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Impact of institutional care on attachment disorganization and insecurity of Ukrainian preschoolers: Protective effect of the long variant of the serotonin transporter gene (5HTT)

Marian J. Bakermans-Kranenburg,[1] Natasha Dobrova-Krol,[1] and Marinus van IJzendoorn[1]

Abstract

Institutional care has been shown to lead to insecure and disorganized attachments and indiscriminate friendliness. Some children, however, are surprisingly resilient to the adverse environment. Here the protective role of the long variant of the serotonin receptor gene (5HTT) is explored in a small hypothesis-generating study of 37 Ukrainian preschoolers reared in institutional settings or in their biological families. Attachment was observed with the Strange Situation Procedure, and indiscriminate social behavior was assessed in a semistructured interview with the caregiver. We found a moderating role of 5HTT for the association between adverse environment and attachment disorganization. Children with the *ss* or *sl* genotype showed more attachment disorganization and less attachment security when they grew up in an institution compared to children who lived in a family, but children who were homozygous for the *l* allele appeared to be protected against the adverse institutional environment on attachment. We conclude that not all children may be equally vulnerable to extremely adverse rearing experiences.

Keywords

attachment disorder, deprived children, developmental psychopathology, orphans, serotonin receptor gene 5HTT

Children exposed to institutional care do not receive the type of nurturing and stimulating environment needed for healthy psychological development. They show delays and maladaptation in various domains of development as is evident from a range of studies (see for a review van IJzendoorn, Palacios, et al., in press). Children growing up in institutions are substantially delayed in IQ compared with children reared in biological families or with foster parents, their physical growth is retarded (Johnson & Gunnar, in press), they show atypical patterns of diurnal cortisol activity (Carlson & Earls, 1997; Gunnar, 2000), and high rates of insecure attachment—especially high rates of disorganized attachment (Dobrova-Krol, van IJzendoorn, Bakermans-Kranenburg, & Juffer, 2010; Herreros, 2009; Steele, Steele, Jin, Archer, & Herreros, 2009; The St. Petersburg–USA Orphanage Research Team, 2008; Vorria et al., 2003; Zeanah, Smyke, Koga, Carlson, & The BEIP Core Group, 2005).

Overall, the distribution of attachment classifications of institution-reared children of 17% secure, 6% avoidant, 5% resistant, and 73% disorganized attachments to the favorite caregiver deviates markedly from the typical distribution (van IJzendoorn, Palacios, et al., in press). Indeed, almost three-quarters of the institution-reared children are considered disorganized. The lower prevalence of secure attachment and the higher rate of disorganized attachment in an institutional environment compared to those in family-reared normative groups are to be expected because of the element of structural neglect that is inherent to most institutional child rearing settings.

It is however clear that not all children exposed to similar institutional circumstances develop in a similar way. Heterogeneity in terms of both degree and type of impairment is characteristic of the developmental outcomes of children who experience early institutionalization. Even children reared in the same institutions, and therefore presumably subject to the same caregiving circumstances, do not show the same developmental outcomes (Smyke et al., 2007; Vorria et al., 2003; Zeanah et al., 2005). This is referred to as multifinality, that is, a particular adversity (e.g., institutional rearing) does not necessarily lead to the same outcomes in each individual (Cicchetti & Rogosch, 1996), due to nonshared environmental effects and child-related resilience or protective mechanisms (van IJzendoorn, Palacios, et al., in press). Child-based genetic factors may operate to reduce or increase the vulnerability of a particular child to risk in general, to institutional deprivation particularly, and/or to the effects of institutional deprivation on specific outcomes. The evidence that genetic factors can moderate pathways between social risk and developmental outcome is growing (e.g.,

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Bakermans-Kranenburg & van IJzendoorn, 2006, 2007; Belsky & Pluess, 2009).

A number of molecular genetic studies have indicated that the long variant of the 5HTT serotonin transporter gene may function as a protective factor in the domain of socioemotional development (e.g., Caspi et al., 2003; Gilissen, Bakermans-Kranenburg, van IJzendoorn, & Linting, 2008). The serotonin transporter gene is involved in regulating the level of serotonin, a neurotransmitter affecting individuals' coping with stress. In a number of gene-by-environment interaction studies (G×E studies) 5HTT genotype has been shown to moderate the effects of negative environmental influences (e.g., Caspi et al., 2003; Kaufman et al., 2006). Although two meta-analyses cast some doubt on the replicability of effects resulting from the interplay between the 5HTT genotype and stressful life events (Munafo, Durrant, Lewis, & Flint, 2009; Risch et al., 2009), these studies unintentionally underscored the importance of adequately measuring the environment. In two reviews Uher and McGuffin (2008, 2010) showed that the method of assessment of the environmental factor was an important determinant of the outcome of the study. In fact, nonreplications consistently used self-report questionnaires to assess the environment, whereas detailed interview-based approaches were associated with significant G×E findings.

The 5HTT serotonin transporter genotype can thus be considered a good candidate for testing genetic moderation of the association between an adverse environment and emotional development. The comparison of institutionalized care with family care clearly entails an objective assessment of the environment as recommended by Uher and McGuffin (2010). Moreover, the effect of early institutionalized care on adolescent emotional problems was found to be moderated by 5HTT genotype in the English and Romanian Adoptee Study (Kumsta et al., 2010), a prospective longitudinal study of individuals exposed to early institutional deprivation. Adolescents with the *ss* and *sl* genotypes who experienced severe institutional deprivation showed the highest levels of emotional problems, whereas adolescents with the *ll* genotype showed the lowest levels even when they experienced severe deprivation (Kumsta et al., 2010). In addition, 5HTT has been found to moderate the association between parental responsiveness and attachment security (Barry, Kochanska, & Philibert, 2008). In search of constitutional factors that may protect children against adverse environments, we thus tested whether genetic variations in the serotonin transporter gene 5HTT moderated the effects of the rearing environment (institutionalized care vs. family care) on socioemotional development, specifically attachment security and disorganization, and indiscriminate social behavior.

We included 37 Ukrainian preschoolers reared in institutional settings or within their biological families. The majority of the child care institutions in Ukraine are state-run, with a standardized structure and similar functioning across the country. They house children who are deprived of parental care from birth to young adulthood. Institutions are differentiated according to the children's age (age groups from 0–3 years; 3–7 years, and 7–18 years). Child care institutions for young children in Ukraine may house up to 200 children and are usually characterized by high child-to-caregiver ratios, multiple shifts, and frequent change of caregivers. The daily schedule in Ukrainian institutions is strictly regimented. Apart from routines around sleeping, meals, and hygiene, it usually includes group learning activities and indoor and outdoor play activities. All children are expected to participate in the daily routine except when they are ill or as a form of punishment (Dobrova-Krol, van IJzendoorn, Bakermans-Kranenburg, Cyr, & Juffer, 2008).

Gunnar (2001) classified institutions into three levels, based on the quality of care they provide: (a) institutions characterized by global deprivation of the child's health, nutrition, stimulation, and relationship needs; (b) institutions with adequate health and nutrition support, but deprivation of the child's stimulation and relationship needs; and (c) institutions that meet all needs except for stable, long-term relationships with consistent caregivers. The majority of Ukrainian child care institutions are best described by the second category. They provide fairly clean environments, good medical care, and adequate nutrition, with limited cognitive and social stimulation especially during the first year of life.

In our previous studies on Ukrainian preschoolers reared in institutional care or in their own family we found institutional care to be associated with less favorable outcomes in all developmental domains examined thus far, including growth, stress regulation, cognition, and attachment (Dobrova-Krol et al., 2008; Dobrova-Krol, van IJzendoorn, et al., 2010; Dobrova-Krol, Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2010). However, we also found surprisingly large individual variations in outcomes. For instance, despite substantial growth delay for the average institutionalized child, almost 30% of children's height-for-age scores were within one standard deviation from population norms at the time of the assessment (Dobrova-Krol et al., 2008); 7% of children demonstrated cognitive performance within the normal range (Dobrova-Krol, van IJzendoorn, et al., 2010); and 21% of children succeeded in the age-appropriate theory of mind task (Dobrova-Krol, 2009). Moreover, 28% of the institutionalized children managed to form secure attachment relationships with their favorite caregiver, more than 50% were not classified as disorganized, and about 37% of children exhibited little or no signs of indiscriminate friendliness (Dobrova-Krol, Bakermans-Kranenburg, et al., 2010). These findings of remarkable resilience in at least some children suggest that certain contextual, relational, or constitutional factors may buffer or exacerbate the influence of institutional care (van IJzendoorn, Palacios, et al., in press).

In the current study we test whether 5HTT genotype is a moderator of the association between adverse environment (growing up in an institution vs. in a family) and attachment security, disorganization, and indiscriminate friendliness. Based on previous studies we expect that carriers of the short allele (*ss* and *sl* genotypes) are more affected by institutionalized versus family care than children who are homozygous for the long allele (*ll* genotype).

Method

The current study is part of a series of studies conducted in Ukraine with four ethnically homogeneous (Caucasian) groups of children: children with and without perinatal HIV infection who were reared either in their biological families or in childcare institutions. Family-reared children were raised in families with low to middle income. The first wave of data collection involved children without perinatal HIV infection in families and in institutions; the second wave involved HIV-infected children. Genetic data were collected in the first phase of the study and were thus only available for uninfected children.

Table 1. Characteristics of institution-reared and family-reared children

	Institution-reared ($n = 18$)		Family-reared ($n = 19$)		
	M	*SD*	*M*	*SD*	*t*
Age mother (in years)	30.5[1]	8.0	32.1[2]	5.9	0.62
Age child (in months)	49.3	10.2	51.4	9.8	0.66
Cognitive development (SON-R)	68.6	18.3	97.6	19.4	4.69**
Attachment security	3.67	1.94	5.97	1.74	3.92**
Attachment disorganization	4.44	1.77	2.79	1.66	−2.93**
Attachment formation	3.56	1.20	5.00	0.00	5.11**[3]
Indiscriminate social behavior	2.39	1.24	0.63	0.90	−4.96**
5HTTLPR *ss/sl* (%)	58		78		$\chi^2 = 1.67$

Notes. [1]$n = 13$, [2]$n = 17$, [3]equal variances not assumed; *$p < .05$, **$p < .01$.

Table 2. Analysis of variance of attachment disorganization with 5HTTLPR and type of care as factors and IQ as covariate

Predictors	*F* (1,32)	*p*	*Partial* η^2
IQ	0.93	.34	.03
5HTTLPR	0.48	.49	.02
Type of care (family vs. institutionalized)	0.81	.38	.03
5HTTLPR * Type of care	4.54	.04	.12

Note. $N = 37$.

Participants

Participants were 18 institution-reared children and 19 family-reared children living with their biological parents, matched for gender and age.

Institution-reared children. Institution-reared children were recruited from four children's homes located in Odessa and Belgorod-Dnestrovsky, Ukraine. The following selection criteria were applied: (a) age between 3 and 6 years old; (b) no genetic syndromes (e.g., Down syndrome); (c) no evidence of fetal alcohol syndrome in the medical records; (d) no HIV infection; (e) permanent residence in residential care institutions since admission. Only one child in the institution-reared group was an orphan, whereas the others were admitted to institutional care because of poverty ($n = 9$), family disruption ($n = 4$), or because one or both parents were in prison ($n = 4$). Since admission to their current institution, all children had experienced a change of primary caregivers, with 50% having experienced more than three changes. On average, children had been living in institutional care for 43.3 months ($SD = 14.4$; *range* 12.0–64.7). The median age at admission to institutional care of the institutionalized children was 1 month.

Family-reared children. For the comparison group, family-reared children were recruited in the same geographical area as the children in children's homes, but from kindergartens, schools, and clinics where routine health checks take place. Children were selected according to the following criteria: (a) age between 3 and 6 years old; (b) living in two-parent biological families; (c) no genetic syndromes; (d) no fetal alcohol syndrome; (e) no HIV infection; (f) no previous history of institutionalization, hospitalization, or prolonged separation (more than 2 weeks) from a primary caregiver.

Background characteristics. Each child from the family-reared group was matched on age and gender with a child from institutional care. Mean age of the children was 50.4 months ($SD = 9.9$; see Table 1). There were eight boys in the institutional care group and nine in the comparison group. Results of univariate ANOVAs and chi-square tests on available demographical data showed no significant differences between the family-reared group and institution-reared group on age of biological mother, child gender, or child age. However, the biological mothers of all institution-reared children were current substance users (alcohol and/or drugs), while none of the family-reared-group's mothers were (for more details, see Dobrova-Krol et al., 2008).

Procedure

For all children enrolled in the study, informed consent was obtained. For the children in institutionalized care consent was obtained from the local department of the Ministry of Health, and for the children in the family-reared group, consent was obtained from their biological parents. During the laboratory assessment procedure, institution-reared children were accompanied by their "favorite" caregiver, as determined through preliminary informal interviews with children and caregivers. If a favorite caregiver was difficult to identify, the person who spent most time with the child and knew him/her best was invited. Family-reared children were accompanied by their primary caregiver (the biological parent). Since lower cognitive development may be related to more disorganized attachment behavior we administered a brief nonverbal test for cognitive development during the session.

Measures

Cognitive development. The Snijders-Oomen Nonverbal Intelligence Test (SON-R) for children between 2.5 and 7 years of age was used to assess cognitive performance (Dobrova-Krol, van IJzendoorn, et al., 2010; Tellegen, Winkel, Wijnberg-Williams, & Laros, 1998). The SON-R does not require the use of spoken or written language, and consists of six subtests focusing on visual–spatial abilities and abstract reasoning. Previous research showed good psychometric qualities and proved that the SON-R test is suited for use with children in various countries (e.g., in China; Zhang, Gong, Sun, & Tian, 1997). We selected two of the most reliable subtests of the SON-R to assess children's cognitive performance: *patterns* and *analogies*. The internal consistency (Cronbach's alpha) of these subtests was .81. Total cognitive performance score was calculated with the SON-R computer program.

Attachment. Attachment to the caregiver was observed using the Strange Situation Procedure (SSP; Ainsworth, Blehar, Waters, & Wall, 1978). The procedure involves a series of episodes in which the infant is exposed to mildly stressful events: the entrance of a stranger and two separations from the caregiver, followed by reunions. The SSP was coded by two experienced observers (MHvIJ and MJBK) according to the Cassidy and Marvin coding system (Cassidy & Marvin, with the MacArthur Working Group on Attachment, 1992). According to the guidelines of this system a continuous score for attachment security was assigned, as well as a classification as secure, avoidant, resistant/dependent, or insecure/other. In addition to these classifications, children were rated on a 9-point rating scale for disorganized/controlling behavior, and a classification as disorganized was assigned when children received a rating of at least 5 on the rating scale for disorganized/controlling behavior. The observers were blind to the rearing status of the participants. Sixteen cases representing all four classifications were double coded. Agreement for the four attachment classifications was 81%, $k = .70$. The intercoder reliabilities for the continuous rating scales for security and disorganization were .88 and .73, respectively ($n = 16$; single measure, absolute agreement). To document the degree of attachment formation the 5-point rating scale for attachment formation was used (Zeanah et al., 2005). Ratings of 5 indicated consistence with traditional organized and disorganized attachment classifications. Ratings of 4 indicated evidence of attachment behavioral organization and the presence of pervasive behavioral anomalies (beyond the scope of traditional disorganization coding). Ratings of 3, 2, and 1 were assigned for behavioral displays ranging from fragmented or incomplete sequences of attachment behavior differentially directed toward the caregiver, to isolated attachment signals and responses, or no evidence of attachment behavior. The intraclass correlation coefficient for interrater reliability was .84 ($n = 16$).

Indiscriminate friendliness. A semistructured interview with the caregiver to evaluate the child's behavior toward the parent and other adults in both novel and familiar situations was used (Chisholm, 1998). Caregivers were asked whether the child (a) wandered without distress; (b) was willing to go home with a stranger; (c) was very friendly with new adults; (d) was ever shy; and (e) what the child typically did upon meeting new adults. For each question a score of 1 was given if a caregiver gave a response indicating indiscriminate social behavior; as for instance, in response to Question 3 the caregiver reports that the child was very friendly with all new adults. Research demonstrated substantial convergence of this measure with other measures of indiscriminate social behavior, with correlations ranging from $r = .64$ to $r = .83$ (Zeanah et al., 2002). In the current sample the internal consistency as estimated by Cronbach's alpha was .66. Deleting the first item (the child wandered without distress) increased Cronbach's alpha to .74, therefore we computed the total score by adding scores on items 2 to 5 (range 0–4).

Genotyping. DNA samples of the children were collected with buccal swabs. The 5-HTTLPR polymorphism in the promoter region of the *SLC6A4* gene was genotyped by polymerase chain reaction (PCR) amplification followed by agarose gel electrophoresis. Primer sequences were adopted from Gelernter, Kranzler, and Cubells (1997), the forward primer being 5'-ATGCCAGCACCTA ACCCCTAATGT-3' and the reverse primer being 5'-GGACCG CAAGGTGGGCGGGA-3'. These primers are expected to produce a short fragment of 375bp representing the 14 repeat allele, and a long fragment of 419bp representing the 16 repeat allele. The nomenclature of the alleles is as suggested by Heils et al. (1996), with the 375bp allele designated "s" (short) and the 419bp allele designated "l" (long). PCR fragments containing the 5-HTTLPR polymorphism were obtained in a total reaction volume of 25 µL, containing 50 ng of genomic DNA, 0.3 mM dNTPs, 1.5 mM $MgCl^{2+}$, 10 pmol of each primer and 0.3U of BioThermAB polymerase (Genecraft, Munster, Germany). PCR conditions were the following: an initial denaturation step of 10 min at 94 °C, 36 cycles of 30 sec at 94 °C, 1 min at 68 °C, and 1 min at 72 °C, followed by a final extension step of 15 min at 72 °C. The amplification products were separated on a 2% agarose gel with 0.001% ethidium bromide and visualized by ultraviolet transillumination. Genotypes (*ss*, n = 6; *sl*, $n = 19$; *ll*, $n = 12$) were in Hardy–Weinberg equilibrium, $\chi^2(1, N = 37) = 0.11$, $p = .74$.

Results

Using the three-way attachment classification system, 13 children (35%; 10 of them institutionalized) were classified as avoidant, 18 (49%; five institutionalized) as secure, and three (8%; none institutionalized) as resistant. Three children (8%; all institutionalized) were insecure/other. In addition to these classifications, eight children (22%; five institutionalized) were classified as disorganized. The continuous scores for attachment security and disorganization were not significantly correlated, $r(37) = -.14$, $p = .40$, showing that they represent nonoverlapping dimensions of attachment behavior.

We conducted an analysis of variance of the continuous attachment disorganization scores with 5HTT genotype (*ss*/*sl* vs. *ll*) and type of care (family vs. institutionalized) as factors, and IQ as covariate (see Table 2). No significant main effects of genotype or type of care were found. The interaction between 5HTTLPR and type of care significantly predicted attachment disorganization scores, $F(1,32) = 4.54$, $p = .04$, partial $\eta^2 = .12$. Children with the *ss* or *sl* genotype showed significantly higher levels of disorganization when they grew up in an institution ($M = 4.82$, $SD = 1.60$) compared to children who lived in a family ($M = 2.45$, $SD = 1.80$), $t(23) = 3.48$, $p < .01$, $d = 1.45$, whereas children who were homozygous for the *l* allele appeared to be protected against high scores for attachment disorganization, even when they were reared in institutions (institution $M = 3.12$, $SD = 1.93$; family $M = 3.25$, $SD = 1.44$, $t(10) = -0.13$, $p = .90$, $d = -0.08$). Figure 1 shows the mean scores for attachment disorganization of family- and institution-reared children with 5HTT *ss/sl* or *ll* genotype. Using the *classification* for disorganized attachment, the difference in distributions fell short of significance but results were essentially similar: among children with the 5HTT *ss/sl* genotype, 50% who grew up in an institution versus 18% who grew up in a family were disorganized ($p = .10$); among children with the 5HTT *ll* genotype, 25% who grew up in an institution versus 13% who grew up in a family were disorganized ($p = .58$).

In a similar analysis for attachment security the interaction of 5HTTLPR and type of care was not significant, $F(1,32) = 2.48$, $p = .13$, partial $\eta^2 = .07$. Effects were, however, convergent with those reported for attachment disorganization: children with the *ss* or *sl* genotype showed significantly lower levels of attachment security when they grew up in an institution ($M = 3.29$, $SD =$

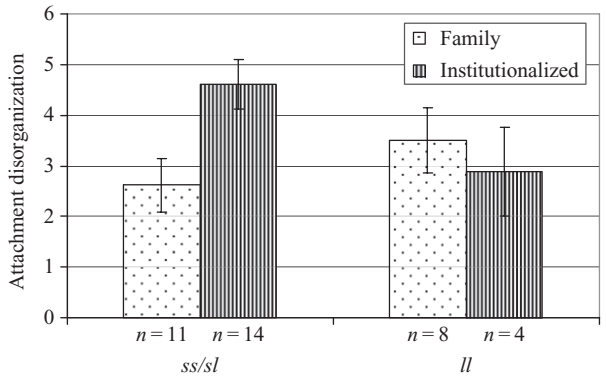

Figure 1. Attachment disorganization (*M*, *SE*) of family-reared and institution-reared children with 5HTT *ss/sl* or *ll* genotype, controlling for IQ.

1.66) compared to children who lived in a family ($M = 6.14$, $SD = 1.87$), $t(23) = 4.03$, $p < .01$, $d = 1.68$, whereas children who were homozygous for the *l* allele appeared to be protected, even when they were reared in institutions (institution $M = 5.00$, $SD = 2.04$; family $M = 5.75$, $SD = 1.65$, $t(10) = 0.69$, $p = .51$, $d = 0.43$). Among children with the 5HTT *ss/sl* genotype, 14% who grew up in an institution versus 46% who grew up in a family were classified as securely attached ($p = .09$); among children with the 5HTT *ll* genotype, 50% who grew up in an institution versus 75% who grew up in a family were disorganized ($p = .39$).

The analyses for the continuous ratings for attachment formation and for indiscriminate friendliness did not show a significant moderation by 5HTT genotype; for attachment formation the interaction between 5HTTLPR and type of care amounted to $F(1,32) = 1.80$, $p = .19$, partial $\eta^2 = .05$, for indiscriminate friendliness $F(1,32) = 1.23$, $p = .28$, partial $\eta^2 = .04$.

Discussion

Institution-reared children are at high risk for developmental delays in all developmental domains, in particular when institutionalization starts soon after birth and continues during the first few sensitive years of life (Nelson et al., 2007; van IJzendoorn, Palacios, et al., in press). Reviewing studies that compared the development of children in institutions with children from socially disadvantaged families, Bowlby (1951) concluded that "children thrive better in bad homes than in good institutions" (p. 68). The rearing environment in most institutions is characterized by structural neglect due to discontinuous routine-like care and multiple shifts of overburdened professional caregivers working with too many children. The development of attachment is particularly jeopardized in this type of care. Nevertheless, it appears that even in institutions some children might escape the negative consequences of early deprivation and manage to develop organized and even secure attachment relationships. Their genetic layout may play a role in this apparent resilience: we found a moderating role of 5HTT genotype for the association between adverse rearing environment and attachment disorganization. Carriers of one or two short alleles appeared to suffer most from the adverse institutional environment, whereas carriers of two long alleles seemed protected.

Of course, this finding should be considered preliminary due to the small subgroups involved, and replication in larger samples is very much needed. Nevertheless, not many environmental, relational, or constitutional factors have been found that can explain the amazing resilience of some children in extremely adverse environments (van IJzendoorn, Palacios, et al., in press), and our findings replicate the results recently found for adoptees in the English and Romanian Adoptee Study (Kumsta et al., 2010), where adoptees with the 5HTT *ll* genotype showed the lowest levels of emotional problems even when they experienced severe early institutional deprivation. Moreover, our results converge with those of Barry et al. (2008) for family-reared children: infants with the 5-HTT *ss/sl* genotypes and unresponsive mothers were more likely to be insecure as compared to infants whose mothers were responsive, but infants with the 5HTT *ll* genotype scored high on attachment security independent of the variation in mothers' responsiveness. We therefore propose to take the protective role of 5HTT as a grounded hypothesis for independent and thorough tests in other and larger samples. It is noteworthy that the protective effect of the 5HTT *ll* genotype is not only observed in environments with moderate amounts of environmental adversity or stress (e.g., Caspi et al., 2003; Gilissen et al., 2008; see for a review Uher and McGuffin, 2010), but also (and perhaps surprisingly) in extremely traumatic circumstances.

A recent report of the Bucharest Early Intervention Project (Drury et al., 2010) seems to support this preliminary conclusion. In this study an interaction between the COMT val158met polymorphism and institutional care on depressive symptoms in 54-month-old Romanian children was found. The *met* allele appeared to be a protective factor in the development of depression when children grew up in institutional care. In a similar vein, Stevens et al. (2009) found that among children who experienced severe institutional deprivation carriers of the DAT1 10R-6R haplotype had significantly more attention deficit and hyperactivity disorder (ADHD) symptoms from childhood to mid-adolescence than those with the low-risk DAT1 haplotype. These gene-by-environment interaction effects document that common genetic polymorphisms in the dopamine and serotonin system may explain at least some of the amazing resilience of children suffering from severe early deprivation.

However, we should be careful in applying common evolutionary thinking to such potential genetic resilience of children growing up in Romanian or Ukrainian orphanages and consider specific genotypes as "functional" in these rearing environments. The pathogenic institutional environment simply lies outside of the range of conditions that were encountered over human evolution (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2011) and has little in common with the original environment of evolutionary adaptedness proposed by Bowlby to be the cradle of attachment (Bowlby, 1969/1997). As Hrdy (1999) argued, human offspring cannot have been selected to adapt to evolutionary, historically, and culturally unique conditions of collective rearing by employed nonkin caregivers. Communal kibbutzim (with a collective sleeping arrangement for the infants at night) failed to provide a satisfactorily protective and nurturing rearing environment. That these communal kibbutzim did not survive the pressures of parents and children to restore family life (Aviezer, van IJzendoorn, Sagi, & Schuengel, 1994) is another piece of evidence for the artificiality of radical forms of collective child rearing. Some genetic polymorphisms may fulfill a protective role even in these extreme environments, but resilient children growing up in institutional conditions of structural neglect and nevertheless thriving against all odds cannot be considered the outcome of an evolutionary process.

The major limitations of the current study are of course the small sample size and its quasi-experimental design that did not allow for

random assignment of children to different rearing conditions (in contrast to the Bucharest Early Intervention Project; Nelson et al., 2007). Besides, children are never admitted to institutional care at random and often suffer from various additional disadvantageous conditions including poor perinatal condition and physical health. In this study we also used a traditional dyadic approach to the assessment of attachment relationships of institution-reared children and studied attachment relationships with only one, favorite, caregiver. Whether attachment classifications, in particular disorganized attachments, mean the same in an institution as in a family environment remains to be determined (Bakermans-Kranenburg et al., in press; Rutter, Kreppner, & Sonuga-Barke, 2009; Zeanah et al., 2005). Institutionalized children's attachment formation with a specific caregiver may be incomplete, or—in a more positive scenario—multiple attachment relationships may develop, resulting in an attachment network with more predictive power than a single relationship assessment (van IJzendoorn & Sagi-Swartz, 2008). Lastly, structural neglect in institutions may be considered as a form of child maltreatment, which has been shown to be able to influence gene expression through methylation (McGowan et al., 2009), in particular the expression of 5HTT (Beach, Brody, Todorov, Gunter, & Philibert, 2009). Methylation might drastically alter the moderating role of the gene involved (van IJzendoorn, Caspers, Bakermans-Kranenburg, Beach, & Philibert, 2010). Unfortunately, epigenetic information is not available for the current sample.

In sum, although also in modern times most institutions create a childrearing environment that is best typified by structural neglect, some children remain resilient even in the most adverse settings. Genetic differences may play a role in the explanation of variability in developmental outcomes in similar extreme rearing environments. Genetic factors may reduce the receptivity of children to the experience of adversity (differential susceptibility based on genetic factors; Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Ellis et al., 2011), or high-risk environments may alter the expression of genes (Meaney, 2010; Mill & Petronis, 2008). There is emerging evidence of the power of methylation in shaping human development, in particular in circumstances of severe deprivation, abuse or neglect (McGowan et al., 2009; van IJzendoorn, Bakermans-Kranenburg, & Ebstein, in press).

For future research it seems important to study the interaction between child characteristics and the institutional environment at a microlevel, taking into account individual resilience and vulnerabilities at the genetic level as well as strengths and weaknesses of the specific child-rearing setting. Gene-by-environment interaction studies enriched with epigenetic information may bring us a step forward. A closer look at the interactions between child characteristics and various facets of the institutional environment may provide insight into ways to improve institutional life for the children involved wherever some kind of family-based care is impossible.

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