both parents had least total depressiveness and anhedonia. The intermediate position seems to be the best alternative, as these twins had the least symptoms.

Psychosomatic and depressive symptoms were evaluated in relation to co-twin dependence in young adult twins. MZ twins, especially MZ females, reported most often co-twin dependence at all ages. There were no significant differences in depressive symptoms between dependent and independent twins. Twin's subjective experience about co-twin dependence appeared to be important for the twin's mental well-being, as dependence-independence imbalance within twin pair was associated with elevated levels of depressive symptom reporting, especially in twins who perceived themselves as dependent and the co-twin as independent.

Dominance-submissiveness between co-twins and its relationship to mental health was assessed in young adulthood. Dominance-submissiveness in the twin relationships was assessed separately in three domains of life: physical and psychological dominance-submissiveness and the role of a spokesperson. Submissiveness in the psychological domain seemed to be associated with increased depressiveness, nervous complaints and psychosomatic symptoms in males of male-female twin pairs. Among females of same-sex twin pairs, submissiveness in the psychological domain was most clearly associated with depressive symptoms.

We conclude that being submissive, especially in the psychological domain, to a female twin partner seems to be stressful, whereas it is easier, especially for females, to be submissive to a male twin partner. This was in contrast to co-twin dependency, which was experienced positively when occurring towards a twin sister.

Keywords: co-twin dependence, depressiveness, dominance-submissiveness, parental preference, psychosomatic symptoms

To my family

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Abbreviations

ADHD	Attention deficit hyperactivity disorder
CDI	Children's Depression Inventory
IPD	Inter personal dependency
MZ	Monozygotic
MZF	Monozygotic female
MZM	Monozygotic male
DZ	Dizygotic
SS	Same-sex (twins)
OS	Opposite-sex (twins)
SSMZ	Same-sex monozygotic (twins)
SSDZ	Same-sex dizygotic (twins)
OSDZ	Opposite-sex dizygotic (twins)
op	Original publication
SCID	Structural Clinical Interview for DSM IIIR
SPSS	Statistical Package of Social Sciences
STAKES	Sosiaali- ja terveysalan tutkimus- ja kehittämiskeskus (National Research and Development Centre for Welfare and Health)

List of original papers

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II Trias T, Ebeling H, Penninkilampi-Kerola V, Kunelius A, Tirkkonen T, Moilanen I (2006) How long do the consequences of parental preference last: A study of twins from pregnancy to young adulthood. Twin Res Hum Genet 9(2): 240-249

III Trias T, Ebeling H, Penninkilampi-Kerola V, Moilanen I (2006) Psychosomatic symptoms and depressiveness in twins with special reference to co-twin dependence. (manuscript)

IV Ebeling H, Porkka T*, Penninkilampi-Kerola V, Berg E, Jarvi S, Moilanen I (2003) Inter-twin relationships and mental health. Twin Res 6: 334-343.

In addition, some unpublished data have been included in this thesis.

*Trias T née Porkka T.

Contents

1 Introduction

About 3% of the infants born in Finland are twins (Stakes, 2005). One third of them are monozygotic (MZ), having the same genotype. Dizygotic (DZ) twins are genetically as much alike each other as siblings are in general, as they share on average 50% of their segregating genes. The proportion of twins among newborns has been on the increase, because the probability to expect twins has been growing along with the increasing age of the mother and after various treatments for infertility (Loos *et al.* 1998). Twinning rates have increased steeply in the Nordic countries; rates averaged 10/1000 in 1980, increasing slightly during the next decade to be clearly above 10/1000 by 1990, after which the increase was uniformly steeper until 1998. Since that the time trends in each country have diverged. A clear decline was observed in Finland after 1998. (Kaprio and Marttila 2005).

Twins have long been the object for genetic studies. To examine the generalizability of results from twin studies to the general population it is important to know whether the twinship context is developmentally adaptive or not.

Growing up as a twin is biologically and psychologically different from growing up as a singleton (Ainslie 1985, Rutter and Redshaw 1991). Perinatal mortality and morbidity are higher in twins than in singletons, and are mainly caused by low birth weight and prematurity by twin-twin transfusion syndrome, but also by malpresentation and the mode of delivery (Alin Åkerman and Fischbein 1991, Aslan *et al.* 2004). RDS is no more common among twins than singletons after adjustment for birth weight and gestational age (Marttila *et al.* 2004).

Accordingly, cumulative incidences of various handicaps are higher in twins (Moilanen and Rantakallio 1989, Alin Åkerman and Fischbein 1991, Levy *et al.* 1996,). The human relationships of twins have their special features from the early beginning. Twins have to share the attention from the parents, and some parents resolve the situation by sharing the twins: a ‘mother’s child’ and ‘father’s child’ may develop (Burlingham 1952, Joseph 1961, Joseph and Tabor 1961, Ainslie 1985, Moilanen and Ebeling 1998). Twins may be dependent on each other, and the inter-twin relationship can also be characterized by dominance-submissiveness (Ainslie 1985, Moilanen and Ebeling 1998).

This study tries to answer to which extent parental preference and inter-twin relationships may affect twin’s mental well-being even in young adulthood.

2 Review of the literature

2.1 Development of twins

There are some special features in the physical growth of twins. In comparison to singletons, twins are at higher risk of being born prematurely (Luke and Keith 1992, Rydhström and Heraib 2001) and of having postnatal complications (Alin Åkerman and Fischbein 1991, Moilanen and Rantakallio 1990, Rydhström and Heraib 2001). The overall perinatal mortality rate for twins is about 3 to 7 times higher than that for singletons (Sherer 2001). The significantly increased incidence of preterm delivery for twins compared to singletons prior to 34 weeks is likely to explain the significantly increased infant mortality in twins (Rydhström and Heraib 2001). MZ monochorionic (The chorion is the outer membrane of the sac surrounding a foetus in utero. When MZ twins are contained in a shared chorion they are referred to as monochorionic) newborns are at a higher risk of dying perinatally than DZ newborns, especially before birth, whereas MZ dichorionic (Twins that develop in separate sacs are considered dichorionic. All DZ twins are dichorionic) infants have the same risk as DZ newborn, which indicates that perinatal mortality is more a matter of chorionicity than zygosity (Loos *et al.* 1998, Sherer 2001). Some single MZ placentas are divided on a 50-50 basis, but 60-40, 70-30 and 80-20 splits are also seen (Loos *et al.* 1998). Birth weight is highest in DZ twins and diminishes stepwise in MZ dichorionic and MZ monochorionic twins (Levy *et al.* 1996, Loos *et al.* 1998). The twin-twin-transfusion syndrome represents a major unique risk factor facing the monochorionic twin pregnancy (Blickstein 1990), but also malpresentation and the mode of delivery (Aslan *et al.* 2004) pose risks. Second-born twins have shown worse neonatal outcomes than first-born twins, and they have potentially greater susceptibility to hypoxia and trauma (Young *et al.* 1985, Haest *et al.* 2005). Twins small for gestational age continue to be smaller in height and weight up to adolescence, but the difference from others is of practically no significance (Silva *et al.* 1982, Pietiläinen *et al.* 2001)

Many twins show slightly delayed development in language acquisition (Koch 1966, Zazzo 1976), most probably because of the risks of twin pregnancy and delivery and also because of the fact that there is less verbal communication with adults in twins who have

to share the mother with the other twin (Lytton *et al.* 1977). Twins tend to receive less speech that is specifically directed to them as an individual, they participate in fewer and shorter episodes of joint attentional focus with their mothers, and have fewer and shorter individual conversations than singletons (Lytton *et al.* 1977, Lytton 1980, Clark and Dickman 1984). One explanation might also be the close inter-twin relationship which does not necessarily need words and which can even develop its own, peculiar language (Rutter and Redshaw 1991, Bishop & Bishop 1998, Thorpe *et al.* 2004). Biological hazards may be important in individual cases, but they seem to have a limited impact on twins as a group.

Twins often develop at different speeds and at different times both physically and emotionally (Ainslie 1985, Bryan 1992). Differences in physical development within a pair of DZ twins may become very apparent during puberty. The normal age for the onset of puberty varies greatly, so it is not uncommon for one twin to have a spurt in growth several years ahead of the other. Sometimes the difference can be very disconcerting for the smaller twin, who may then find being regarded as the younger brother or sister. Females tend to enter puberty earlier than males (Bryan 1992, Dick *et al.* 2001) and they tend to become more responsible and work-oriented earlier (Bryan 1992). This increase in size and maturity can be accompanied by a bossy ''elder sister'' attitude. (Bryan 1992)

The development of interpersonal relationships in twins has some special features, the main factors being inter-twin dependence and dominance-submissiveness (Moilanen 1987b). This inter-twin relationship may be very intimate, rewarding and binding (Siemon 1980). As the person who is most constantly present within the twin's range of perception is his co-twin, twins easily identify with their co-twin. Identification between twins is usually mutual and of equal intensity. Identification is made with an individual who is at the same developmental level, which might be less growth-promoting than having a parent or other mature role model as an identification figure (Leonard 1961, Siemon 1980).

According to Schave and Ciriello (1983), there is no single type of attachment between twins, as the nature of the bond between twins may vary from the very close psychological dependency of *unit identity* twins to the significant but less intertwined psychological closeness of *sibling attachment identity* twins. It has been suggested that a more limited amount of mothering leads to closer bonding between the twins (Leonard 1961, Schave and Ciriello 1983).

In their search for individuality twins may create differences, sometimes even artificial ones, between themselves (Schave and Ciriello 1983) by accentuating slight differences in behavioural continuums, e.g. one twin is more dominant while the other is more submissive (Segal 1999).

2.2 Risk factors and psychopathology

As a higher proportion of twins have experienced prematurity, perinatal morbidity, delayed development, language delay and reading retardation (Rutter and Redshaw 1991), twins might be predisposed to higher rates of psychopathology. A comparison of 6- to 11-year-old and 12- to 16-year-old twins (n=1,824, Virginia Twin Registry) with

non-twin samples rated on the Child Behaviour Checklist (CBCL) showed a small elevation in the mean scores of twins for externalizing behaviours for younger children, and for both externalizing and internalizing (depression and psychosomatic symptoms) behaviours for older children (Gau *et al.* 1992). Levy *et al.* (1996) found a higher rate of attention deficit hyperactivity disorder (ADHD) in twins than in their siblings in Australia, and there was a strong association between ADHD symptoms and speech and reading problems.

However, several studies have failed to show any evidence of increased rates of psychopathology in twins (Gjone and Novik 1995, Van den Oord *et al.* 1995, Simonoff *et al.* 1997, Pulkkinen *et al.* 2003). Levy *et al.* (1996) did not find any significant differences between twins and siblings for symptoms of Oppositional Defiant disorder (ODD), Conduct Disorder (CD) or Separation Anxiety (SA). In some studies twins have even had fewer emotional problems, such as depressive symptoms in childhood (Gjone and Novik 1995, Moilanen *et al.* 1999, Pulkkinen *et al.* 2003). Gjone and Novik (1995) compared 5- to 15-year-old same-sex twins (n=1,832, Norwegian Medical Birth Register) with general population rated on CBCL. There was a slightly lower level of internalizing behaviour among twins aged 12 to 13 years than in the general population. It has also been found that twin adolescents may show less adverse behaviour, such as drinking and smoking than singletons (Moilanen and Rantakallio 1990). In a Danish study a reduced suicidal risk was found in twins (Tomassini *et al.* 2003)

No difference has been shown between twins and the general population in the frequency of schizophrenia (Kringlen 1967, Rosenthal D 1960). The incidence of treated psychotic and affective disorders in twins (Swedish National Twin and Psychiatric Registries) did not differ from that found in the general population and did not differ across zygosity groups (Kendler *et al.* 1996). In the case of mental illness of a twin, the disturbed one has been most often the shy, submissive and dependent individual of the twin pair (Tienari 1963, Kringlen 1967). These characteristics of personality could possibly be non-specific premorbid social or developmental impairments or even prodromal symptoms of schizophrenia. Personality traits are generally thought to relate to psychopathology (Fanous & Kendler 2004), e.g. adoption studies have demonstrated that the biological offspring of schizophrenic mothers are more likely to have schizotypal personality disorder compared to children of control mothers (Tienari *et al.* 2003, Fanous & Kendler 2004). Although some individuals show relatively stable patterns of subtle social and neurocognitive impairments, those who develop schizophrenia typically enter a prodromal phase characterized by a gradual but marked decline in social and academic functioning (including social withdrawal, declining school performance, uncharacteristic and odd behaviour, odd ideas, and changes in affect) that precedes the onset of active psychotic symptoms (Hollis 2005). Although these are also characteristic features of schizotypal personality disorder, in a schizophrenic prodrome there is usually progression to more severe dysfunction (Hollis 2005).

Analyses of gender differences have shown that, like girls in general, also twin girls exceed twin boys (12 years) in internalizing behaviours, such as depressive symptoms and social anxiety (Pulkkinen *et al.* 2003), and in psychosomatic symptoms, such as cephalalgia, abdominal pain and lack of energy in adolescence (Moilanen 1991). Somatic complaints may be used by children as a way to express negative emotions when depression or another emotional disorder occurs. Internalizing symptoms have been more

often associated with headache among adolescent female than male twins (Virtanen *et al.* 2004). Among adult twins, depressive symptoms have been shown to be more common in women than men (Inaba *et al.* 2005, Marcus *et al.* 2005, Wauterickx and Bracke 2005).

2.3 Parenting twins

Parenting twins differs from parenting singletons. Differences begin during pregnancy and are found in the infant-parent relationship as well as in twins' social-emotional development (Ainslie 1985). Parents may experience a feeling of privilege, as only about one expectant mother in seventy will give birth to twins. On the other hand, awareness of the special risks involved in a twin pregnancy and delivery may cause additional stress (Holditch-Davis *et al.* 1999).

The twin situation has been shown to be influential in shaping parent-child interaction, particularly in its impact on parent socialization practices (Lytton 1980). As the mother may have difficulties coping alone while taking care of two infants the father may become increasingly important in looking after the children. It often happens that the father takes responsibility for nursing one of the babies while the mother takes over the other one (Burlingham 1952, Joseph 1961, Joseph and Tabor 1961, Lytton 1980, Ainslie 1985, Robin *et al.* 1988, Moilanen and Pennanen 1997). This is how the situation with a '*mother's twin*' and a '*father's twin*' or 'parental preference' begins.

Families develop different means of coping with the burden of baby care. Robin *et al.* (1988) described mother-twin interaction in a study of 21 French families made up of 14 DZ and 7 MZ twin pairs. Preliminary data were obtained from a questionnaire at two months post term. Direct observations were conducted at the twins' 2, 4, 6, 9, 12, 18, 24 and 36 months of age, and cross-sectional observations at the age of one year, a follow-up study involving home observation and parental interviews from birth to the age of 3, point to the specificity of the triadic situation. According to the authors, the mother may decide that two people are necessary to take care of the infants and has recourse to a 'maternal double' who may be the father, a relative, or outside help (46% had help). Alternatively, the mother (25%) may decide to handle things alone and be quick to refuse offers of assistance, including that of the father. Some women develop a mode of organization which cuts care time down to a minimum.

In some cases, the father may play a 'surrogate mother' role (Robin *et al.* 1988). Baby care, carried out by both parents in tandem is more individualized and makes it easier to take the rhythm of each infant into consideration. The triadic situation thus becomes a quadratic one. Some mothers tend to prefer one twin whereas the father prefers the other. Some parents desirous to set up an individualized relationship for each twin with the mother and the father are careful to set up egalitarian rituals, e.g. they do not take care of the same infant all the time.

Mother's attitudes can range from 'early twinship', where the two babies are treated as though they were a single unit, to attempts to create two dyadic relationships (Robin *et al.* 1988). Women who adopted 'early twinship' type of organization are in general egalitarian and exhibit no preferences. This type of maternal relationship seems to restrict mother-infant interaction and encourage autonomy, while on the other hand facilitating

interaction between the twins. According to authors these maternal attitudes may help to shed light on some of the features of later psychoemotional development in twins.

A consistent, nurturing relationship between parents and child is necessary for the child's psychological well-being (Bowlby 1958). It has been postulated that the mother can optimally attach to only one infant at a time. Thus, parents of twins are thought to face more difficulties in developing an attachment relationship with their twins (Abbink 1982, Bryan 2003). As a result, parents may be attached to the twin dyad, or they may bond with one of the infants (Robin *et al.* 1988, Sandbank 1999).

A study by Minde & al. (1990) indicates the possible association between differential parenting and attachment. Twenty-four pairs of premature twins were observed, together with their parents, at seven periods during the first 48 months of their lives. They found that mothers with a stable preference for a particular twin (two-thirds of the mothers in their sample) responded to their preferred infant more sensitively than to the co-twin during the early stages of the twins' development, from birth up to age 4 years. Differential treatment was suggested to be beneficial for the development of attachment style for the favoured child as it provides that child with individualized attention. However, this appeared to be at some cost to the disfavoured child, who experienced less sensitive and responsive parenting. This disadvantageous situation of maternally non-preferred twin may sometimes be compensated by father's preference (Sandbank 1999).

Some studies show the ways in which postnatal medical complications may lead to preference on the part of the mother for one of the twins. While the study of seriously premature twins (weight < 1501g) by Minde *et al.* (1990) showed that mothers tended to prefer the stronger, medically sounder twin, in another study of only slightly premature and healthy twins, preference based on perinatal difficulties was rare (Robin *et al.* 1992). In some studies mothers developed a closer bonding with the weaker or ailing twin (Allen *et al.* 1971, Ainslie 1985, Moilanen and Pennanen 1997). Fathers have appeared to choose the more robust of the twins (Allen *et al.* 1971, Ainslie 1985). The hospitalization of one of the newborn twins may have long-lasting effects on the attachment bond (Minde *et al.* 1990). However, other studies have not found differences in attachment security between twins and singletons (Vandell *et al.* 1988, Moilanen *et al.* 2000).

Different aspects of temperament may be at play in structuring parent-twin relationship. In twinships where there are differences in activity level, one mother may for example wittingly or unwittingly feel more comfortable with her active twin, while another feels more comfortable with the less active twin (Ainslie 1985, Minde *et al.* 1990, Bokhorst *et al.* 2003). The parents' own history of being parented may also affect the characteristics of the parenting style (Ainslie 1985).

Parental preference may persist into adolescence. Minde *et al.* (1990) found that the majority of mothers maintained the preference for at leas four years. Sandbank (1988) noted in her study of 7- to 17-year-old twins (53 pairs) that birth weight and birth order can affect the way in which twins interact with each other as well as family interaction, particularly in the case of DZ twins, but zygosity and sex appear to be important as well. Lighter twins were closest to the mother in the case of MZ boys and DZSS and DZOS boys and girls. MZ girls were influenced in the opposite direction, with the heavier girls being closest to the mother. Closeness to mother was generally accompanied by a higher negative score from the father, heavier MZ girls being the only exception which, according to Sandbank, might suggest dominance. MZ boys were closer to the father,

seeing him as a more maternal figure, which appeared to affect their relationship with the mother. DZ boys showed the opposite picture, a stronger attachment to mother and an uneasy relationship with father.

In some twinships each twin appears to be primarily identified with one parent or the other (Lytton 1980, Ainslie 1985). In other twinships it has not been clearly evident that both parents were involved in the process. Rather there appeared to be differences in the nature and quality of the twins' relationship to the mother, with one twin clearly closer to her, the other less so. Further, in some cases the twin who did not appear to have the closer relationship with the mother did not necessarily have a closer relationship with the father (Ainslie 1985).

In a sample of 157 MZ and DZ twins, genetic and environmental influences on infant attachment and temperament were quantified. Environmental factors played a decisive role in the development of (non)secure attachment as assessed in the Ainsworth Strange Situation Procedure. Behaviour genetic modelling indicated that the heritability of disorganized and secure attachment behaviour was negligible. Only unique environmental or error components could explain the variance in disorganized attachment. For secure versus non-secure attachment, 52% of the variance in attachment security was explained by shared environment, and 48% by unique environmental factors and measurement error. Genetic factors explained 77% of the variance in temperamental reactivity, and unique environmental factors and measurement error accounted for 23% (Bokhorst *et al.* 2003).

Lytton (1980) studied the effects of parents' child-rearing practices on children's behaviour, and children's reciprocal effects on parents through naturalistic observation in the home, interviews and overall ratings, and experiment in the laboratory playroom in 2-year-old boy twins and singletons in Calgary, Canada. When attachment behaviour was assessed, the mother was the main object of attachment for about 70% of the children and the father for 30%. There were 49 twins and 34 singletons in the mother-attached group and 27 twins and 10 singletons in the father-attached group, suggesting that there is a much greater likelihood for twins than for singletons to take the father as their preferred attachment object. Thirteen of the 27 twins in the father-attached group had twin partners who were mother-attached. In comparison with mother-attached children, the father-attached children were less mature, and their mothers displayed fewer positive qualities; less positive interactions and a more punitive approach to the child.

Numerous authors have noted that, for twins, competition tends to be heightened (Burlingham 1949, 1952, Joseph 1961, Joseph and Tabor 1961). The sources of this heightened competition have been linked to competition for parental attention, especially for the mother (Lytton 1980). The solution of "dividing/sharing the twins" as mother's and father's twin has been suggested to relieve mutual rivalry between them and to promote individual development of the twins as each has his or her own parent as an object of identification and attachment (Allen *et al.* 1971). Differing relationships with parents may be one important source of differentiation for twins (Ainslie 1985). On the other hand, so-called 'mother's twins' have been shown to have the highest prevalence of mild psychiatric and psychosomatic symptoms in adolescence (234 twin pairs), while least psychosomatic symptoms were seen in twins in the intermediate position (Moilanen and Pennanen 1997). The same finding of the favourable intermediate position was also

seen in a small sample of 18-month-old twin infants (n=58) whose attachment was most secure in the intermediate situation (Moilanen *et al.* 2000).

Twin families must cope with problems related to e.g. finance, health of twins, fatigue of the mother, as well as psychological and emotional problems (Ainslie 1985, Robin *et al.* 1988, Bryan 2003). The burden of maternal tasks leaves little time for a relationship based on pleasure or play. Interviews with mothers have suggested that mothers will 'burn out' caring for their young twins and that they consequently spend even less time with their twins, resulting in the twins spending more time with each other (Ainslie 1985). It has been observed that twins receive fewer demonstrations of affection and verbal interaction from their parents resulting in reduced speech attempts among twins (Lytton 1980, Holditch-Davis *et al.* 1999). The impossibility of responding simultaneously to the needs of two babies and the difficulty of forming relationships on an individual basis foster early concerns for egalitarianism (Robin *et al.* 1988). Preference for one of the twins or the mother's divided attention may generate maternal conflict, distress and guilt (Ainslie 1985, Robin *et al.* 1988). Feelings of exhaustion, anxiety and depression are not rare among twin families (Hay and O'Brien 1983, Robin *et al.* 1991, Griffith *et al.* 2005). These factors may have long-lasting influences on twins' psychoemotional development and well-being.

One component of twins' non-shared environments is the extent to which parents treat co-twins similarly or differently. Treating twins the same way may indicate a lack of parental sensitivity to differences in twins' interests and desires and so hinder development. On the other hand, if twins are treated differently, it may be evidence of the twins being viewed as individuals, but it may also highlight favouritism (Robin *et al.* 1988, Vandell 1990).

Some mothers have been noted to be more likely to differentiate in bringing up their twins (Robin *et al.* 1988, 1994). Robin *et al.* (1988) observed that for these women, the twins' personal rhythms were respected, thus enabling the mother to have one-to-one exchanges. These mothers wanted to adapt to the personality of each infant and exhibited no tendency for comparison or preference. This tendency has been found among more highly educated mothers (Robin *et al.* 1988, 1994) depending on their socio-economic background (Zazzo, 1984, Ainslie 1985, Tourette *et al.* 1989). This attitude is more difficult to maintain when there is a physical resemblance between the infants, especially among MZ twins (Burlingham 1952, Leonard 1961, Robin *et al.* 1988, 1994). Some mothers try to avoid showing preference for one of the twins (Koch 1966, Abbink *et al.* 1982, Robin *et al.* 1988, Minde *et al.* 1990, Robin *et al.* 1994, Holditch-Davis *et al.* 1999) resulting in less individualized treatment. Some parents may even have their own unconscious need to see a continuation of the intertwin relationship (Orr 1941). Parents may suppress the differences between twins and emphasize the similarities by e.g. treating and dressing them alike. This has been found especially among MZ twins (Leonard 1961, Schave and Ciriello 1983, Ainslie 1985). Contrarily, other mothers may refuse to recognize the physical similarity between MZ twins (Zazzo, 1984).

Parenting styles may differ as fathers and mothers appear to engage in different types of interactions with their infants (Parke 1996, Lamb 1997). Fathers have been found to engage in more physical games while mothers engage more in conventional play activities and reading than fathers (Yogman 1981, Lamb 1997). Fathers tend to be more tactile, physical and arousing, while mothers tend to be more verbal, didactic and object-

oriented in their play. These patterns shift across development. Maternal and paternal roles continue to differ in adolescence (Parke 1996). Thus twins preferred by the mother or the father may have different kinds of experiences from these play activities.

MZ and DZ twin pairs may differ in the amounts of differential experience as a function of their varying degrees of genetic similarity. Lytton noted (1977) in an observational study of 17 MZ and 29 DZ male twin pairs at 2.5 years of age that the greater difference in parental behaviour shown towards DZ twin pairs was due to the DZ twins' pronounced variability in requests and demands. Parents did not vary significantly in their treatment of DZ and MZ pairs in behaviour they themselves initiated (e.g. giving material rewards).

Baker and Daniels (1990) examined different experiences of siblings within the family and its relation to personality differences in a sample of 161 MZ and 74 DZ twins between the ages of 18 and 75 in California. The twins reported retrospectively their different experiences when growing up. The Sibling Inventory of Differential Experience (SIDE) was used and in addition, the twins provided self-reported measures of affect and personality. In accordance to Lytton's findings in toddlers, MZ adult twins reported fewer differences than DZ twins in their experiences with parents, peers, and each other while growing up. There was evidence for genetic variance in the SIDE scales, as differences between MZ and DZ twins appeared far more substantial than those between adoptive and biological siblings. Nevertheless, the SIDE showed an association with differences in personality and affect for MZ twins reflecting environment-behaviour relations.

2.3.1 Differential parenting and mental well-being

Earlier studies have given indications of the possible nature of the association between differential parenting and mental health in twin children, adolescents (Carbonneau *et al.* 2002, Dunn *et al.* 1990, Minde *et al.* 1990) and adults (Baker & Daniels 1990, Kendler & Gardner 2001). A child's experience of being unjustly or unfairly treated in comparison to a sibling is a powerful parent-child relationship dynamic which has the potential not only to affect the child's individual well-being adversely, but also to shape the child's experiences of other relationships within the family system (Sheehan 1997). The characteristics that form points of differentiation (whether actual or created) in intelligence, strength and sociability also constitute points of tension (Ainslie 1985). In some twinships each twin might feel that the other is recognized in ways that seem somewhat unfair. In twinship, the fact that each twin might have different areas of talent that are reinforced or acknowledged by the parents does not necessarily mitigate the feeling that the other is favoured or that the other's characteristics are the preferred ones to have (Ainslie 1985).

Carbonneau *et al.* (2002) assessed within-family environmental differences (absolute vs. differential ratings) and its relationship with conduct problems in 8-16-year-old twins. The sample comprised 1117 same-sex male and female twins and their parents, recruited from the school population of Virginia. The within-family environment was assessed from the Twin Inventory of Relationships and Experiences, which provided measures of differential parental criticism, parental preference for one twin, and twins' peers' conduct

problems, as rated by mothers, fathers and each of the twins. Differential ratings of the twins' environment showed significant associations with differences in conduct problems between the twins, whereas the difference in absolute ratings of each twin did not. The differential parental criticism effect was uninfluenced by the overall level of criticism in the family.

Sheehan and Noller (1998, 2002) evaluated perceptions of differential parenting in association with well-being in a study of 174 MZ (n=36 dyads) and DZ (41 dyads) 15- to 18-year-old adolescent twins. The subjects were identified through the National Health and Medical Research Council twin registry, a national registry of Australian twins who are recruited voluntarily. Adolescent twins who perceived they had been disfavoured in comparison with their co-twin tended to view their family in a negative light; family environment as less intimate, more conflicted and the family decision making-style as more controlling. Twins' reports of having been disfavoured in comparison with their co-twin were associated with attachment insecurity, anxiety, and lower personal self-esteem. It was found that twins' reports of differential maternal affection predict adolescent twins' anxiety (Sheehan and Noller 2002).

Differential parenting is a frequent practice in families (Sheehan and Noller 1998). Differential parenting is founded on very real developmental, skill-based, health, age and temperament differences between children. The tendency for adolescents to focus on parental behaviour which challenges the adolescents' independence and sense of self may also cause them to be overly sensitive to differential parenting.

Baker and Daniels (1990) found that parental treatment differences were strongly predictive of twin differences in depression and psychological well-being also in adult twins (161 MZ and 74 DZ twins). Maternally disfavoured twins reported greater affect intensity and depression during adulthood than their favoured co-twin. Twins with whom the mother was stricter reported poorer adjustment than the co-twin, and twins with whom the father was stricter reported better adjustment than the co-twin.

Kendler and Gardner (2001) identified 72 adult MZ female pairs from a population-based Virginia-twin registry discordant for a lifetime history of major depression. Affected and unaffected members were compared on a wide range of correlates. The affected twin differed from her unaffected co-twin on many variables: maternal protectiveness, conflictual parent-child relationship, low optimism, current stressful life events and a history of phobia and nicotine dependence. The affected twin was rated as more rebellious during adolescence than her unaffected co-twin. Affected twins reported themselves as having had significantly lower levels of paternal and maternal warmth and significantly higher levels of paternal and maternal protectiveness and maternal authoritarianism. There was no difference between levels of neuroticism in the affected and unaffected member of twin pairs, suggesting that genetic factors mediate much of the neuroticism-MD association. A cluster analysis suggested three environmental pathways to MD characterized by: 1) childhood vulnerability and anxiety, 2) acting-out and demoralization and 3) interpersonal difficulties.

2.4 The dependent personality

Interpersonal dependency refers to a complex of thoughts, beliefs, feelings and behaviours which revolve around the need to associate closely with, interact with and rely upon valued other people (Hirschfeld *et al.* 1977). A dependent person is hypothesized to be highly motivated to please other people. It seems that the fundamental motivation in attachment and dependence has different antecedents and correlates and predicts different aspects of adult behaviour (Ainsworth 1969, Bornstein 1992).

The social learning model hypothesizes that as the primary caretaker provides biological and psychological gratification to the infant through feeding, providing warmth and contact comfort etc., she comes to be associated with pleasurable experiences. To the extent that the infant's beliefs and expectations regarding the caretaker's nurturing behaviour generalize to other potential caretakers (e.g. teachers, romantic partners), dependent behaviour will continue to be exhibited in these relationships as well. It seems that the motivation of the dependent person, from which the behaviours that are exhibited in different situations are derived, is a strong desire to obtain and maintain nurturant, supportive relationships (Bornstein 1992).

In *the classical psychoanalytic model*, dependence is linked to the events of the infantile oral stage of development. In this model, frustration or overgratification during the oral stage is hypothesized to result in oral "fixation" and in an inability to resolve the developmental issues that characterize this stage (i.e. conflicts regarding dependence-independence) (Tyson and Tyson 1990).

Two theoretical models of dependency evolved from the classical psychoanalytic model: object relations theory and ethological (i.e. attachment) theory. These models hypothesize that the overall quality of the infant-caretaker relationship during infancy and early childhood is the primary determinant of dependent traits in adulthood (Ainsworth 1969).

The object relations model of dependence emphasizes separation-individuation and the development of the self concept as critical developmental tasks that occur during infancy and early childhood. Thus self and object representations that are internalized or introjected during infancy and early childhood are hypothesized to play a central role in personality development and dynamics (Bornstein *et al.* 1986).

According to *the ethological approach,* the propensity for attachment is a biologically based inborn instinctual response system that is activated by certain signals of internal or external origin. Bowlby's basic assumption is that human infants begin life with at least five highly structuralized response systems: sucking, crying, smiling, clinging and following or orienting. These response systems activate maternal response behaviour, which provides feedback to the infant systems, activating certain behaviours that mediate attachment (Tyson and Tyson 1990).

Although there is some overlap between the concepts of dependency and attachment, e.g. dependence is an important component of certain forms of attachment behaviour (insecure attachment) (Ainsworth 1969), there are individual differences in these relationships as well. Attachment behaviour is manifested primarily by proximity seeking, whereas dependent behaviour is manifested primarily by help seeking (Ainsworth 1969, Bornstein 1992).

Dependence has recently been increasingly linked with depression, as dependence is viewed in terms of a cognitive style in which a person perceives himself as powerless, helpless and unable to influence the outcome of events in a positive way (Abramson *et al.* 1978).

Bornstein in his review article (1992) compared psychoanalytic and social learning models of dependence. The most important similarity between the psychoanalytic and social learning models of dependence involves the role of dependence-related cognitions in the development and expression of dependent behaviours, although they are differently conceptualized in each model. In psychoanalytic theory, mental representations of the parents and other significant figures are hypothesized to play a key role in determining the degree to which a person experiences and expresses strong dependence needs. In social learning theory, beliefs and expectations regarding rewards and punishments associated with expressing or not expressing dependence needs are regarded as a central determinant of a person's dependence-related behaviours.

Bornstein came into the conclusion that although both the psychoanalytic and social learning models have received some support from empirical studies of the dependent personality, the ensuing review of the literature showed that dependence-related cognitions are the key to understanding the diverse behaviour that are exhibited by dependent people in various situations. Thus, to understand more fully the behaviour of the dependent person, one must use an *interactionist approach* rather that relying solely on the traditional trait-oriented models. In other words, although the core underlying motivation of the dependent person remains constant, the behaviour that is exhibited by the dependent person changes somewhat from one situation to another, reflecting a) the person's perceptions of the demands, expectations, and behavioural constraints that characterize a given situation and b) his beliefs regarding what behaviours are most likely to produce the desired outcome, given those demands, expectations and constraints.

2.4.1 Aetiology and psychopathology

The aetiology of dependence appears to lie in overprotective, authoritarian parenting. However, dependent behaviour exhibited by the child may also serve to encourage and reinforce overprotective, dependence-fostering behaviour in the parents; thus the relationship of child dependency and parental behaviour may be synergistic and can be characterized by mutual influence and reciprocal reinforcement (Bornstein 1992). In social settings, dependence has been associated with suggestibility, conformity, compliance, interpersonal yielding, affiliative behaviour and sensitivity to interpersonal cues.

Dependence has been linked to numerous psychological disorders including depression, schizophrenia, phobias, conversion disorders and eating disorders (Bornstein 1992). However, empirical studies suggest that the dependency-psychopathology relationship is somewhat more limited than many theoretical accounts suggest, indicating that dependency is an established risk factor for only depression and eating disorders (Nietzel and Harris 1990, Bornstein and Greenberg 1991, Bornstein 1994).

Dependence predicts the onset of certain psychological disorders and follows the onset of others. There are plenty of studies that have found a significant, positive relationship between level of dependence and level or incidence of depression (Klein *et al.* 1988). Research has demonstrated that changes in the level of depression are associated with changes in dependent thoughts, feelings and behaviours (Klein *et al.* 1988). Some studies have argued that dependency is a product of depression, following rather than preceding the onset of depressive symptomatology (Akiskal *et al.* 1983). The magnitude of the dependency-depression relationship has been shown to somewhat higher in men than in women (Klein 1989, O'Neill & Bornstein 1991)

2.5 Separation and individuation

According to psychoanalytic theory, a child identifies with the mother or primary caretaker and through this process becomes aware of its separateness. Like all children, twins undergo this process of separation and individuation from their primary caregiver. For twins there is also another process of separation - this time from the co-twin (Siemon 1980). Because they are each other's most constant companions, twins identify with each other as well as with a caregiver (Burlingham 1952, Ainslie 1985, Siemon 1980). To become an individual, the twin infant, child or adolescent needs to be able to develop adequate intimate relationships and to experience other people as distinct from and separate from him or herself (Ainslie 1985). During the process of separating from the parent, twins use their closeness to ease the pain and anxiety this engenders.

The inevitable frustrations which prevail throughout the oedipal period have been thought to enhance the inter-twin relationship as a substitute for the disappointing parents (Joseph 1961, Joseph and Tabor 1961). Thus it has been suggested that in twins there is a lessened need to incorporate and identify with the parent, since the pre-existing inter-twin identification offers an easier alternative and they may establish each other as a permanent ego ideal (Joseph and Tabor 1961). Identification may also be used as one defence against feelings of rivalry (Leonard 1961, Ainslie 1985).

Second separation and individuation occurs in mid-late adolescence or adult life and may subtly re-emerge in later life transitions. Although twins achieve separation from the parents, they may continue to be emotionally connected to each other (Adelman and Siemon 1986).

The drive toward separating may be opposed by the gratification of the dependency that twins experience with each other. The heightened empathy and their ability to predict each other's behaviour can be inherently gratifying. Whether twin relationships are egalitarian, complementary, or competitive, twins learn to function as a team (Siemon 1980). During separation, this consensus may be re-examined and challenged. Separation can also represent the loss of sharing and diminishing feeling of power that being twins can bring (Adelman and Siemon 1986). Problems may occur if the process of individualization is not successful and one or both twins continue to identify themselves by the twinship.

Adelman and Siemon (1986) argued that in order for interdependent twins to achieve a successful separation, they must move from implicit patterns of interaction into making

their relational bond explicit. In particular, twins need to acknowledge their feelings of loss during separation, concerns for their future relationship, and affirm mutual caring. Furthermore, being explicit about their relationship can set a precedent for developing intimate ties with others.

Thus, according to the theoretical literature, twins may face special problems with respect to personality development (Burlingham 1952, Joseph and Tabor 1961, Leonard 1961, Siemon 1980, Adelman and Siemon 1986). Case study material on adult twins has confirmed the expected pathology; deficits in separation-individuation, object relations and self-esteem have been reported (Orr 1941, Joseph and Tabor 1961, Lidz *et al.* 1962, Fiegelson 1983). There are few empirical studies on the personality of adult twins (Burlingham 1949, 1952, Winestine 1969, Zazzo 1976, Schave and Ciriello 1983). Since the majority of these studies are descriptive and twin samples are small, it is difficult to generalize the findings of these studies. However, these studies provide a deeper understanding in the reactions and behaviour observed in these twin individuals; the origin and development of the symptoms and their meaning to the personality.

In contrast to theoretical literature and case studies, the data evaluated by Pearlman (1990) did not support the notion that twins face special problems with respect to personality development or the idea that twins have more difficulty than others in establishing and maintaining close relationships. She compared MZ twins, DZ twins and singletons (n=30 in each group) on objective measures of separation-individuation, object relations and self-esteem in adulthood (mean age 41 years). Self-esteem was assessed by means of the total positive score obtained on the Tennessee Self-concept Scale. Object relations were assessed by means of the 10-item Object Relations subscale of the Ego Functioning Assessment Scale. Separation-individuation was assessed by means of the total score on the 30-item Family Systems Personality Profile. There were no significant differences found between twins and singletons. However, MZ twins, while growing up, were more likely than DZ twins to have shared a room, dressed alike, shared the same class at school, received encouragement from their parents to be alike, to have been separated for the first time later in their educational careers and attended the same school until a later age. However, the MZ twins were not less differentiated than DZ twins. Clearly, the relationship between how twins are raised and the degree to which they are differentiated as adults is one that merits further study.

2.6 Co-twin dependence

The sibling bond is the longest lasting relationship for most people. It is a relationship with the potential to provide intimacy, congenital involvement and social support as well as to influence the development of social and cognitive skills. Twin relationship creates a special type of sibling relationship. While twinship may be the closest relationship possible between two people, it may be also fraught with ambivalence and psychological hazards (Burlingham 1945, Siemon 1980). The close twin relationship has been called by names such as co-twin dependence, couple effect, twinning bond and twinning reaction (Joseph and Tabor 1961)

Leonard (1961) classified four factors that influence mutual identification in twins:

1. The cultural attitude, which usually emphasizes the positive aspects of identification, and at the same time may suppress the emergence of a natural sibling rivalry.
2. The parental attitude: The parents may be treating their twins as similar because they want to be equitable. Parental attitude may intensify the inter-twin identification; if the twins are left in each other's company for long periods of time, they have relatively little opportunity to spend time with an adult.
3. The physical similarity: It is easier to treat twins who look different as individuals than twins who look alike.
4. Socio-economic factors: Parents under economic stress will be particularly hard put to find the time and energy to give the twins individual attention. Parents lacking in higher education may be more influenced by the accepted cultural attitude toward twins and therefore further emphasize the twin relationship.

The four factors provide a combination of circumstances, all of which may serve to emphasize intertwin identification.

Winestine (1969) introduced the concept of twinship in his study of psychological individuation of twins. Twinning was assessed by interviewing 30 MZ male twin pairs between 8 and 12 years of age. The twins were selected from elementary schools throughout Brooklyn in the United States. Winestine arrived at four indicators of twinning, also defined as partial fusion of self and object representation:

1. Self-image of being part of a whole, i.e. complete only when the other twin is present.
2. Inability to form object relationships with peers or view oneself as a discrete object choice for peers apart from the co-twin.
3. Difficulty in tolerating separation from the co-twin.
4. Differences in personality and interests evolving as a reaction to the other twin rather than by individual positive identification.

Winestine suggested that the presence of all these indicators signifies poor individuation in twins and an increased risk of developing a psychic disease. However, many twins are somewhat dependent on each other.

Two psychoanalysts, Schave and Ciriello (1983), both of them members of MZ twin pairs, have made a thorough study of the development and consequences of identity and intimacy in twins, based on a group of 20 monozygotic and 20 dizygotic twin pairs who had successful careers and adequate relationships with other people. They discovered six patterns of twinship, each having experienced a typical model of parenting. Their results shed much light on the inter-twin relationship, but few conclusions can be drawn regarding the consequences on mental health, as the study group was highly selected. (Table 1)

Table 1. Patterns of twinship, after Schave & Ciriello (1983) (Moilanen 1987c).

Relationship	Definition	Hypothesized model of parenting
Unit identity	Egos may function as one	Extremely limited
Interdependent identity	Best friends	Somewhat limited
	No ambivalence towards each other	Not happy about having twins
Split identity	Opposite self-images, ``good`` twin and ``bad twin``	Somewhat inadequate Projective
Idealized identity	Something special about being twins. May lack openness and intimacy. ``Superficial`` with co-twin	Mainly adequate Happy with the ``privilege`` of having twins
Competitive identity	Constant competition between twins. Clear ego boundaries, close and enduring tie with co-twin	Adequate. Treated fairly and on an individual basis. Competition encouraged
Sibling identity	Clear ego boundaries. Like siblings	Adequate. Identity between twins never confused

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A co-twin can provide security and comfort in a moment of distress already from the early stages of life. From approximately the fifth or sixth month on, twins are sufficiently aware of each other so that being together seems to have a quieting effect (Leonard 1961). Gottfried *et al.* (2001) examined the roles of the mother and the co-twin in inhibiting emotional arousal using the modified version of Ainsworth's strange situation (the isolation episode was placed near the end of the session because the high degree of distress aroused in the isolation situation made it necessary to end the session shortly thereafter) among 15 children aged 18 to 34 months. The subjects' distress was minimal when they were separated from the mother with the co-twin present. Upon reunion, stable social behaviour was quickly restored. However, separation from the mother and co-twin produced a high level of distress for the subjects. When reunited, the isolated twin initiated physical contact with the mother, soliciting and receiving comfort from her. Furthermore, the distress of the isolated twin was transmitted to the co-twin who had remained with the mother during the isolation period.

In observations of young twin infants between 6 and 24 months (n=64), a clear preference for interacting with one's own twin emerged during the second year of life, suggesting that the twins' relationship with one another was becoming more solidified. It may be after this point that twins come to actively prefer one another to others. Twins who were insecurely attached to their mothers were less likely to interact with each other or with an unfamiliar-twin peer than were twins who were securely attached to their mothers (Vandell *et al.* 1988). Schave and Ciriello (1983) found a similar linkage between adult twins' relationships with each other and prior mother-twin relations. Twins who had received problematic early mothering had more problematic relationships with each other. Experiences during the first few years of life with a sensitive, responsive and warm mother foster secure attachments (Vandell *et al.* 1988, Balleyguier 1991, Kochanska *et al.* 2005). Interaction experiences may foster interaction skills that can be used with peers (Vandell *et al.* 1988). Attachment and peer competence could both be mediated by infants' characteristics that predate both attachment and peer competence.

On the other hand, some infants may be less sociable or more prone to be angry with their mothers and peers, resulting in them receiving less sensitive mothering and thus more insecure or avoidant attachment ratings (Balleyguier 1991, Kochanska *et al.* 2005). Other studies have failed to show this kind of relationship between a child's temperament and attachment (Szajnberg *et al.* 1989, Vaughn *et al.* 1989, Minde *et al.* 1990)

The intensity with which twins appear to be drawn to each other and therefore to identify with each other seems to be affected by the degree they resemble each other. It is much easier for the parents as well as for other people to relate to twins as individuals when distinct differences exist, especially if they are of opposite gender, than to those who are very much alike (Leonard 1961). In various studies MZ twins have reported that they are closer to or more dependent on one another than DZ twins in school age, adolescence as well as in adulthood (Koch 1966, Tambs *et al.* 1985, Neyer 2002, Penninkilampi-Kerola *et al.* 2005). Koch (1966) noted that MZ co-twins tended to be closer to each other and play together more than DZs from same-sex pairs, and that DZs from same-sex pairs were closer than DZ co-twins who were from opposite-sex pairs (five-six-years of age). MZ twins were less likely to play alone. MZ twins were more likely to report using each others' things without permission and not minding if the co-twin uses their things without permission. DZ twins, in contrast, reported that they were more concerned about their own rights. They reported greater rivalry. Girl twins from same-sex groups tended to be closer than male twins. MZ males, who were very close as a group, exhibited less sociability and leadership than did the other SS twins. This trend was opposite to that observed for the girls and mixed-sex groups. It was noted that when the mothers were older at the birth of the twins, the closer their co-twin daughters tended to be to each other. Those twins who were placed in the same class at school also tended to be closer to each other.

Moilanen (1979) has studied inter-twin dependence and its implications to mental health in the previous stage of the present study sample of twins born in Oulu University Hospital in Finland during the years 1965-1973 (234 twin pairs). The more these twins had suffered from perinatal morbidity or mild developmental delays the more co-dependent they were in adolescence, and the more dependent ones had also more often mild abnormalities in the background activity of the EEG. The hypothesis was that even minor perceptual difficulties, caused by perinatal complications and manifested also by developmental delays and EEG abnormalities, tend to make the adolescent feel insecure when trying to adapt to a new situation, so that he seeks security in his co-twin. On the other hand, concern about the child's early morbidity may increase the parents' alertness and even overprotection of the child, which may in turn delay the child's getting a sense of autonomy and independence (Moilanen 1988a).

In a Finnish population-based sample of 5,268 adolescent twins (16 years) by Penninkilampi-Kerola *et al.* (2005), more MZ twins (33.6%) than DZ twins (19.3%) reported that they were dependent, but there was no significant difference in co-twin dependence between SSDZ and OSDZ twins. Co-twin dependence was strongly associated with gender, as girls were more likely to report themselves co-twin dependent than boys in all zygosity groups.

The relationship development of 133 monozygotic and 60 same-sex dizygotic older twin pairs has been studied retrospectively and contrasted with their other sibling relationships (Neyer 2002). Since adolescence MZ twins lived closer to one another and

had more frequent contact, social support, and emotional closeness. For both MZ and DZ pairs, contact and emotional closeness decreased since early adulthood, but increased again in old age. After leaving the family of origin, contact and emotional closeness decreased until twins reached their thirties and forties, when each twin was involved in raising their children and/or in their careers. After these reproductive and generative years the intensity of both qualities increased again as the respondents approached the empty nest or retirement phase. Compared with their other sibling relationships, the relationships between MZ and DZ twins were more intense with respect to all relationship domains, e.g. contact, intimacy, conflict and support. Whereas higher attachment security and relationship satisfaction in MZ pairs were independent of contact frequency, security and satisfaction were less intense in DZ pairs and strongly dependent on their contact, suggesting that MZ and DZ twin relationships are different kinds of sibling relationships in old age.

Conventional twin studies of personality comparing the relative resemblance of MZ co-twins to age-matched DZ twin pairs have shown a greater resemblance among the MZ pairs (Goldsmith 1983). In these conventional analyses it is assumed that experiences shared by siblings growing up together in a nuclear family are of little or no influence in creating their personality similarities: Siblings' similarity is attributed solely to their shared genes (Rowe and Ploming 1981).

Cross-sectional studies provide evidence that behavioural similarities of adult MZ co-twins are associated with their age at initial separation and the frequency of their subsequent social interaction. Twins who separated early and twins in infrequent interaction were less alike. Rose and colleagues (1988) evaluated similarities for Extraversion (E) and Neuroticism (N) scale scores from the Eysenck Personality Inventory in 7,144 adult twin pairs, drawn from the population-based Finnish Twin Cohort (a 1981 survey), as a function of the co-twins genetic resemblance, gender, age and the frequency of their social interaction with each other. To separate the effects of shared genes from shared experience hierarchical multiple regression of double-entry data matrices was performed. Genetic effects remained significant when tested after the effects of social contact were removed, and for N scores, the effects of social contact remained significant when assessed after genetic influences were removed. The resemblance was found to be greater for E and N between MZ twins.

Rose and Kaprio (1988) evaluated the effects of shared experience on adult personality resemblance for extraversion and neuroticism in 2,320 pairs of adult MZ twins drawn from the same population-based Finnish Twin Cohort. The twins were classified by the frequency of their social interactions with one another. Experiential differences between MZ pairs yield a sensitive measure of shared experience free of genetic confounds. MZ twin pairs in more frequent interaction were significantly more alike for both personality dimensions. For both MZ twins and 4,824 age-matched DZ twin pairs, adult resemblance was associated with the age at separation.

Results of a follow-up study led Kaprio *et al.* (1990) to conclude that changes in social contact between MZ cotwins precede and contribute causally to changes in their intrapair similarity. In this longitudinal analysis of the 1975-1981 surveys of the same population-based Finnish Twin Cohort all cohabiting MZ co-twins, ages 18-25 at the 1975 baseline, were followed up in 1981, and pairwise similarities at baseline and follow-up were compared for three groups: MZ pairs that remained cohabiting, separated pairs in which

the co-twins retained regular contact with one another, and separated co-twins whose social interactions at follow-up were infrequent. For cohabiting MZ twins aged 18-25 there were no differences in baseline resemblance for N and alcohol use between pairs who had little social contact 6 years later and pairs who remained living together. But at follow-up, pairwise resemblance of those now living apart had significantly decreased, in the absence of change for pairs continuing to live together, suggesting that decreased social contact precedes and causally contributes to decreased intrapair similarity for N and alcohol use. Baseline differences in resemblance for E scores preceded follow-up differences in social interaction.

Lykken *et al.* (1990) also found that MZ cotwins who were in frequent contact as adults were more similar than those who were not. However, the correlation between similarity and contact was very small. The authors discussed that MZ adult twins who still cohabit would more likely to be selected for similarity.

2.6.1 Co-twin dependence and mental well-being

Very strong co-twin dependence has been seen as a risk factor to mental health especially in Western countries (Joseph and Tabor 1961, Leonard 1961, Fiegelson 1983). Some studies have indicated that in comparison to singletons, twins present more sociability problems, withdrawal and introversion (Zazzo 1960, Clark and Dickman 1984). Case reports and material from the analysis of twins have demonstrated that due to their close relationship, twins may have more difficulties in identity formation and object relations (Joseph and Tabor 1961, Leonard 1961, Fiegelson 1983). Based on material from psychoanalytic case reports and studies, intensification of the primary intertwin identification had been thought to cause comparable disturbances to personality development. Such intensification may occur as a result of lack of opportunity of the individual twin infant to have adequate contact with the mother (Leonard 1961, Robin *et al.* 1988). The finding by Vandel *et al.* (1988) in observations of young twin infants between 6 and 24 months (n=64) did not support this assumption. The twins were more likely to interact with each other if both twins were securely attached than if one or both twins were insecurely attached.

The essence of “twinning reaction” consists of a mutual interidentification and part fusion of object and self-representation, leading to a diffusion of ego boundaries between the two individuals. A non-individuated twin will rely on external sources of validation, be afraid of being alone, and lack self-confidence and the ability to make decisions (Joseph and Tabor 1961, Winestine 1969). On the whole, psychoanalytical case reports and studies suggest that the twin with the weakest ego tends to develop illness.

Jacobs and Mesnicoff (1961) reported four cases of alternating psychoses in twin adolescents and adults. They found that the dependence of the twins on each other appeared to be accompanied by feelings of competitiveness, envy and anger often intensified when there was a threat of separation. Most frequently the alternating psychoses occurred when one twin was experiencing anger towards important persons or objects, the threat of loss or if there was a conflict between the twins. Such stresses do not necessarily lead to psychotic states, but stress in the presence of an inadequate ego,

lack of emotional support or hereditary or constitutional defects may lead to neurotic or psychotic symptomatology.

Jackson (1960) uses the terms ‘identity fusion’ and ‘identity fission’ to describe the mixed identity of twins who are intimate with each other. By fusion he means feelings of grandeur, which may be due to the possession of a double ego, while fission refers to the hard fact that the twin shares his ego with another person. The identity problem of the schizophrenic, according to Jackson, could find no better nidus than in this intertwining of twin identities. According to Kringlen (1967), the more introverted, the more submissive, the more dependent, the more obsessive twin is usually more likely to develop schizophrenia. He noted, however, that sometimes the apparently healthier twin falls ill with schizophrenia. These above-mentioned personality traits could possibly be features of schizotypal personality disorder or prodromal symptoms of schizophrenia rather than causal factors. Multigene models of schizophrenia assume that multiple genes combine with one another and with environmental factors to produce schizophrenia. According to this model, individuals with a very high loading of risk factors may manifest schizophrenia, whereas those with a lesser loading may show signs of schizotypal personality disorder, negative symptoms or cognitive impairments (Hollis 2005).

Koch (1966) found little cause for alarm over the effects of twin closeness in five-six-year old twins as co-twin compatibility appeared to be positively associated with positive social and cognitive attitudes, instead of intellectual and social lack (n=180). DZOS males who professed to be closest to their sisters tended to be judged less submissive, more socially confident, more popular, more involved with other children, more affectionate, and somewhat effeminate in their attitude. The closer DZOS girls, on the other hand, seemed not much distinguished by qualities with a male cast. The closer among them appeared to have more interests and to talk more and more correctly, as well as to portray mother-child relationships less favourably in their stories. Koch suggested that since girls tend to be less strong and active than boys, these girls may have had to step up their verbal efforts to compensate for their lack of strength and agility.

Paluzny *et al.* (1977) investigated closeness and its relation to depression in 22 MZ and 13 DZ adult twin pairs. Each twin rated himself on a questionnaire including questions on the twinship and a self-rating depression scale. The degree of depression showed an inverse correlation with closeness, i.e., the closer the twins rated themselves, the less likely they were to show depression. Paluzny stated that the correlation between feeling close to one’s twin and low level of depression might suggest a causal relationship between the two phenomena, i.e., feeling of closeness decreases depression, or that the experience of depression in itself can lead a person to feel quite distant from those significant others who surround him.

Findings by Moilanen (1988) indicated that there was a tendency for co-twin dependent twins to score higher on psychosomatic symptoms and depressiveness than co-twin independent twins or twins in an intermediate position, and they reported more often feelings of inferiority and were more likely to be the submissive co-twin in the twin dyad.

In a population-based twin study (Penninkilampi-Kerola 2006), co-twin dependent twins reported higher levels of psychological distress, somatic and psychological symptoms in adolescence than co-twin independent twins (n=4,478). This was suggested to reflect differences in the relational shift (separation-individuation process) and

developmental phase between dependent and independent twins. In early adulthood, the relationship between co-win dependence and the different symptom scores had diminished. Dependent twins were in general more likely to be satisfied with their co-twin relationship compared to independent twins in adulthood. MZ twins were more likely to be very satisfied with their co-twin relationship than DZ twins, and MZ twins reported on average less somatic stress and fewer psychological symptoms than DZ twins among both dependent and independent twins. The likelihood that MZ twins provide higher levels of social support to each other than DZ twins might in part explain the lower level of distress in MZ twins, which was interpreted to be due to different dynamics manifested in MZ and DZ twin relationships (Penninkilampi-Kerola 2006).

In a population-based study (Virginia Twin Registry, formed from a systematic review of all birth certificates in the Commonwealth of Virginia) by Sanathara *et al.* (2003), 7,174 twins were interviewed to assess interpersonal dependency (IPD) and major depression. Interpersonal dependency was strongly associated with a risk for lifetime major depression in twin adults. While females had higher interpersonal dependency scores, IPD scores were more significantly associated with risk for lifetime major depression in males. It was suggested that the higher levels of IPD in women than in men may contribute significantly to the sex differences in risk for major depression.

The majority of these studies of different characteristics and qualities of twin relationship are descriptive, and they are based on case reports, analysis, interviews and observational data. Since most of the twin samples are small and the population is highly selected, it is difficult to generalize the findings of these studies. Unfortunately much of the literature has emphasized the more extreme and pathological aspects of the twin bond, focusing on dyadic influence and ignoring the larger social milieu that shapes the relationship (Paluzny 1977, Adelman and Siemon 1986, Borstein 1992). Psychoanalytic material is also largely based on case studies of “troubled twin subjects” (Schave and Ciriello 1983). Recently researchers have examined how larger social systems reinforce and affect twinship (Vandel *et al.* 1988, Stewart 2000) or vice versa (Pulkkinen 2003). E.g. Pulkkinen *et al.* (2003) found that twins, particularly male twins, were more popular among their classmates, and they interacted with other children more often than singletons. The authors concluded that twinship forms a positive developmental environment for socioemotional behaviour, particularly in the opposite-sex twinship.

2.7 Dominance-submissiveness

Co-twins may experience their relationships with each other differently. One way in which twinship may be experienced differently is in the area of dominance and submission, as one twin may be dominant and the other submissive. This shows itself most clearly in the social field in such ways as a tendency for the dominant twin to enter a room first, to speak up for the pair in company and to make decisions for the pair.

Earlier studies have suggested that dominance seems to have various manifestations among twins. Galton (1883) noted in his scientific study of the personality of twins that among the differences between physically similar twins there was a tendency for one to take the lead. Von Bracken (1936) termed the twin who took care of outside contacts

when the twins were together '*outside representative*', and the one who had a more important role in the inter-twin relationship '*inside representative'*.

According to Burlingham (1952), many of the differences that appeared in the first two or three years seemed to follow the division between pairs of twins into one *active* and one *passive* partner. To adopt these different roles meant that the twins developed opposite characteristic, which they brought into play in their relationship to each other. The active twin would develop dominant, aggressive, selfish characteristics, whereas the passive one would increase the gentle, submissive, altruistic traits, which fitted his role. Leadership may take many forms and other diversions of role or polar developments may occur, as when one is described as the *good twin*, the other as the *bad twin*, '*angel*', '*devil*', or when one is '*more for mother*', the other '*more for father'* (Shields 1962, Preedy 1999). Preedy (1999) characterized three different types of dominance in multiples in her study of school-aged children; '*one mothers*, *other follows*' (20%), '*one speaks for the other*' (24%) or '*one leads/bosses*' (40%). However, the most common differentiating relationship that develops between twins is probably that of *dominance-submissiveness*. This feature can be seen in three different areas of life: *physical* and *psychic* dominance and the *role of spokesman* (Tienari 1966).

Low birth weight and being the second-born twin has been seen as important predictors for submissiveness in male twins (Tienari 1966). Burlingham (1952) described in her case reports of three identical twin pairs that the leadership was often assumed by the twin who was physically stronger, and that the first intrapair differences were frequently related to differences in weight and strength in such a way that the stronger was more demanding and developed into a more active person, while the weaker assumed a more passive role.

Tienari (1966) evaluated dominance and submissiveness in his study of 29- to 38-year-old Finnish same-sex male twins (903 twin pairs). The twin who was physically stronger in childhood was significantly more frequently the one who was psychically more dominating as well. The twin who was psychically more dominating in childhood had highly significantly more often the role of spokesman in childhood, did better at school, had been more livelier in childhood and was more leading in youth. The twin who had had the role of spokesman in childhood had also been highly significantly more often livelier in childhood and more of a leader in youth. Psychic dominance and the role of the spokesman were strongly intercorrelated, and both correlated with liveliness, leadership in youth and the disturbance variables. The pairs were classified separately on the basis on the interview data and the test results and placed in one of the following five degree-of-disturbance categories: 1) psychically wholly normal, 2) mild personality disturbances or deviations, 3) neurosis, 4) personality disturbances graver than neurosis, 5) psychoses). As the information was received by personal interviews posterior to disturbance, the personality traits as well as childhood memories are subjective and may be biased by the disturbance.

In the material of Northern Finnish twins born in 1965-1973 (234 twin pairs, previous stage of this present study sample), the correlation between perinatal factors and submissiveness showed only a statistically non-significant trend: low birth weight, low Apgar score, perinatal asphyxia and hypoglycaemia predicted later submissiveness to some extent. Those having developed faster or with higher intelligence were more often the leaders of the twin pair (Moilanen 1987a).

Koch (1966) noted in her study on five- to six-year-old twins that the dominance-submission relationship or ascendance-non-ascendance was sometimes limited to areas of activity and sometimes it was shifting. According to the mothers, sometimes an illness seemed to cause such a shift, or entrance into school, or differences in the twins' teachers' ability to inspire confidence in the child, or the partiality of a visiting relative. In 61 per cent of the pairs, however, the relationship remained rather stable through the years. Dominance seemed more stable in the same-sex girl pairs than in the boy pairs. Similar phenomena were also found by Burlingham (1952), who observed that the originally more passive twin may grow more aggressive if the stronger twin becomes the weaker e.g. due to illness.

According to Koch (1966), the dominant children of the two genders seem to exhibit somewhat different traits, but marked sex differences were few. The dominant boys were inclined to a pattern of aggressiveness, exhibitionism, combativeness, lack of physical apprehensiveness, and friendliness to adults and children. Among girls, on the other hand, the ascendant ones were characterized by less inclination to dawdle, tendency to project blame, less affectionateness, and greater distance from adults.

Dominance appears to be expressed differently at different points in development. Dominance in toddler twins is reflected by a greater likelihood to engage in both positive and negative interactions. As toddlers, the more dominant twin is more talkative and likely to assert his/her rights (Lytton 1980). Dominant 5- to 6-year-old twins are not only more likely to initiate interactions with their co-twin, or show friendliness to adults and children, but also to be generally more disobedient, aggressive and inclined to project blame (Koch 1966). In adolescence boys have been shown to be more often physically dominant while girls dominate more often in the other two fields; psychic dominance and the role of the spokesman (Moilanen 1987b).

Three fourths of the mothers interviewed by Lytton (1980) noted clear differences in their toddlers in terms of dominance (136 male twins). Equality or dominance in another area often compensates submissiveness in one area. Based on interviews with 234 pairs of adolescent twins, within each domain (physical, psychic and verbal), a substantial majority (some 75%) reported equal or shared contributions, with only about 10% of adolescents being submissive or dominant in all three areas (Moilanen 1987b).

By conquering different areas of expertise or domains of selfhood, twin siblings can avoid conflict and enhance mutual co-operation. The term *complementary* is often used to describe a twin pair, the members of which have consciously or unconsciously developed different and even opposite features (Schave and Ciriello 1983, Ainslie 1985). Together they make up a well-functioning unit, and this resolution helps them to avoid competing in the same field. *Complementarity* could also be defined as shared dominance, e.g. the physically stronger brother may bring the shopping to the mother, while the talkative twin sister, in the role of spokesman, takes care of the payment to the shopkeeper (Siemon 1980, Moilanen and Ebeling 1998). Split roles can help twins to develop their sense of self as separate from the co-twin by having certain distinguishing characteristics.

2.7.1 Dominance-submissiveness and mental well-being

In addition to high inter-twin dependence, also pronounced dominance-submissiveness has been seen as a main risk factor for twins' mental health (Kringlen 1967, Tienari 1966, Moilanen 1987b).

According to Moilanen (1987b), the most submissive twins suffer most often from psychosomatic symptoms and depressiveness in adolescence. The process of constantly adapting oneself to the will of others and only seldom having the opportunity to show one's real abilities seems to enhance these symptoms. The most dominant ones suffer most often from nervous symptoms (nervousness, irritability and loss of energy), which finding might be understood as a consequence of the leader's task of always taking the responsibility, while the 'followers' may have it easier in this sense (Moilanen 1987b)

Developmental factors may also influence manifestation of some diseases, as has been suggested in some case reports (Bruch 1969, Bryan 1992). Bruch has reported how a submissive monozygotic twin develops anorexia nervosa as a consequence of the stronger twin's aspirations for independence and separation from her in puberty. Moilanen *et al.* (1985) did not find inter-twin relationships to be such important aetiological factors for anorexia nervosa among dizygotic twins as has been reported in the literature concerning monozygotic twins.

Neurotic symptoms have been associated with dominance (Tienari 1966), while the more submissive and dependent member of a twin pair has been reported to have a higher incidence of psychiatric problems, e.g. schizophrenia (Tienari 1966, 1963, Kringlen 1967) or anorexia nervosa (Bruch 1969).

However, other studies have failed to show any evidence of a relation between dominance submissiveness and psychopathology in twins. Kendler and Gardner (2001) evaluated 72 adult MZ female pairs discordant for a lifetime history of major depression. Parents reported that in 37 of these pairs, a stable leader-follower relationship was established in childhood. No relationship was found between parental report of this leader-follower status and later development of major depression.

Koch (1966) did not find any general alarm over the ascendance-nonascendance relationship, especially in same-sex pairs of five- to six-year old twins. However, the DZOS males seemed to suffer most from having to play a subordinate role as they showed most signs of stress. Koch suggested that perhaps, in our culture, even at this early age, this subordinate role is not a beneficial one for a male to play in relation to females.

Pulkkinen *et al.* (2003) found that among 11- to 12-year-old Finnish twins (n=1,874 twins) socially active behaviour and high leadership were the most distinctive characteristics of OSDZ females as compared with other twins or their singleton classmates, whereas OSDZ males rated higher in compliant and constructive behaviour. Contrary to the findings by Koch, OS males did not seem to suffer from this position. Male twins were actually lower in depressive symptoms than females. Twins, particularly male twins, were more popular among their classmates, and they interacted with other children more often than singletons. Twin relationship was suggested to form a positive developmental environment for socio-emotional behaviour, particularly in the opposite-sex twinship.

It seems that when dominance-submissiveness is pronounced, twins might be predisposed to higher rates of psychopathology, as indicated by some studies and case reports. The most vulnerable individuals are possibly most affected. However, there is a lack of population-based studies on dominance-submissiveness and its relationship to psychopathology. Furthermore, this pronounced situation does not seem to concern all twin pairs, as other studies have failed to find a connection between dominance-submissiveness and psychopathology. Additionally, several studies have failed to show any evidence of increased rates of psychopathology in twins (Gjone and Novik 1995, Van den Oord *et al.* 1995, Simonoff *et al.* 1997, Pulkkinen *et al.* 2003). Thus twinship must either provide other protective elements, or the effect of dominance-submissiveness on mental well-being is relatively small on a larger scale. Furthermore, in some cases twins may even benefit of their complementary roles as they may form a well-functioning unit.

2.8 Shared and non-shared environments

Classic twin studies show that a substantial portion of individual differences are explained by genetic differences (Boomsma *et al.* 2002). The classical twin study compares phenotypic resemblances of MZ and DZ twins. MZ twins derive from a single fertilized egg and therefore inherit identical genetic material. Comparing the resemblance of MZ twins for a trait or disease with the resemblance of DZ twins offers the first estimate of the extent to which genetic variation determines phenotypic variation of that trait. Studies of MZ twins living or reared apart can show whether and how different environments can affect e.g. personality or mental well-being (Boomsma *et al.* 2002). Additionally there are possibilities for research that goes beyond the classical twin design (Boomsma *et al.* 2002).

The interest in the phenomenon of differential parental treatment and its effects on children's social and emotional development began with the exploration of non-shared environmental influences on personality development in the 1980s (Plomin 1994). Non-shared environment refers to any environmental experience, whether perceived or actual, that differs for siblings growing up in the same family. Interactions with parents, friends, and siblings, along with chance events, all combine in subtle yet complex ways to create a very different environment for each child within the same family (Plomin 1994). When applied to behavioural phenotypes, quantitative genetic research is known as behavioural genetics. Thus research focussing on the genetic side of the personality is relying on twin studies for insights into the environmental side.

Heritability, the effect size of genetic influence, is a descriptive statistic that refers to a particular population with its range of genetic and environmental influences. This descriptive statistic can change if the magnitude of genetic or environmental influences changes across age, cohorts, or cultures.

Most estimates of the heritability of liability to schizophrenia have been between 0.60-0.83, and to major depression 0.33 (0.95% interval 0.26-0.39) (Kendler 2001). Dimensions of personality have been linked with liability to psychiatric illness. Twin studies have reported that most of the covariation between neuroticism and major depression is due to shared additive genetic factors (Fanous and Kendler 2004). Adoption

studies have demonstrated that the biological offspring of schizophrenic mothers are more likely to have schizotypal personality disorder than are children of control mothers (Tienari *et al.* 2003, Fanous and Kendler 2004). Thus personality and psychiatric illness are thought to share the same aetiological factors and to represent two ends of a single continuum of severity.

'Emergenesis' or an 'emergenic trait' is an emergent property of a configuration of several or many independent or partly-independent genes. It is a polygenic mechanism in which the gene effects combine configurally rather than additively. It is suggested that such traits are determined by the interaction of genetic influences. While these traits are genetic, they still do not tend to run in families (Lykken 1982).

Genetic epidemiology defines family environment (common or shared environment) in a particular way that refers only to those shared experiences that influence liability to a disorder similarly in both members of the twin pair, e.g. strict religious upbringing with strong belief that drug use is sinful. However, many things occur in families that do no affect both members of a twin pair similarly, e.g. a traumatic event. From the perspective of twin studies, it would be seen as *an individual-specific environmental risk* because it was not shared by both members of the pair and tended to make the twins less rather than more similar. Sometimes twins respond differently to the same objective event. For example, because of prior differences in parent-child relationships (e.g. one twin is closer to the mother and one to the father), parental divorce could prove more pathogenic to one twin than to another (Kendler 2001). However, many environmental measures are both shared and not shared (Plomin 1994).

Kendler describes (2001) three models which could explain genetic effects on family functioning and adolescent adjustment. 1) Family functioning and adolescent adjustment may be causally unrelated to one another, but both may be due to correlated sets of genetic risk factors. 2) Genes may influence adolescent adjustment, which in turn affects family functioning. 3) Genes may affect family functioning, perhaps through early childhood temperament, which then influences adolescent adjustment.

In addition to family characteristics, variations in schools, neighbourhoods and communities may also influence children's behavioural development. Rose *et al.* (2003) documented extrafamilial environmental effects by fitting maximum likelihood models to questionnaire data collected from double dyads consisting of twins and their classmate controls. The classmate controls in each double dyad were genetic strangers living in separate households, but they shared school, neighbourhood, and community environments with their yoked twin pair and with one another. At ages 11 to 12, the control classmates showed significant similarities in religious practices and smoking and drinking patterns, demonstrating that environmental influences outside the family affect children's behavioural development.

The results by Rose *et al.* (1988) establish the predictive significance of both genetic and experiential influence for extraversion and neuroticism, as genetic effects remained significant when tested after the effects of social contact were removed, while the effects of social contact remained significant when assessed after genetic influences were removed. Sameroff suggests in his transactional model that each of these factors (genetic - phenotypic - environmental factors) have effect on one another (Sameroff 1989). The OS twin pair has been seen as the most informative twin type for sex differences (Kendler 2001). In such pairs, two individuals - one male and one female - are conceived at the

same time, develop in the same womb, are born at the same time and reared in the same family.

Children's personalities have been thought to shape parental treatment (Lytton 1980) even among MZ twins, as MZ twins may differentiate somewhat by displaying different levels of a trait, a concept called polarity (Segal 1999). As mentioned earlier, some twins may be slightly more assertive or more decisive, more dependent or independent than their co-twins, possibly exchanging roles in different situations (Koch 1966, Moilanen 1987b, Preedy 1999, Segal 1999). Differentiating MZ twins along behavioural continuums is a convenient way for parents and others to distinguish them, but this can exaggerate twins' slight discrepancies (Segal 1999). For example, physical similarity has been found unrelated to personality similarity in MZ twins, suggesting that parents or twins themselves may accent minor differences between the twins in order to emphasize each twin's individuality (Plomin *et al.* 1976). Several concepts are of interest (Plomin *et al.* 1977, Segal 1999):

> *Active gene-environment correlation*: for example, do people with certain genetic backgrounds choose certain profession or recreations? MZ twins reared in separate households have both chosen the same profession and have had same interests. In contrast, DZ twins reared in the same household individually favoured different kinds of professions and interests. Individuals seek experiences congruent with their genetically influenced personality traits, offering insight into why family members differ (Scarr and McCartney 1983).
> *Reactive gene-environment correlation*: Children's genetically influenced personalities shape parental treatment. MZ twins' matched personality traits elicit similar reactions in others, but this similar treatment does not appear to cause their similarity.
> *Gene-environment interaction*: Does the same environment affect people with different personality traits differently? Parental rearing styles (the environment in this case) may affect some individuals differently depending on the type of parental control.
> *Special MZ twin environments*: Is personality similarity affected by the unique MZ twin relationship? Monozygotic twins show much higher similarity than dizygotic twins in many aspects. There is controversy as to whether this is due to their special rearing situation or to emergenesis, the unique combinations of genes shared by MZ twins but not by DZ twins. Evidence favours emergenesis, explaining why siblings (who are genetically equivalent to DZ twins) can differ so greatly from one another (Kendler 2001).
> *Twins' perceived differences in experience*: Are MZ twins' perceived differences in parental treatment and experience linked to behavioural differences between them? For example, adolescent twins who experienced having been disfavoured by their parents in comparison with their co-twin reported more anxiety and lower self-esteem. (Sheehan and Noller 2002). Studying monozygotic twins in this way shows how environmental events impact behaviour because they are perfect genetic controls.
> (Segal 1999, p.73)

Thus the need to identify specific non-shared environmental influences among siblings arises from the behaviour genetic evidence, indicating that these factors account for the phenotypic variance on a variety of behavioural traits (Plomin 1994). The present study focuses on factors such as co-twin dependence, dominance-submissiveness and parental preference and tries to answer to which extent they may affect twins' mental well-being measured as depressive and psychosomatic symptoms in young adulthood. These traits were evaluated separately in male and female twins. As the twinship has been suggested to constitute a different growing environment for MZ, same-sex DZ and opposite-sex twin pairs (Allen *et al.* 1971, Pulkkinen *et al.* 2003) the differences in symptom reporting were also evaluated in different twin pairs.

3 Aims of the study

This is a longitudinal study of twins followed from pregnancy to young adulthood.

The aims were:

1. to study special features in developmental phases of twins, as measured by the occurrence of depressive, emotional and psychosomatic symptoms in early, middle and late adolescence.
2. to evaluate parental preferences and their implications for the mental health of twins in their young adulthood.
3. to focus on the different aspects of twins' dominance-submissiveness and its implications for their mental health in young adulthood.
4. to evaluate depressive and psychosomatic symptoms in twins in relation to co-twin dependence in young adulthood.

4 Material and methods

4.1 Study population

This is a follow-up study of 234 twin pairs from Northern Finland, focusing on the inter-twin and parent-twin relationships and their relation to twins' mental well-being in adolescence and in young adulthood. The original study group is made up of all 335 twin deliveries in Oulu University Hospital during the years 1965 – 1973 (Koivisto *et al.* 1975). Following perinatal and neonatal (0-28 days) mortality, a total of 603 (90%) twins, 289 twin pairs, and 25 'single' twins whose pair had died were alive at the end of the neonatal period. Pregnancy, delivery, and neonatal data were gathered from the hospital records. The twins have been followed at ten-year intervals, at 2-10 years of age, 12-20 years of age and at 22-30 years of age.

4.2 Procedure

4.2.1 First follow-up

In 1975-76, a follow-up study was carried out in this twin cohort (n=572), then aged 2-10 years. Records were collected from health care centres about 272 twin pairs and 20 'single' twins and by parental questionnaire about 260 twin pairs and 17 single twins. Information about 93 same-sex (SS) male twin-pairs, 77 SS female twin pairs, and 105 opposite-sex (OS) twin pairs was collected at this point. The information included data about development, health, temperament, and twin relationship. Every third twin pair and all twins who had lost their co-twin during the perinatal or neonatal period (and thus had an elevated risk for developmental disorders) were invited to the outpatient clinic of the paediatric hospital for examinations. Paediatric, developmental, and neurological examinations were carried out, including EEG (n=168). Additional psychological assessments (WISC, Bender, Goodenough) were made of all those who were at least five years old (n=120). Determination of zygosity based on similarity methods was also

performed for those twins who were subjected to the clinical examination (Moilanen and Pennanen 1997).

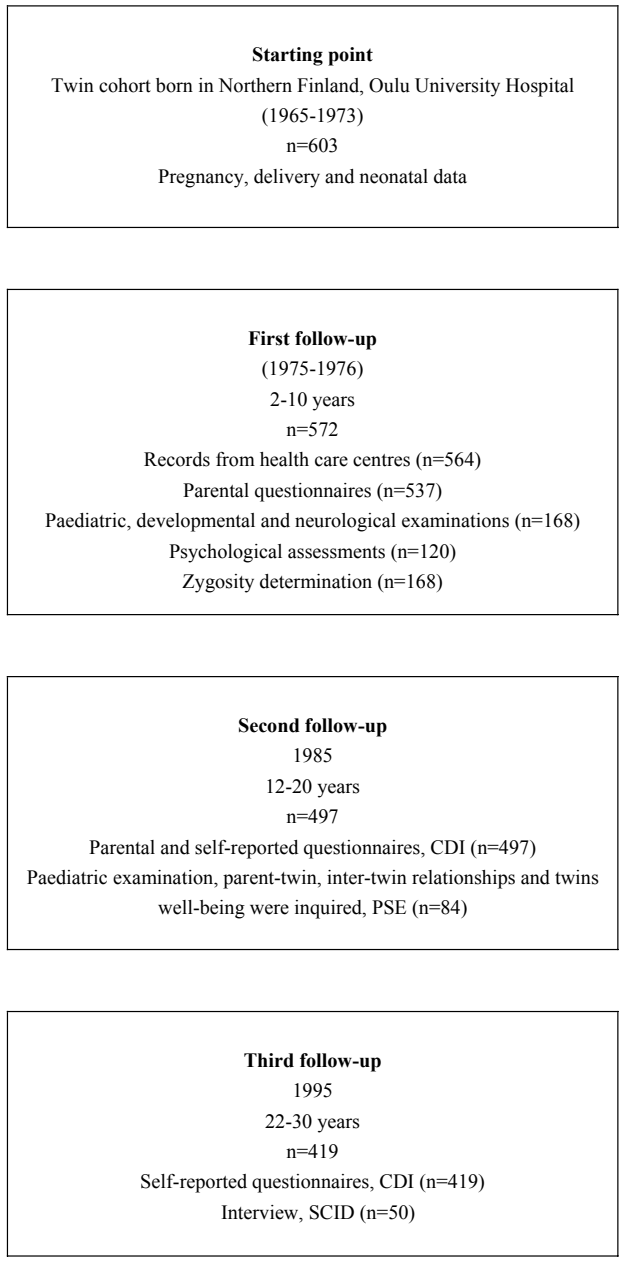

Fig. 1. A follow-up study

4.2.2 Second follow-up

A second follow-up was conducted in 1985, when the twins were 12-20 years old, by using questionnaires completed by the parents and the twins themselves, and by inviting the twins who had undergone the entire examination package in 1975-76 to the outpatient clinic. Data on development, academic achievement, health and lifestyle, psychosomatic symptoms, inter-twin relationships, and parent-twin relationships were elicited, and additionally, the twins completed the Children's Depression Inventory (CDI; Kovacs 1980).

The dominance-submissiveness of the co-twins was assessed separately in three domains of life: physical and psychological dominance-submissiveness and the role of a spokesman (Moilanen 1987a,b).

At the outpatient clinic, a paediatric somatic examination was performed, inter-twin and parent-twin relationships were inquired in line with, for example, Schave and Ciriello (1983), and a psychiatric Present State Examination (PSE; Wing *et al.* 1977) was performed by another child psychiatrist blinded to the previous data and the contents of the earlier interviews (conducted by Moilanen).

Questionnaires were sent to the probands who had responded to the first follow-up inquiry. Questionnaire data were received from 497 (82.4% of the original 603) twins and interviews were conducted with 84 twins. (Moilanen 1987a,b, Moilanen 1988a,b, Moilanen 1991, Moilanen and Pennanen 1997).

For the purposes of this study, the period of adolescence was divided into early, middle and late adolescence, corresponding to 12-14, 15-16 and 17-20 years of age, respectively (Mangs and Martell 1995)

4.2.3 Third follow-up

A third follow-up was carried out in 1995, when the twins were 22-30 years old.

At this follow-up, 419 twins whose co-twin was alive (72.5% of the original 578) returned the questionnaire. There were 201 males and 218 females; 184 complete pairs as well as 51 twins who were the only ones of the pair to respond. Of the probands, 123 were males of SS twin pairs, 78 were males of OS pairs, 131 were females of SS twin pairs, and 87 females of OS twin pairs.

Zygosity was determined in 344 twins, 32 of whom were monozygotic males (MZM), 65 same-sex dizygotic males (SSDZM), 78 opposite-sex dizygotic males (OSDZM), 32 monozygotic females (MZF), 50 same-sex dizygotic females (SSDZF) and 87 opposite-sex dizygotic females (OSDZF).

The twins completed questionnaires about academic achievement, health and lifestyle, and life circumstances, such as employment and their own family and children. Parental preference and inter-twin relationships were assessed as well.

4.3 Measures

4.3.1 Zygosity determination

Zygosity was determined at two ages. In the first follow-up at 2-10 years of age, 1975-1976, about one third of the twins were subjected to clinical examination, and determination of zygosity for these twins was based on similarity methods (Moilanen and Pennanen 1997). Later, at age 22-30, during the present investigation, all twins received questionnaires with items of 1) 'similarity', 'were you and your twin partner during childhood as like as 'two peas in a pod' or were you of ordinary family likeness?', and 2) 'confusion', 'were you and your twin partner so similar in appearance before, at or after school age that people had difficulty in telling you apart?' (Sarna *et al.*1978). These questions were used in the decision tree to determine zygosity: if both SS twins replied 'like two peas in a pod' and 'yes' to the question about people having difficulty in telling them apart at and after school age, they were considered MZ. Conversely, twins were regarded DZ if they both replied 'of ordinary family likeness' and 'no' to questions about confusion in appearance at and after school age. If the answers about similarity and 'people having difficulty in telling twins apart' disagreed or at least one twin had replied 'don't know', zygosity was confirmed from the zygosity determination data at 2-10 years of age, available for one third of twins, while the rest remained in the group of unclassified cases (n=75). Genetic marker tests in order to confirm zygosity have not yet been performed. Questionnaire-based methods of zygosity diagnosis are very accurate (Sarna *et al.* 1978, Rietveld *et al.* 2000), and misclassification of zygosity is unlikely to be a major source of bias.

4.3.2 Questionnaires

4.3.2.1 Children's Depression Inventory

Depressive symptoms reflect depressed mood over a relatively short period of time. Depressiveness scores were measured by the Children's Depression Inventory (CDI; Kovacs, 1980). Twenty-six of the twenty-seven items were used, modifying the questions for age, e.g. replacing 'I never have fun at school' with '… during studies or work'. The item about suicidal tendencies had been excluded from the previous inquiries for ethical reasons and was excluded here as well. The items were scored from 0 to 2.

In addition to total depressiveness, three sub-scores were formed based on a factor analysis performed on an epidemiological study in Finland (Moilanen, 1990). The factors were "low self-confidence" (items: I hate myself, nobody loves me, I look ugly, I am bad, I do everything wrong, I do very badly), "anhedonia" (items: nothing is fun, things bother me, I never have fun at my studies or at work), and "sadness" (items: I am sad all the time, I feel like crying, I feel lonely). The items having loadings of more than 0.499 on each of these three factors were selected to make up the sum variables for these three

aspects of depressiveness. These three factors were in line with factor analysis for adult inventories. The General Health Questionnaire (GHQ) has lack of self-confidence and anhedonia in common with the present analysis, while the present sum variable of sadness takes the form of feelings of loneliness in GHQ. The common factor with Beck's depression inventory is sadness, which resembles more closely Beck's first factor, depressive mood, while anhedonia in the present analysis probably resembles Beck's second factor, loss of energy, to some extent, while low self-confidence reminds us most of Beck's fourth factor: guilt, indecision and self-observation.

4.3.2.2 Nervous complaints and somatic symptoms

Items assessing nervous complaints and somatic symptoms were adapted from previous Finnish studies of juvenile health habits (Rimpelä *et al.* 1983). Reports of symptom frequency were classified into four categories, the frequencies of which were evaluated by assigning four ordered values to occurrences "never or less than monthly" (0), "monthly" (1), "weekly" (2), and "daily" (3). 1) Nervous complaints (nervousness total) were made up of nervousness, irritability and loss of energy, and 2) somatic complaints (somatic symptoms total) of cephalalgia and abdominal pain (Moilanen 1987). Additionally, the following psychosomatic and somatic symptoms were covered separately: nervousness, irritability, loss of energy, cephalalgia, abdominal pain, sleeping difficulties and loss of appetite. Since the number of subjects was small in each category and the distribution of symptoms was positively skewed, the scores 'monthly', 'weekly' and 'daily' were combined into 'often/at least monthly'.

4.3.2.3 Parental preference

Parental preference was inquired from the twins in two directions 1) *experienced parental preference* 'did you feel that either parent preferred you?', and 2) *twin's own preference* 'which one of the parents did you feel closer to?'. The twins reported these two dimensions as young adults, and retrospectively, concerning ages before school and at school age, which in Finland includes the years from seven to sixteen (compulsory school age), or to nineteen (upper secondary school).

Pairwise parental preference was formed on the basis of the responses of each individual co-twin of a pair to questions about experienced parental preference and twin's own preference. Twin pairs were classified into six categories: 1) *both equal* (both twins of a pair reported being equally close to both parents), 2) *opposite poles* (one twin of a twin pair reported being preferred by the mother and the co-twin reported being preferred by the father), 3) *both mother's* (both twins of a pair reported being preferred by the mother), 4) *both father's*, 5) *equal and mother's* (one twin evaluated to be preferred by the mother and the co-twin evaluated to be equally close to both parents) and 6) *equal and father's*. *Pairwise twin's own preference* was formed equally.

4.3.2.4 Co-twin dependence

Co-twin dependence was measured as young adults, and retrospectively, concerning ages before school and at school age, which in Finland includes years from seven to sixteen (compulsory school age), or to nineteen (upper secondary school). The twins answered two questions: 'In your opinion, are you dependent on your co-twin?' and 'In your opinion, is your co-twin dependent on you?' with response alternatives yes and no. The responses were all evaluated regardless of whether the twins' opinion about themselves was in conflict with the co-twin's opinion or not.

Two measures of pair-wise dependence were included as in a previous study by Penninkilampi-Kerola *et al.* (2006). The first, 'pair-wise dependence' was formed on the basis of the responses of each individual twin to the question 'In your opinion, are you dependent on your co-twin?' Twin pairs were classified into three categories: (1)'*concordantly dependent'* (both twins of a pair reported themselves dependent; n=8 twin individuals, 4.6%), (2)'*concordantly independent*' (both twins of a pair reported being independent; n=142 twin individuals, 81.6%), and (3) '*discordantly dependent'* (one twin of a twin pair reported dependence and the co-twin reported independence; n=24 twin individuals, 13.8%).

The second measure of pair-wise dependence reflected each individual twin's subjective perception of the dependence within the twin pair. This measure was labelled '*individual-based perception of pair-wise dependence*' in order to distinguish it from the first measure of pair-wise dependence. Twins were assigned into four groups based on each individual twin's report of his/her and the co-twin's dependence. The classification was based on two questions: 'In your opinion, are you dependent on your co-twin?' and 'In your opinion, is your co-twin dependent on you?'. (1) The '*consonantly dependent'* group included twins who considered themselves dependent and also perceived their co-twin as being dependent on them (n=41 twin individuals, 10.3%). In the (2)'*consonantly independent'* group, one twin individual reported not being dependent and perceived the co-twin as also being non-dependent (n=346 twin individuals, 86.5%). The (3)'*dissonantly dependent'* group consisted of twins who reported dependence for their own part, but viewed their co-twin as independent (n=4 twin individuals, 1.0%). The fourth group, in which twin individuals had reported themselves independent but viewed their co-twin as dependent, was labelled (4) '*dissonantly independent'* (n=9 twin individuals, 2.3%).

4.3.2.5 Dominance-submissiveness

Dominance-submissiveness between twins and in the twin relationships were assessed separately in three domains of life: physical and psychological dominance-submissiveness and the role of a spokesperson (Moilanen 1987 a,b, Moilanen & Ebeling 1998). Dominance-submissiveness was measured as young adults, and retrospectively, concerning ages before school and at school age. The twins answered three questions: 'Has one of you acted as a 'leader' in the physical domain?', 'Has one of you acted as a

'leader' in the psychological domain (studying, opinions etc.)?' and '…as a spokesperson?', here referred to as verbal dominance. The reply alternatives to the questions were 1) I was always dominant, 2) I was often dominant, 3) We were equal, 4) My co-twin was often dominant and 5) My co-twin was always dominant. For the statistical analysis, options 1 and 2 were combined into 'dominant', option 3 into 'intermediate', and 4 and 5 into 'submissive'. A sum variable for "total dominance-submissiveness" was calculated by adding up the three features of dominance on a scale of 3 to 15 points, where 3-7 corresponded to 'dominant', 8-10 to 'equal', and 11-15 to 'submissive'.

4.4 Statistical methods

The mean values of the total depressiveness scores and sub-scores were presented. If data were missing in one third or less of the sum-variable items (low self-confidence, anhedonia, sadness, nervous complaints and somatic complaints), the missing data were replaced by modes (=0); otherwise the case was excluded from the analyses. Thus the number of subjects varied slightly in different analyses depending on the presence of missing data in other variables.

In the statistical analyses, the Pearson Chi-Square test, Fisher's Exact test, Mann-Whitney U-test and Kruskal-Wallis test were performed. In post hoc analysis comparing the difference between the means of the two groups, Bonferroni's test significance levels were used.

As we mainly had both twins in each pair, same sex-twins were not totally independent of each other. Therefore, we analysed the data using weights in order to avoid replicates (Altman 1991). In weighted analysis, the twins of SS pairs got a weight of 0.5 and the twins of OS pairs got a weight of 1. This was done in publications I and IV. No adjustment was used in publication III.

Alternatively to the weighted analysis, to account for the fact that observations of twin pairs are correlated, we used the complex survey data analysis methods in Stata 8.0 in publication II. To test the differences in proportions between different twin types and gender, differences in distribution and means were tested by using the Wald F-statistics for chi-square tests and tests adjusted for correlated data (Rao & Scott, 1984). As the distribution of depressiveness and psychosomatic symptom scores were positively skewed, they were classified into categorical variables for statistical analysis.

The analyses were performed using the SPSS (SPSS for Windows, release 12.01, SPSS, Inc.) as well as Stata (Stata Statistical Software, release 8.0, Stata Corporation) programs. Statistical significance was set at $p<0.05$, and higher p-values were considered to be non-significant. P-values of 0.05-0.10 were taken to indicate a non-significant trend.

5 Results

5.1 Emotional and psychosomatic symptoms in adolescence and in young adulthood (I, IV)

5.1.1 Depressive symptoms

5.1.1.1 In adolescence (I)

Depressive symptoms were evaluated at the different stages of adolescence in both genders (Table 2). Boys reported most depressiveness and anhedonia in middle adolescence (15-16-years of age) and most sadness towards late adolescence (17-20 y). Girls experienced most depressiveness, lowest self-confidence and most anhedonia in mid-adolescence. In the comparison of genders, boys reported more depressiveness in early adolescence (12-14 y) and girls in late adolescence. In addition, boys had more anhedonia in early adolescence than girls, while girls reported more sadness than boys. In middle and late adolescence, girls reported low self-confidence more frequently than boys. (Table 1, original publication I)

The depression symptom scores and sub-scores were also evaluated in same-sex (SS) and opposite-sex (OS) twin pairs in each age group (Table 2). In a comparison of the age groups, SS boys had most sadness in late adolescence. SS females had most depressiveness and lowest self-confidence in mid-adolescence. The females of OS pairs showed most depressiveness and anhedonia in mid-adolescence. (Table 2, op I)

As far as the whole age group (12-20 years) was concerned, the males of SS twin pairs reported more anhedonia than the males of OS twins pairs. There were no differences in depressiveness or its sub-scores between SS and OS males or SS and OS females.

Gender differences were more distinct between SS males and SS females than between OS twins of different genders, suggesting an inter-twin identification to affect personality development. (Table 2, op I)

5.1.1.2 In young adulthood (III)

No differences were found in depressive symptom reporting between the genders in young adulthood (Table 2). When different twin pairs were analysed separately, the males of the OS pairs reported more sadness than the males of the SS pairs. No significant statistical differences in depression or other symptoms were found between females of different twin pairs. Females from SS twin pairs had a non-significant trend to report more total depressiveness and sadness than SS twin males.

Table 2. Total scores of self-reported depressive symptoms and sub-scores of low self-confidence, anhedonia and sadness are given in same-sex (SS) and opposite-sex (OS) twin males and females in early, middle and late adolescence as well as in young adulthood.

Sum variables	Males					Females				P1-value
	Total Mean (n)	SS males Mean (n)		OS males Mean (n)		SS females Mean (n)		OS females Mean (n)	Total Mean (n)	Between males and females
Depressiveness total score										
Early adolescence	5.00 (96)	5.30 (64)	<*>	4.41 (32)		4.37 (52)	<†>	3.28 (32)	3.95 (84)	0.039‡
Mid-adolescence	6.36 (44)	6.23 (26)		6.56 (18)		7.22 (23)		6.58 (19)	6.93 (42)	NS
Late adolescence	4.48 (108)	4.81 (62)	<†>>	4.04 (46)	<†>>	5.82 (68)		5.80 (49)	5.81 (117)	0.009‡
	(P2=0.09)‡	*(P2=NS)*		*(P2=NS)*		*(P2=0.01)*		*(P2=0.01)*	(*P2<0.001*) ‡	
Young adulthood	4.38 (200)	3.94 (123)		5.08 (77)	<<†>	4.70 (130)		4.90 (86)	4.78 (216)	NS
Low self-confidence										
Early adolescence	0.99 (97)	1.02 (65)		0.91 (32)		0.98 (50)		0.94 (32)	0.99 (84)	NS
Mid-adolescence	1.33 (45)	1.12 (26)	<*>>	1.63 (19)		1.78 (23)		1.74 (19)	1.76 (42)	0.045
Late adolescence	0.97 (108)	1.06 (63)	<*>>	0.85 (46)		1.50 (68)		1.24 (49)	1.39 (117)	0.022‡
	(P2=NS)	*(P2=NS)*		*(P2=NS)*		*(P2=0.01)*		*(P2=NS)*	*(P2=0.01)* ‡	
Young adulthood	0.67 (197)	0.60 (122)		0.79 (75)		0.68 (130)		0.81 (85)	0.73 (215)	NS
Anhedonia										
Early adolescence	1.05 (97)	1.12 (65)	<*>>‡	0.91 (32)	<†>>	0.77 (52)		0.53 (32)	0.68 (84)	0.002‡
Mid-adolescence	1.31 (45)	1.50 (26)		1.05 (19)		1.04 (23)		1.11 (19)	1.07 (42)	NS
Late adolescence	0.94 (109)	1.06 (63)		0.76 (46)		0.96 (68)		1.08 (49)	1.01 (117)	NS
	(P2=0.05)	*(P2=0.08)*		*(P2=NS)*		*(P2=NS)*		*(P2=0.03)*	*(P2=0.04)* ‡	
Young adulthood	1.10 (194)	1.02 (120)		1.24 (74)		0.98 (126)		1.18 (85)	1.06 (211)	NS
Sadness										
Early adolescence	0.01 (97)	0.02 (65)	<*>>‡	0.00 (32)	<*>>‡	0.15 (52)		0.19 (32)	0.17 (84)	0.001‡
Mid-adolescence	0.13 (45)	0.15 (26)		0.11 (19)		0.30 (23)		0.26 (19)	0.29 (42)	NS
Late adolescence	0.19 (109)	0.24 (63)		0.13 (46)		0.24 (68)		0.29 (49)	0.26 (117)	NS
	(P2=0.01) ‡	*(P=0.028)*		*(P2=NS)*		*(P2=NS)*		*(P2=NS)*	*(P2=NS)*	
Young adulthood	0.18 (181)	0.11 (114)	<**>	0.30 (67)	<<†>	0.22 (129)		0.31 (85)	0.26 (214)	NS

P1-value: indicates the differences between the genders, Mann-Whitney U-test. P2-value: indicates the significances of differences between the age groups (adolescence), Kruskal-Wallis test. Note: < > indicates the significance between the two groups beside each other and < >> indicates the significance between the two groups apart from each other. Man-Whitney U-test significance levels *p<0.05, **p<0.01. † indicates non-significant trend, 0.05<p<0.1. ‡ indicates that difference was significant in weighted analysis (p<0.05), with SS pairs given a weight of 0.5 and OS pairs a weight of 1.

5.1.2 Somatic symptoms

5.1.2.1 In adolescence (I)

Somatic/psychosomatic symptoms were evaluated at the different stages of adolescence and in young adulthood. According to the adolescents' own report, boys experienced more commonly lack of appetite in early and middle adolescence, but they reported more often being sad towards late adolescence. Girls self-reported most sleeping difficulties and abdominal pain towards late adolescence. (Table 3, op I)

In a comparison of the genders, girls self-reported significantly more abdominal pain than boys in early and late adolescence, and more headache in late adolescence.

There were more remarkable gender differences between SS males and SS females than between the males and females of OS pairs. According to the twins' own reports, late adolescent SS females had more headache and abdominal pain and higher psychosomatic symptom total scores than SS males. (Table 4, op I)

5.1.2.2 In young adulthood (III)

Females reported more irritability, headache and abdominal pain, and they scored higher than males in the somatic symptom total score. Females from both SS and OS twin pairs showed more somatic symptoms than males. In further analysis, MZ females showed more somatic symptoms than MZ males. Females from SS twin pairs had a non-significant trend to have more irritability and less nervousness than SS twin males. (Tables 1 and 2, op III)

5.2 Parental preference and twins' mental health (II)

Parental preference was evaluated in two directions: which one of the parents was reported to feel closer to the twin - *experienced parental preference* evaluated by the twin, and which one of the parents the twin felt closer to - *twin's own preference*. The twins reported these two dimensions as young adults, and retrospectively, concerning ages before school and at school age.

5.2.1 Experienced parental preference

Twins experienced most often to be equally close to both parents. After starting school, female twins in particular experienced being increasingly preferred by their mother. However, when compared with males, females experienced more often having been preferred by fathers before and during school age. Males of SS pairs experienced most often being equally close to both parents at all ages, and as many as 90% of MZ males

had experienced equal preference before and at school age (Table 1, op II). In evaluation of 'pairwise parental preference' about half of the twins experienced having been equally close to both parents, while about 30% were from 'equal and mother's' pair type. SS twins experienced most often being equally close to both parents, that is, 'both equal' and OS twins fell into the category 'equal and mother's' or 'both equal' (Table 2, op II).

Depressive and psychosomatic symptoms in relation to parental preference at 22-30 years were evaluated separately in males and females (Table 3). Males who reported being equally close to both parents had the lowest total depressiveness score, while males who experienced being preferred by the mother had most depressiveness. In further analysis, a low total depressiveness score of equally preferred male twins was found especially among males in SS twin pairs. (Table 4, Table 3a, op II)

Female twins who were equally close to both parents had the highest self-confidence and least anhedonia and nervousness (Table 3). The favourable situation of equally preferred female twins was especially prominent among OS females, as they reported the lowest total depressiveness score, highest self-confidence, least anhedonia and nervousness. (Table 4, Table 3b, op II)

When depressive and psychosomatic symptoms were evaluated in relation to 'pairwise experienced parental preference', the highest depressiveness and the lowest self-confidence were found among twins who were from 'both mother's' pairs. (Table 4, op II)

5.2.2 Twin's own preference regarding parents

Males felt more often equally close to both parents than females twins, while females in all twin types tended to feel closer to one of the parents, most often the mother (Table 1, op II). When the 'pairwise twin's own preference' was evaluated, about one third of the pairs were 'both equal', one third 'both mother's', and one third 'equal and mother's'. MZ twins fell most often into the category of 'both mother's' twin pair, SSDZ twins into the 'both equal' category, OS twins were most often from 'both mother's' or 'equal and mother's' pairs. (Table 2, op II)

Males who felt both parents to be equally close had the lowest total depressiveness score and least anhedonia (Table 3). When analysing different kinds of twin pairs further, males of SS pairs who felt the mother to be the closer parent had the highest total depressiveness score and most anhedonia and sadness, while those SS males who felt the father to be closer had the lowest total depressiveness score and least anhedonia. The intermediate situation of feeling both parents to be equally close also seemed beneficial for males of OS pairs as they had the lowest total depressiveness score and least nervousness. (Table 4, Table 3c, op II)

Females who felt equally close to both parents had least anhedonia (Table 3). In further analysis of different twin types, this favourable situation of feeling equally close to both parents was found only in females of SS pairs. (Table 4, Table 3d, op II)

Table 3. Depressive and psychosomatic symptoms in relation to parental preference at twin's age of 22-30 years.

Symptoms	Males				P*	Females				P*
	Closer parent Mother Mean (n)	Equal Mean (n)	Father Mean (n)	Total Mean (n)		Closer parent Mother Mean (n)	Equal Mean (n)	Father Mean (n)	Total Mean (n)	
Experienced parental preference										
Depressiveness	5.65 (51) <**>	3.70 (135)	5.00 (8)	4.27 (194)	0.046	5.95 (62)	4.23 (119)	4.54 (13)	4.80 (194)	NS
Low self-confidence	0.88 (50)	0.54 (134)	1.29 (7)	0.65 (191)	NS	0.97 (62) <**>	0.58 (119)	0.69 (13)	0.71 (194)	0.087
Anhedonia	1.25 (51)	1.02 (131)	0.86 (7)	1.08 (189)	NS	1.21 (61) <*>	0.96 (115)	1.23 (13)	1.06 (189)	NS
Sadness	0.26 (50)	0.12 (119)	0.43 (7)	0.17 (176)	0.071	0.34 (61)	0.24 (119)	0.23 (13)	0.27 (193)	NS
Nervousness	2.84 (51)	2.44 (132)	3.43 (7)	2.58 (190)	NS	3.15 (61) <**>	2.45 (118)	2.69 (13)	2.69 (192)	0.030
Somatic symptoms	0.65 (51)	0.60 (134)	0.43 (7)	0.61 (192)	NS	1.27 (62)	1.27 (119)	1.31 (13)	1.27 (194)	NS
Preference felt by the twin										
Depressiveness	5.32 (66) <**>	3.70 (120)	5.20 (10)	4.32 (196)	0.007	5.08 (117)	4.07 (74)	6.08 (13)	4.77 (204)	NS
Low self-confidence	0.77 (64)	0.57 (120)	1.22 (9)	0.66 (193)	NS	0.76 (117)	0.64 (73)	0.85 (13)	0.72 (203)	NS
Anhedonia	1.35 (66) <*>	0.94 (114)	1.10 (10)	1.09 (190)	0.062	1.15 (115)	0.79 (71) <**>	1.69 (13)	1.06 (199)	0.019
Sadness	0.24 (63)	0.10 (105)	0.33 (9)	0.16 (177)	NS	0.32 (114)	0.19 (75)	0.38 (13)	0.27 (202)	NS
Nervousness	2.86 (65)	2.44 (117)	3.22 (9)	2.62 (191)	NS	2.77 (115)	2.30 (73)	3.54 (13)	2.65 (201)	NS
Somatic symptoms	0.72 (65)	0.54 (119)	0.44 (9)	0.60 (193)	NS	1.21 (116)	1.23 (73)	1.62 (13)	1.24 (202)	NS

P*: Significances of differences in depressive and psychosomatic symptoms between parental preference groups were calculated. Note: Significance levels *P<0.05, **p<0.01. < > indicates the significance between the two groups beside each other (Wald-F Statistics for correlated data)

Table 4. Depressive and psychosomatic symptoms in relation to parental preference in different twin groups at twin's age of 22-30 years. In this table, primarily results showing statistical significance are presented.

Symptoms	Mother Mean (n)		Equal Mean (n)		Father Mean (n)	P*
Experienced parental preference						
SS Males						
Depressiveness	5.57 (21)	<*>	3.57 (93)		1.00 (4)	0.056
Anhedonia	1.24 (21)	<*>	0.97 (92)		0.00 (3)	0.010
Sadness	0.24 (21)	<**>	0.06 (85)		0.00 (4)	0.023
SSDZM						
Depressiveness	5.90 (10)	<**>	3.33 (49)		0.50 (2)	0.063
Anhedonia	1.30 (10)	<**>	0.96 (49)		0.00 (1)	0.041
OS Males						
Low self-confidence	1.00 (30)		0.44 (41)		2.67 (3)	0.029
Sadness	0.28 (29)		0.26 (34)	<**>	1.00 (3)	0.053
OS Females						
Depressiveness	6.40 (30)	<*>	3.40 (43)		6.67 (3)	0.070
Low self-confidence	1.03 (30)	<†>	0.53 (43)		1.67 (3)	0.058
Anhedonia	1.43 (30)	<**>	0.83 (42)	<*>	1.67 (3)	0.042
Nervousness	3.48 (29)	<†>	2.26 (43)		3.67 (3)	0.013
Preference felt by the twin						
SS Males						
Depressiveness	5.48 (31)	<**>	3.43 (83)	<<**>	1.17 (6)	0.009
Anhedonia	1.45 (31)	<**>	0.88 (80)	<<*>	0.33 (6)	0.012
Sadness	0.24 (29)	<***>	0.04 (76)		0.00 (6)	0.004
MZM						
Depressiveness	5.38 (13)	<**>	2.88 (16)		0.50 (2)	0.010
SSDZM						
Anhedonia	1.47 (15)	<*>	0.93 (43)		0.00 (2)	0.010
Sadness	0.23 (13)		0.02 (41)		0.00 (2)	0.038
OS Males						
Depressiveness	5.17 (35)		4.30 (37)	<*>	11.25 (4)	0.070
Nervousness	2.88 (34)		2.58 (36)	<*>	6.67 (3)	NS
SS Females						
Anhedonia	1.08 (64)		0.80 (45)	<**>	1.75 (8)	0.055

P*: Significances of differences in depressive and psychosomatic symptoms between parental preference groups were calculated. (Wald-F Statistics for correlated data). Note: Significance levels *P<0.05, **P<0.01, ***p<0.001, † 0.05<p<0.01. < > indicates the significance between the two groups beside each other. << > indicates the significance between the two groups apart from each other.

5.3 Co-twin dependence and mental health (III)

Co-twin dependence was evaluated in young adulthood and retrospectively before and at school age. Co-twin dependence seemed to decrease with increasing age. Females reported more often co-twin dependence than males in young adulthood. (Table 3, op III)

MZ twins reported most often co-twin dependence at all ages. In comparison between MZ and DZ twins in both genders, MZ males reported significantly more dependence before and at school age than DZ males. Among females MZ twins reported significantly more often co-twin dependence than DZ females at all ages. (Table 5)

Table 5. Distributions of self-reported co-twin dependence by zygosity and gender in different age groups reported by twins themselves in young adulthood.

Co-twin dependence	MZM	SSDZM	OSDZM	MZF	SSDZF	OSDZF
	%	%	%	%	%	%
Before school age	84.4	65.5	54.7	90.6	69.2	61.6
		P1=0.008 [b]	P2=0.013 [b]		*P1=0.004* [a]	P2=0.010 [b]
School age	75.0	43.3	44.0	87.5	54.0	41.9
		P1=0.001 [a]	P2=0.006 [b]		*P1<0.001* [a]	P2<0.001 [a]
Young adulthood	12.9	5.0	4.0	31.0	7.8	9.4
		P1=0.074	P2=NS		*P1=0.001* [a]	P2=0.005 [a]
	(n=32)	(n=60)	(n=75)	(n=32)	(n=52)	(n=86)

P1 indicates significance of difference between MZ and DZ twins, and P2 indicates significance of difference between all three zygosity groups in each gender (Chi-Square Test). Significances of differences remained significant [a] or showed a non-significant trend ($0.05< p< 0.10$) [b] in weighted analysis.

Distributions of dependence and pair-wise dependence in different twin types in young adolescence are presented in Table 6. MZ twins (21.7%) were three times more likely to report dependence than DZ twins (~7%). Regarding *pair-wise dependence*, most twins could be classified as concordantly independent (84.4%). MZ twins were more likely to be from concordantly dependent twin pairs than DZ twins. With respect to the *individual twin's perception of the co-twin dependence* within the twin pair, most of the twins perceived their co-twin relationship as consonantly independent (88.4%). MZ twins were more likely to perceive their co-twin relationship as consonantly dependent (20.0%) than SSDZ twins (6.4%) or OSDZ twins (4.4%).

Table 6. Distributions co-twin dependence in individuals and within twin pairs in young adulthood.

Co-twin dependence	MZ % (n)	SSDZ % (n)	OSDZ % (n)	Total % (n)
Twin individuals (n=331)				
Dependent	21.7 (13)	6.3 (7)	6.9 (11)	9.4 (31)
Independent	78.3 (47)	93.7 (104)	93.1 (149)	90.6 (300)
Pair-wise dependence (n=141 pairs)				
Concordantly dependent	16.0 (4)	0.0	0.0	2.8 (4)
Concordantly independent	68.0 (17)	87.8 (43)	88.1 (59)	84.4 (119)
Discordantly dependent	16.0 (4)	12.2 (6)	11.9 (8)	12.8 (18)
Individual-based perception of pair-wise dependence (n=328)				
Consonantly dependent	20.0 (12)	6.4 (7)	4.4 (7)	7.9 (26)
Consonantly independent	76.7 (46)	91.8 (101)	90.5 (143)	88.4 (290)
Dissonantly dependent	1.7 (1)	0.0	1.9 (3)	1.2 (4)
Dissonantly independent	1.7 (1)	1.8 (2)	3.2 (5)	2.4 (8)

5.3.1 Consequences of co-twin dependence on depressive and psychosomatic symptoms

Depressive and psychosomatic symptoms were evaluated in relation to co-twin dependence in young adulthood in each gender. There were no significant differences found in depressive symptom reporting. However, dependent twins reported more somatic symptoms (total score) (1.15, n=46, males and females both) than the independent ones (0.92, n=352, p1=0.051 Mann-Whitney U Test, p2=NS, weighted analysis). (Table 6, op III)

In comparison between SS and OS twin pairs no significant differences were found among males. Dependent SS females reported less sadness (0.13, n=24) than dependent OS females (0.88, n=8, p1=0.019, p2=0.008). In comparison between the genders, dependent SS males reported less somatic symptoms (0.64, n=11) than dependent SS females (1.29, n=24, p=0.041, p2=0.083).

The same evaluation was also performed in each zygosity group (Table 7), and again only few significant differences were found between dependent and independent twins. Dependent MZ males reported significantly lower self-confidence, and females who were dependent on their twin brother (OS females) reported significantly more sadness than independent ones.

Additionally, some findings that remained non-significant in statistical analysis were of interest (Table 7). Dependent SSDZ males seemed to have less total depressiveness, anhedonia and nervousness than independent ones, but the differences did not reach statistical significance. Males who were dependent on their twin sister (OS males) seemed to report less depressiveness, higher self-confidence, less anhedonia and nervousness, again with the differences remaining non-significant. Furthermore,

dependent MZ females seemed to have less depressiveness than the independent ones and there was a trend of higher self-confidence. Contrarily, females who were dependent on their twin brother (OS females) seemed to report more depressiveness and nervousness than the independent ones.

Table 7. Depressive and psychosomatic symptoms in relation to co-twin dependence in young adulthood.

Symptoms	MZM	SSDZM	OSDZM	MZF	SSDZF	OSDZF
Co-twin dependence	Mean (n)	Mean (n)	Mean (n)	Mean (n)	Mean (n)	Mean (n)
Depressiveness (total)						
Dependent	4.25 (4)	2.00 (3)	2.67 (3)	3.56 (9)	4.00 (4)	7.43 (7)
Independent	4.15 (27)	3.65 (57)	4.96 (71)	5.10 (20)	5.28 (46)	4.69 (77)
Low self-confidence						
Dependent	1.25 (4) [1 b]	0.67 (3)	0.00 (3)	0.22 (9) [3]	0.50 (4)	1.00 (7)
Independent	0.48 (27)	0.61 (56)	0.75 (69)	0.75 (20)	0.76 (46)	0.79 (76)
Anhedonia						
Dependent	0.75 (4)	0.00 (3) [2 b]	0.67 (3)	1.00 (8)	1.00 (3)	1.57 (7)
Independent	1.12 (26)	1.05 (56)	1.24 (68)	1.05 (19)	1.04 (46)	1.14 (76)
Sadness						
Dependent	0.00 (4)	0.00 (3)	0.00 (3)	0.11 (9)	0.25 (4)	0.88 (8)
Independent	0.19 (26)	0.08 (52)	0.30 (61)	0.50 (20)	0.28 (46)	0.25 (75) [4 a]
Nervousness (total)						
Dependent	2.50 (4)	1.00 (3)	2.00 (3)	1.67 (9)	2.00 (4)	3.63 (8)
Independent	2.30 (27)	2.46 (56)	2.87 (69)	2.60 (20)	3.02 (45)	2.70 (74)
Nervousness						
Dependent	0.75 (4)	0.33 (3)	0.67 (3)	0.22 (9)	0.25 (4)	1.25 (8)
Independent	0.59 (27)	0.72 (57)	0.77 (70)	0.65 (20)	0.80 (45)	0.68 (76)
Irritability						
Dependent	1.50 (4)	0.33 (3)	0.67 (3)	1.22 (9)	1.25 (4)	1.50 (8)
Independent	1.00 (27)	1.11 (56)	1.25 (69)	1.25 (20)	1.38 (45)	1.32 (75)
Loss of energy						
Dependent	0.25 (4)	0.33 (3)	0.67 (3)	0.22 (9)	0.50 (4)	0.88 (8)
Independent	0.70 (27)	0.65 (57)	0.83 (70)	0.70 (20)	0.85 (46)	0.71 (75)
Somatic symptom (total)						
Dependent	0.75 (4)	0.67 (3)	1.00 (3)	1.22 (9)	1.50 (4)	1.50 (8)
Independent	0.59 (27)	0.44 (57)	0.70 (70)	1.50 (20)	1.41 (46)	1.23 (74)
Cephalalgia						
Dependent	0.75 (4)	0.67 (3)	0.67 (3)	0.44 (9)	1.00 (4)	0.63 (8)
Independent	0.44 (27)	0.26 57)	0.44 (70)	0.75 (20)	0.81 (47)	0.61 (74)
Abdominal pain						
Dependent	0.00 (4)	0.00 (3)	0.33 (3)	0.78 (9)	0.50 (4)	0.88 (8)
Independent	0.15 (27)	0.18 (57)	0.26 (70)	0.75 (20)	0.63 (46)	0.62 (74)

Significances of difference between dependent and independent twins in symptom reporting were calculated by Mann-Whitney U Test. [1] $p=0.015$, [2] $p=0.062$, [3] $p=0.054$, [4] $p=0.042$. Significances of differences remained significant [a] or non-significant trend ($0.10< p>0.05$) [b] in weighted univariate analysis

Pair-wise dependence, based on reports of both twins of the pair, was also evaluated in relation to depressive and psychosomatic symptoms, but no significant differences were found.

However, when the individual-based perception to pair-wise dependence (reflecting twin's subjective experience of dependence within the pair) was evaluated in relation to symptom reporting, dissonantly dependent twins showed most total depressiveness and sadness, while consonantly dependent twins reported least sadness (Table 8). All these four dissonantly dependent twins were dependent twins from discordantly dependent pairs when the pair-wise dependence was evaluated (dependent twin from discordantly dependent pairs, n=12).

Table 8. Depressive and psychosomatic symptoms in relation to individual-based perception of pair-wise dependence evaluated by twins in young adulthood.

Symptoms	Consonantly dependent Mean (n)		Consonantly independent Mean (n)		Dissonantly dependent Mean (n)		Dissonantly independent Mean (n)	Total Mean (n)
Depressiveness	3.95 (41)		4.55 (344)	<>[4]	8.00 (4)		5.11 (9)	4.54 (398)
Low self-confidence	0.63 (41)	<>>[1]	0.69 (340)		1.25 (4)		0.67 (9)	0.69 (394)
Anhedonia	0.82 (39)	<>>[2]	1.10 (336)		1.50 (4)		1.22 (9)	1.07 (388)
Sadness	0.15 (41)	<***>>[3]	0.20 (324)	<***>[5]	1.25 (4)	<*>[6]	0.33 (9)	0.21 (378)
Nervousness	2.32 (41)		2.62 (337)		3.75 (4)		3.44 (9)	2.61 (391)
Somatic symptoms	1.07 (41)		0.92 (340)		1.75 (4)		0.78 (9)	0.94 (394)

Note: Bonferroni significance levels *p<0.05, **p<0.01 and ***p<0.001. < > indicates the significance between the two groups beside each other. << > indicates the significance between the two groups apart from each other. Significances of differences in weighted univariate analysis: [1] p=0.058, [2]p=0.058, [3] p=0.014, [4] p=0.017, [5] p<0.001, [6] p=0.040.

5.4 Dominance and submissiveness and mental health (IV)

Dominance-submissiveness was evaluated in relation to mental health between co-twins in young adulthood and retrospectively before and at school age (Table 9).

An intermediate dominance-submissiveness relationship was most common, especially in the psychological domain. In the physical domain, males were more commonly dominant than females at and after school age. In contrast, before and at school age, girls had been more dominant than boys in the psychological domain and verbally as the pair's spokesperson and thus in total dominance. However, the differences levelled off in adulthood. Submissiveness in one domain was often compensated for by

dominance in another, and equality between co-twins in their dominance-submissiveness increased with age. After school age, 81% of twins considered themselves equal with their co-twin.

Table 9. The proportions of dominance-submissiveness reported by the twins at the age of 22-30 years.

Dominance-submissiveness	Physical		Psychological		Verbal		Total	
	Male %	Female %	Male %	Female %	Male %	Female %	Male %	Female %
Before school age (n)	(198)	(216)	(195)	(210)	(192)	(211)	(189)	(205)
Dominant	28.3	27.8	12.8	24.8	14.6	34.6	11.6	28.8
Intermediate	53.0	46.3	72.8	63.3	70.3	46.9	74.6	60.5
Submissive	18.7	25.9	14.4	11.9	15.1	18.5	13.8	10.7
	P=NS		P=0.009		P<0.001		P<0.001	
School age (n)	(197)	(213)	(197)	(209)	(195)	(211)	(190)	(204)
Dominant	31.0	26.3	19.3	30.1	19.5	36.5	16.8	28.4
Intermediate	52.8	47.4	61.9	55.5	60.5	43.1	71.1	60.3
Submissive	16.2	26.3	18.8	14.4	20.0	20.4	12.1	11.3
	P=0.045		P=0.035		P<0.001		P=0.023	
After school age (n)	(192)	(215)	(191)	(211)	(193)	(211)	(182)	(207)
Dominant	17.7	11.2	10.5	13.3	17.1	18.5	14.8	12.6
Intermediate	76.0	75.8	83.2	82.0	76.7	75.8	79.7	82.1
Submissive	6.3	13.0	6.3	4.7	6.2	5.7	5.5	5.3
	P=0.020		P=NS		P=NS		P=NS	

P-value indicates the significance between the gender distribution of dominance at the defined age

5.4.1 Consequences of physical dominance

When all male twins or, respectively, female twins were analysed together, physical dominance-submissiveness had no association with depressiveness, nervousness, or psychosomatic symptoms at the age of 22-30 years. When the twins of different twin pairs were compared, physical dominance-submissiveness did not result in any significant differences in any of the symptoms in the males of the SS twin pairs or the females of the OS twin pairs. The OS twin pairs included no physically submissive males, and the intermediate males of these pairs were more nervous compared to the dominant males. The females of the SS twin pairs who reported being physically submissive or dominant had more problems with self-confidence compared to the intermediate twins. The intermediate SS females expressed least anhedonia and psychosomatic symptoms. (Tables 10 and 11)

5.4.2 Consequences of psychological dominance

When both genders were analysed together, twins who were submissive in the psychological domain reported more depression (7.91) than did either intermediate (4.36, *post hoc* p<0.001) or dominant twins (4.58, *post hoc* p=0.004).

Males submissive in the psychological domain reported more total depressiveness than did either intermediate or dominant males. The submissive males from OS twin pairs reported more depression (12.17, n=6) than did intermediate (4.69, n=67, *post hoc* p=0.001) or dominant ones (0.33, n=3, *post hoc* p=0.001). The submissive male twins as a whole had lower self-confidence than intermediate or dominant males (Table 10). This tendency was found among males from OS twin pairs (dominant 0.00, n=3; intermediate 0.74, n=65; submissive 1.83, n=6; Kruskall-Wallis test p=0.041). The submissive males from OS twin pairs also reported more anhedonia (2.50, n=6) than did dominant (0.33, n=3, *post hoc* p=0.017) or intermediate (1.17, n=64, *post hoc* p=0.017) OS male twins. In an analysis of all male twins taken together, submissive males were more sad than others. This was evident in OS pairs, where submissive males reported most sadness. (Table 10, Figure 1, op IV)

When all female twins were analysed together, there was no difference in depression in relation to psychological dominance-submissiveness. However, the dominant females expressed more sadness than intermediate ones. There was no significant difference in depression or any other symptom in relation to psychological dominance-submissiveness. In the SS twin pairs the submissive females reported most depression and anhedonia. The intermediate females of the SS twin pairs reported less sadness than dominant ones. (Table 11, Figure 1, op IV)

When nervousness was analysed, the dominant males of the SS twin pairs were more nervous (3.29) than the intermediate (2.29) or submissive (2.83, Kruskal-Wallis test p=0.047) ones. Contrariwise, the submissive males of the OS twin pairs had more nervous complaints (4.33) compared to the dominant (0.67, *post hoc* p=0.049) males. The dominant females as a whole were more nervous than the intermediate ones. (Tables 10 and 11, Figure 2, op IV)

The psychologically submissive males had significantly more psychosomatic symptoms than the dominant or intermediate males. This feature was seen especially among the males of the OS twin pairs. (Tables 10 and 11, Figure 3, op IV)

5.4.3 Consequences of verbal dominance

When both genders were analysed together, verbally submissive twins were most depressive. The submissive males from SS twin pairs reported significantly more total depressiveness (7.43) than did intermediate (3.58, *post hoc* p=0.015) male twins (Figure 4, op IV). They also reported lower self-confidence (1.29, n=7) than dominant SS male twins (0.35, n=20, *post hoc* p=0.039). In OS pairs, differences in depression or its sub-scores among males in relation to verbal dominance-submissiveness did not reach statistical significance. (Table 10)

Verbally submissive females were more depressive than intermediate ones (Table 11). In SS twin pairs, females submissive in the verbal domain reported most depressiveness. The verbally submissive females as a whole reported more anhedonia than the intermediate ones. This was seen in a comparison of the three groups in the SS pairs. In OS twin pairs only one female reported being verbally submissive to her male twin partner, and there was no difference in any of the symptoms in OS females in relation to dominance submissiveness. (Table 11, Figures 4,5 & 6, op IV)

When both genders were analysed together, verbally submissive twins reported most nervousness. This feature was shown especially by the males of the OS twin pairs. The intermediate females of the SS pairs were least nervous. (Tables 10 and 11, Figure 5, op IV)

Verbally submissive males reported most psychosomatic symptoms. This was evident in the SS twin pairs as well as in the OS pairs. Among female twins there were no differences in psychosomatic symptoms in relation to verbal dominance-submissiveness. (Tables 10 and 11, Figure 6, op IV)

5.4.4 Consequences of total dominance

When both genders were analysed together, twins who were submissive, based on the total scores of dominance, were more depressive (6.90) than dominant (4.23, *post hoc* p=0.027) or intermediate (4.39, *post hoc* p=0.015) twins. This was evident among the males from OS twin pairs. Submissive males from OS pairs also reported more anhedonia, they had a tendency to be more nervous and they had more psychosomatic symptoms than dominant or intermediate ones. In view of total dominance, there were no significant differences in any of the symptoms seen in the males of the SS twin pairs.

The tendency of submissive twins to report the most total depressiveness did not reach statistical significance in females twins as whole, or in different female twin pairs. In OS twin pairs, intermediate females reported least sadness. The intermediate female twins were less nervous than dominant ones. (Tables 10 and 11)

Table 10. Emotional and psychosomatic symptoms in relation to dominance-submissiveness in male twins at the age of 22-30 years.

Symptoms	Males					p-value	Total
	Dominant Mean (n)		Intermediate Mean (n)		Submissive Mean (n)		Mean (n)
Physical dominance							
Depressiveness	3.39 (33)		4.47 (146)		4.17 (12)	NS	4.36 (191)
Low self-confidence	0.61 (33)		0.71 (143)		0.67 (12)	NS	0.69 (188)
Anhedonia	0.94 (31)		1.14 (142)		0.92 (12)	NS	1.09 (185)
Sadness	0.23 (30)		0.18 (133)		0.00 (11)	NS	0.18 (174)
Nervousness	2.18 (34)		2.67 (141)		2.75 (12)	NS	2.59 (187)
Psychosomatic symptoms	0.68 (34)		0.60 (144)		0.50 (12)	NS	0.61 (190)
Psychological dominance							
Depressiveness	3.40 (20)	<***>>	4.11 (158)	<***>	9.25 (12)	<0.001	4.36 (190)
Low self-confidence	0.40 (20)	<*>>	0.66 (155)	<*>	1.50 (12)	0.015	0.68 (187)
Anhedonia	0.89 (19)		1.09 (153)		1.75 (12)	NS	1.11 (184)
Sadness	0.05 (19)	<**>>	0.16 (141)	<**>	0.64 (11)	0.001	0.18 (171)
Nervousness	2.90 (20)		2.49 (154)		3.58 (12)	NS	2.61 (186)
Psychosomatic symptoms	0.20 (20)	<**>>	0.59 (156)	<*>	1.25 (12)	0.003	0.59 (188)
Verbal dominance							
Depressiveness	4.21 (33)	<*>>	4.03 (147)	<**>	7.67 (12)	0.012	4.29 (192)
Low self-confidence	0.52 (33)		0.68 (144)		0.92 (12)	NS	0.67 (189)
Anhedonia	1.16 (31)		1.01 (144)		1.73 (11)	NS	1.08 (186)
Sadness	0.10 (31)		0.20 (133)		0.30 (10)	NS	0.18 (174)
Nervousness	2.31 (32)		2.56 (144)		3.58 (12)	NS	2.58 (188)
Psychosomatic symptoms	0.55 (33)	<**>>	0.53 (146)	<***>	1.50 (12)	<0.001	0.60 (191)
Total dominance							
Depressiveness	3.15 (27)		4.32 (144)		6.60 (10)	NS	4.27 (181)
Low self-confidence	0.41 (27)		0.72 (141)		0.90 (10)	NS	0.68 (178)
Anhedonia	0.77 (26)		1.12 (139)		1.50 (10)	NS	1.09 (175)
Sadness	0.11 (27)		0.20 (127)		0.20 (10)	NS	0.18 (164)
Nervousness	2.22 (27)		2.64 (140)		3.40 (10)	NS	2.62 (177)
Psychosomatic symptoms	0.56 (27)	<**>>	0.53 (143)	<**>	1.50 (10)	0.002	0.59 (180)

Note: <> indicates the significance between the two groups beside each other. <>> indicates the significance between the two groups apart from each other. Post Hoc Bonferoni significance levels *p<0.05, **p<0.01, ***p<0.001

Table 11. Emotional and psychosomatic symptoms in relation to dominance-submissiveness in female twins at the age of 22-30 years.

Symptoms	Females					p-value	Total
	Dominant		Intermediate		Submissive		
	Mean (n)		Mean (n)		Mean (n)		Mean (n)
Physical dominance							
Depressiveness	5.92 (24)		4.56 (162)		5.26 (27)	NS	4.80 (213)
Low self-confidence	0.88 (24)		0.68 (162)		0.88 (26)	NS	0.73 (212)
Anhedonia	1.29 (24)		1.02 (157)		1.15 (27)	NS	1.07 (208)
Sadness	0.29 (24)		0.26 (160)		0.26 (27)	NS	0.26 (211)
Nervousness	3.46 (24)		2.47 (160)		2.81 (26)	NS	2.62 (210)
Psychosomatic symptoms	1.67 (24)		1.16 (160)		1.33 (27)	NS	1.24 (211)
Psychological dominance							
Depressiveness	5.43 (28)		4.60 (171)		6.30 (10)	NS	4.79 (209)
Low self-confidence	0.64 (28)		0.74 (170)		0.80 (10)	NS	0.73 (208)
Anhedonia	1.36 (28)		1.01 (166)		1.30 (10)	NS	1.07 (204)
Sadness	0.56 (27)	<*>	0.22 (170)		0.30 (10)	0.024	0.27 (207)
Nervousness	3.64 (28)	<*>	2.48 (168)		2.50 (10)	0.015	2.64 (206)
Psychosomatic symptoms	1.32 (28)		1.20 (169)		1.40 (10)	NS	1.23 (207)
Verbal dominance							
Depressiveness	5.08 (39)		4.42 (159)	<*>	7.67 (12)	0.015	4.73 (210)
Low self-confidence	0.74 (39)		0.71 (158)		0.83 (12)	NS	0.72 (209)
Anhedonia	1.08 (38)		0.99 (156)	<*>	1.75 (12)	0.049	1.05 (206)
Sadness	0.32 (38)		0.24 (157)		0.33 (12)	NS	0.26 (207)
Nervousness	3.08 (38)		2.42 (156)		3.58 (12)	0.038	2.61 (206)
Psychosomatic symptoms	1.33 (39)		1.17 (156)		1.58 (12)	NS	1.23 (207)
Total dominance							
Depressiveness	5.35 (26)		4.46 (169)		7.18 (11)	0.053	4.71 (206)
Low self-confidence	0.81 (26)		0.69 (168)		1.00 (11)	NS	0.72 (205)
Anhedonia	1.23 (26)		0.98 (165)		1.64 (11)	NS	1.05 (202)
Sadness	0.48 (25)		0.23 (168)		0.30 (10)	NS	0.26 (203)
Nervousness	3.50 (26)	<*>	2.42 (165)		3.45 (11)	0.013	2.62 (202)
Psychosomatic symptoms	1.38 (26)		1.19 (166)		1.09 (11)	NS	1.21 (203)

Note: <> indicates the significance between the two groups beside each other. <>> indicates the significance between the two groups apart from each other. Post Hoc Bonferoni significance levels *p<0.05, **p<0.01, ***p<0.001

5.5 Parental preference and inter-twin relationships (Previously unpublished data)

5.5.1 Co-twin dependence and parental preference

Co-twin dependence was evaluated in relation to parental preference in young adulthood (Table 12). When analysing all twin pairs together, no significant differences were found between dependent and independent twins in different parental preference groups. However, when this evaluation was carried out further in different twin groups, dependent SS males experienced relatively often having been preferred by the mother (45.5%, n=5), while independent SS males were most often equally close to both parents (82.7%, n=86, Fisher's Exact Test p1=0.012, weighted analysis p2=0.070). This was especially true among independent SSDZ males, who were most often equally close to both parents (83.9%, n=47, Fisher's Exact Test p1=0.033, p2=ns, *experienced parental preference*), and this was found also when twin's own preference was evaluated (75.0%, n=42, p1=0.018, p2=0.037).

Dependent MZ females were often equally close to both parents (77.8%, n=7), while the independent ones were often preferred by the mother (40%, n=8) or equally close to both parents (50%, n=10, p1=0.047 Fisher's Exact Test, p2=ns, *experienced parental preference*).

In evaluation between genders, among equally preferred twins, males reported more often independence than did females (experienced parental preference, p1=0.008 Chi-Square Test, p2=0.076), and this was also found in the twin's own view (twin's own preference, p1=0.021, p2=0.084). No other significant differences were found between the genders or between parental preference groups.

Table 12. Co-twin dependence in relation to parental preference (experienced parental preference and twin's own preference regarding parents) in both genders in young adulthood.

Parental preference	Males		Females		Both	
	Dependent % (n)	Independent % (n)	Dependent % (n)	Independent % (n)	Dependent % (n)	Independent % (n)
Experienced						
Mother	42.9 (6)	23.4 (41)	30.0 (9)	31.3 (50)	34.1 (15)	27.2 (91)
Equal	50.0 (7)	72.6 (127)	60.0 (18)	62.5 (100)	56.8 (25)	67.8 (227)
Father	7.1 (1)	4.0 (7)	10.0 (3)	6.3 (10)	9.1 (4)	5.1 (17)
Twin's own						
Mother	38.5 (5)	32.6 (57)	58.1 (18)	56.8 (96)	52.3 (23)	44.5 (153)
Equal	53.8 (7)	62.3 (109)	38.7 (12)	36.1 (61)	43.2 (19)	49.4 (170)
Father	7.7 (1)	5.1 (9)	3.2 (1)	7.1 (12)	4.5 (2)	6.1 (21)

There were no significant differences in co-twin dependence between the various groups of parental preference (ChiSquare Test, Fisher's Exact Test, weighted analysis)

5.5.2 Dominance-submissiveness and parental preference

Dominance-submissiveness was evaluated in relation to parental preference in young adult twins (Table 13 *experienced parental preference* and Table 14 *twin's own preference*). There were no significant differences found in occurrence between dominance-submissiveness in different parental preference groups. However, there was a non-significant trend of verbally dominating males to have been preferred by the mother more often than the intermediate or submissive ones. Accordingly, dominant and intermediate females in the psychological and verbal domain reported slightly more often being preferred by the mother than the submissive ones.

When dominance-submissiveness was evaluated in relation to *twin's own preference*, no significant differences were found, either. However, a non-significant trend was found that psychologically submissive males felt the mother to be the closer parent slightly more often than the dominant or intermediate ones. Accordingly, physically submissive females felt slightly more often closer to the mother than dominant or intermediate ones. Submissive females in the verbal domain felt slightly more often the mother to be the closer parent than the dominant ones.

Table 13. Twin's experienced parental preference in relation to dominance-submissiveness in young adulthood.

Parental preference	Males			Females			Both		
	Dominant % (n)	Intermediate % (n)	Submissive % (n)	Dominant % (n)	Intermediate % (n)	Submissive % (n)	Dominant % (n)	Intermediate % (n)	Submissive % (n)
Physical dominance									
Mother	31.3 (10)	23.1 (33)	33.3 (4)	43.5 (10)	28.4 (42)	39.1 (9)	36.4 (20)	25.8 (75)	37.1 (13)
Equal	68.8 (22)	72.0 (103)	58.3 (7)	47.8 (11)	65.5 (97)	52.2 (12)	60.0 (33)	68.7 (200)	54.3 (19)
Father	(0)	4.9 (7)	8.3 (1)	8.7 (2)	6.1 (9)	8.7 (2)	3.6 (2)	5.5 (16)	8.6 (3)
Psychological dominance									
Mother	26.3 (5)	25.0 (39)	33.3 (4)	30.8 (8)	31.0 (48)	22.2 (2)	28.9 (13)	28.0 (87)	28.6 (6)
Equal	63.2 (12)	71.2 (111)	66.7 (8)	57.7 (15)	63.2 (98)	66.7 (6)	60.0 (27)	67.2 (209)	66.6 (14)
Father	10.5 (2)	3.8 (6)	(0)	11.5 (3)	5.8 (9)	11.1 (1)	11.1 (5)	4.8 (15)	4.8 (1)
Verbal dominance									
Mother	37.5 (12)	24.0 (35)	16.7 (2)	38.9 (14)	30.3 (43)	25.0 (3)	38.2 (26)	27.1 (78)	20.8 (5)
Equal	56.3 (18)	71.9 (105)	83.3 (10)	52.8 (19)	64.1 (91)	58.3 (7)	54.4 (37)	68.1 (196)	70.8 (17)
Father	6.3 (2)	4.1 (6)	(0)	8.3 (3)	5.6 (8)	16.7 (2)	7.4 (5)	4.9 (14)	8.3 (2)

There were no significant differences found in dominance-submissiveness between different parental preference groups. (ChiSquare Test, Fisher's Exact Test, weighted analysis)

Table 14. Twin's own preference regarding the parents in relation to dominance-submissiveness in young adulthood.

Parental preference	Males			Females			Both		
	Dominant % (n)	Intermediate % (n)	Submissive % (n)	Dominant % (n)	Intermediate % (n)	Submissive % (n)	Dominant % (n)	Intermediate % (n)	Submissive % (n)
Physical dominance									
Mother	35.5 (11)	31.9 (46)	33.3 (4)	41.7 (10)	57.4 (89)	64.0 (16)	38.2 (21)	45.2 (135)	54.1 (20)
Equal	64.5 (20)	62.5 (90)	50.0 (6)	41.7 (10)	36.8 (57)	36.0 (9)	54.5 (30)	49.2 (147)	40.5 (15)
Father	(0)	5.6 (8)	16.7 (2)	16.7 (4)	5.8 (9)	(0)	7.3 (4)	5.7 (17)	5.4 (2)
Psychological dominance									
Mother	36.8 (7)	32.3 (50)	41.7 (5)	51.9 (14)	57.3 (94)	55.6 (5)	45.7 (21)	45.1 (144)	47.6 (10)
Equal	52.6 (10)	62.6 (97)	58.3 (7)	44.4 (12)	36.0 (59)	33.3 (3)	47.8 (22)	48.9 (156)	47.6 (10)
Father	10.5 (2)	5.2 (8)	(0)	3.7 (1)	6.7 (11)	11.1 (1)	6.5 (3)	6.0 (19)	4.8 (1)
Verbal dominance									
Mother	36.4 (12)	33.6 (48)	33.3 (4)	48.7 (19)	58.0 (87)	63.6 (7)	43.1 (31)	46.1 (135)	47.8 (11)
Equal	57.6 (19)	60.8 (87)	66.7 (8)	43.6 (17)	35.3 (53)	36.4 (4)	50.0 (36)	47.8 (140)	52.2 (12)
Father	6.1 (2)	5.6 (8)	(0)	7.7 (3)	6.7 (10)	(0)	6.9 (5)	6.1 (18)	(0)

There were no significant differences found in dominance-submissiveness between different parental preference groups. (ChiSquare Test, Fisher's Exact Test, weighted analysis)

5.5.3 Co-twin dependence and dominance-submissiveness

Table 15 shows co-twin dependence in relation to the quality of dominance-submissiveness in each gender in young adulthood. The majority of the twins were independent and in the intermediate position in each quality of dominance. Dependent males were slightly more often also submissive, and independent males intermediate or dominant in the physical domain (non-significant trend), while dependent female twins were significantly more often submissive and independent females dominant in the psychological domain. In further analysis this was found especially among SS females, as the SS females who were dependent in the psychological domain were most often submissive (16.7%, n=4) and the independent ones dominant (15.2%, n=15, p1=0.024 Fisher's Exact Test, p2=ns). There were no differences found among different zygosity groups.

Table 15. Co-twin dependence in relation to the quality of dominance in each gender in young adulthood.

Quality of dominance	Males		Females		Both	
	Dependent % (n)	Independent % (n)	Dependent % (n)	Independent % (n)	Dependent % (n)	Independent % (n)
Physical						
Dominant	7.1 (1)	18.5 (32)	3.1 (1)	13.0 (23)	4.3 (2)	15.7 (55)
Intermediate	71.4 (10)	76.3 (132)	87.5 (28)	72.9 (129)	82.6 (38)	74.6 (261)
Submissive	21.4 (3)	5.2 (9)	9.4 (3)	14.1 (25)	13.0 (6)	9.7 (34)
	P=0.063					
Psychological						
Dominant	7.1 (1)	11.0 (19)	6.3 (2)	15.0 (26)	6.5 (3)	13.0 (45)
Intermediate	85.7 (12)	83.1 (143)	78.1 (25)	82.1 (142)	80.4 (37)	82.6 (285)
Submissive	7.1 (1)	5.8 (10)	15.6 (5)	2.9 (5)	13.0 (6)	4.3 (15)
			P=0.005		P=0.028	
Verbal						
Dominant	0.0	17.1 (30)	19.4 (6)	19.0 (33)	13.3 (6)	18.1 (63)
Intermediate	85.7 (12)	77.1 (135)	67.7 (21)	76.4 (133)	73.3 (33)	76.8 (268)
Submissive	14.3 (2)	5.7 (10)	12.9 (4)	4.6 (8)	13.3 (6)	5.2 (18)

Significances of differences have been calculated by Chi-Square Test and Fisher's Exact Test. These differences did not remain significant in weighted analysis

Parental preference was also evaluated in relation to dominance-submissiveness and co-twin dependence in young adulthood (Table 16).

Table 16. Twin's experienced parental preference and twin's own preference regarding parents in relation to dominance-submissiveness and co-twin dependence in young adulthood.

Quality of dominance	Experienced parental preference			Twin's own preference		
Co-twin dependence	Mother	Equal	Father	Mother	Equal	Father
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Physical						
Dominant	18.5 (20)	13.1 (33)	9.5 (2)	11.9 (21)	15.6 (30)	17.4 (4)
Dependent	0,0 (0)	3.0 (1)	50.0 (1)	(0)	(0)	25.0 (1)
Independent	100,0 (19)	97.0 (32)	50.0 (1)	100.0 (20)	100.0 (30)	75.0 (3)
Intermediate	69.4 (75)	79.4 (200)	76.2 (16)	76.7 (135)	76.6 (147)	73.9 (17)
Dependent	18.6 (13)	10.7 (21)	12.5 (2)	16.2 (21)	11.3 (16)	5.9 (1)
Independent	81.4 (57)	89.3 (175)	87.5 (14)	83.8 (109)	88.7 (126)	94.1 (16)
Submissive	12.0 (13)	7.5 (19)	14.3 (3)	11.4 (20)	7.8 (15)	8.7 (2)
Dependent	15.4 (2)	15.8 (3)	33.3 (1)	10.0 (2)	20.0 (3)	(0)
Independent	84.6 (11)	84.2 (16)	66.7 (2)	90.0 (18)	80.0 (12)	100.0 (2)
Psychological						
Dominant	12.3 (13)	10.8 (27)	23.8 (5)	12.0 (21)	11.7 (22)	13.0 (3)
Dependent	15.4 (2)	3.7 (1)	(0)	4.8 (1)	9.1 (2)	(0)
Independent	84.6 (11)	96.3 (26)	100.0 (5)	95.2 (20)	90.9 (20)	100.0 (3)
Intermediate	82.1 (87)	83.6 (209)	71.4 (15)	82.3 (144)	83.0 (156)	82.6 (19)
Dependent	15.9 (13)	9.8 (20)	20.0 (3)	14.4 (20)	9.3 (14)	10.5 (2)
Independent	84.1 (69)	90.2 (184)	80.0 (12)	85.6 (119)	90.7 (137)	89.5 (17)
Submissive	5.7 (6)	5.6 (14)	4.8 (1)	5.7 (10)	5.3 (10)	4.3 (1)
Dependent	(0)	28.6 (4)	100.0 (1)	22.2 (2)	30.0 (3)	(0)
Independent	100.0 (5)	71.4 (10) 1	(0)	77.8 (7)	70.0 (7)	100.0 (1)
Spokesman						
Dominant	23.9 (26)	14.8 (37)	23.8 (5)	17.5 (31)	19.1 (36)	21.7 (5)
Dependent	4.2 (1)	8.3 (3)	(0)	10.3 (3)	8.6 (3)	(0)
Independent	95.8 (23)	91.7 (33)	100.0 (5)	89.7 (26)	91.4 (32)	100.0 (5)
Intermediate	71.6 (78)	78.4 (196)	66.7 (14)	76.3 (135)	74.5 (140)	78.3 (18)
Dependent	17.6 (13)	8.8 (17)	21.4 (3)	13.7 (18)	8.8 (12)	11.1 (2)
Independent	82.4 (61)	91.2 (176)	78.6 (11)	86.3 (113)	91.2 (125)	88.9 (16)
Submissive	4.6 (5)	6.8 (17)	9.5 (2)	6.2 (11)	6.4 (12)	(0)
Dependent	20.0 (1)	23.5 (4)	50.0 (1)	18.2 (2)	25.0 (3)	(0)
Independent	80.0 (4)	76.5 (13)	50.0 (1)	81.8 (9)	75.0 (9)	(0)

Significances of differences between dominant-submissive and dependent-independent twins in each parental preference group were calculated by Chi-Square and Fisher's Exact Tests. [1] p=0.044. There were no significant differences found in weighted analysis.

6 Discussion

6.1 Psychosomatic symptoms and depressiveness in adolescent and young adult twins

6.1.1 In adolescence

In contrast to population studies, which have shown depression to increase consistently during adolescence (Hankin *et al.* 1998, Pine *et al.* 1998), twins in our sample reported the most depressive symptoms in middle adolescence. Twins' psychosomatic symptoms also peaked in middle adolescence, while a decline was seen in late adolescence, as has been reported in singletons as well (Rauste von Wright and von Wright 1981, Rimpela *et al.* 1983, Aro *et al.* 1987, Garber *et al.* 1990). Middle adolescence thus seemed to be the most difficult phase for twins. This might be due to the process of separation-individuation, the typical developmental task in middle-adolescence (Mangs and Martell 1995). Apart from breaking away from their parents, twins must also cope with another separation, that from the co-twin (Bruch 1961, Siemon 1980).

However, late adolescence poses even greater demands, such as moving away from home and beginning independent life. Depression increases at this age in the general population, but we found depression to decrease in twins. This might indicate the support and companionship of the co-twin, which may still continue and protect twins in these changes.

In an analysis of gender differences at the different stages of adolescence, twins also differed from the general population in that females exceeded males in symptom reporting only in late adolescence, which is later than in population studies (Rimpela *et al.* 1982, Aro *et al.* 1987, Garber *et al.* 1990, McCauley *et al.* 1991, Angold *et al.* 1998, Hankin *et al.* 1998, Haugland *et al.* 2001, Wade *et al.* 2002, Pulkkinen *et al.* 2003, Toros *et al.* 2004). The gender differences were smallest among OS twin pairs. Possibly OS twins influence each other, thus decreasing the above-mentioned gender differences as long as they have frequent contact. Growing up in an SS twin pair seems to enhance the

development of personality features typical of the gender, as the differences between genders were most distinct in these pairs.

When the different twin types were evaluated, it seemed to be easier for twins to grow up with a co-twin of the opposite gender. Males of SS pairs showed a tendency towards more depressiveness than OS males in early adolescence. Females from SS twin pairs appeared to report depressive and psychosomatic symptoms more often than other twins. OS males thus seemed to be in the most favourable position, particularly in late adolescence. The research of Pulkkinen *et al.* (2003) on 11- to 12-year old adolescent twins showed that the twin relationship has a positive impact on the development of socio-emotional behaviour, particularly in OS male twins, as twinship provides opportunities for practising social skills. In an OS pair the twin sister often takes the role of a caregiver (Bryan 1992) and spokesman (Moilanen 1987b), which may relieve the male's social burden.

We conclude that middle adolescence seemed to be the most difficult phase of adolescence, during which twins reported most depression and psychosomatic symptoms. Gender differences only emerged in late adolescence. The differences between genders were most distinct in the comparison between male-male and female-female twin pairs. The differences in symptom reporting by different twin pairs support the findings of previous studies suggesting that twinship constitutes a different growing environment for SS and OS twins (Allen *et al.* 1971, Pulkkinen *et al.* 2003).

6.1.2 In young adulthood

Twins in our sample did not report more depressive symptoms in young adulthood in comparison to their symptom reporting in adolescence. However, a higher proportion of twins reported more various somatic symptoms occurring at least monthly than in adolescence.

In contrast to population studies (Inaba *et al.* 2005, Wauterickx *et al.* 2005), females in our sample did not exceed males in depressive symptom reporting in young adulthood. However, females showed more various somatic symptoms than males, as has been found in a population study by Silverstein (1999). Thus twinship might protect females from depression but not from somatic symptoms.

6.2 Parental preference and mental well-being

Consistent with previous findings by Baker and Daniels (1990), the present study indicates that parental preference still continues to have implications on twins' mental well-being in young adulthood.

Egalitarianism seemed to be most beneficial for twins even in young adulthood, as intermediate positioned twins had the least depressive symptoms. This was found in both views, in twin's experienced parental preference and in twin's own preference. In young adulthood this situation may reflect sufficient independence and a balanced adult relationship with both parents.

Those twins who experienced being preferred by the mother had more depressive symptoms and nervousness than those in intermediate position. Different attitudes toward the twin on the part of the parents might be symptomatic, more effect than cause, as the mother may come to support the weaker one.

In pair-wise parental preference towards twins about half of the twins were from pairs where both twins experienced having been equally close to both parents, while about thirty percent were from an 'equal and mother's' pair. In sixteen pairs both twins felt being preferred by the mother and in two by the father. According to twin's own preference, about one third of the twin pairs were 'both equal', one third 'both mother's' and one third 'equal and mother's'.

Those twins who both experienced that they were preferred by the mother had the highest depressiveness and the lowest self-confidence. This may reflect the excess burden of the parent who takes most of the responsibility in nurturing and bringing up the two children resulting in a lack of time and sensitivity towards the children.

Male twins, especially SS males, who felt the mother to be the closer parent (twin's own preference) had the most total depressiveness and anhedonia, while females who felt the father to be closer showed slightly more depressive and psychosomatic symptoms. While an equally good relationship with both parents seems to be reflecting the most balanced situation in adult life, a closer relationship with the opposite-sex parent may reflect difficulties in positive identification with the same-sex parent (Tyson and Tyson 1990).

While MZ twins are genetically identical and live in the same family situation, they do nevertheless have different experiences, just like other twin types; they may, for example, be viewed and treated differently by their parents. Among others, being closer to the mother or to the father has an impact on the twin's mental well-being and should therefore possibly be included as a non-shared environmental factor in genetic analyses, especially on those related to mental health.

The following conclusion can be drawn about bringing up twins: the division of twins between the parents should not be total, and it is important that both parents have a good relationship with both twins.

6.3 Co-twin dependence and mental well-being

Co-twin dependence decreased with increasing age in both genders. This phenomenon can be understood by the developmental tasks twins undergo, namely the process of separation and individuation from each other.

In accordance with previous studies (Koch 1966, Tambs 1985, Neyer 2002, Sanathara *et al.* 2003, Penninkilampi-Kerola 2005), MZ twins, especially MZ females, reported most often to be dependent on their co-twin. This finding is also in line with the typically feminine characteristic of emphasis on inter-personal relationships and concerns.

When symptom reporting was evaluated in relation to co-twin dependence, neither position, dependent or independent, seemed to be clearly better than the other, as there were only few significant differences found between dependent and independent twins. Contrary to earlier findings (Bornstein 1992, Sanathara *et al.* 2003) no significant

differences were found in depressive symptoms between dependent and independent male and female twins.

However, in further analysis, some findings that remained non-significant in statistical analysis, possibly because of the small number of dependent twins in each zygosity group, were of particular interest and maybe worth further investigation. It was noted that all down the line dependent DZ male and SS female twins seemed to report less various depressive symptoms. It could be that being dependent on a female twin partner might protect from depressiveness. This situation concerning co-twin dependence appeared to be different from the situation of co-twin submissiveness to a twin sister, which was found in this present study sample to be stressful (Ebeling *et al.* 2003). In opposite-sex twin pairs twin sisters are likely to 'mother' and act like older sisters towards their twin brothers (Bryan 1992). Thus dependence may indicate a feeling of being well cared for by the twin sister.

Contrarily to the situation with a twin sister, it seemed more difficult to be dependent on one's twin brother, as dependent MZ males reported significantly lower self-confidence and females who were dependent on their twin brother (OS females) reported significantly more sadness than independent ones. Again, the situation seems to differ from that of co-twin submissiveness, as it was found in this same study sample that it is easier for females to be submissive to a male twin partner (Ebeling *et al.* 2003).

Dependence-independence imbalance within twin pair was associated with elevated levels of symptom reporting, especially in twins who perceived themselves as dependent and the co-twin as independent. These dissonantly dependent twins showed the most depressive symptoms while consonantly dependent twins reported the least symptoms. This agrees with the findings by Penninkilampi-Kerola *et al.* (2006), who previously found dissonantly dependent twins to have significantly higher rates of depressiveness than consonantly independent twins and more problems with self-confidence than consonantly independent and consonantly dependent twins. Thus, in accordance with the findings by Penninkilampi-Kerola *et al.* (2006), our results suggest that twin's 'subjective' experience of the balance or imbalance in the co-twin relationship may be more important for mental well-being than 'actual' balance/imbalance of the relationship when the information is provided by the two twin individuals of a twin pair (pair-wise dependence). The small number (n=4) of these dissonantly dependent twins in our sample may warrant some caution in the generalization of these results.

An excess of interpersonal dependence has been associated with a vulnerability to several psychiatric disorders (Bornstein 1992, Sanathara *et al.* 2003). According to Leonard (1961), however, continuation of the intertwin identification and lack of individuation do not in themselves lead to serious personality disturbances. Bornstein (1992) stated that the quality of emotional dependence plays a more essential role in twins' well-being than the simple distinction of whether a twin is dependent or not. Thus, the behaviour of the dependent person can only be completely understood with reference to the context in which it is exhibited (Bornstein 1992).

Furthermore, in earlier studies attachment and dependence have been suggested to measure similar patterns of social behaviours (Ainsworth 1969, Lytton 1980, Neyer 2002). Dependence has often had negative connotations such as immaturity. Although the first dependency relationship is a specific one with the mother, dependence is viewed as a personality trait generalizing to other subsequent interpersonal relations (Ainsworth

1969). Dependent behaviour implies seeking contact with and proximity to others as well as help, attention and approval (Ainsworth 1969).

Attachment refers to an affectional tie that one person forms to another specific person (Bowlby 1958). The first tie is formed to the primary care giver, but this may be supplemented by attachments to other specific persons (Bowlby 1958). Like object relations, attachment relationships continue to be important throughout the life span (Waters el al. 2000) and do not necessarily imply immaturity or helplessness. The attachment system is viewed as functioning continuously in order to provide children with a sense of security. Attachment behaviour may be heightened or dampened under the conditions of threat or danger. Thus the relationship with the co-twin may be activated in a constructive manner when there is a need for proximity and support, e.g. in moments of distress and anxiety.

While excess of inter-twin dependence has been seen as a risk factor for mental health, dependency is also associated with positive traits (Bornstein 1992, 1994). Furthermore, behaviour that may look like dependence may possibly in some cases be an expression of attachment to the co-twin. We conclude that co-twin dependence was not found to be a risk factor for depressive symptoms in male and female young-adult twins. It seemed that being dependent on a female twin partner was experienced more positively than being dependent on a twin brother as far as depressive symptoms were concerned.

Twin's subjective experience about the co-twin dependence appeared to be important for the twin's mental well-being, as dependence-independence imbalance within the twin pair was associated with elevated levels of depressive symptom reporting, especially in twins who perceived themselves as dependent and the co-twin as independent.

6.4 Dominance and submissiveness and mental well-being

Dominance-submissiveness between co-twins was assessed from three separate perspectives: physical dominance, psychological dominance and the role of spokesman /verbal dominance. In the physical domain, males were more commonly dominant than females at school age and in adulthood. Before and at school age, girls were more dominant than boys in the psychological and verbal domains, as well as in total dominance. These differences disappeared in adulthood, and 81% of adult twins felt themselves equal to their co-twin in total dominance.

The domain most important for subjective well-being in young adulthood seemed to be psychological dominance-submissiveness. The males of male-female twin pairs seemed to suffer most from submissiveness to a twin sister in the psychological domain, as submissiveness seemed to be associated with increased depressiveness, nervous complaints and psychosomatic symptoms in these OS males.

Among females of same-sex twin pairs, submissiveness to a twin sister in the psychological domain was most clearly associated with depressive symptoms, whereas psychological or verbal dominance-submissiveness to a twin brother among females from male-female twin pairs was not associated with symptoms. It seemed to be difficult for both genders to be 'inferior' to the twin sister. Because of the closeness of the early relationship with the mother, a large variety of archaic feelings are easily directed

towards the mother. Other females, especially ones wielding authority, such as a dominant female sister, may also evoke the early conflicting emotions that were an inevitable part of the early relationship.

Verbally submissive males in same-sex twin pairs had more depression and psychosomatic symptoms. Verbally submissive males of the OS twin pairs seemed to be more nervous and to have psychosomatic symptoms, and not being physically dominant also increased nervous complaints. It may be that verbally and physically submissive males are more timid, reserved, and anxious than males who express themselves more freely.

Psychologically dominant males and females of same-sex twin pairs expressed greater nervousness than did their co-twins. This was also found among this same study sample in adolescence. It may well be that an active role in a symmetric relationship requires more aggression and also generates nervous complains. Neurotic symptoms have also been associated with dominance among twin males (Tienari 1966), which is consistent with the elevated frequency of nervous complaints in dominating twins, but contradictory to the finding that depressive symptoms are more frequent among submissive twins.

We conclude that being submissive, especially in the psychological domain, to a female twin partner seems to be stressful, whereas it is easier, especially for females, to be submissive to a male twin partner. This was in contrast to co-twin dependency, which was experienced positively towards a twin sister.

6.5 Parental preference and inter-twin relationships

Co-twin dependence was evaluated in relation to parental preference in young adulthood. Dependent males experienced relatively often being preferred by the mother or being equally close to both parents, but the number of these dependent males was small in comparison to independent ones. Dependent males seemed to report being preferred by the mother more often than dependent females, but the difference between the genders did not reach statistical difference. In adolescence among this same twin sample the ‘mother’s twins’ were the most dependent on their co-twin while ‘father’s twins’ tended to show the highest desire for autonomy from their co-twin (Moilanen and Pennanen 1997).

There were no significant differences found in dominance-submissiveness in different parental preference groups in young adulthood. However, males who were dominant in verbal domain seemed to experience more often having been preferred by the mother than intermediate or submissive ones. Dominant and intermediate females in the psychological and verbal domain were preferred by the mother slightly more often than submissive ones. When the evaluation of parental preference was made by the parents among this same twin sample in adolescence, the ‘mother’s twins’ had more often been the psychological leaders of the pair and the submissive members in physical aspects (Moilanen and Pennanen 1997).

When the dominance-submissive aspect of twinship was evaluated in relation to *twin's own preference*, no significant differences were found.

Co-twin dependence was evaluated in relation to the quality of dominance-submissiveness in young adulthood. The majority of the twins were independent and in the intermediate position in each quality of dominance. Dependent males were more often also submissive and independent males dominant in the physical domain, while dependent female twins were more often submissive and independent females dominant in the psychological domain. In further analysis this was found among SS females, but not in females of OS twin pairs.

6.6 Limitations

First, it would have been interesting to compare the prevalence of depressive and psychosomatic symptoms in twins with those in singletons. However, this study design did not enable this kind of comparison as it focuses on mental health and relationships in twin families.

The second limitation of this study was that the family pattern was not known. Inquiry was primarily addressed to the twins' qualities in order to avoid drop-outs which could have taken place if intimate or delicate parental matters had been assessed. In the future, in order to make more profound analysis possible, we are planning to inquire these matters retrospectively, e.g. with which parent(s) the twin has been living during different age periods. However, at the time of these twins' childhood the divorce rates were not as high as nowadays.

At this point of the longitudinal study mental well-being was measured only as depressiveness and its three sub-scores in addition to nervousness and psychosomatic symptoms. Thus, other disorders, such neuropsychiatric or conduct disorders that are often manifested at this age as criminality, were not included.

The small number of twins in each zygosity group, in different kinds of twin pairs, in each parental preference group as well as in dependence and dominant-submissive twin groups warrants some caution in the generalisation of our results.

6.7 Clinical implications

The following conclusions can be drawn about bringing up twins: It is to the benefit of the children's development that they are allowed to spend time with both parents so that neither remains distant to them.

Secondly, according to our findings co-twin dependence was not found to be a risk factor for depressive symptoms in young adulthood. Earlier studies have indicated that twins are seldom lonely and they enjoy more emotional support than singletons (Clark and Dickman 1984). Thus, the special relationship shared by twins should be respected and fostered. However, as not all of the child's socially mediated needs are met by this situation, twins need relationships with other people, children as well as adults.

As nervous symptoms tend to accumulate in the dominant members and depressiveness and somatic complaints in the submissive ones, compensation of

submissiveness in one area of life by dominance or at least equality in another area is an ideal situation so that neither twin dominates the other in all areas of life.

6.8 Conclusions

Middle adolescence seemed to be the most difficult phase of adolescence, during which twins reported the most depression and psychosomatic symptoms. Gender differences only emerged in late adolescence. The differences between genders were most distinct in the comparison between the male-male and female-female twin pairs. The differences in symptom reporting by different types of twin pairs support the findings of previous studies suggesting that twinship constitutes a different growing environment for SS and OS twins (Allen *et al.* 1971, Pulkkinen *et al.* 2003).

Egalitarianism of parents towards both members in a twin pair seemed to be most beneficial for twins even in young adulthood, as intermediate positioned twins had the least depressive symptoms. Thus, the division of twins between parents should not be total, and it is important that both parents have a good relationship with both twins.

Co-twin dependence was not found to be a risk factor for depressive symptoms in male and female young-adult twins as there were no significant differences in depressive symptoms between dependent and independent twins. It seemed that as far as depressive symptoms are concerned, being dependent on a female twin partner was experienced more positively than being dependent on a twin brother. Additionally, in line with earlier studies (Penninkilampi-Kerola 2006, Bruch 1969), our results indicate that it is important to take the individual as well as dyadic nature of the twin relationship into consideration when studying its implications on twins' mental well-being.

Being submissive to a female partner, especially in psychological and verbal domains, was found to be stressful, whereas it was easier, especially for females, to be submissive to a male twin partner. This was in contrast to co-twin dependency, which was experienced positively towards a twin sister.

Our findings support the previous findings that twinship constitutes a different growing environment for SSMZ, SSDZ and OSDZ twins. We conclude that inter-twin relationships should be taken into account when bringing up twins and in mental care of twins. Additionally, inter-twin relationships should be taken into account as possible confounders or modifiers in behavioural genetic analyses.

7 Summary

The purpose of the present thesis was (1) to study special features in developmental phases of twins in early, middle and late adolescence, measured as depressive, emotional and psychosomatic symptoms, (2) to evaluate parental preferences and their implications for the mental health of twins in their young adulthood, (3) to focus on the different aspects of twins' dominance-submissiveness and its implications for their mental health in young adulthood, and (4) to evaluate depressive and psychosomatic symptoms in twins in relation to co-twin dependence in young adulthood.

The sample consisted of 234 twin pairs, born in 1965-1973, from Northern Finland who had been followed at ten-year intervals, at 2-10 years, 12-20 years and 22-30 years of age. Data on development, academic achievement, health and lifestyle, psychosomatic symptoms, parent-twin relationships and inter-twin relationships were elicited, and additionally, the twins completed the Children's Depression Inventory modified to fit their age.

Zygosity was determined at two ages. In the first follow-up at 2-10 years of age, about one third of the twins were subjected to clinical examination, and determination of zygosity for these twins was based on similarity methods. Later, at age 22-30, all twins received validated questionnaires with items of 'similarity' and 'confusion' between the twins.

Parental preference was inquired from the twins in two directions 1) experienced parental preference and 2) twin's own preference regarding parents. Co-twin dependence was enquired and dominance-submissiveness between twins was assessed separately in three domains of life: physical and psychological dominance-submissiveness and the role of a spokesperson, also referred to as verbal dominance.

Middle adolescence seemed to be the most difficult phase of adolescence, during which twins reported the most depression and psychosomatic symptoms. Gender differences only emerged in late adolescence. When different twin pairs were evaluated separately, the males of opposite-sex twin pairs seemed to be in the most favourable position, particularly in late adolescence, as they reported the least depressive symptoms. Gender differences were most distinct in comparisons between twins of male-male pair and female-female pairs.

When the same evaluations were made in young adult twins no differences were found in depressive symptom reporting between the genders. However, females reported more irritability, cephalalgia and abdominal pain than males. Also in young adulthood the gender differences were most distinct between twins of same-sex pairs.

Twins experienced most often to be equally close to both parents (*experienced parental preference*). After starting school, female twins in particular experienced being increasingly preferred by their mother. Males of SS pairs experienced most often being equally close to both parents at all ages, and as many as 90% of MZ males had experienced equal preference before and at school age. About half of the twins were from pairs where both twins experienced having been equally close to both parents, while about thirty percent were from an 'equal and mother's' pair, where one twin evaluated having been preferred by the mother and the co-twin evaluated having been equally close to both parents. According to the twin's own preference, about one third of the twin pairs were 'both equal', one third 'both mother's' and one third 'equal and mother's'.

Those males who were equally close to both parents (experienced parental preference) had least total depressiveness, while females in intermediate situation had the highest self-confidence and least anhedonia and nervousness. According to twins' own preference, twins who felt equally close to both parents had least depressiveness and anhedonia. The intermediate position seems to be the best alternative, as these twins had the least symptoms.

Psychosomatic and depressive symptoms were evaluated in relation to co-twin dependence in young adult twins. MZ twins, especially MZ females, reported most often co-twin dependence at all ages. Inter-twin dependence decreased with increasing age in both genders. Co-twin dependence was not found to be a risk factor for depressive symptoms in male and female young-adult twins as there were no significant differences in depressive symptoms between dependent and independent twins. It seemed that being dependent on a female twin partner was experienced more positively than being dependent on a twin brother as far as depressive symptoms are concerned. Additionally, a twin's subjective experience about co-twin dependence appeared to be important for the twin's mental well-being, as dependence-independence imbalance within the twin pair was associated with elevated levels of depressive symptom reporting, especially in twins who perceived themselves as dependent and the co-twin as independent.

Dominance-submissiveness between co-twins and its relationship with mental health was assessed in young adulthood. In the physical domain, males were more commonly dominant than females at school age and in adulthood. Before and at school age, girls were more dominant than boys in the psychological and verbal domains, as well as in total dominance. These differences disappeared in adulthood, and 81% of adult twins felt themselves equal to their co-twin in total dominance. Submissiveness in the psychological domain seemed to be associated with increased depressiveness, nervous complaints and psychosomatic symptoms in males of male-female twin pairs. Verbally submissive males in same-sex twin pairs had more depression and psychosomatic symptoms. Among females of same-sex twin pairs, submissiveness in the psychological domain was most clearly associated with depressive symptoms, whereas psychological or verbal dominance-submissiveness among females from male-female twin pairs was not associated with symptoms. Psychologically dominant males and females of same-sex twin pairs expressed greater nervousness than did their co-twins. Being submissive,

especially in the psychological domain, to a female twin partner seems to be stressful, whereas it is easier, especially for females, to be submissive to a male twin partner.

As a concept, dependence is close to attachment, and both measure similar patterns of social behaviours. Co-twin dependence seemed more likely to be a protective factor than a risk factor for psychosomatic and depressive symptoms, while being submissive to a female twin partner seemed to be stressful.

Yhteenveto

Kyseessä on 419 pohjoissuomalaisen, vuosina 1965-1973 syntyneen kaksosen seurantatutkimus raskauden ajoista aina nuoriksi aikuisiksi saakka. Masennus ja psykosomaattisten oireiden esiintymistä on kartoitettu eri ikäkausina. Lisäksi kaksosuuden psykologiassa on kiinnitetty huomiota kaksosten väliseen riippuvuuteen, johtajuuteen/alistuvuuteen sekä siihen onko lapsi isän vai äidin lempilapsi.

Keskinuoruus näytti olevan vaikein ikävaihe kaksosille, sillä heillä esiintyi tuolloin eniten masennus ja psykosomaattisia oireita, kun taas nuorilla yleensä masentuneisuus lisääntyy läpi nuoruusiän. Kun erilaisia kaksospareja vertailtiin keskenään, tyttö-poika parien pojat näyttivät olevan hyvässä asemassa, sillä he ilmoittivat vähiten masennus oireita erityisesti myöhäisnuoruudussa.

Kaksosilta tiedusteltiin tunsivatko he jomman kumman vanhemmista pitävän itseään läheisempänä tai tunsiko kaksonen itse jomman kumman vanhemmista läheisemmäksi ennen kouluikää, kouluiässä ja nykyään, nuorena aikuisena. Suurin osa kaksosista tunsi itsensä molemmille vanhemmille yhtä läheiseksi ja nämä molemmille vanhemille itsensä yhtä läheiseksi kokevat ilmoittivat vähiten masennus oireita ja hermostuneisuutta.

Kaksosten välistä riippuvuutta ja sen yhteyttä psykosomaattisten oireitten esiintymiseen ja mielialaan arvioitiin niinikään varhaisaikuisuudessa. Identtiset kaksoset, erityisesti tytöt ilmoittivat useimmiten olevansa riippuvaisia kaksosparistaan. Kaksosten välinen riippuvuus väheni iän myötä. Kaksosten välinen riippuvaisuus ei osoittautunut olevan riskitekijä masennusoireiden suhteen.

Johtajuutta arvioitiin kolmella eri alueella: fyysinen, psyykkinen sekä verbaalinen johtajuus eli puhemiehen rooli. Pojat olivat tyttöjä useammin fyysisiä johtajia jo kouluiässä ja johtajuus jatkui aikuisuuteen. Tytöt olivat poikia useammin johtajia henkisissä asioissa ja ottivat puhemiehen tehtävät hoitaakseen (psyykkinen ja verbaalinen johtaja) ennen kouluikää ja kouluiässä, mutta aikuisiässä tätä eroa ei ollut havaittavissa. Verbaalisesti alistuvilla poika-poika kaksosparien pojilla oli enemmän depressiivisyyttä sekä psykosomaattisia oireita. Psyykkinen alistuvuus tyttö-tyttö parin tytöillä oli yhteydessä depressiiviseen oireiluun. Alistuminen tytölle ennen kaikkea psyykkisellä osa-alueella näyttää olevan vaikeaa etenkin pojille, sen sijaan erityisesti tytön on helpompi olla alistuvampi osapuoli silloin kun kaksospari on poika.

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