Miia Metsänen

THOUGHT DISORDER AS A PREDICTIVE SIGN OF MENTAL DISORDER

A STUDY OF HIGH-RISK AND LOW-RISK ADOPTEES IN THE FINNISH ADOPTIVE FAMILY STUDY OF SCHIZOPHRENIA

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A study of high-risk and low-risk adoptees in the Finnish Adoptive Family Study of Schizophrenia

Academic dissertation to be presented, with the assent of the Faculty of Medicine of the University of Oulu, for public defence in the Auditorium of the Department of Pharmacology and Toxicology, on February 9th, 2007, at 12 noon

OULUN YLIOPISTO, OULU 2007
Metsänen, Miia, Thought disorder as a predictive sign of mental disorder. A study of high-risk and low-risk adoptees in the Finnish Adoptive Family Study of Schizophrenia
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Abstract
Early recognition of schizophrenia could lead to a better clinical course and a better prognosis. Therefore, researchers have started to investigate the possible vulnerability markers of schizophrenia. Both genetic and environmental factors have been found to be essential in the understanding of the development of psychiatric disorders.

The present study is part of an extensive Finnish adoptive family study of schizophrenia. The substudies of this thesis focused on investigating the predictive value of thought disorder measured by Thought Disorder Index (TDI) in terms of the future psychiatric disorders of adoptees at high risk (HR, biological mother with a diagnosis of schizophrenia or paranoid psychosis) and low risk (LR, biological mother with no diagnosed psychosis) for schizophrenia, who had no psychiatric diagnosis at the initial assessment (n = 171). The adoptees' psychiatric status was first re-assessed based on the DSM-III-R criteria in a re-interview 11 years later and then based on the available national hospital discharge registers 16 years later. The predictive value of thought disorder as a sign of vulnerability to mental disorder was clarified by examining the stability of thought disorder (n = 158). The adoptees' TDI scores were evaluated twice at a median interval of 12 years (the adoptees' median ages at evaluation were 22 and 36 years). Furthermore, the possible genotype-environment effect in the development of thought disorder was investigated by assessing the adoptees' thought disorders at the initial and follow-up assessments as well as the CD (Communication Deviance) of their adoptive parents at the initial assessment (n = 89).

High scores on several TDI variables at the initial assessment were shown to predict a follow-up diagnosis of a psychiatric disorder among all adoptees. These TDI variables were found to be stable over time, which enhanced the predictive value of thought disorder. There was an association between the thought disorder of the adoptees and the CD of their parents. Furthermore, the genotype-environment interactions were also related to the presence of thought disorder.

The results of these investigations provide new information to the prevention of mental disorders, especially among person with prodromal symptoms of psychosis, such as mood disorders and cognitive dysfunctions.

Keywords: adoption family study, communication deviance, schizophrenia, thought disorder
Metsänen, Miia, Ajatushäiriöt mieleterveyden häiriöiden ennustajana. Suomalaisen adoptiolapsiperheaineiston riski- ja verrokkilapset. Lääketieteellinen tiedekunta, Psykiatrian klinikka, Oulun yliopisto, PL 5000, 90014 Oulun yliopisto; Psykiatrian klinikka, Oulun yliopistollinen sairaala, PL 26, 90029 OYS; Psykiatria klinikka, Päijät-Hämeen keskussairaala, Keskussairaankatu 7, 15850 Lahti

**Tiivistelmä**

Skitsofrenian varhaisen tunnistamisen myötä saattaa olla mahdollista kohentaa skitsofrenian ennustetta. Siksi tutkijat selvittävät mahdollisia skitsofreniaan altistavia ja ennakoivia tekijöitä. Sekä geneettiset että ympäristöstä johtuvat tekijät ovat olennaisiksi seikoiksi psykiatristen häiriöiden kehittymisen ymmärtämässä.

Tämä tutkimus on osa laajempaa Suomalaisa adoptiolapsitutkimusta. Tutkimuksen tavoitteena oli selvittää ennustavat Thought Disorder Index -asteikolla (TDI) mitattat ajatushäiriöt tutkimushetkellä oireettomien (ei täyttänyt psykiatrisen diagnoosin kriteereitä) riski (biologinen äidillä skitsofrenia tai paranoidinen psykoosi diagnoosi)- ja verrokkia adoptiolasten (biologisella äidillä ei psykoosi diagnoosia) tulevaa mieleterveyttä (n = 171). Adoptiolasten psykiatrininen status arvioitiin 11 vuotta myöhemmin tehdysä seurantatutkimuksessa DSM-III-R -kriteeristöllä ja tämän jälkeen seuraamaan 16 vuotta kansallisia sairaaloiden uloskirjoitustietoja. Ajatushäiriöiden ennuste arvioitiin mahtavaa havaitsuvuusindikaattoreina selvitettiin tutkimalla ajatushäiriöiden pysyvyyttä (n = 158). Adoptiolasten TDI pisteen arvioitiin kahdesti heidän 22- ja 36-vuotiaana, tutkimuksen alussa ja 12 vuoden (mediaani) seuranta-ajan jälkeen. Lisäksi mahdollista perimää-ympäristötäkiöiden yhdysvaikutusta ajatushäiriöiden kehittymisessä tutkittiin arvioimalla adoptiolasten adoptiovanhempien kommunikaatiohäiriöt (CD) alkututkimuksessa ja adoptiolasten ajatushäiriöt sekä alku- että seurantatutkimuksessa (N = 89).

Erätä alkututkimuksessa mitatut kohonneet TDI-muuttujat (TD_R = TDI-asteikon kokonaispistemäärä, 0.50 vakavuusaste ja omituinen sanojen käyttö) ennustivat seurannassa adoptiolasten psykiatrisen diagnoosin kriteereiden täyttymistä. Kyseiset TDI-muuttujat olivat myös pysyviä ja täten niiden ennustavo vahvistui. Adoptiolasten ajatushäiriöiden kehittyminen alku- ja seurantatutkimuksen välillä oli yhteydessä alkututkimuksessa mitattuun adoptiovanhempien kommunikaatiohäiriöiden esiintyvyyteen ja perimään ja ympäristön yhdysvaikutus tuli esille. Tämän tutkimuksen tulokset tuovat uutta tietoa ennaltaehkäisevälle mieleterveyestyölle, erityisesti niiden henkilöiden kohdalla, joilla esiintyy joitakin huolestuttavia, erityisesti psykoosin ennakko-oireita kuten mieliala-oireita ja kognitiviaisuuksia.

**Asiasanat:** ajatushäiriö, skitsofrenia, adoptioperhetutkimus, kommunikaatiohäiriöt
Kimmolle ja Aleksille
Acknowledgements

This work was carried out at the Department of Psychiatry, University of Oulu, Clinic of Psychiatry, Oulu University Hospital, and Clinic of Psychiatry, Päijät-Häme Central Hospital.

I would like to express my sincere gratitude to Docent Karl-Erik Wahlberg, Ph.D, and Docent Outi Saarento, M.D., who supervised my research. Both of them gave me enormous amounts of intellectual supervision and advice during the research project. I would especially like to thank Docent Karl-Erik Wahlberg for answering to every question I had (and there were many), for being there every time I had problems, and the possibility to have supervision via videoconference, thousands of emails, and innumerable telephone calls. This research would not have been possible without your flexibility and humanity.

I owe my deep gratitude to Emeritus Professor Pekka Tienari. His enormous contribution to the Finnish Adoptive Family Study of Schizophrenia has created a unique sample, and has offered an opportunity to conduct several studies. Furthermore, Emeritus Professor Pekka Tienari gave me valuable advice and was always willing to help whenever I needed guidance. I thank the psychologists Taneli Tarvainen, Lic. Psych., Pekka Koistinen, Ph.D., and Karl-Erik Wahlberg, Ph.D., for teaching me the scoring of Rorschach records. For statistical advice I am grateful to Jouko Miettunen, Ph.D., and Helinä Hakko, Ph.D. I thank especially Helinä Hakko for being extremely helpful and supportive about every issue I had.

My sincere thanks are also due to Professor Matti Joukamaa and Professor Ranan Rimon for supporting me in many financial issues. I wish to express my profound gratitude to Ms. Pirkko Kaan for helping me in many practical questions and to Mrs. Sirkka-Liisa Leinonen, who revised the language of the manuscript and the published articles.

I would also like to express my sincere gratitude to all those people, who have made huge contributions to the Finnish Adoptive Study of Schizophrenia in data collection and analysis: Heljä Anias-Tanner, M.A., Pirjo Keskitalo, Ph.D., Ilpo Lahti, M.D., Ph.D., Kristian Liiksy, M.D., Mikko Naarala, M.D., Docent Juha Moring, M.D., Ph.D., Outi Saarento, M.D., Markku Settamaa, M.A. and Anneli Sorri, M.D.
Docent Risto Antikainen, Ph.D., and Docent Eila Laukkanen, M.D., carefully reviewed the manuscript and gave valuable advice and constructive criticism, for which I extend my warmest thanks.

While I was working at Visala Psychiatric Hospital in the Northern Ostrobothnia Hospital District, I had an opportunity to participate in the Finnish Adoptive Family Study of Schizophrenia. Without the extremely favourable attitude of Kari Lehtinen, Chief Medical Officer and Pentti Ollanketo, Director of Nursing Service, at Visala Psychiatric Hospital, this research project would not have succeeded. Therefore, I am deeply grateful for their support. I am also grateful to my nearest co-workers in Päijät-Häme Central Hospital and to my bosses Per-Erik Bredbacka, Eija Kivinen and Auli Sarikka for the time they have allowed me to pursue my research. The warmest thanks go to my closest co-worker Jaana Hahl-Viljanen. You have supported me on good and bad days.

Financial support for this research was obtained from the grant MH39663 from the Public Health Service, a grant from the Scottish Rite Schizophrenia Research Program, N.M.J., USA, and from The Academy of Finland, The Emil Aaltonen Foundation, The Finnish Konkordia-Union, The Jalmari and Rauha Ahokas Foundation, Yrjö Jahnsson Foundation, The Paolo Foundation, Päijät-Häme Central Hospital, Oulu University Hospital, Department of Psychiatry, The Alma and K.A. Snellman Foundation and Varhaiskuntoutuksen tukisäätiö.

My deepest thanks are due to my husband Kimmo and my three-year-old sonAleksi. Words are not enough to express my gratitude for the support you gave me during these years. Kimmo, you taught me that it is possible to take things easy and rationally. Aleksi, your calm and easy temperament made it possible for your mother to have the strength to work on research during your naps. During your first two years you participated in many scientific meetings while asleep, and hopefully this has not stifled your interest in science in the future. To my parents, thank you for having been my parents. Your attitude to life has shown that everything is possible if you just want it. This book is my birthday present to my mother on the 9th of February 2007.

Kangasala 7.12.2006

Miia Metsänen
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ANCOVA</td>
<td>Analysis of covariance</td>
</tr>
<tr>
<td>APD</td>
<td>Any Psychiatric Disorder</td>
</tr>
<tr>
<td>AOPD</td>
<td>Any Other Psychiatric Disorder</td>
</tr>
<tr>
<td>BSSD</td>
<td>Broad Schizophrenia Spectrum Disorder</td>
</tr>
<tr>
<td>CD</td>
<td>Communication Deviance</td>
</tr>
<tr>
<td>DSM-III-R</td>
<td>Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised</td>
</tr>
<tr>
<td>HR</td>
<td>High-risk adoptee</td>
</tr>
<tr>
<td>LR</td>
<td>Low-risk adoptee</td>
</tr>
<tr>
<td>NPD</td>
<td>No Psychiatric Disorder</td>
</tr>
<tr>
<td>OR</td>
<td>Odds Ratios</td>
</tr>
<tr>
<td>TDI</td>
<td>Thought Disorder Index</td>
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<tr>
<td>$TD_R$</td>
<td>Thought Disorder on the Rorschach</td>
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List of original publications

This thesis is based on the following original publications, which are referred to in the text by the Roman numerals I-IV.


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1 Introduction

The course and prognosis of schizophrenia could be improved by recognition of the disorder as early as possible (McGlashan & Johannessen 1996, McGorry et al. 2000). Therefore, there is an apparent need to explore the possible vulnerability markers of schizophrenia. Previous studies have focused on anatomical, molecular, physiological, chemical, and other biological abnormalities as signs of vulnerability to schizophrenia (Carpenter & Buchanan 1994). It is also obvious that genetic factors play an important role in the development of schizophrenia.

According to the vulnerability/stress and stress-diathesis models, there are inherited and possible neural factors that make some persons more vulnerable to developing symptoms of schizophrenia in stressful life situations (Rosenthal 1963, Zabin & Spring 1977, Nuechterlein 1987). Cognitive deficits have been found to be characteristic of schizophrenia as well as essential vulnerability signs of the disorder. The cognitive functioning of schizophrenic patients has been shown to be 1-1.75 standard deviations below the normal mean (Censits et al. 1997, Heaton et al. 2001, Mohamed et al. 1999). The meta-analytic study of Heinrichs & Zakzanis (1998) revealed that almost all aspects of cognition are somewhat impaired in schizophrenia, especially episodic memory, ideational fluency, and aspects of complex attention. Furthermore, these cognitive deficits appear to be relatively stable over time and independent of symptomatic manifestations of the illness (Censits et al. 1997, Heaton et al. 2001, Rund 1998). Several studies have further revealed impairments in intellectual, attentional, and academic functioning in early childhood, which are likely to increase the risk of subsequent psychotic symptoms (Cannon et al. 2000, Cornblatt et al. 1999, David et al. 1997, Davidson et al. 1999, Erlenmeyer-Kimling et al. 2000, Erlenmeyer-Kimling et al. 2001, Isohanni et al. 2000, Jones et al. 1994, Niendam et al. 2003). Cannon et al. (2000) found cognitive dysfunction to be evident as long as 10-15 years before the onset of formal diagnostic symptoms. Furthermore, Erlenmeyer-Kimling et al. (2000) pointed out that subjects who experienced schizophrenia-related psychoses in adulthood had deficits in verbal memory, gross motor skills, and attention at 7-12 years of age already. Among cognitive impairments, thought disorders have been related to mental disorders, especially schizophrenia. Therefore, attention has been given to the possibility that the presence of thought disorder could be an indicator of vulnerability to schizophrenia (Hurt et al. 1983,
At the same time, environmental factors, such as complications of delivery (McNeil 1991, Cannon et al. 1993, Jones et al. 1998, Isohanni et al. 2004) and viral infections of the mother in the second trimester (Sorensen et al. 2004, Tochigi et al. 2004), have been found to be risk factors for schizophrenia. Unwanted pregnancy (Myhrman et al. 1996) and maternal depression during the antenatal period (Jones et al. 1998) have also been associated with the development of schizophrenia. In contrast to the differentiation between genetic and environmental factors, Kendler & Eaves (1986) pointed out that comprehensive understanding of the development of psychiatric disorders presumes recognition of the joint effect of genetic and environmental risk factors. Today, it is widely accepted that genotype-environment interaction is essential for the development of schizophrenia (Carter et al. 2002, Tienari et al. 2004, Wahlberg et al. 2004).

One possible environmental risk factor is the communication deviance (CD) present in these families (Wynne et al. 1977). Adoptees at high genetic risk for schizophrenia have been found to be more sensitive to problems in the rearing adoptive family (Tienari et al. 2004). Correspondingly, the interaction of genetic liability to schizophrenia spectrum disorder and communication deviance of the adoptive parents have predicted psychiatric disorders in the adoptees at adult age (Wahlberg et al. 2004). Wahlberg et al. (1997, 2000) also demonstrated that thought disorder differentiated high-risk adoptees from low-risk adoptees only in the presence of high levels of communication deviance. Therefore, the adoptees at high genetic risk could be more sensitive to the environment, including a protective environment. High-risk adoptees with low communication deviance adoptive parents had more consistent thought processes than low-risk adoptees reared by parents with low communication deviance levels (Wahlberg et al. 1997).

This study is part of the Finnish adoptive family study (Tienari et al. 1987a,b, 2000, 2003), which aims to explain the relationships between the genetic and environmental factors contributing to the normal and psychopathological outcomes of subjects at genetic risk. The adoptive study design provides an opportunity to differentiate between family rearing variables and genetic risk. The purpose of the present study was to explore vulnerability markers among individuals at risk to get a psychiatric diagnosis in the future. A further aim was to investigate variables that could be associated with the development of vulnerability markers.
2 Review of the literature

2.1 General systems theory, biopsychosocial model
and vulnerability theories

Comprehensive understanding of human development and the development of psychiatric disorders requires a broad perspective. The general systems theory (Bertalanffy 1969, Benjamin 1982) and the biopsychosocial model (Engel 1977) connect the neurobiological factors, the individual development, and the broad environmental influence. From the systematic perspective, a phenomenon is considered a whole of several parts, which are in reciprocal interaction (Bertalanffy 1969, Benjamin 1982). A change in one part of the system changes the whole system, and the feedback influences the part that initiated the change in the first place. The system has a tendency towards homeostasis, meaning that it resists the change with negative feedback. However, the system is able to change and develop with the help of positive feedback.

The biopsychosocial model includes four major levels which influence human behavior (Engel 1977). These are the biological level, the personality, the social network, such as family and work, and the larger community and the state. From the systematic viewpoint, a change at one of these four levels affects the other levels as well.

In studies of psychiatric disorders, especially schizophrenia, the vulnerability/stress and diathesis-stress theories have offered a broad perspective, which draws on the general systems theory and takes into account both genetic, individual, and environmental factors in the development of psychiatric disorder (Rosenthal 1963, Zubin & Spring 1977, Wynne 1978, Nuechterlein & Dawson 1984, Nuechterlein 1987). The core idea in these theories is that there is a vulnerability to schizophrenia, in which both biological factors (derived from genetic or environmental causes) and life experience factors play a role (Mirsky & Duncan 1986). Stress activates this diathesis, and the potential predisposition (vulnerability) transforms into the presence of psychopathology (Monroe & Simons 1991). Vulnerability factors are non-specific, internal, and inherited dimensions, which are mostly related to the development of genetic and neural factors (Wynne 1978, Green 1998). In addition, complications during pregnancy and delivery may influence the development of the central nervous system (Nuechterlein 1987). Environmental stressors
include communication deviance in the family. Green (1998) has speculated that the greater the vulnerability is, the less pressure in the environment is needed for the onset of a psychiatric disorder. Vulnerability models have also revealed protective factors. Nuechterlein (1987) has proposed that a personal ability of adjustment and good communication and problem-solving skills in the family could protect from psychiatric disorder.

2.2 Thought disorder

2.2.1 Definition of thought disorder

Thought disorder has been a familiar term in psychiatry ever since Emil Kraepelin (1896/1919) and Eugen Bleuler (1911/1950, 1924) identified thinking problems as one of the primary features of schizophrenia. However, psychiatric researchers have not reached full consensus as to the definition of thought disorder. Kraepelin (1896/1919) identified the incoherence and “derailments” of thought sequences in schizophrenia, while Bleuler (1911/1950) emphasized the splitting of thoughts and feelings and called this process “loosening of associations”. Other early theorists, such as Storch (1924) and Werner (1957), believed primitive language usage to be characteristic of schizophrenic patients. Correspondingly, Goldstein (1944) and Arieti (1974) viewed schizophrenic thinking on the concrete-abstract continuum. Goldstein (1944), Arieti (1974), and Barison (1949) characterized thought processes in schizophrenia as concrete, while Barison (1949) found schizophrenic thinking to be overly abstract. Cameron (1944) considered the thinking problems in schizophrenia to be due to an inability to maintain conceptual boundaries, in accordance with Fish (1962), who defined thought disorder as a disturbance of conceptual thinking. Von Domarus (1944) added to the conceptualization of thought disorder the idea of predicative thinking, which means that two things are identified on the basis of a common predicate rather than on the basis of a common subject. Some psychoanalytically orientated scholars viewed schizophrenic thinking as the manifestation of the primary process, representing a regression to an earlier, infantile state of psychic development (Johnston & Holzman 1979), while Harrow and Quinlan (1985) regarded thought disorder as consisting of diverse types of verbalization and thinking labeled by others as bizarre and idiosyncratic. Today, thought disorder is considered a broader phenomenon, including not only impaired pace and flow of associations, but also errors in syntax, word usage, syllogistic reasoning, inappropriate levels of abstracting, failure to maintain conceptual boundaries, and breakdown of the discrimination of internal from external perceptions (Kleiger 1999).
2.2.2 Cognitive mechanisms in thought disorder

Although psychiatric researchers have not reached agreement concerning the definition of thought disorder, it is widely accepted that language and speech provide the structure through which thought is communicated (Harrow & Quinlan 1985, Lanin-Kettering & Harrow 1985, Holzman et al. 1986). Numerous studies have investigated the cognitive and neurological substrate of thought disorder. Impairments in attention, information processing, working memory, discourse planning, and semantic processing have been found to be related to thought disorders in schizophrenia (Nuechterlein & Dawson 1984, Hoffman et al. 1986, Liddle 1987, Manschreck et al. 1991, Shenton et al. 1992, Goldberg et al. 1998, Nestor et al. 1998, Tallent et al. 2001, Minassian et al. 2004, Leeson et al. 2005). It has been suggested that, because of a deficit in working memory, schizophrenic patients lose their train of thought, fail to perceive causal relationships, and are unable to regulate their behavior by internal schemata and ideas (Goldman-Rakic 1992).

Impairments in different aspects of executive function have also turned out to be related to thought disorder (McGrath 1991, Goldstein et al. 2002, Kerns & Berenbaum 2003, Dixon et al. 2004, Covington et al. 2005). For example, poor planning could make an individual unable to focus on a topic and thereby give rise to a loss of goal.

Studies concerning the pathophysiology of thought disorder have concluded that there are multiple brain areas and/or miscommunication between brain areas producing disturbed thinking (Friston 1998, Andreasen et al. 1999). Studies of brain morphology have found that, especially among schizophrenic patients, the degree of reduced or reversed lateralization of the posterior superior temporal gyrus is associated with the severity of thought disorder (Shenton et al. 1992, Rossi et al. 1994, Petty et al. 1995, Hirayasu et al. 1998, Rajarethinam et al. 2000, Kircher et al. 2002). High degrees of thought disorder have also been accompanied by significant activations in the fusiform gyrus and precuneus (Erkwoh et al. 2002). Kircher et al. (2001) further found the severity of positive thought disorder to correlate inversely with the level of activity in the Wernicke area.

In summary, previous studies concerning the cognitive background of thought disorder have produced different results on what is essential in thought disorder. However, the evaluation of these studies is quite challenging because of their marked diversity. Different studies have used different methods, and sample sizes have not always been very large. It could be presumed that, especially in studies of pathophysiology, technological development could offer more sophisticated methods in the future and thus enable more precise results.

2.2.3 The qualitative aspects of thought disorder

Schizophrenia research has made a general distinction between positive and negative symptoms. This differentiation has also been applied to thought disorder. Positive thought disorder includes unusual ideas, delusions, and hallucinations and is commonly flagrantly apparent as bizarreness of speech and logic (Kleiger 1999). Thinking affected by positive thought disorder is not based on normal logic (Marengo & Harrow 1988).
Correspondingly, negative thought disorder is considered a deficit or absence of normal functioning, such as poverty of speech and thought content (Kleiger 1999). Persons with negative thought disorder have special difficulty in producing thoughts (Marengo & Harrow 1988).

Extensive research made it apparent that thought disorder is not a single phenomenon but consists of several factors. Harrow and Quinlan (1985) showed different types of thought disorder to be present in the different phases of a psychiatric disorder. Looseness, conceptual overinclusiveness, and fallacious logic were more often present in acute conditions, while inability to think abstractly and excessively concrete thinking were more prominent among chronic schizophrenic patients (Harrow & Quinlan 1985). Johnston & Holzman (1979) found concept formation, cognitive focusing, reasoning, and reality testing to be important components of thought disorder.

Thought disorder has turned out to be a continuous variable. Disordered thinking appears to vary between milder forms of thought disorder and more severe thinking problems (Harrow & Quinlan 1977, 1985; Johnston & Holzman 1979, Andreasen & Grove 1986, Holzman et al. 1986). There is also variability within a given diagnostic group or even within an individual, depending on the phase of the illness (Harrow & Quinlan 1977). Positive and negative thought disorders have also been seen within one and the same person (Pogue-Geile & Harrow 1985).

Although previous studies have used different methods to evaluate thought disorder, their results have consistently shown that thought disorder consists of several factors and is a continuous variable. Furthermore, the samples have included dozens of subjects in each psychiatric disorder group.

### 2.2.4 Thought disorder in psychiatric disorders

Thought disorder has been traditionally associated with schizophrenia. The thinking and speech of schizophrenic patients seem to be confused and disorganized and contain idiosyncratic and peculiar phrases (Johnston & Holzman 1979, Holzman et al. 1986, Solovay et al. 1987, Koistinen 1995). Furthermore, fluid and perseverative responses, which seem odd and devoid of consensual meaning to the listener, have been shown to be typical of schizophrenia (Kleiger 1999). Extremely severe thought disorders, such as neologisms, incoherent statements, and responses merging two separate and incompatible percepts (contamination), have been found among schizophrenic patients (Harrow & Quinlan 1985, Koistinen 1995). The thinking of schizophrenic and schizotypal children is also more impaired than that of normal children (Caplan et al. 1989, 1990, 2000; Caplan 1994, Tompson et al. 1997). Especially illogical thinking and loose associations were more characteristic of schizophrenic and schizotypal children (Caplan et al. 1989, 1990). In addition, Caplan et al. (1992) found that schizophrenic children used significantly fewer cohesive devices to connect ideas expressed within and across sentences than normal children. Furthermore, Makowski et al. (1997) demonstrated idiosyncratic word usage, illogical reasoning, perceptual confusion, loss of realistic attunement to the task, and loosely related ideas among schizophrenic adolescents. Furthermore, Docherty et al. (2003) indicated clinically rated thought disorder to be associated with the severity of
positive but not negative schizophrenic symptoms. The level of thought disorder has also been found to be significantly elevated in the relatives of persons with schizophrenia (Johnston & Holzman 1979, Shenton et al. 1989, Hain et al. 1995, Vaever et al. 2005). The thought processes of the first-degree relatives of schizophrenic and schizoaffective manic patients have also been shown to be more deviant than those of normal controls (Shenton et al. 1989, Kinney et al. 1997). In view of the large number of studies with sample sizes ranging from 20 to 88 inpatients and outpatients with chronic and recent schizophrenia as well schizophrenic and schizotypal children, the presence of thought disorder in schizophrenia is convincing.

Thought disorder is present in other psychiatric disorders as well. Previous studies have shown thought disorder in patients with obsessive-compulsive (n=15) (Lee et al. 2005), affective (n=1-48) (Dunayevich & Keck 2000, Wilcox 2000, Rubin & Arceneaux 2001, Dixon et al. 2004, Tai et al. 2004), schizoid (n=32) (Wolff et al. 1991), and borderline personality disorders (n=51-83) (Edell 1987, Gandolfo et al. 1991). Furthermore, thought disturbances have been found in schizotypal disorder (n=50) (Handest & Parnas 2005) as well as in autistic (n=11-14) (Dykens et al. 1991, van de Gaag et al. 2005), bulimic (n=12) (Smith et al. 1991), and multiple complex developmental disorders (n=20) (van de Gaag et al. 2005) and in children with attention-deficit hyperactivity disorder (ADHD) (n=13-115) (Caplan et al. 2001, van de Gaag et al. 2005). However, studies have revealed qualitative differences in thought disorder, depending upon the severity of the psychopathology (Holzman et al. 1986, Cuesta & Peralta 1993, Vaever et al. 2005). Holzman et al. (1986) showed that manic patients (n=20) produce more often combinatory thinking, intrusions of irrelevant ideas, and playful and humorous statements. Correspondingly, the thinking of schizophrenic patients (n=43) involved interpenetrations of one idea into another and idiosyncratic and peculiar words. Thought disorders among schizoaffective (n=22) and schizophrenic patients (n=43) have been found to include many similarities and congruence (Shenton et al. 1987). Similarly to schizophrenia, idiosyncratic verbalizations, autistic thinking, and confusion were also present in the thinking of schizoaffective-manic patients. The number of studies concerning thought disorder in psychiatric disorders other than schizophrenia is large, and the sample sizes are sufficient to warrant the conclusion that thought disorder is not unique to schizophrenia.

Although thought disorder is usually related to psychiatric disorders, it is important to remember that the occurrence of minor cognitive slippage is possible in healthy individuals as well. Most often, such slippage occurs during periods of anxiety or fatigue (Solovay et al. 1987). Previous studies have shown that normal subjects (n=22) also have thought disorders, but they are significantly less common and less severe than those seen among psychiatric samples (Holzman et al. 1986, Solovay et al. 1987). However, it still unknown how common thought disorders are in the normal population.
2.2.5 Stability of thought disorder

Thought disorder occurs most often during the acute phase of schizophrenia (Asarnow & MacCrimmon 1982, Harrow et al. 1982, Marengo & Harrow 1997). Some patients continue to have thought disorder after the acute phase, while improvements in specific areas of thought disorder occur. Overall, thought disorders have been found to be rather stable among schizophrenic patients (Adair & Wagner 1992, Earle-Boyer et al. 1986, Marengo & Harrow 1988). Marengo & Harrow (1997) studied thought disorder in schizophrenia, schizoaffective disorder, and other psychotic and non-psychotic disorders at 2, 4.5, and 7.5 years after index hospitalization and found the stability of thought disorder to be most prominent in schizophrenia (correlations of 0.42-0.47, depending on the length of follow-up). In other psychiatric disorders, contrariwise, stability was quite low and thought disorders did not persist throughout the follow-up period. Adair & Wagner (1992) also found that the group mean of unusual verbalization (UV) scores among schizophrenic patients did not significantly change during 6.4 years of follow-up. The correlations were, however, modest at best (r= 0.16-0.50). Negative thought disorder turned out to be relatively consistent in schizophrenics after 10 days’ acute admission, but less consistent in manic patients (Earle-Boyer et al. 1986). Docherty et al. (2003) also found moderate (r=0.48) consistency of formal thought disorder during 9-month follow-up of schizophrenic patients. Correspondingly, Andreasen & Grove (1986) showed that most types of thought disorder remitted in manic patients during 6 months of follow-up, but persisted in schizophrenics, while patients with schizoaffective disorder also showed substantial improvement of thought disorder.

It appears that thought disorder is a trait in some subgroups of schizophrenic and manic patients (Braff et al. 1988, Harvey et al. 1990). The presence of thought disorder after the resolution of an acute psychotic episode appears to be a powerful predictor of poor outcome (Norman et al. 1999). However, it is also suggested that thought disorder in psychiatric patients could have both trait and state features (depending on the context) (Holzman 1986, Ragin & Oltmanns 1986). In healthy individuals, the presence of thought disorder is assumed to be more a state-like feature. However, some “thinking problem” subscales measuring communication deviance (CD) have shown certain stability among adult subjects (r=0.29-0.35) but not among subjects aged 20 years or younger (Wahlberg et al. 2001). As stated before, the presence of thought disorder could be a sign of vulnerability to schizophrenia. Furthermore, previous studies have indicated that patients with thought disorder had a poorer outcome in the future (Harrow et al. 1983, Jorgensen & Aagaard 1988).

In summary, thought disorder has been found to have both trait and state-like features. It is noticeable that the stability of thought disorder has not been a very popular topic of research. Only a few studies have been made, and the follow-up times have not been very long.
2.2.6 Assessment of thought disorder

Thought disorder can be assessed by using interviews (structured or semi-structured) or different psychological tests. Well-known interviews have included, for example, the Brief Psychiatric Rating Scale (BPRS) (Overall & Gorham 1962, Andreasen et al. 1974, Dingemans et al. 1983, Simpson & Davies 1985), the Present State Examination (PSE) (Ianzito et al. 1974), and the Positive and Negative Syndrome Scale (PANSS) (Kay et al. 1987). In the assessment of thought disorder using psychological tests, the most common method has been the analysis of responses to Rorschach cards. Several test measures have been developed to evaluate thought disorder, such as Exner’s Comprehensive System (Exner 1993), the Scale for the Assessment of Thought, Language and Communication (TLC) (Andreasen 1986), and the most widely used test, namely the Thought Disorder Index (TDI) (Johnston & Holzman 1979, Holzman et al. 1986, Solovay et al. 1986).

The Thought Disorder Index (TDI) was developed to tag, classify, and measure disturbances in thinking (Johnston & Holzman 1979, Holzman et al. 1986, Solovay et al. 1986). TDI can be used to evaluate thinking problems that occur during verbal discourse. Any verbal sample can be used, but responses to Rorschach cards are most common. TDI allows assessment of both qualitative and quantitative disturbances of thought processes ranging from very mild to very severe (Holzman et al. 1986).

2.3 Communication deviance

2.3.1 Communication patterns in the development of thought processes

In general, cognitive development is attributed to both heritable (genetic) and early environmental factors (Schaie & Zuo 2001, Schaie 2005. Traditionally, it is also suggested that the stage of intellectual development is reached by age 13 or 16 (Schaie 2005). However, it is very important also to recognize other behavioral developments such as the adoption or neglect of favorable lifestyles as well as the development of flexible response styles and appropriate management of stress and emotional conflicts, that could affect the development of cognitive functions later in life (Rowe & Kahn 1987). Environmental influences do not cease in adulthood (Schaie 2005). The Seattle Longitudinal Study (n=499, 14 year of follow-up) (SLS; Schaie 1996, Schaie 2005) showed that, from the age of 25 to 81, cognitive abilities such as inductive reasoning, verbal memory, perceptual speed, and spatial orientation performance declined evenly (Schaie et al. 2004). However, the ability to understand ideas expressed in words (verbal ability) and the ability to understand numerical relationships (numeric ability) showed a positive age effect such that performance was better at age 46 than 25 (Schaie et al. 2004).

The development of thinking has been found to progress by stages. Piaget (1988) stated that thinking develops in children in the same order but at individual rates. Thinking processes change qualitatively upon entry into each new stage. In line with Piaget, Vygotski (1982) also found the development of thinking to proceed through
stages. From the primitive state thinking progressed via different stages to the extremely logical system. The systematic view of thinking postulates that thought processes develop in the interaction between the subject and the environment (Bronfenbrenner 1988, 1991a, 1991b). Thus, the development of a child’s thinking is an outcome of the interaction between the child and the parental communication. The association between the child’s thinking and the parental communication patterns was first empirically studied by Wynne & Singer (n= 35 families, of which 20 included young adult schizophrenic offspring, nine borderline schizophrenic offspring, and six severely neurotic young adult offspring) (Wynne & Singer 1963a, b; Singer & Wynne 1965a, b). The parents’ ability to share attention and meaning was regarded as essential to the development of the child’s thinking. Disorders in parental attention and focusing were seen to have a negative impact on the emotional and cognitive development of the offspring (Singer & Wynne 1965a). Such disorders in communication patterns create a confusing and disorganized environment. Topics change all the time, items are not processed to the end, and the child is not able to learn how to concentrate on the essentials (Wynne & Singer 1963a). The parents talk either very much or very little, and their speech is difficult to follow and understand. The ways in which the parents communicate and share attention and meaning with the child are critical to the child’s cognitive development, especially thinking, experiencing, and communicating (Stierlin 1969; Wynne & Singer 1963a; Wynne 1968). Especially the effects of unclear, amorphous, or fragmented communication were found to be quite destructive for a child with a biological predisposition to schizophrenia (Singer et al. 1978).

### 2.3.2 The Definition of Communication Deviance

The concept of communication deviance (CD) was outlined by Wynne and Singer (Wynne & Singer 1963a, b; Singer & Wynne 1965a, b). CD was defined as an unusual way of perceiving, talking about, and reasoning about the world. The presence of CD leaves the listener uncertain, puzzled, and unable to share a focus of attention with the speaker. Parental CD is a relatively stable (Wahlberg et al. 2001) and enduring “environmental” stressor during the child’s development.

CD has been found to be a heterogeneous phenomenon involving both perceptual-cognitive disturbance and disturbance of linguistic-verbal reasoning (Miklowitz & Stackman 1992). Wynne & Singer (1963a, b) differentiated between fragmented thinking (difficulties in attention and perception, inadequate integration of stimuli or concepts) and amorphous thinking (vague, indefinite, perseverative, impoverished speech). Correspondingly, Jones (1977) found factors related to primarily perceptual distortion, and factors measuring language or speech deviance. Studies have also proposed that the perceptual-cognitive part of CD might be largely genetically acquired (Asarnow et al. 1988, Nuechterlein et al. 1989, Wagener et al. 1986), whereas the forms of CD reflecting deviance in linguistic-verbal reasoning tend to be more heavily influenced by psychosocial factors (Miklowitz & Stackman 1992).
2.3.3 Parental Communication Deviance and the psychiatric status of the offspring

Parental communication patterns have been studied in psychiatric patients’ families. Singer & Wynne (1963) found that the parents of schizophrenics (n=20) produce significantly more communication deviance than the parents of autistic, acting-out, and withdrawn children (n=20). Furthermore, Wynne et al. (1977) showed that the total parental CD scores increased monotonically with the severity of disturbance in the offspring (normal, n=20; neurotic, n=25; borderline, n=25, and schizophrenic, n=44). It is noteworthy that, using parental communication data, Singer & Wynne (1965a, b) were able to predict the offspring diagnosis in 80% of the cases, including the severity of offspring disturbance and the severity of offspring thinking problems. Parental CD scores were also related to the child’s poor social adjustment and cognitive performance (n=62) (Doane et al. 1982). Thus, communication deviance is not unique to the parents of schizophrenics (Jones et al. 1977, n=44; Velligan et al. 1988, n=54, Miklowitz et al. 1991, n=64, Asarnow et al. 1988). In addition, the studies showed that not all parents of schizophrenics produce very much communication deviance. It was found that the parents of children with prevalent thought disorder show a high rate of CD (Sass et al. 1984, n=25; Rund 1986, n=50; Wahlberg 1994, n=154, Wahlberg et al. 1997, n=154). Thus, parental communication deviance is assumed to be a continuous and long-term environmental factor affecting the child’s cognitive development (Wahlberg et al. 2000, n=151).

Parental Communication Deviance has been found in different psychiatric patients’ families, especially in families with severe mental disorder in the offspring. The sample sizes in these studies have been large enough to provide relevant results. More importantly, the connection between parental CD and the child’s cognitive development has been confirmed by adoptive family studies where genetic liability and environmental effects (CD of the adoptive parents) have been studied both separately and in interaction.

2.3.4 Stability of Communication Deviance

Previous studies have shown Communication Deviance (CD) to have stable, trait-like features. Doane & Mintz (1987) examined 29 schizophrenic patients and found at 15-year follow-up that CD was relatively stable among 16 women (r= .59, p<.05). Velligan et al. (1995) studied Interactional Communication Deviance (ICD) in a series of 24 male schizophrenic patients and their mothers. The stability of total ICD was .64 for the male patients and .55 for the mothers over a mean time interval of 88.8 days. Nugter et al. (1997) investigated the stability of CD and the effect of treatments on 37 two-parent and 14 single-parent families of schizophrenic patients. Parental CD was resistant to change over a 12-month period in both treatment groups (individual treatment group and individual treatment plus family therapy). Wahlberg et al. (2001) also found CD to be stable in the older (over 20 years of age) 158 participants over the 11-year interval. Furthermore, gender, genetic risk for schizophrenia, and DSM-III-R psychiatric
diagnoses had no effect on this stability. The stability of CD has also been verified by Keskitalo (2000). CD was fairly stable both temporally and from one interactive situation to another.

2.3.5 Connection between parental Communication Deviance and the psychiatric disorder in the offspring

The connection between parental CD and psychopathology in the offspring is obvious, several models have been applied to interpret this correlation. One model presents that parental CD has a stressful impact on the cognitive development of the offspring, which results in vulnerabilities of perception, attention, and logical thought (Wynne & Singer 1963a, Jones 1977). According to another model, the parents’ communication deviance is a reaction to the disordered thinking of the offspring. Referring to this model, Bell (1968) stated that the strange and incomprehensible behavior of a schizophrenic child provokes strange behavior in the parents. Correspondingly, the third model postulates that perceptual-cognitive vulnerability mechanisms serve as a link between parental CD and offspring schizophrenia (Nuechterlein & Dawson 1984). Communication disturbances in the parents are thus a sign of shared genetic vulnerabilities (Nuechterlein & Dawson 1984, Subotnik et al. 2002). The fourth model postulates the parents’ CD to be a reflection of their own psychopathology (Miklowitz & Stackman 1992). Previous studies have not conclusively supported the reactivity (model two) or parental psychopathology (model four) models (Wynne et al. 1977, Doane & Rehhaut 1981). Especially the previous results concerning the stability of CD make the reactivity model questionable. CD was found to be stable during adulthood over an 11-year follow-up (Wahlberg et al. 2001). Furthermore, Wahlberg et al. (1997) showed that the genetic vulnerability of an adoptee did not affect the communication patterns of the adoptive parents. Wahlberg et al. (2004) indicated the genotype interaction to be a more significant predictor of adoptee pathology than either high genetic risk or CD of the adoptive parents alone.

The systematic interpretation is that parental CD as an interactive environmental factor and the child’s genetic vulnerability have a synergistic effect on the child’s cognitive development (Wahlberg 1994). Furthermore, the main responsibility for interaction belongs to the parents (Wahlberg 1994). Naturally, a stable high level of parental CD creates a specific environment, which shapes the development of the child’s thought processes.

2.4 Summary of the literature reviewed

Previous studies have clearly pointed out the possibility of thought disorder as one of the signs of vulnerability to schizophrenia. Furthermore, it is known that thought disorder is not a unique characteristic of schizophrenia but also appears in individuals with other psychiatric disorders as well as in healthy individuals during anxiety or fatigue. However, the predictive value of thought disorder among other psychiatric disorders has not yet
been studied. It has also become apparent that thought disorder has both qualitative and quantitative aspects. More information is still needed to clarify specifically the kinds of thought disorder that could be conclusive signs of vulnerability to mental disorders. Furthermore, the data about the stability of thought disorder has been obtained from studies with rather short follow-up periods. In order to study the predictive value of thought disorder, longer follow-ups are needed.

Studies concerning the development of thinking have indicated that the child’s thinking is a result of the interaction between the child and the parents’ communication. Especially, parental communication deviance (CD) has been found to be an enduring “environmental” stressor during the child’s development. The association between thought disorder and CD also needs some clarification in the longitudinal perspective.
3 Aims of the present study

The purpose of this study was to investigate the predictive value of thought disorder concerning subsequent psychiatric disorder (I), the stability of thought disorder (II, III), and the association between thought disorder and Communication Deviance (CD) (IV).

The specific research questions were:

1. Could premorbid signs of thought disorder determined by TDI (Thought Disorder Index) predict the subsequent manifestation of psychiatric disorders (I)?
2. Are thought disorders present after a 12-year follow-up? Does the genetic liability to schizophrenia affect the stability of thought disorder (II)?
3. Are thought disorders only stable at certain severity levels and in the presence of certain schizophrenia factors of the Thought Disorder Index (TDI) scale? What is the significance of genetic status and the type of psychiatric disorder for the persistence of TDI severity levels and factors (III)?
4. Are the thought disorders of high- and low-risk adoptees associated with the Communication Deviance (CD) of the adoptive parents in the longitudinal perspective (IV)?
4 Materials and methods

4.1 Study population of the Finnish Adoptive Family Study of Schizophrenia

This investigation is part of the extensive Finnish adoptive family study of schizophrenia (389 families) (Tienari et al. 1987a, b, 1994, 2000) that focuses on gene-environment interactions in schizophrenia. The hospital records of the 19,447 women admitted to Finnish psychiatric hospitals from January 1, 1960 through 1979 were reviewed to identify those with a diagnosis of a schizophrenic or paranoid psychosis. Index mothers who had given one or more offspring up for adoption were identified through every census and parish register in the country. Women were excluded if they had an organic brain syndrome, severe mental retardation, primary alcoholism (preceding schizophrenia), or any other major physical illness (Tienari et al. 1987a, b, 2000, 2003).

Once the adoptees at high risk (HR) for schizophrenia had been identified, their adoptive parents were eligible for the study with no diagnostic exclusion criteria (Tienari et al. 2000). Low-risk (LR) adoptees and their adoptive parents consisted of families in which the adoptees had been adopted away by biological mothers with non-spectrum diagnoses or no psychiatric disorder. No diagnostic exclusion criteria of either physical or mental illness were applied to the control adoptive parents. Adoptees were excluded if they had been adopted by a relative, adopted abroad, or adopted after the age of 4 years.

The final sample included 190 genetically high-risk (HR) offspring whose biological mothers had verified DSM-III-R diagnoses of the broad schizophrenia spectrum (n=174 (Kendler et al. 1996, Tienari et al. 2000, 2003). The broad schizophrenia spectrum included the following diagnoses: DSM-III-R schizophrenia, odd-cluster personality disorders (schizotypal, schizoid, and paranoid personality disorders plus avoidant personality disorder), nonschizophrenic nonaffective psychoses (schizoaffective, schizophreniform, and delusional disorders and psychotic disorder not otherwise specified), and affective psychoses (bipolar and depressive disorders with psychotic features). The HR offspring were blindly compared with the 192 adoptees at low genetic risk (LR) whose biological mothers had nonspectrum diagnoses or no psychiatric disorder (n=190).
All available adoptees were evaluated twice. At the initial assessment the adoptees’ median ages were 26 years (IR=18-36) for the HR adoptees and 22 years (IR=17-33) for the LR adoptees (Tienari et al. 2003). Correspondingly, the median age at the follow-up evaluation was 44 years (IR=36-52) for the HR and 43 years (IR=37-51) for the LR adoptees. Of the high-risk adoptees, 92 were male and 98 female, whereas 90 of the LR adoptees were male and 102 were female (Tienari et al. 2003).

4.2 Procedure of the study

All available biological mothers and biological fathers at high risk (HR) and low risk (LR) for schizophrenia were personally interviewed (Tienari et al. 1987a,b). The interviewers of the biological parents were experienced psychiatrics trained in diagnostic interviews for the Present State Examination (PSE) (Wing et al. 1974), they were provided training, and interrater reliability checks were performed at Maudsley Hospital in London (Tienari et al. 1987a,b). The initial and subsequent hospital and clinic records as well as personal interviews were used to make the research diagnoses according to the DSM-III-R. In addition, the diagnoses and the diagnostically relevant information have been checked based on the register data available for all study subjects (Tienari et al. 2000). The parental communication patterns were also evaluated by using the Rorschach test.

The evaluations of the adoptees’ psychiatric status and thought disorders were part of the study. The psychiatric assessment included personal interviews, a review of possible hospital records and registers, and interviews with family members and other informants. A psychological evaluation, including an individual Rorschach test, was also performed. All evaluation procedures were carried out in the adoptive families’ home.

The adoptees were independently re-examined in the same manner after a median interval of 12 years (Interquartile range, IR=8-15). Thereafter, the adoptees’ psychiatric diagnoses and diagnostically relevant information were followed up until the end of the year 2000 from national health and hospital registers. The median follow-up period was 18 years (IR=15-21). The follow-up interview schedules included an expanded lifetime version of the Present State Examination (Wing et al. 1974), the Structured Clinical Interview for DSM-III-R Personality Disorders (Spitzer & Williams 1986), and the Structured Interview for Schizotypy (Kendler et al. 1989).

4.3 Study samples in the original publications I-IV

Study sample in original publication I. The study sample included the adoptees without any psychiatric disorder at the initial assessment who had been administered the Rorschach test (n=171). Of these subjects, 75 were HR and 96 were LR adoptees. The median age of the adoptees was 21 years at the initial assessment (Interquartile range, IR=16-29) (mean=23, sd±9.2), 34 years at follow-up assessment (IR=28-43) (mean=35, sd±9.3), and 42 years at register follow-up (IR=35-50) (mean=42, sd±9.4). Their median age at placement in the adoptive families had been 12 months (IR=5-24) (mean=17,
there were 90 female and 81 male adoptees. The social status of the adoptive families was rated by using a Finnish classification of the main provider’s occupation and education (Handbook for Office of Statistics 1983). This classification is based on the social status of occupations. The first group included people in managerial positions; the second included entrepreneurs, foremen, and higher officials; the third included skilled workers and lower officials; and the fourth comprised unskilled workers. Accordingly, 11% of the families were rated as being in social class I, 47% in class II, 37% in class III, and 5% in class IV. The median follow-up interval in this subsample was 12 years (IR=7-15) (mean=11, sd±4.1). There were no statistically significant differences in the demographic variables (age, age at placement, gender, and social group) between the HR and LR adoptees. A comparison of the demographic variables of the adoptees in this subsample and in the whole sample revealed no statistically significant differences, except in the adoptees’ age. The adoptees in this study were younger (median age=21 years, IR=16-29) than those in the whole sample, and this variable was therefore controlled in the multivariate model (logistic regression analysis).

Study sample in original publications II-III: This subsample included the 158 adoptees whose thought disorder had been assessed by Thought Disorder Index (TDI) both at the baseline of the study and at follow-up. A further inclusion criterion was that the Rorschach records had been tape-recorded and transcribed. Of these subjects, 78 were high-risk (HR) and 80 low-risk (LR) adoptees. The median age of the adoptees was 22 years at the initial assessment (IR=17-32) (mean=25, sd±9.8) and 36 years at the follow-up assessment (IR=31-45) (mean=37, sd±9.8). Their median age at placement in the adoptive families was 13 months (IR=6-24) (mean=17, sd±13.4). There were 86 female and 72 male adoptees. The distribution of the social groups of the adoptive families were as follows: social group I 13%, social group II 48%, social group III 32%, and social group IV 7%. The median follow-up interval in this subsample was 12 years (IR=8-14) (mean=11, sd±3.8). A comparison of the demographic variables of the adoptees in this subsample and in the whole sample revealed no statistically significant differences. The HR adoptees did have significantly more psychiatric disorders than the LR adoptees at follow-up (p=.01; χ² test, two-tailed significance). (II, III Table 1)

Study sample in original publication IV: This study sample included the adoptees whose thought disorder had been assessed at both initial and follow-up evaluations by using the Thought Disorder Index (TDI). The inclusion criterion was that the Rorschach records had been tape-recorded and transcribed. Furthermore, the assessment of communication deviance (CD) of both adoptive parents was relevant. Three single-parent families who had never had an adoptive father were also included. In these cases, the CD of the tested adoptive mother was multiplied by two to get a CD score comparable to two parents’ combined CD score. The final subsample included 89 adoptees. Of the subjects, 38 were high-risk (HR) and 51 low-risk (LR) adoptees. The median follow-up interval in this subsample was 13 years (IR=9-14) (mean=12, sd±3.6). The adoptees’ median age was 18 years at the initial assessment (IR=16-23) (mean=20, sd±6.7) and 33 years at the follow-up assessment (IR=28-37) (mean=33, sd±7.9). Their median age at placement in the adoptive families was 12 months (IR=5-23) (mean=16, sd±13.5). There were 50 female and 39 male adoptees. The social group distribution of the adoptive families was as follows: social group I 9%, social group II 53%, social group III 34%, and social group
4.4 Variables

The Rorschach test was used to evaluate both the adoptees’ thought disorder and the adoptive parents’ communication patterns. The assessments were performed according to Klopfer & Davidson (1962) and Singer & Wynne (1986) in order to evaluate the degree of communication deviance (Appendix 1). The interview and testing sessions were tape-recorded, and the tapes were transcribed verbatim. The psychiatrists administered the Rorschach test with a complete set of ten cards. They were trained to do this by an experienced clinical psychologist (Karl-Erik Wahlberg).

The Thought Disorder Index (TDI) was used to assess the adoptees’ thought disorders. The scoring of TDI at the initial assessment was done by four experienced psychologists (Heljä Anias-Tanner, Pekka Koistinen, Taneli Tarvainen, Karl-Erik Wahlberg) pairwise unaware of the subjects’ relatedness to their biological and adoptive families or their psychiatric diagnoses. They only knew the subjects’ age, sex, and occupation. The TDI instrument has not been used before in Finland, and an enormous amount of work had to be done to adapt the TDI questionnaire to the Finnish language and culture (Wahlberg 1994, Koistinen 1995). A procedure of determining the reliability of the scores between the raters was also developed. These operations were done in co-operation with Dr. P.S. Holzman (one of the developers of the scale) and the Drs Wynne and Singer. In cases of disagreement concerning the scoring, a consensus score was negotiated between the psychologists (Wahlberg 1994). The scoring of TDI at follow-up was made by one psychologist (M. Metsänen), again unaware of the subjects’ relatedness to their biological and adoptive families and their psychiatric diagnoses. As at the initial assessment, she only knew the subjects’ age, sex, and occupation. Furthermore, she was blind to the ratings of the other psychologists. M. Metsänen was trained by K-E Wahlberg, P. Koistinen, and T. Tarvainen to use the TDI scoring system. In the training process, a large number of Rorschach records were reviewed, and the reliability study was done by using 20 records.

The communication patterns of the adoptive parents was assessed for Communication Deviance (CD). Dr Singer and Dr Wynne trained Dr Wahlberg in the scoring of CD, and the minor modifications of the scoring in Finnish compared to English were discussed (Wahlberg 1994). The scoring was carried out by two psychologists (K-E. Wahlberg, P. Keskitalo) unaware of the participants’ status in accordance with the manual of Singer and Wynne (1986). The Finnish translation of the CD manual was also produced as team work between the Finnish psychologists (K-E. Wahlberg, P. Keskitalo) and the Drs Singer and Wynne (Wahlberg 1994, Keskitalo 2000).

The adoptees’ psychiatric status was assessed by psychiatrists blind to their high-risk/low-risk status and other background information. The diagnoses were made according to the DSM-III-R criteria (American Psychiatric Association 1987).
4.4.1 Thought Disorder Index (I-IV)

The Thought Disorder Index (TDI) identifies 23 different items weighted along a continuum of severity (0.25, 0.50, 0.75 and 1.0) (Johnston & Holzman 1979, Solovay et al. 1987) (Table 1). The 0.25 severity level represents minor idiosyncrasies. It is very common that even healthy individuals make comments at the 0.25 level, especially under anxiety or fatigue. At the 0.50 severity levels, responses indicate a loss of mooring, shaky reality contact, emotional overreaction, and distinct oddness but are still in reality (Solovay et al. 1986). The 0.75 level is associated with psychotic disruption and characterized by instability of thinking and perception, absurdity, and an unrestrained combinatory tendency (Solovay et al. 1986). The 1.0 level represents responses completely out of reality (Solovay et al. 1986).

The developers of the TDI scale (Johnston & Holzman 1979, Holzman et al. 1986, Solovay et al. 1986) used weighted scores, and to calculate total TDI (TD\textsubscript{h}), the following formula was applied in this study:

\[
TD\textsubscript{h} = \frac{0.25 \times A + 0.50 \times B + 0.75 \times C + 1.00 \times D}{\text{Total number of Rorschach responses}} \times 100
\]

where A=the number of responses scored at the level 0.25, B=the number of responses scored at the level 0.50, C=the number of responses scored at the level 0.75, and D=the number of responses scored at the level 1.00.

Every severity level was calculated by summing up the relevant item scores and dividing the sums by the number of responses.

Holzman et al. (1986) constructed a set of factors from the TDI categories that discriminated best between schizophrenic and manic patients. They were able to construct three factors that were conceptually characteristic of schizophrenic patients: fluid thinking, confusion, and idiosyncratic verbalization. Each factor scale was calculated by summing up all relevant thought disorder item scores and dividing the sums with the number of responses. Fluid thinking includes the TDI items 9 (Relationship verbalization), 17 (Fluidity), and 21 (Contamination), confusion the items 5 (Word-finding difficulty), 12 (Confusion), 18 (Absurd responses), and 23 (Neologisms), and idiosyncratic verbalization item 4 (Peculiar verbalizations and responses).
Table 1. a) Thought Disorder Index levels and categories (I Table 1).

<table>
<thead>
<tr>
<th>0.25 level</th>
<th>0.50 level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inappropriate distance</td>
<td>8d. External-internal response</td>
</tr>
<tr>
<td>a. Increase of distance</td>
<td>9. Relationship verbalization</td>
</tr>
<tr>
<td>b. Excessive qualification</td>
<td>10. Idiosyncratic symbolism</td>
</tr>
<tr>
<td>c. Concreteness</td>
<td>a. Color symbolism</td>
</tr>
<tr>
<td>d. Overspecificity</td>
<td>b. Image symbolism</td>
</tr>
<tr>
<td>e. Syncretistic response</td>
<td>11. Queer responses</td>
</tr>
<tr>
<td>2. Flippant response</td>
<td>a. Queer expressions</td>
</tr>
<tr>
<td>3. Vagueness</td>
<td>b. Queer imagery</td>
</tr>
<tr>
<td>4. Peculiar verbalizations and responses</td>
<td>c. Queer word usage</td>
</tr>
<tr>
<td>a. Peculiar expression</td>
<td>12. Confusion</td>
</tr>
<tr>
<td>b. Stilted, inappropriate expression</td>
<td>13. Looseness</td>
</tr>
<tr>
<td>c. Idiosyncratic word usage</td>
<td>14. Fabulized combinations, impossible or bizarre</td>
</tr>
<tr>
<td>5. Word-finding difficulty</td>
<td>15. Playful combinations</td>
</tr>
<tr>
<td>6. Clangs</td>
<td>16. Fragmentation</td>
</tr>
<tr>
<td>7. Perseveration</td>
<td></td>
</tr>
<tr>
<td>8. Incongruous combinations</td>
<td></td>
</tr>
<tr>
<td>a. Composite response</td>
<td></td>
</tr>
<tr>
<td>b. Arbitrary form-color response</td>
<td></td>
</tr>
<tr>
<td>c. Inappropriate activity response</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.75 level</th>
<th>1.0 level</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Fluidity</td>
<td>21. Contamination</td>
</tr>
<tr>
<td>18. Absurd responses</td>
<td>22. Incoherence</td>
</tr>
<tr>
<td>19. Confabulations</td>
<td>23. Neologisms</td>
</tr>
<tr>
<td>a. Details in one area generalized to larger area</td>
<td></td>
</tr>
<tr>
<td>b. Extreme elaboration</td>
<td></td>
</tr>
<tr>
<td>20. Autistic logic</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. b) Thought Disorder Index levels and categories (I Table 1).

4.4.2 The validity and reliability of TDI

Thought Disorder Index (TDI) has been found to be a valid indicator of disordered thinking in schizophrenic patients (Holzman et al. 1986, Shenton et al. 1987, Hurt et al. 1983, Hain et al. 1995). The validity of TDI among schizophrenic patients has been confirmed: schizophrenic patients had elevated levels of thought disorder in all categories and at all severity levels, while normal controls demonstrated only rare instances of disordered thinking in most domains. Furthermore, different factors have turned out useful in distinguishing between diagnostic groups (Holzman et al. 1985, Shenton et al. 1987, Solovay et al. 1987). Studies on the reliability of TDI have reported the inter-rater reliabilities for total TDI scores to range from 0.82 to 0.93 (Johnston & Holzman 1979,
Solovay et al. 1986, Coleman et al. 1993). Furthermore, Solovay et al. (1986) reported individual scoring categories of 0.81, severity levels of 0.79, and various factor scores ranging from 0.84 to 0.89.

In this study, the intraclass correlation (ICC) between the pairs of psychologists at the initial assessment was 0.94 for TDR, 0.92 for 0.25 level, 0.92 for 0.50 level, 0.86 for 0.75 level, 0.66 for 1.0 level, 0.95 for fluid thinking, 0.33 for confusion, and 0.80 for idiosyncratic verbalization (n=59). The reason for the low reliability at the 1.0 level and in confusion was the restricted range in these categories (most subjects had 0 scores), not frequent disagreements between the scorers. Most of the records were randomly selected for reliability analysis, except the 15 records of schizophrenic patients. These were included in the reliability sample to ensure that there were also records with several types of thought disorder. Reliability was also checked (every 20. record) (n=31) at follow-up by the single-measure ICC between the two psychologists (M. Metsänen and K-E Wahlberg). The ICCs were 0.98 for TDR, 0.85 for 0.25 level, 0.92 for 0.50 level, 0.95 for 0.75 level, 0.83 for fluid thinking, 0.86 for confusion, and 0.49 for idiosyncratic verbalization. The 1.0 severity level was omitted because only one subject had scores at this level at the initial assessment.

4.4.3 Communication Deviance (IV)

Communication Deviance of both adoptive parents was assessed from tape-recorded individual Rorschach test protocols, which had been transcribed according to the standardized instructions (Appendix 1). In this study, only the CD scores recorded during the test part of the Rorschach were taken into account. The reason for this was that, in many families, the inquiry had been made only partly or not at all because of the informants’ fatigue. Furthermore, the inquiries often included a large proportion of the examiner’s speech, and it was thus difficult to evaluate reliably the subjects’ communication deviance.

Communication deviance (CD) includes 42 items (Singer & Wynne 1966, Singer et al. 1978, M.T. Singer and L.C.Wynne, unpublished 1986 version). These items have been divided into the following six groups (Table 2):

- Disruptions of the Task and the Relationship with the Tester
- Problems of Commitment and Sustaining Task
- Unclear and Unstable References
- Language Anomalies
- Reasoning Problems and Contradictions
- Indefinite and Cryptic Comments

Every item was searched from the transcribed text, and the presence of an item was scored as one point. All speech in a response given by the subject was recorded as a transaction. The total CD was calculated separately for each parent as the frequency of the scored CD items divided by the number of transactions in the individual Rorschach test. The quotients were used as the CD for each parental pair. The intra-class coefficient for CD between the psychologists in this study was 0.95 (51 records scored).
<table>
<thead>
<tr>
<th>CD categories</th>
<th>I Disruptions of the Task and the Relationship with the Tester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Put-down of the tester of the task</td>
</tr>
<tr>
<td></td>
<td>Interruptions of the examiner’s speeches</td>
</tr>
<tr>
<td></td>
<td>Nonverbal disruptive behavior</td>
</tr>
<tr>
<td></td>
<td>Environmental task disruptions</td>
</tr>
<tr>
<td></td>
<td>Disruptive humor</td>
</tr>
<tr>
<td></td>
<td>Other conversation stoppers</td>
</tr>
<tr>
<td></td>
<td>II Problems of Commitment and Sustaining Task</td>
</tr>
<tr>
<td></td>
<td>Abandoned, abruptly ceased, uncorrected remarks</td>
</tr>
<tr>
<td></td>
<td>Responses in negative form</td>
</tr>
<tr>
<td></td>
<td>Subjunctive, “if” responses</td>
</tr>
<tr>
<td></td>
<td>Question responses</td>
</tr>
<tr>
<td></td>
<td>Nihilistic remarks about task or life in general</td>
</tr>
<tr>
<td></td>
<td>Inability or failure to verify own responses</td>
</tr>
<tr>
<td></td>
<td>Forgetting responses</td>
</tr>
<tr>
<td></td>
<td>Answering unasked questions</td>
</tr>
<tr>
<td></td>
<td>Hopping around among responses</td>
</tr>
<tr>
<td></td>
<td>Negativistic, temporary card rejection followed by a response</td>
</tr>
<tr>
<td></td>
<td>Concrete-set responses</td>
</tr>
<tr>
<td></td>
<td>Assigning to other responsibility for the percept</td>
</tr>
<tr>
<td></td>
<td>III Unclear and Unstable References</td>
</tr>
<tr>
<td></td>
<td>Unintelligible remarks: a) brief, without context, or b) the total effect ending with an unintelligible referent</td>
</tr>
<tr>
<td></td>
<td>Unstable percepts</td>
</tr>
<tr>
<td></td>
<td>Inconsistent and ambiguous references</td>
</tr>
<tr>
<td></td>
<td>Incompatible alternatives or incompatible aspects of images</td>
</tr>
<tr>
<td></td>
<td>Derogatory, disparaging, critical disqualifications of a response</td>
</tr>
<tr>
<td></td>
<td>Nihilistic remarks</td>
</tr>
<tr>
<td></td>
<td>Partial disqualification</td>
</tr>
<tr>
<td></td>
<td>IV Language Anomalies</td>
</tr>
<tr>
<td></td>
<td>Ordinary words or phrases used oddly, incorrectly, or out of context</td>
</tr>
<tr>
<td></td>
<td>Odd sentence construction</td>
</tr>
<tr>
<td></td>
<td>Private, contrived terms and labeling</td>
</tr>
<tr>
<td></td>
<td>Clang associations, rhymed phrases, and word play</td>
</tr>
<tr>
<td></td>
<td>Reiteration</td>
</tr>
<tr>
<td></td>
<td>V Reasoning Problems and Contradictions</td>
</tr>
<tr>
<td></td>
<td>Contradictory information</td>
</tr>
<tr>
<td></td>
<td>Retractions and denials</td>
</tr>
<tr>
<td></td>
<td>Odd, tangential, inappropriate responses or remarks</td>
</tr>
<tr>
<td></td>
<td>Peculiar logic; illogical combinations or percepts</td>
</tr>
<tr>
<td></td>
<td>Non sequitur reasoning</td>
</tr>
<tr>
<td></td>
<td>Assigning meaning on the basis of nonessential attributes of the cards</td>
</tr>
<tr>
<td></td>
<td>Contaminations</td>
</tr>
<tr>
<td></td>
<td>VI Indefinite and Cryptic Comments</td>
</tr>
<tr>
<td></td>
<td>Gross indefiniteness and lack of specificity</td>
</tr>
<tr>
<td></td>
<td>Cryptic remarks</td>
</tr>
<tr>
<td></td>
<td>Abstract, global terms and technical phrases</td>
</tr>
</tbody>
</table>
4.4.4 DSM-III-R diagnoses of the adoptees (I-IV)

The diagnoses of the adoptees were made according to the DSM-III-R criteria (American Psychiatric Association 1987) based on the personal interviews (Tienari et al. 2000). The interview schedules included an expanded lifetime version of the PSE (Wing et al. 1974), Structural Clinical Interview for DSM-III-R Personality Disorders (SCID-II) (Spitzer et al. 1989), and the Structured Interview for Schizotypy (SIS) (Kendler et al. 1989). The DSM-III-R diagnoses were made according to the best estimate of the most severe lifetime Axis I (clinical syndromes) or Axis II (developmental disorders and conditions, personality disorders) psychiatric disorder based on all available data (psychiatric hospital records, research interviews). Comorbid and supplementary diagnoses were also applied. The diagnoses were made at maximum certainty, i.e. the disorder had to be diagnosed as probable or definite. The kappa coefficient for inter-rater reliability varied between the different raters, ranging from 0.71 to 0.80 (Tienari et al. 2000).

Original paper I: The adoptees were divided into three major diagnostic groups. The diagnostic hierarchy of disorders was established in line with the suggestions of Kendler et al. (1996). The first group consisted of the subjects without psychiatric disorder (No Psychiatric Disorder, NPD) at either the initial or the follow-up assessment (n=130). The second group (n=33) consisted of adoptees with Any Other Psychiatric Disorder (AOPD) except the broad spectrum of schizophrenia at follow-up. The second group consisted of borderline (3), antisocial (2), narcissistic (2), histrionic (5), and obsessive-compulsive (2) personality disorders, personality disorder NOS (2), anxiety (6), alcohol (3), mild mood (6), and dysthymic (2) disorders. The third group comprised subjects with Broad Schizophrenia Spectrum Disorders (BSSD) (n=8) and included cases with schizophrenia (1), paranoid (2), avoidant (2), and schizoid (1) personality disorders, bipolar psychosis (1), and depressive psychosis (1). The second and third groups together constituted the group of adoptees with Any Psychiatric Disorder (APD).

Original paper II-III: The study sample was divided into two diagnostic groups. The first group consisted of adoptees without Any Psychiatric Disorder (No Psychiatric Disorder, NPD) (n=87). All possible diagnoses were excluded from the NPD group in order to study the stability of TDI in a maximally healthy sample. The second group included adoptees with Any Psychiatric Disorder (APD) (n=87). The distribution of the APD group was as follows: schizophrenia (3), schizotypal (1), paranoid (2), schizoid (2), avoidant (4), antisocial (6), borderline (7), narcissistic (4), histrionic (5), dependent (2), and obsessive-compulsive (2) personality disorders, personality disorder NOS (4), bipolar (2), and depressive (1) psychosis, anxiety (10), alcohol (5), mild mood (7), dysthymic (5), eating (1), somatoform (2), and other (12) psychiatric disorders.

Original paper IV: The adoptees were divided into two diagnostic groups. The first group included adoptees without any psychiatric disorder (NPD; at the initial assessment n=74, at follow-up n=53). The second group consisted of adoptees with any psychiatric disorder (APD). The APD group included the adoptees with the following diagnoses at the initial assessment (n=15): schizophrenia (1), bipolar psychosis (1), antisocial (2), borderline (1), and dependent (2) personality disorders, personality NOS (1), anxiety disorders (3), eating disorders (1), alcohol use (1), and dysthymic disorder (2). Correspondingly, the distribution of the diagnoses at follow-up was as follows (n=36):
schizophrenia (1), paranoid (2), schizoid (1), antisocial (4), borderline (4), narcissistic (2), histrionic (3), avoidant (2), dependent (1), and obsessive-compulsive (1) personality disorders, personality disorder NOS (2), mild mood disorders (3), dysthymic disorder (1), and anxiety disorders (4).

4.5 Statistical methods

The group differences (two independent samples) in the categorical variables were assessed with the Chi-square $\chi^2$ test or Fisher’s Exact test and those in the continuous variables with Student’s t-test or the Mann-Whitney U-test. The differences between the initial and follow-up assessments (two related samples) in the continuous and categorical variables were analyzed with the pair-samples t-test and McNemar’s test, respectively (McCullagh & Nelder 1989, Bland 1995).

Analysis of covariance (ANCOVA) was used to examine group differences in the continuous variables after controlling for potential confounders. The Tukey-Kramer method was used as an adjustment procedure for multiple testing in ANCOVA. (Tabachnick & Fidell 1989). Logistic regression analysis was used to assess the statistical significance of an association of the independent categorical and continuous explanatory variables with the dichotomous outcome variable (Kleinbaum 1994). Receiver operating characteristic (ROC) curve analysis was done to find the best cut-off point for each TDI subscale (Gniner et al. 1981).

All statistical analyses were performed using the SPSS (version 9.0, 11.0, 12.0) and the SAS version 8.2 version (SAS Institute, Cary, NC).

4.6 Ethical considerations

The Finnish Adoptive Family Study was approved by the Ethics Committee of the Medical Faculty of the University of Oulu (Finland). The sample used in the study already existed. Thus, there was no need to meet personally the study subjects of the study. The ethical considerations of this study are related to the use of the achieved results in possible preventive work in the future. Collaboration with the people at risk to develop a psychiatric disorder at follow-up and their relatives is extremely important. The goal of preventive work is not to control their lives but to provide ways to support their mental health. The relatives of these persons could also learn new ways to help their family member at risk. Furthermore, it is essential to emphasize that not all people with risk factors eventually develop a psychiatric disorder.
4.7 Personal involvement

I have been participating in the Finnish Adoptive Family Study of Schizophrenia since 2000. I have scored all follow-up TDI records, completed the reliability studies of the follow-up TDI records, performed statistical analyses, interpreted the results, and written all manuscripts with consultation of co-workers.
5 Results

5.1 Premorbid signs of thought disorder and psychiatric disorder at follow-up (I)

High scores at the initial assessment were shown to be statistically significantly more common among the adoptees with a follow-up diagnosis of ‘Any Psychiatric Disorder’ (APD, n=41) than among the adoptees with ‘No Psychiatric Disorder’ (NPD, n=130) at follow-up on the following TDI measures: TDR (APD vs. NPD, 61% vs. 43%, χ² test, df=2, p=.05), the 0.50 severity level (71% vs. 51%, χ² test, df=2, p=.03), and idiosyncratic verbalization (63% vs. 40%, χ² test, df=2, p=.01) (Table 2). These differences were especially prominent in a comparison of the adoptees with ‘Any Other Psychiatric Disorder’ (AOPD, n=33) to the NPD adoptees: TDR (AOPD vs. NPD, 64% vs. 43%, χ² test, p=.04), 0.50 severity level (70% vs. 51%, χ² test, p=.05), and idiosyncratic verbalization (61% vs. 40%, χ² test, p=.03). No statistically significant difference in these TDI measures was seen between the adoptees with ‘Broad Schizophrenia Spectrum Disorder’ (BSSD, n=8) and the NPD adoptees.

The TDI scores of the high-risk (HR) adoptees were not associated with their subsequent psychiatric status. There was, however, a tendency toward a greater proportion of HR adoptees with high scores (as compared to low scores) at the initial assessment to have TD\(_R\) (63% vs. 37%), 0.25 severity level (95% vs. 5%), and idiosyncratic verbalization (68% vs. 32%) among the group of AOPD adoptees observed at follow-up. (Table 3: I Table 3; The table of the original article included a misprint in the result of the 0.25 severity level, which has now been corrected).
Table 3. Percentage (%) and number (n) of high and low initial TDI variables of the high-risk adoptees in the different groups of mental disorders (n=75)(I Table 3)

<table>
<thead>
<tr>
<th>TDI variables</th>
<th>NDPa</th>
<th></th>
<th>AODPb</th>
<th></th>
<th>BSSDc</th>
<th></th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=50 (67%)</td>
<td></td>
<td>n=19 (25%)</td>
<td></td>
<td>n=6 (8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDR</td>
<td></td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>high</td>
<td>48.0</td>
<td>24</td>
<td>63.2</td>
<td>12</td>
<td>50.0</td>
<td>503</td>
<td></td>
</tr>
<tr>
<td>low 0.25</td>
<td>52.0</td>
<td>26</td>
<td>36.8</td>
<td>7</td>
<td>50.0</td>
<td>3</td>
<td>0.33</td>
</tr>
<tr>
<td>high 0.50</td>
<td>88.0</td>
<td>44</td>
<td>94.7</td>
<td>18</td>
<td>100.0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>low 0.75</td>
<td>12.0</td>
<td>6</td>
<td>5.3</td>
<td>1</td>
<td>0.0</td>
<td>3</td>
<td>0.41e</td>
</tr>
<tr>
<td>fluid thinking</td>
<td></td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>high</td>
<td>30.0</td>
<td>15</td>
<td>31.6</td>
<td>6</td>
<td>16.7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>low 0.50</td>
<td>70.0</td>
<td>35</td>
<td>68.4</td>
<td>13</td>
<td>83.3</td>
<td>5</td>
<td>0.86</td>
</tr>
<tr>
<td>confusion</td>
<td></td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>high</td>
<td>12.0</td>
<td>6</td>
<td>0.0</td>
<td>0</td>
<td>16.7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>low 0.50</td>
<td>88.0</td>
<td>44</td>
<td>100.0</td>
<td>19</td>
<td>83.3</td>
<td>5</td>
<td>0.41e</td>
</tr>
<tr>
<td>idiosyncratic</td>
<td></td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>verbalization</td>
<td></td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>high</td>
<td>50.0</td>
<td>25</td>
<td>68.4</td>
<td>13</td>
<td>66.7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>low 0.50</td>
<td>50.0</td>
<td>25</td>
<td>31.6</td>
<td>6</td>
<td>33.3</td>
<td>2</td>
<td>0.14</td>
</tr>
</tbody>
</table>

a no psychiatric disorder at the initial assessment and at follow-up
b no psychiatric disorder at the initial assessment and any other psychiatric disorder at follow-up
c no psychiatric disorder at the initial assessment and broad schizophrenia spectrum disorder at follow-up
d no psychiatric disorder at the initial assessment and any psychiatric disorder at follow-up
e Fisher’s exact test

Furthermore, 87.5% of the low-risk (LR) adoptees with a follow-up diagnosis of APD (n=16) had high scores on the 0.50 severity level at the initial assessment, while the respective proportion of high scores among the NPD adoptees (n=80) at follow-up was 51% ($\chi^2$ test, $p=.01$). This difference was especially obvious among the adoptees in the AOPD group (n=14) (AOPD vs. NPD, 86% vs. 51%, $\chi^2$ test, $p=.02$). Similarly to the HR adoptees, high scores on the TDI measures at the initial assessment were found to be more common among the LR adoptees with a follow-up diagnosis for mental disorders (I Table 4).

Logistic regression analysis was used to predict the follow-up psychiatric status of the adoptees with genetic liability for schizophrenia and different TDI variables measured at the initial assessment. The statistically significant associations are presented in Table 4.
Table 4. Adjusted odds ratios (OR) for different high TDI scores of the adoptees with predictors of genetic liability for schizophrenia at the initial assessment and interaction of TDI scores and genetic liability for any psychiatric disorder (APD) at follow-up.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>high TDI</td>
<td>2.20</td>
<td>1.06-4.58</td>
<td>0.04</td>
</tr>
<tr>
<td>genetic liability</td>
<td>3.34</td>
<td>1.04-10.81</td>
<td>0.04</td>
</tr>
<tr>
<td>interaction for TDI and genetic liability</td>
<td>0.61</td>
<td>0.13-2.86</td>
<td>0.53</td>
</tr>
<tr>
<td>high 0.50 severity level</td>
<td>2.68</td>
<td>1.23-5.85</td>
<td>0.02</td>
</tr>
<tr>
<td>genetic liability</td>
<td>8.87</td>
<td>1.72-45.63</td>
<td>0.01</td>
</tr>
<tr>
<td>interaction for 0.50 severity level and genetic liability</td>
<td>0.20</td>
<td>0.03-1.31</td>
<td>0.09</td>
</tr>
<tr>
<td>high idiosyncratic verbalization</td>
<td>2.55</td>
<td>1.22-5.31</td>
<td>0.02</td>
</tr>
<tr>
<td>genetic liability</td>
<td>2.49</td>
<td>0.79-7.82</td>
<td>0.12</td>
</tr>
<tr>
<td>interaction for idiosyncratic verbalization and genetic liability</td>
<td>0.87</td>
<td>0.19-4.04</td>
<td>0.86</td>
</tr>
</tbody>
</table>

* Odds ratios with 95% confidence interval from a logistic regression model predicting the likelihood for the adoptee’s psychiatric disorder at follow-up with different TDI variables and the genetic liability for schizophrenia (high-risk, low-risk).

5.2 Stability of thought disorder (II, III)

The stability of the adoptees’ thought disorder between the initial and follow-up assessments was investigated using the total TDI scores, the severity levels (0.25, 0.50 and 0.75), and schizophrenia factors (fluid thinking, confusion, idiosyncratic verbalization) separately.

At the baseline, the variation of the total TDI score was shown to associate statistically significantly only with female gender (ANCOVA, F-statistic = 10.52, p = 0.002), but not with any other main effects (genetic risk, psychiatric status), age at the initial assessment, or any interactions between genetic risk, gender, and psychiatric status (Table 2). At follow-up, only the baseline TDI explained the variation of the total TDI at follow-up, but none of the main effects, age at follow-up, or interaction terms did (Table 5: II Table 3).
Table 5. Total TDI (TDI<sub>3</sub>) scores at follow-up assessment and their association with genetic risk, gender and psychiatric status of the adoptees. (II Table 3)

<table>
<thead>
<tr>
<th>TD&lt;sub&gt;3&lt;/sub&gt; at follow-up</th>
<th>N</th>
<th>Adj. mean (SE) for main effects</th>
<th>ANCOVA* F-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected model *</td>
<td>158</td>
<td></td>
<td>1.28</td>
<td>0.25</td>
</tr>
<tr>
<td>Main effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LR</td>
<td>80</td>
<td>7.19 (0.76)</td>
<td>0.04</td>
<td>0.84</td>
</tr>
<tr>
<td>HR</td>
<td>78</td>
<td>6.97 (0.77)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>86</td>
<td>6.55 (0.73)</td>
<td>0.92</td>
<td>0.34</td>
</tr>
<tr>
<td>Boys</td>
<td>72</td>
<td>7.61 (0.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychiatric status at follow-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No psychiatric disorder (NPD)</td>
<td>71</td>
<td>7.44 (0.81)</td>
<td>0.44</td>
<td>0.51</td>
</tr>
<tr>
<td>Any psychiatric disorder (APD)</td>
<td>87</td>
<td>6.71 (0.74)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic risk*Gender</td>
<td></td>
<td></td>
<td>0.26</td>
<td>0.61</td>
</tr>
<tr>
<td>Genetic risk*Psychiatric status</td>
<td></td>
<td></td>
<td>2.86</td>
<td>0.09</td>
</tr>
<tr>
<td>Gender*Psychiatric status</td>
<td></td>
<td></td>
<td>0.02</td>
<td>0.89</td>
</tr>
<tr>
<td>Genetic risk<em>Gender</em>Psychiatric status</td>
<td></td>
<td></td>
<td>1.46</td>
<td>0.23</td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDI&lt;sub&gt;3&lt;/sub&gt; at initial assessment</td>
<td></td>
<td></td>
<td>5.21</td>
<td>0.02</td>
</tr>
<tr>
<td>Age at follow-up</td>
<td></td>
<td></td>
<td>1.96</td>
<td>0.17</td>
</tr>
</tbody>
</table>

* ANCOVA was used to assess the statistical significance of the mean difference in follow-up scores between the groups (genetic risk, gender, psychiatric status) after adjustment for TDI at the initial assessment and the adoptee’s age at follow-up and correction for multiple comparisons with the Tukey-Kramer method.

The TDI scores at all TDI severity levels decreased between the initial and follow-up assessments (III Table 2). However, stability of the scores between the initial and follow-up assessments was seen at the 0.50 and 0.75 severity levels, but not at the 0.25 severity level (Figure 1; III Figure 1). The adoptees’ genetic or psychiatric status was not associated with the results (III Table 3).
Correspondingly, despite the decreased scores of all Holzman’s schizophrenia factors (III Table 4), only idiosyncratic verbalization was shown to remain stable between the initial and follow-up assessments, and this stability was not related to the adoptee’s genetic or psychiatric status. (Table 6: III Table 5)
Table 6. Association of Holzman’s schizophrenia factors on the TDI scale between the initial and follow-up assessments among the adoptees. (III Table 5)

<table>
<thead>
<tr>
<th>Schizophrenia factors</th>
<th>OR (95%CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid thinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1, unadjusted*</td>
<td>2.29 (0.87-6.05)</td>
<td>0.09</td>
</tr>
<tr>
<td>Model 2, adjusted **</td>
<td>2.34 (0.84-6.54)</td>
<td>0.11</td>
</tr>
<tr>
<td>Confusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1, unadjusted</td>
<td>2.22 (0.43-11.56)</td>
<td>0.34</td>
</tr>
<tr>
<td>Model 2, adjusted</td>
<td>2.05 (0.38-10.99)</td>
<td>0.40</td>
</tr>
<tr>
<td>Idiosyncratic verbalization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1, unadjusted</td>
<td>2.16 (1.13-4.15)</td>
<td>0.02</td>
</tr>
<tr>
<td>Model 2, adjusted</td>
<td>2.33 (1.19-4.53)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* Model 1: In each schizophrenia factor, binary logistic regression analysis (odds ratios, OR, and 95% confidence intervals, CI) was used to assess the association between the TDI at follow-up assessment (as outcome) and the TDI at baseline.

**Model 2: In each schizophrenia factor, binary logistic regression analysis (OR, 95% CI) was used to assess the association between the TDI at follow-up assessment (as outcome) and the TDI at baseline after controlling for gender, age, and genetic and psychiatric status and their interactions.

5.3 Association between parental Communication Deviance (CD) and adoptee’s thought disorder (IV)

The effect of the adoptive parents’ Communication Deviance (CD) on the adoptee’s total TDR scores was discussed in the original publication IV. The upper quartiles in the distribution of both the adoptees’ TDR and the parents’ CD were defined as the most deviant extremes of these variables (high TDR, high CD).

At the initial assessment, the proportion of adoptees with high TDR scores was about twofold if the adoptive rearing parents had high CD scores compared to the rearing parents with low CD scores (40.9% vs. 19.4%, χ²-test, p-value = 0.04). However, this difference in proportions was no longer present at follow-up (IV Table 2).

The LR adoptees reared by adoptive parents with high CD scores were shown to have a statistically significantly increased likelihood for high TDR scores at follow-up, while no association was seen in the HR adoptees. Additional analyses of male and female adoptees separately revealed no significant association between parents’ CD and adoptees’ TDR at follow-up. (Table 7: IV Table 3)
Table 7. Association between high Communication Deviance (CD) scores of adoptive parents at initial evaluation and likelihood for high scores in Thought Disorder Index at follow-up among low- and high-risk adoptees in the Finnish Adoptive Family Study of Schizophrenia (IV Table 3).

<table>
<thead>
<tr>
<th>Variable</th>
<th>LR adoptees (n=51)</th>
<th>HR adoptees (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td>High CD of adoptive parents</td>
<td>6.92 (1.30 - 36.89)</td>
<td>0.02</td>
</tr>
<tr>
<td>Psychiatric status (APD)</td>
<td>2.76 (0.56 - 13.60)</td>
<td>0.21</td>
</tr>
<tr>
<td>Gender, male</td>
<td>1.06 (0.23 - 4.81)</td>
<td>0.94</td>
</tr>
<tr>
<td>Age at follow-up</td>
<td>1.10 (0.98 - 1.23)</td>
<td>0.11</td>
</tr>
<tr>
<td>Social status of the adoptive</td>
<td>1.08 (0.23 - 5.04)</td>
<td>0.92</td>
</tr>
<tr>
<td>family</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: High TD, and high CD indicate the scores belonging to upper quartile of the distribution of a variable.
6 Discussion

6.1 Discussion of the results (I-IV)

6.1.1 Thought disorder as a prospective sign of mental disorder (I)

High scores on several TDI variables at the initial assessment predicted psychiatric disorder at follow-up in all adoptees. These results are consistent with the previous studies, which have suggested that thought disorder is related to psychiatric disorders (Holzman et al. 1986, Arboleda & Holzman 1985, Solovay et al. 1987, Koistinen 1995, Wahlberg et al. 2000). However, the early presence of any TDI variable did not alone predict broad schizophrenia spectrum disorder at follow-up. Thus, it is very important to recognize that elevated scores on different TDI variables can predict an increased risk to develop any psychiatric disorders, including schizophrenia spectrum disorders. The reason for the results obtained here could be the limited size of our sample. Only eight cases of broad-spectrum schizophrenia were present. Prediction was statistically unsuccessful among the high-risk (HR) adoptees because of the small number of cases, but high scores at the 0.50 severity level did predict mental disorders among the low-risk (LR) adoptees. However, HR adoptees did have a higher risk to have any psychiatric diagnosis at follow-up than LR adoptees. The result is consistent with the previous findings of the Finnish Adoptive Family Study of Schizophrenia (Tienari et al. 2000).

The 0.50 severity level had a predictive value. This result was not surprising in view of the content of this level. The 0.50 level includes responses related to loss of mooring, shaky reality contact, emotional overreactions, and distinct oddness (Solovay et al. 1986). These characteristics are considered precursors of future psychosis (Olin & Mednick 1986). The absence of predictive value at the other severity levels was also logical. The 0.25 severity level responses are very general, and most people occasionally make comments classifiable at the 0.25 level at times of fatigue or anxiety. Correspondingly, the 0.75 severity level is in itself an obvious sign of severe psychopathology and cannot therefore be an actually predictive sign of mental disorder.
Idiosyncratic verbalization was found to be related to other than broad schizophrenia spectrum disorders. The result is in line with the findings of Holzman et al. (1986), which showed idiosyncratic verbalization, fluid thinking, and confusion to be connected with serious mental disorders. Surprisingly, in this study, fluid thinking and confusion did not predict any psychiatric disorder. It was even found that the adoptees whose scores were low on the confusion subscale tended to have some other psychiatric disorder at follow-up, while the adoptees whose scores were high tended to have no diagnosis at all. This result can probably be explained by the large number of 0.25 severity level responses (word finding difficulty) on the confusion subscale in our sample. One theory is that healthy persons’ thought processing might include such content because they might want to achieve the best possible result in the test situation, and this might cause more processing to choose between different words.

### 6.1.2 Stability of thought disorder (II, III)

The number of thought disorders decreased during the follow-up period. Previous studies have shown that, in the longitudinal perspective, age had a positive effect on, for example, verbal ability (Schaie et al. 2004). Thus, the decrease of different TDI scores might also be related to the maturation of thought functions. Many adoptees were quite young (mean 25 years) at the initial assessment, and they grew up during the follow-up. Despite the decrease of thought disorders, the main finding was that the initial TDRI scores statistically significantly predicted the TDRI scores at follow-up, thus indicating the stability of thought disorder over time. Furthermore, a more specific result was that the stability of TDI seems to be related to the most severe categories of thought disorders.

The adoptees’ genetic or psychiatric status at follow-up did not affect the results. Thus, genetic risk alone is probably not the only crucial factor underlying the stability of thought disorder, but environmental factors are needed, too. This result is in line with the findings of Wahlberg et al. (2000), which showed idiosyncratic verbalization to be linked not only with the genetic risk but also with the communication patterns of the adoptive rearing parents. In our study, only genetic factors were taken into account. The absence of stability of thought disorders among psychiatric disorders could be explained by the low number of subjects with schizophrenia and other severe mental disorders in our study. Marengo & Harrow (1997) especially found thought disorder to be more prevalent and severe over time in schizophrenia than in nonschizophrenic disorders. Episodic thought disorder is common among other psychiatric diagnoses, such as nonpsychotic disorders (Marengo & Harrow, 1987).

An interesting gender-related result was obtained at the initial assessment. Women had significantly more TDRI scores than men. Previously studies have not addressed possible gender differences, and the reason for this result can hence only be speculated. Yurgelun-Todd et al. (2002) found sex-specific developmental differences in the relations between cerebral structure and function, and it is thus possible that, in the initial test situation, the anxiety experienced by the women was so high that it affected their thought processes. Previous studies have shown that some psychiatric disorders, such as eating disorders, anxiety disorders, and depression, including major depression, dysphoria, seasonal
affective disorder, posttraumatic stress disorder, panic disorder, and generalized anxiety disorder, are more common among women (Strober et al. 2000). Although the possible gender differences in the diagnoses were not investigated here, it could be speculated whether it is possible that, in a stressful situation, the thought functions of women are more vulnerable to confusion and more liable to thought disorders. Overall, differences in specific cognitive functions have been found, as women have relied on emotional content to a greater degree than men in processing information (Bremner et al. 2001).

The instability of mild thought disorders, such as 0.25 severity level responses, was not surprising because they are related to state-like features, such as anxiety and fatigue (Solovay et al. 1986). On the other hand, the lack of stability in fluid thinking and confusion was rather unexpected. However, these factors are especially related to schizophrenia, and our sample included only three subjects with schizophrenia diagnosed at the end of the follow-up. The content of fluid thinking represents thought disorders in which subject’s perceptions and thought processes are very unstable. Confusion also reflects very serious vagueness and disorientation in thinking. Thus, changes in thought disorders, which are characterized by rapid alterations, could also be very understandable. However, it is assumed that thinking processes are cognitive qualities and hence rather stable. In addition, the rates of occurrence of fluid thinking and confusion in our sample were distinctly lower than that of idiosyncratic verbalization. The subjects’ maturation could also explain the instability of fluid thinking and confusion. The adoptees grew older during the follow-up period, and their thought processes also became less fluid and confused. The abilities to manage stress and emotional conflicts develop later in life, and these abilities have been found to affect the development of cognitive functions (Rowe & Kahn 1987).

6.1.3 Parental communication deviance and thought disorders of offspring (IV)

Our result on the association between the adoptees’ thought disorder and parental Communication Deviance supported the earlier finding of Wahlberg et al. (1997). However, adoptive parents’ CD at follow-up only predicted thought disorders in the low-risk (LR) adoptees. It is significant that TDI scores decreased over time despite the stable nature of thought disturbances, possibly because of the maturation of thought processes. This phenomenon could also affect the result concerning the long-term association of CD and TDI scores. Another explanation could be the change in the adoptees’ environment. It is most probable that the adoptees had moved away from home during the follow-up period. Thus, they were no longer exposed to the CD of their adoptive parents, but possibly had a less confusing and thus more “protective” environment. Especially high-risk (HR) adoptees have been found to be more sensitive to their environment than LR adoptees (Wahlberg et al. 1997, Tienari et al. 2004). HR adoptees had more thought disorder than LR adoptees if their adoptive parents had high levels of CD. Correspondingly, HR adoptees had a lower incidence of thought disorders than LR adoptees if they were living with low-CD adoptive parents. Thus, it could be speculated whether the HR adoptees in this study were more sensitive to the possible positive
changes in their environment and therefore no longer displayed the association of TD_R
with CD at follow-up.

6.2 Strengths and limitations of the studies (I-IV)

The Finnish Adoptive Family Study of Schizophrenia is based on a study design that
provides a rare opportunity to investigate separately genetic and environmental factors,
but also to study the interaction of these variables. The most obvious strength of the
present studies is the possibility to use the unique data obtained during this adoption
study. One strength of the Finnish Adoptive Family Study of Schizophrenia is the long
follow-up time, and the present study has also taken advantage of this. In the previous
studies concerning the stability of thought disorder the follow-up periods have been
rather short (6-7 years). In our studies (II, III) the follow-up time was 11 years. The
Finnish Adoptive Family Study of Schizophrenia has also used extensive and reliable
methods. Furthermore, long follow-up data of Rorschach protocols are very rare. To our
knowledge, the Thought Disorder Index (TDI) has not been used before to assess the
stability of thought disorder in a longitudinal setting (II, III). TDI is a valid indicator of
disordered thinking in schizophrenia, and its reliability has ranged from 0.79 to 0.93.

Although the possibility to use the existing data from the Finnish Adoptive Family
Study of Schizophrenia offers many opportunities and strengths, it also poses some
limitations. First, the sample that offers the possibility to study the predictive value of
thought disorder includes only eight subjects in the broad schizophrenia spectrum group,
and the distribution of diagnoses in the group with any other psychiatric disorder was so
large that it was not possible to study which specific diagnoses the thought disorders were
related to (I). Severe mental disorders were also rare in our stability studies (II, III).
Especially the low number of schizophrenic subjects could clearly bias the results. Again,
the small number of cases in the specific diagnostic groups did not allow us to study the
putative association of different psychiatric disorders with the adoptees’ TDI level (II,
III). One further problem in our stability studies (II, III) is the fact that thought disorder
was evaluated twice. We have no way of knowing what had happened in the subjects’ life
during the follow-up time, and how the possible life events could affect the person’s
thought disorders. Furthermore, it was not possible to study reliably enough the
environmental factors in study IV. It would be especially important to know the adoptees’
place of residence during the follow-up, in order to study in more detail the high-risk
(HR) adoptees’ sensitivity to their environment (IV). The information concerning the
presence or absence of communication deviance in the environment would also be very
important. Unfortunately, the background data does not include information of the
adoptees’ place of residence. Thus, it is only possible to speculate whether or not it
affects the obtained results.
7 Conclusions

7.1 Main results

Early presence of thought disorder predicted a psychiatric disorder at follow-up (I). High scores on TDI variables (TD_R, 0.50 severity level, idiosyncratic verbalization) at the initial assessment were found more often among the adoptees with ‘Any Psychiatric Disorder’ (APD) at follow-up. This result was especially present among the adoptees with ‘Any Other Psychiatric Disorder’ (AOPD). High scores at the 0.50 severity level predicted mental disorders among the low-risk (LR) adoptees but not among the high-risk (HR) adoptees.

The predictive value of thought disturbances is apparent, as thought disorder turned out to be stable over time, especially in the most severe categories of thought disorder (II, III). Stability of the TDI scores between the initial and follow-up assessments was seen at the 0.50 and 0.75 severity levels, but not at the 0.25 severity level. Of Holzman’s ‘schizophrenia’ factors, only idiosyncratic verbalization was shown to remain stable between the initial and follow-up assessments. Again, it was shown that not only the genotype affects thought processes. There was an association between the adoptee’s thought disorder and the adoptive parents’ communication patterns in the longitudinal perspective (IV). However, the adoptive parents’ CD predicted thought disorders at follow-up only in the LR adoptees.

7.2 Clinical implications and implications for future research

Numerous studies have shown the presence of thought disorder in psychiatric disorders, especially in schizophrenia. Furthermore, previous studies have indicated that thought disorders occur most often during the acute phase of the illness and have both trait and state features (depending on the context). However, our results provide further evidence of the predictive value of thought disorder. Thought disorder could be one vulnerability sign of mental disorder, and is thus an important factor in the recognition of psychiatric disorders. Thus, it is essential to notice that other psychiatric disorders could actually be
recognized much earlier than we have believed. Furthermore, this study showed that especially severe thought disorders are not transient states but clearly have stable features. As it is stated in the current schizophrenia care guidelines,, cognitive deficits are common in first-episode psychosis, and it is therefore important to use neuropsychological assessment as one element of the whole assessment procedure, in order to recognize the high-risk subjects as early as possible (Suomen Psykiatriyhdistys, Käypää hoito, 2001). Thus, when a person has some specific psychic symptoms, the evaluation of thought disorder should be one tool in this assessment process. In order to accomplish a valid and reliable assessment of thought disorder, it is advisable to have trained psychologists elicit the Thought Disorder Index (TDI) from the Rorschach test.

It is important to remember that the presence of thought disorder is not a definitive precursor of later mental disorder. However, it is a critical sign that should be taken seriously, and possible interventions to clarify the individual’s thought processes should be designed. The connection between thought disorder and parental communication deviance in adoptive families provides ideas of how to influence the subject’s thought processes. If thought disorder occurs, it might be useful to give appropriate information to him/her and his/her environment (including the family) about the connection of thought disorder and psychiatric disorders and to instruct how, in practice, to clarify the environmental communication patterns in a such way that it helps to structure the person’s thought processes.

Future research is especially needed to clarify the environmental factors contributing to thought processes. A further challenge is to investigate what kind of interventions could be appropriately used to direct the person’s cognitive development, including thinking, into the right direction. More studies are also needed to investigate the prevalence of thought disorders in healthy populations.
References


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Rajarethinam RP, DeQuardo JR, Nalepa R & Tandon R. Superior temporal gyrus in schizophrenia: a volumetric magnetic resonance imaging study. Schizophrenia Research, 41: 303-312.


Singer M & Wynne L (1965b) Thought disorder and family relations of schizophrenics. IV results and implications. Archives of General Psychiatry 12: 201-212.


Storch A (1924) The primitive archaic forms of inner experience and thought in schizophrenia. Nervous and Mental Disease Monographs, New York.


Appendix 1. The writing instructions for the Rorschach test
(these instructions are not complete)

A. Typing: The typing must be verbatim. The typist should neither “fix up” odd statements nor distort through additions or omissions what a speaker has said. Reading the scoring manual which follows, permits typists to see how raters will eventually score the typescripts. The need for accurate transcribing of exact wording, word order and reasoning becomes clear. Two main types of transcribing errors, either correcting or distorting what a speaker actually said are to be avoided. These two problems are discussed below.

1. Avoid fixing and correcting. Do not correct into better English, nor make into better sense what is heard. Type without revising, substituting, or rearranging what is said by speakers. Both beginning raters and typists should be familiar with the typing remarks and descriptions which usually accompany viewing the Rorschach cards. Speakers are often pointing to parts of the blots or describing features of the cards which may be puzzling if one is not familiar with the typical exchanges which occur during the procedure. Do not “fix” either normal ellipses, breaks in thought, nor unusual phrasings such as illustrated below. Type what was actually said.

Here are a few examples of exact wordings, odd as they may be, which can tempt a typist to edit, but which should be typed as heard.

I see ribs and of the esophagus.
These are protozoa, though alive they are.
A mural (sic) with outstretched arms. (i.e., mural.)
That is a caricature (sic) of a man. (i.e., caricature)

To do with birth again I feel; they’re sort of uh, about to give birth itself
I think to one another.

2. Avoid distorting what is heard. If a typist faithfully avoid correcting what is heard, only two other major problems occur; either the typing of sounds which some persons append to words, or the failing to properly insert words which are said rapidly as a speaker glides from one word of phrase to the next. The following examples illustrate inclusion and omission errors:

a. Inclusion errors: Certain persons add an extra “uh” sound at the end of words terminating in hard sounds such as “k”, “g”, “ing”, and similar sounds. These sounds in ordinary conversation go unnoticed as part of the speaker’s regionalism or idiosyncratic style, but are audible on tapes and are to be ignored. However, those must be distinguished from those genuine separate “uh” sound which serve as space fillers and non-word verbalizations, and which should be included in the typescript.

(a) Original incorrect typing of “regionalism”: “That uh looks uh like a dog uh with uh collar.”
(b) Correct version gained from listening to tape with knowledge about the criteria above: “That looks like a dog, a dog with a collar”.

Inclusions such as in (a) above are not likely to be scored, but add to the work of reading and evaluating a record. For global ratings such can mislead a reader into thinking a speaker was extremely hesitant. The features below are likely to cause incorrect scoring with the manual which follows this introduction.
b. Omissions: Failing to hear words of failing to indicate phrasing and pauses can mislead raters.

(1) Word omissions: Short words are often elided as they are spoken. They are formed, but faint and blended into the preceding word’s ending or blended into the start of the following word. The sentences below suggest a cryptic speaker:

(a) “Two figures bending forward touching something, tearing apart”.

(b) “Here star which actually somewhat sevenpointed star”.

Rechecking the tape revealed the speaker had said many more words than a new typist had transcribed. She had not heard the underlined words which were present in elided form as shown here:

(a) “There are two figures bending forward touching something and tearing it apart.”

(b) “Here’s a star, which is actually, it’s somewhat a seven-pointed star.”

The speakers actually had fully formed and smoothly stated remarks.

(2) Phrasing omissions: A speaker groups his ideas in phrases and the typescript should reflect accurately these groupings. Example (a) below illustrates a failure to indicate phrasing. Example (b) shows what checking and audiotape revealed.

(a) “Two large feet with a show with a high heel”

(b) “Two large feet with uh, shoes with a high heel”

Here a reader sees a speaker corrected his thoughts and phrased clearly whereas the typing originally suggested one long peculiarly strung together utterance.

In summary, tapes must be checked, certain linguistic principles understood, and ideas properly grouped until a faithful transcript of the tapes occurs.
Original publications

This thesis is based on the following original publications, which are referred to in the text by the Roman numerals I-IV.


The original papers have been reprinted with the permission from Elsevier (I-III).

Original publications are not included in the electronic version of the dissertation.

893. Trias, Tuulikki (2006) Inter-twin and parent-twin relationships and mental health. A study of twins from adolescence to young adulthood


901. Riekki, Riitta (2006) Late dermal effects of breast cancer radiotherapy

902. Leskela, Hannu-Ville (2006) Human bone marrow stem cells—a novel aspect to bone remodelling and mesenchymal diseases


Miia Metsänen

THOUGHT DISORDER AS A PREDICTIVE SIGN OF MENTAL DISORDER

A STUDY OF HIGH-RISK AND LOW-RISK ADOPTEDS IN THE FINNISH ADOPTIVE FAMILY STUDY OF SCHIZOPHRENIA