ASSOCIATION BETWEEN COMMUNICATION DEVIANCE OF ADOPTIVE PARENTS AND FORMAL THOUGHT DISORDER OF ADOPTEE WHEN THE LENGTH OF PARENTS' SPEECH IS STANDARDIZED IN DIFFERENT WAYS

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Communication Deviance (CD) is considered to be a potential environmental factor in gene-environment interaction leading to offspring psychopathology, for example thought disorders and mental disturbances. The aim of this study was to examine the relationship between formal thought disorder of genetic high-risk and low-risk adoptees and Communication Deviance of adoptive parents when the length of their speech is standardized with spoken words (Word Count, WC).

The sample included a group of 58 adoptees at high genetic risk for schizophrenia spectrum disorders and a comparison group of 96 low-risk adoptees and their adoptive families. Communication Deviance (CD) of the adoptive parents was assessed by measuring their frequencies of CD. The scores were standardized by dividing them by the number of spoken words (Word Count, WC). Thought disorders of the adoptees were measured by the Index of Primitive Thought scale (IPT).

CD scores and WC measures correlated highly and significantly with each other. When CD was standardized by diving the score by the number of words, there was no interaction between genetic risk of adoptees and CD of adoptive parents that would explain thought disorder in adoptees.

Length of speech may be an essential part of Communication Deviance, indicating that high verbosity could in itself be unclear communication. Standardization of CD makes the scores of the subjects comparable, but dividing CD scores by word count seems to conceal the gene-environment interaction. Further, CD score standardized by dividing by number of transactions (responses) instead of words may represent CD more accurately, when each Rorschach response is thought as an attempt to share one meaning unit with another person. In this case CD score of a response reflects the failure in this sharing.

Keywords: Adoption study, communication deviance, gene-environment interaction, schizophrenia, thought disorders

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Vanhempien kommunikaatiohäiriön (Communication Deviance, CD) ja perinnöllisen altistuksen välisen yhdysvaikutuksen on katsottu olevan yhteydessä jälkeläisten psykopatologiaan (esimerkiksi ajatus- ja mielenterveyden häiriöihin). Tämän tutkimuksen tarkoituksena oli selvittää adoptiovanhempien kommunikaatiohäiriöiden yhteyttä perimän kautta skitsofreniaspektrihäiriöihin altistuneiden adoptiolasten ja heidän verrokkiadoptiolasten ajatushäiriöihin, kun vanhempien puheen pituutta kontrolloitiin puhuttujen sanojen lukumäärällä.

Tutkimusaineistoon kuului 58 korkean perinnöllisen riskin omaavaa ja 96 matalan riskin omaavaa adoptiolasta ja heidän perhettään. Adoptiovanhempien kommunikaatiohäiriöitä mitattiin laskemalla adoptiovanhempien kommunikaatiohäiriöiden (Communication Deviance, CD) frekvenssit. Pisteet standardisoitiin jakamalla ne sanojen lukumäärällä (Word Count, WC). Adoptiolasten ajatushäiriöitä mitattiin Index of Primitive Thought (IPT) asteikolla.

Kommunikaatiohäiriöpisteet ja sanojen lukumäärä korreloivat korkeasti ja merkitsevästi toistensa kanssa. Kun kommunikaatiohäiriöpisteet standardoitiin jakamalla ne sanojen lukumäärällä, adoptiolasten geneettisen riskin ja adoptiovanhempien kommunikaatiohäiriön välillä ei ollut yhdysvaikutusta, joka selittäisi adoptiolasten ajatushäiriötä.

Puheen pituus saattaa olla olennainen osa kommunikaatiohäiriötä, osoittaen että puheliaisuus voisi olla itsessään epäselvää kommunikaatiota. Kommunikaatiohäiriön standardisoiminen tekee koehenkilöiden tulokset vertailukelpoisiksi, mutta kommunikaatiohäiriöpisteiden jakaminen sanojen lukumäärällä näyttää piilottavan perimän ja ympäristön vuorovaikutuksen. Adoptiovanhempien kommunikaatiohäiriöpisteiden standardisoiminen jakamalla ne sanojen sijaan transaktioiden (vastauksien) lukumäärällä saattaisi kuvata kommunikaatiohäiriötä tarkemmin, kun jokainen Rorschachin vastaus ajatellaan yritykseksi jakaa yksi merkitysyksikkö toisen henkilön kanssa. Tällöin vastauksen kommunikaatiohäiriöpisteet kuvaavat epäonnistumista tässä jakamisessa.

Avainsanat: Adoptiotutkimus, ajatushäiriöt, kommunikaatiohäiriö, perimän ja ympäristön yhdysvaikutus, skitsofrenia

INTRODUCTION

Formal Thought Disorder (FTD) and cognitive impairments have been related to schizophrenia both as a possible vulnerability sign and a symptom of the illness. Since cognitive deficits are found among relatives of people with schizophrenia they might lead to an enhanced vulnerability to psychosis and schizophrenia or predict who develops the illness (Fusar-Poli, et al., 2007). Formal thought disorder increases the risk for mental illness and that might indicate vulnerability to schizophrenia spectrum disorders (Metsänen et al., 2004, Levy et al., 2010). Thinking disturbances have been searched from genetics (Shenton, Solovay, Holzman, Coleman, & Gale, 1989; Gooding et al., 2012) and family communication patterns (Wynne & Singer, 1963). Similarly, attempts to find causes for schizophrenia have been focused on finding out the effects of interaction between genetics and environmental factors. The research has largely consisted of biological studies (Kim, Zerwas, Trace & Sullivan, 2011) as well as family (Asarnow, Goldstein, & BenMeir, 1988; Miklowitz et al., 1991; Docherty, Cordinier, Hall & Cutting, 1999), twin (Docherty & Gottesman, 2000) and adoption studies (Tienari & Wynne, 1994). However, it is impossible to distinguish between genetic and environmental factors when biological parents also create the rearing environment. The Finnish Adoptive Family Study of Schizophrenia (Wahlberg et al., 1997; Wahlberg et al., 2004; Tienari et al., 2004) has provided a sample in which genetic and environmental factors can be disentangled: genetic predisposition comes from the biological parents, whereas growth environment is shaped by the adoptive parents.

   Findings from the Finnish Adoptive Family Study of Schizophrenia (Wahlberg et al., 1997; Wahlberg et al., 2004; Tienari et al., 2004) have consistently supported a hypothesis of gene-environment interaction (Kendler & Eaves, 1986; van Os, Krabbendam, Myin-Germeys & Delespaul, 2005), according to which adoptees with high genetic risk for schizophrenia are more often psychiatrically disturbed when reared in dysfunctional families, while a healthy rearing-environment appears to protect high-risk adoptees from disturbance (Tienari et al., 2004; Wahlberg et al., 2004).

Formal Thought Disorder as a vulnerability indicator

Previous studies of vulnerability signs of schizophrenia have focused on biological abnormalities (Carpenter & Buchanan, 1994). Despite the efforts of genomics, no single gene has been found to be responsible for schizophrenia (Kim, Zerwas, Trace & Sullivan, 2011; Collins et al., 2012). The effect of individual genes on risk for psychiatric disorders is small, often non-specific and difficult to distinguish from other biological or environmental factors (Kendler, 2005). Thus far, neuropsychological research has provided useful understanding to the vulnerability of schizophrenia. Certain cognitive deficits in information processing and attentional processing have been found to be present across populations at risk for schizophrenic disorder, with acute phase of schizophrenic psychosis and in remission after schizophrenic psychotic symptoms (Nuechterlein & Dawson, 1984). An inability to process information adequately and to sustain focal attention selectively may reflect vulnerability factors for schizophrenic disorders (Nuechterlein & Dawson, 1984; Nuechterlein, Edell, Norris & Dawson, 1986; Wahlberg et al., 1997; Cannon et al., 2000). Cannon et al. (2000) found cognitive dysfunction to be present in the childhood of adult people with schizophrenia. In other words, cognitive deficits may be both characteristic of schizophrenia and a sign of vulnerability to the disorder. Cognitive impairments have also been related to thought disorders. Nuechterlein et al. (1986) found that signal-discrimination deficits in the continuous performance test (CPT) and the forced-choice span of apprehension (FCSA) are associated with Formal Thought Disorder (FTD) and negative symptoms among 40 people with schizophrenia.

Levy et al. (2010) have reviewed the evidence for the relationship between thought disorder, language and communication disturbances and schizophrenia and concluded that thought disorders are related to schizophrenia. For example, children with schizophrenia spectrum disorders have been found to have significantly more thought disorders than depressed children (Tompson, Asarnow, Goldstein & Miklowitz, 1990). Metsänen et al. (2004) found that early presence of thought disorder among adoptees predicted psychiatric disorders at follow-up 11 and 16 years later. Thought disorder may also occur in other psychiatric disorders than schizophrenia with qualitative differences, for example in obsessive-compulsive (Lee, Kim & Kwon, 2005), bulimic (Smith, Hillard & Roll, 1991), autistic and multiple complex developmental disorders and in children with attention-hyperactivity disorders (van der Gaag, Caplan, Engeland, Loman & Buitelaar, 2005). In this study, Formal Thought Disorder is considered as a possible vulnerability indicator to psychotic symptoms.

The results have consistently shown that thought disorder consists of several factors and is a continuous variable (for example Harrow & Quinlan, 1977; 1985). Today, thought disorder is considered a broad phenomenon that includes not only impaired pace and flow of associations but also errors in syntax, word usage, inappropriate levels of abstracting, syllogistic reasoning, failure to maintain conceptual boundaries, and breakdown of the discrimination of internal from external perceptions (Kleiger, 1999). By thought disorder as a vulnerability indicator we mean subsyndromal thought disorder, not psychotically disorganized thinking, which is a clinical symptom (Wahlberg et al., 1997). In addition, although thought disorders are related to psychiatric disorders, small slippages in thinking may also occur in healthy individuals, especially during anxiety and fatigue (Solovay, Shenton & Holzman, 1987).

Communication Deviance as a risk indicator

Communication Deviance (CD) can be 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 (Wynne & Singer, 1963; Singer & Wynne, 1966). Non-adoptive family studies have shown that CD is not a specific risk indicator for schizophrenia and that its relationship to CD and other disorders is based on frequency and continuum (Wynne, Singer, Bartko & Toohey, 1977). It is hypothesized that CD is not equivalent to acute or chronic stressful life events or emotional states which would trigger symptomatic illness; instead, CD is related to long-term learning environment that can lead to disturbed thinking and inefficient information processing (Wahlberg et al., 1997). Further, the results of Velligan, Funderburg, Giesecke & Miller (1995) suggest that CD is relatively stable across time and that it is a trait attribute in people with schizophrenia and their mothers. Conforming evidence have been reported (Wahlberg et al., 2000; Roisko, Wahlberg, Hakko, Wynne & Tienari, 2011), and results support the assumption that frequency of CD is a trait rather than a state.

The research of Communication Deviance has focused on nonpsychotic qualities of communication that repeatedly distract a listener who is attempting to share a focus of attention with the speaker and comprehend what the speaker means (Singer & Wynne, 1966). It has been shown that frequent Communication Deviance in parent's speech may impact on child's cognitive development and predispose the child to schizophrenia-spectrum disorders (Roisko et al., 2011).

Miklowitz and Stackman (1992) have introduced four models explaining the connection between parental CD and offspring psychopathology. Firstly, parental CD may act as a psychosocial stress factor that has an effect on the offspring. Secondly, parental CD may be reaction to attributes of the offspring with schizophrenia and it follows that the causal relationship goes from offspring to parent. According to a third model, vulnerability indicators may be mediating variables that explain the association between parental CD and schizophrenia through shared genetic vulnerability. Finally, CD may result from a parent's own level of psychopathology – parents with high CD have more severe psychopathology than parents with low CD.

Support for the third model has come from a study of Docherty, Gordinier, Hall & Cutting (1999) who found that parents of people with schizophrenia had more Communication Deviance than parents in the control group. In addition, the more CD the parent had, the more severe the off-spring's symptoms were. These results support the idea that communication disturbances may be one manifestation of a stable genetic vulnerability to schizophrenia. The results of Roisko et al. (2011) do not support the second model, since the variability of parental CD was not explained by any attributes of the adoptees. However, these four models described above assume only one-way causality: CD causes schizophrenia, schizophrenia causes CD, or a possible underlying factor caus-es both (Roisko et al., 2011). Wynne & Singer (1963; Wynne et al. 1977) have assumed that both normal and psychopathological development of personality is determined by the dynamic interac-tion of both environmental factors and innate maturational factors. The current belief is that both genetic and environmental factors contribute to the development and onset of psychopathology (Tienari et al., 2004, Wahlberg et al., 1997, Wahlberg et al., 2004).

In previous studies, Communication Deviance scores have been standardized in two different ways. Firstly, dividing the total number of CD scores by the number of transactions (Wynne et al., 1977; Wahlberg et al., 1997; Wahlberg et al., 2000; Wahlberg et al., 2004). In the second model, CD scores have been divided by the number of words (Hirsch & Leff, 1975). The length of a trans-action increases the probability of CD occurrence. The difference between these methods is that in dividing by the number of words the length of the speech is controlled, whereas in dividing by transactions those who talk a lot tend to get higher CD scores (Hirsch & Leff, 1975).

The aim of this study is to investigate whether the length of speech (Word Count, WC) is a part of Communication Deviance scale indicating that persons who use many words when they produce a response (a transaction) have difficulties expressing themselves in a consistent and clear manner. The second aim is to compare the results of CD divided by the number of words with the study of Wahlberg et al. (1997) showing that Formal Thought Disorder of adoptees is connected with the Communication Deviance of their adoptive parents. The length of speech in that study was stand-

ardized by dividing the number of CD by the number of transactions. This connection is hypothesized to be more evident in the high-risk adoptees than in the low-risk adoptees.

METHOD

The sample of the study is part of the Finnish Adoptive Family Study of Schizophrenia and the same that was used by Wahlberg et al. in their 1997 publication. The original adoption sample comprised all women in Finland who had given their babies up for adoption and had been hospitalized with a diagnosis of schizophrenia or paranoid psychosis between the years 1960 and 1979 (Tienari, et al. 2000). There were numerous criteria to exclude mothers: an organic brain syndrome, severe mental retardation, primary alcoholism (preceding schizophrenia) or major physical illness. As for the adoptees, they were excluded if they had been adopted by relatives or by families living abroad. In addition, they were excluded if they had been adopted after the age of 4 years or if they had died before the study started. The final sample included 183 High genetic Risk (HR) children given up for adoption by 167 biological mothers. The genetic risk in the Finnish study has later been defined differently, basing on interviews and DSM III R diagnoses of the biological mothers (Tienari et al. 2000). However, in the 1997 paper of Wahlberg et al. the diagnoses of the biological mothers were stated according to Research Diagnostic Criteria scale (Spitzer, Endicott & Robins, 1978).

The comparison group consisted of adoptees whose biological mother had not been hospitalized because of schizophrenia or paranoid psychosis. The final comparison group was 204 adoptees with their families and 202 biological mothers.

The subsample in the present study included 58 High Risk and 96 Low Risk (LR) adoptive families (n=154) with at least one adoptive parent and an adoptee who had been tested by the individual Rorschach test (Wahlberg et al., 1997). Adoptees were aged 36 or younger because the communication styles of the adoptive parents of older adoptees may have changed since the years of rearing the adoptees. In the subsample, biological mothers of the index adoptees had had a DSM-III-R diagnosis of schizophrenia (50 mothers) or schizophrenia spectrum disorder (8 mothers).

The mean age of the adoptees in the subsample was 21 years (median = 19 years) (Wahlberg et al., 1997). The mean age of the adoptive fathers was 58 years (median = 56 years) and 56 years (median = 55 years) for the adoptive mothers. The age of the adoptees at the time of placement in the adoptive families was on average 15 months (median = 11 months). According to the Finnish four-level classification of socioeconomic status (Handbook of Statistics Finland, vol. 17, 1983)

13% of the families belonged to social class I, 48% to class II, 30% to class III, and 9 % belonged to class IV (Wahlberg et al., 1997).

Instruments

The adoptees and their adoptive parents were interviewed and tested with individual 10-card Rorschach test at their homes by psychiatrists who were blind to the index or comparison status of the offspring (Wahlberg et al., 1997). Interviews and test situations were tape-recorded and transcribed. The transcriptions were rated by psychologists who were blind not only to the high-risk or comparison status of the adoptees but also to whether the subjects were adoptees, biological or adoptive parents (Wahlberg et al., 1997).

Index of Primitive Thought (IPT). Friedman's (1952) Index of Primitive Thought scale (IPT) is believed to reflect developmentally lowest level of cognitive functioning (Goldfried, Stricker & Weiner, 1971) It includes three categories of Formal Thought Disorder: contamination (two separate, incompatible percepts are fused and attributed to the same blot area), confabulation (inappropriate attribution of a small area of the inkblot to a larger area) and fabulized combination (two percepts are combined because of contiguity, resulting in a percept that does not occur in nature). In the present study, each response in the transcribed Rorschach protocols was rated using these categories. After that, the total number of positive responses on the IPT was divided by the total number of Rorschach responses and then multiplied by 100. Consequently, the Index of Primitive Thought represents the percentage of Rorschach responses that reflect the lowest level of cognitive functioning.

The scoring of the IPT was performed by two research psychologists. Intraclass correlation coefficient (ICC) for the correlation between the two raters' scores was 0.91 across all Index of Primitive Thought items in 41 Rorschach protocols (Wahlberg et al., 1997).

Communication Deviance (CD). When Communication Deviance (CD) occurs, language is ambiguous or difficult to follow for the listener (Wahlberg et al, 1997). CD index measures the understandability of discourse and concerns especially the effect on the listener instead of the formal characteristics of the speaker's thinking. The categories of the CD are I) disruptions of the task and the relationship with the tester, II) problems of commitment and sustaining task set, III) unclear and unstable referents, IV) language anomalies, V) reasoning problems and contradictions and VI) indefinite and cryptic comments (Singer & Wynne, 1986). Although there is some overlap between

categories of Thought Disorder and Communication Deviance, many categories of communication deviance are not a sign of Thought Disorder or psychosis (Wahlberg et al., 1997).

CD of the adoptive parents was calculated separately for each parent as the frequency of scored CD categories in the test part divided by the number of spoken words (Word Count, WC) in the individual Rorschach test. The quotients were added together for each parental pair and the sum represented CD of the adoptive parents. The number of spoken words was counted by summing together the number of words in test situations for both adoptive parents. If there were missing values for either parent, the value of the other parent was multiplied by two.

ICC of 0.95 was obtained for the total CD scores for 51 protocols by two Finnish raters (Wahlberg et al, 1997). For the 26 categories of CD that occurred with a total frequency of more than 20 times in the 51 protocols, the mean ICC was 0.77. For only three, infrequently occurring categories the ICC was less than 0.60.

Statistical Analysis

The scores on the Index of Primitive Thought (IPT), CD and Word Count (WC) of the adoptive parents were not normally distributed (skewness ≥ 2 or kurtosis ≥ 7) and therefore non-parametric methods were used (Curran, West & Finch, 1996). The associations between different CD variables and Word Count was analysed with Spearman rank correlations when using continuous variables and with chi square test, Mann-Whitney U-test and logistic regression analysis when using categorical variables (Bland, 1995). IPT of the adoptees was categorized in 0 IPT and IPT greater than 0 groups. Communication deviance divided by Word Count was dichotomized by the median (Md= 0.15, IQR, Inter Quartile Range = 0.11 – 0.19). All odds ratios (OR) were derived from logistic regression models and were adjusted for the gender of the adoptees. The statistical software used in analyses was PASW Statistics, version 18.

RESULTS

Association between Communication Deviance scores, Word Count and standardized Communication Deviance measures

Spearman rank correlations were calculated (Table 1) between Communication Deviance (CD) of the adoptive parents and their spoken words (Word Count, WC). The correlations between adoptive parents' scores of CD and WC of all, High Risk (HR) and Low Risk (LR) cases were statistically significant. The corresponding correlations between CD scores and transactions were 0.39 (p < 0.01) for all, 0.35 (p < 0.01) for HR and 0.41 (p < 0.01) for LR cases. Further analyses showed that all correlations between CD and transactions were significantly (p < 0.01) lower than correlations between CD scores and Word Count. As shown in Table 1 the number of CD did not correlate very highly or at all with CD divided by WC. However, CD of the adoptive parents divided by the number of transactions of all, High Risk and Low Risk cases correlated significantly with the CD of the adoptive parents divided by the spoken words and also with the spoken words alone.

The result remained the same also when variables for CD, WC, CD/transactions and CD/WC were dichotomized by their medians (Md) as follows: Md of CD= 56.00 (IQR = 40.75 – 76.00), Md of WC= 753.50 (IQR = 557.75 – 1015.75), Md of CD/transactions = 3.66 (IQR = 2.65 – 4.56), Md of CD/WC = 0.15 (IQR = 0.11 – 0.19). The association between CD scores and WC was significant among all cases (χ^2 = 54.970, df = 1, p < 0.01), HR cases (χ^2 = 23.219, df = 1, p < 0.01) and LR cases (χ^2 = 33.366, df = 1, p < 0.01). Similarly, the association between CD/transactions and CD/WC was significant among all cases (χ^2 = 14.964, df = 1, p < 0.01), HR cases (χ^2 = 4.381, df = 1, p = 0.04) and LR cases (χ^2 = 10.518, df = 1, p < 0.01). Cross tabulation between CD/transactions and Word Count showed significant connection among all cases (χ^2 = 6.650, df = 1, p = 0.01), and HR cases (χ^2 = 5.784, df = 1, p = 0.02) but not among LR cases (χ^2 = 2.127, df = 1, p = 0.15). The association between CD and CD/WC was non-significant among all cases (χ^2 = 0.935, df = 1, p = 0.33), HR cases (χ^2 = 0.484, df = 1, p = 0.49) and LR cases (χ^2 = 0.293, df = 1, p = 0.59).

Table 1. Spearman rank correlations between Communication Deviance (CD) scores and spoken words (Word Count) of the adoptive parents.

	Word Count of the adoptive parents (WC)		CD / Word Count of the adoptive parents	
	r	p	r	p
CD of the adoptive parents (n=154)	.74	p < .01	.23	p < .01
CD of the HR adoptees' parents (n=58)	.75	p < .01	.33	p = .01
CD of the LR adoptees' parents (n=96)	.75	p < .01	.14	p = .17
CD / transactions of the adoptive parents (n=154)	.28	p < .01	.52	p < .01
CD / transactions of the HR adoptees' parents (n=58)	.39	p < .01	.57	p < .01
CD / transactions of the LR adoptees' parents (n=96)	.23	p < .01	.49	p < .01

Association between Communication Deviance of the adoptive parents and Index of Primitive Thought of the adoptee

The association between CD/WC of the adoptive parents and the Index of Primitive Thought of adoptees (IPT) was assessed with dichotomous variables when CD/WC was divided into two groups by the median (Md of CD/WC = 0.15) and IPT in zero (0) vs. 1 or more scores. Associations for all cases ($\chi^2 = 0.955$, df = 1, p = 0.33), for the HR cases ($\chi^2 = 0.653$, df = 1, p = 0.42) and for the LR cases ($\chi^2 = 0.325$, df = 1, p = 0.57) were non-significant. No significant association between CD/WC and IPT was found, either, when CD/WC was dichotomized by its upper quartile (Q_3 =

77.3): all cases ($\chi^2 = 5.058$, df = 2, p = 0.08), the HR cases ($\chi^2 = 1.806$, df = 1, p = 0.18) and the LR cases ($\chi^2 = 0.872$, df = 1, p = 0.35).

The association of the CD/WC of the adoptive parents with IPT of the adoptees was further analysed with a logistic regression analysis by adjusting for gender of the adoptee, genetic status (HR, LR) of the adoptee and the interaction between CD/WC of the adoptive parents and genetic status of the adoptees (Table 2). No statistically significant association of CD/WC of the adoptive parents to IPT of the adoptees was observed. Of covariates, only adoptee's gender was statistically significantly associated with IPT of the adoptees.

Table 2. Association of Communication Deviance divided by the Word Count (CD/WC) of the adoptive parents with the Index of Primitive Thought (IPT) of 154 adoptees after adjusting for gender, genetic risk for schizophrenia and interaction of CD/WC to genetic risk

| | Index of Primitive Thought (IPT) of adoptees | | |
| | Odds | 95 % Confidence | |
Variable	Ratio	Interval	p
CD/WC[1]			
of adoptive parents	1.31	0.57 to 3.00	0.53
Adoptee's gender: male versus			
female	0.45	0.24 to 0.88	0.02
Adoptee's genetic risk of schizo-			
phrenia: high-risk versus comparison subject	0.97	0.36 to 2.65	0.97
Interaction of adoptive parents' Communication Deviance and			
adoptee's genetic risk	1.13	0.29 to 4.46	0.86

[1] Cut-off point Md= 0.15 (IQR, = 0.11 – 0.19)

Further, the association of WC of the adoptive parents dichotomized by the median with the IPT of the adoptees (0 vs. 1 or more scores) was calculated and the results showed a statistically significant association only for HR cases (χ^2 = 4.060, df = 1, p = 0.04), but not in total sample (χ^2 = 2.652, df = 1, p = 0.10) and for LR cases (χ^2 = 0.293, df = 1, p = 0.59). When the association of WC of the adoptive parents dichotomized by the median to IPT of the adoptees (Table 3) was analysed with the logistic regression model adjusting for gender and genetic status (HR, LR) of the adoptees and the interaction between WC and genetic risk term, no significant association was found. Only gender of the adoptees was related with the IPT of the adoptees. When Word Count was entered to the model as continuous variable, a meaningful model could not be found.

Table 3. Odds ratios for high scores on Index of Primitive Thought (IPT) of 154 adoptees with predictors of Word Count (WC) of adoptive parents, gender, genetic risk for schizophrenia and interaction of WC and genetic risk

| | Index of Primitive Thought (IPT) of the adoptees | | |
| | Odds | 95 % Confidence | |
Variable	Ratio	Interval	p
Word Count (WC) of adoptive parents[1]	1.20	0.53 to 2.75	0.66
Adoptee's gender: male versus female	0.43	0.22 to 0.85	0.01
Adoptee's genetic risk of schizophrenia: high-risk versus comparison subject	0.73	0.29 to 1.84	0.50
Interaction of adoptive parents' Word Count and adoptee's genetic risk	2.81	0.69 to 11.47	0.15

[1] Cutt-off point Md= 753.50 (IQR= 557.75 – 1015.75)

Communication Deviance and Word Count of the adoptive parents in the High Risk and Low Risk groups

There was no statistically significant difference between HR and LR groups in CD/WC (Mann-Whitney U-test, U= 2404.00, p = 0.16) nor Word Count (U= 2519.50, p = 0.32) of the adoptive parents.

Distributions of scores on Communication Deviance of the adoptive parents for the High Risk and Low Risk groups

No significant difference between HR and LR adoptees groups was found in CD (dichotomized at median) of the adoptive parents (Table 4).

Table 4. Distribution of scores on Communication Deviance of the adoptive parents dichotomized by its median (Md = 56.00) for adoptees of Low and High genetic Risk

	Low scores of CD	High scores of CD	Total
LR adoptees	51 (53.1 %)	45 (46.9 %)	96
HR adoptees	27 (46.6 %)	31 (53.4 %)	58
Total	78 (50.6 %)	76 (49.4 %)	154

(χ^2 = 0.625, df = 1, p = 0.43)

DISCUSSION

The first aim of the study was to examine whether Word Count (WC) of adoptive parents is a part of Communication Deviance (CD) indicating that a person who speaks a lot produces more CD. The second aim was to see whether the Formal Thought Disorder of the adoptees is connected with the CD divided by the WC of their adoptive parents. Some discussion is also presented addressing the use of different methods to standardize the length of speech when CD was assessed.

The association between Communication Deviance and length of speech

CD and WC correlated significantly with each other, implying that CD and WC are connected with each other. WC is probably part of the CD scale. The associations between CD scores and Word Count are similar as found in the study of Hirsch and Leff (1975). Our result indicates that Word Count may be part of the Communication Deviance scale and could be included as an item of the scale, which was our first aim of the study. In order to confirm our finding, however, further analyses of the CD scale with appropriate statistical methods and larger samples are needed.

Our results indicate as well that the High Risk adoptees do not increase the verbosity of their adoption parents as the Word Count of the adoptive parents was equal in both HR and LR groups. Neither do they increase CD of their adoptive parents because CD was equally distributed in both research groups. This supports the idea that parental CD is not a reaction to the attributes of the offspring with schizophrenia as stated in the second hypothesis of Miklowitz and Stackman (1992).

The frequency of CD of adoptive parents and CD/WC of adoptive parents seem to represent different phenomena because there is no statistical connection between them. However, CD/transactions have a low association with Word Count and a high association with CD/WC. Further analyses are needed to explore the statistical properties of WC and CD/WC in a more detailed manner.

The results supported the first hypothesis that Communication Deviance depends partly on the number of spoken words, suggesting that the length of speech may be part of Communication Deviance scale.

Connection between Formal Thought Disorder and Communication Deviance

The second aim of the study was to compare the results of the study by Wahlberg et al. (1997) that Formal Thought Disorder of the adoptees is connected with the Communication Deviance (CD) of their rearing parents to our results, where a different method of standardization of CD was used. In the study of Wahlberg et al. the length of speech was standardized dividing the CD scores by the number of transactions (number of Rorschach responses). When the CD scores of the adoptive parents were standardized by diving them by the number of spoken words, there was no interaction between genetic risk of the adoptee and CD of the adoptive parents. Thus, the previous significant result in the High Risk group (Wahlberg et al., 1997) disappeared. Lacking the connection between parental CD and children's symptoms, our result would not support any of the models presented by Miklowitz & Stackman (1992), but is consistent with the study of Hirsch and Leff (1975).

Thus, the result did not support our second hypothesis that the Formal Thought Disorder of the adoptees is connected with the CD divided by the WC of their adoptive parents. However, it might be the standardization method (dividing CD scores by Word Count) which makes the association invisible.

Standardization methods of the length of speech

This contradiction between different ways of standardizing CD gives rise to an important question as to which is the correct way to standardize CD scores. Hirsch and Leff (1975) have stated that among people who give longer replies in the Rorschach test, the probability of CD tends to increase, while in shorter responses CD does not have the same opportunity to occur (Hirsch & Leff, 1975). They thought that CD is basically a reflection of the number of words spoken. Based on our result we suggest that WC, per se, may be an essential part of CD. This means that a person who expresses himself with long speeches has difficulties in being clear, consistent and understandable for others as stated in the definition of Communication Deviance. Numerous words or long speeches are not essential as such; what is essential is that other persons have difficulty to follow and understand long speech which contains expressions classified as Communication Deviances. The CD scale describes in detail what kind of communications are disturbing for the listener and hinder him from understanding what was said. From a mathematical point of view, dividing a variable (number of

CD) with another highly correlating variable (Word Count) leads to a result where in some cases values approaches constant or variation between observations vanishes or becomes very small, which may mean that CD/WC cannot differentiate thought disorder between the specific subgroups of adoptees. This needs, however, more statistical consideration and confirmation in other study samples in future.

The length of speech was also controlled by dividing the CD scores by transactions (the number of Rorschach responses). The correlation between transactions and CD scores was significantly lower than the correlation between CD scores and Word Count. This may indicate that transactions do not measure CD, and that may therefore be a suitable way to control the length of speech.

Standardization by dividing CD by the number of transactions may also be a correct way from a conceptual point of view, because the method does not hide the effect of long speeches, which may be a part of the CD scale as stated above. Payne, Caird & Laverty (1964) have included high verbosity in over-inclusive thinking. CD scores are thought to represent the amount of failures in sharing the focus of attention and meaning (Singer & Wynne, 1966; Wynne et al., 1977). In the test situation described above, each response can be thought as an attempt to share one meaning unit, and CD score of one response reflects the failure to share the meaning in question. Therefore, CD score standardized by dividing by number of transactions (responses) would represent Communication Deviance in this sense more accurately. When dividing by the number of words this aspect of CD remains invisible.

Based on our results, we think that it is justifiable to suggest that dividing CD by the number of transactions may be the correct way to standardize the length of speech.

Limitations of the study

To draw more reliable conclusions about the Index of Primitive Thought as a vulnerability indicator of schizophrenia, thought disorder should be found before the clinical diagnosis of the illness; this was not done in this study with the IPT, since we do not know all the diagnoses of the adoptees. The results of follow-up studies using Thought Disorder Index, however, suggest that thought disorder is a plausible vulnerability indicator of psychiatric symptoms (Nuechterlein et al., 1986; Wahlberg et al., 1997; 2000; Metsänen et al., 2004). Hospital records are being followed at the moment to make diagnostic assessments after the adoptees with thought disorders have passed through the primary risk age for clinical schizophrenia.

As mentioned above, CD scale has not yet been analysed with careful statistical methods. Thus, the position of length of speech in relation to Communication Deviance remains somewhat open.

Conclusions

On the basis of our results it appears that the length of speech may be part of Communication Deviance scale. There also seem to be other factors, probably a combination of gene-environment interaction, that seem to be harmful for thought development in children. Further, even though a long response does not necessarily reflect failures in communication, in some cases the scores on Communication Deviance are higher than in others. Standardizing by dividing CD scores by the number of spoken words or the number of transactions makes it possible to compare the results of different subjects with each other. However, the standardization of the CD with the Word Count makes the association between the CD of the adoptive parents and thought disorder of the adoptee invisible.

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