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The effects of severe psychosocial deprivation and foster care intervention on cognitive development at 8 years of age: findings from the Bucharest Early Intervention Project

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Background: Previous reports from the Bucharest Early Intervention Project suggested that children removed from institutions and placed into intervention displayed gains in IQ relative to children randomized to remain in institutional care. **Method:** The current report presents data from the 8-year follow-up of these children. One hundred and three of the original 136 children in the study were tested with the WISC IV. **Results:** Results reveal continued benefit from the intervention even though many of the children in both the intervention and control groups were no longer residing in their initial placements. Gains in IQ were particularly evident for those children who remained with their intervention family. There were also modest timing effects such that children placed earlier displayed higher scores on the WISC processing speed subscale. Early placement was also a significant predictor of a profile of stable, typical IQ scores over time. **Conclusion:** These data suggest the continued importance of early intervention and the negative effects of severe psychosocial deprivation on the development of IQ scores across early childhood. **Keywords:** Family factors, institutions, intelligence, intervention, neglect.

Children abandoned at birth and raised in institutions represent a 'natural' experiment in which the effects of severe psychosocial deprivation and timing of intervention can be examined. Deprived of consistent, sensitive caregiving and contingent responsiveness very early in life, children suffer deficits in cognitive functioning as well as social competence. The animal literature for many years has provided experimental models for understanding the underlying mechanisms for the effects of early deprivation on the developing brain and stress system. Rodents and non-human primates deprived of typical social contact early in life develop atypical cognitive and social behaviors (Harlow, Dodsworth, & Harlow, 1965). The best human analog of animal deprivation studies is infants who are raised in institutions.

There is a long history of documenting the adverse effects of being raised in institutions on human infants. For example, Goldfarb (1943) reported on the problem behaviors of children raised in institutions and the effects of psychosocial deprivation. He later worked with John Bowlby (Bowlby, 1951) on a report for the WHO in 1951 examining the effects of group homes on children's development and commenting on the negative consequences thereof. Some years later, Dennis and Najarian (1957) described the effects of institutionalization on children's intelligence. In two age groups, those between 2 and 12 months of age and those between 4½ and 6 years of age, children raised in institutions had significant deficits in IQ scores. However, those children who were adopted out of the institution by families appeared to have IQs that were in the normal range when they were tested at age 11 years. These findings are important for two reasons: first, they reveal the detrimental effects on cognitive development of being raised in an institution, and second, they suggest that there is a potential for remediation of these negative cognitive effects if the child is removed from an institution and placed in a 'typical' family environment. A recent meta-analysis (van IJzendoorn, Luijk, & Juffer, 2008) examined the effects of IQ on children who were institutionalized. Examining more than 75 studies, the authors found a significant effect upon IQ, with children growing up in institutions having substantially lower IQ scores. These authors also found that the age at which the child was tested was an important moderator, with young children seemingly more impaired at test than older children. Age in the institution, however, was not related to children's IQ score.

One recent study of these effects is the English and Romanian Adoptee (ERA) study directed by Michael Rutter with a group of investigators at the Institute for Psychiatry in London (Rutter et al., 2010). They identified 144 children raised in Romanian institutions and later adopted into families living in the UK. All of the children in this sample were adopted by the time the child was 42 months of age. Rutter and colleagues were able to assess these infants and young children systematically starting at age 4, and they

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recruited a comparison group of infants and young children who were born in the UK and adopted into similar British families. Both groups of children were then followed prospectively and periodically assessed for intelligence (IQ), physical growth, and a range of social and behavioral competencies (Rutter et al., 1998; Rutter, Sonuga-Barke, & Castle, 2010).

Based upon parent report, Rutter and his group found that, at the time of adoption, infants and young children arriving from Romania were significantly delayed in their intellectual development (Rutter and the English and Romanian Adoptees (ERA) Study Team., 1998). By the time children were 4–6 years of age, the children who were below the age of 6 months when they were adopted appeared to catch up to their British-born adopted controls, though the children adopted from Romania after the age of 6 months manifested deficits in IQ. Indeed, there was a significant negative correlation for children adopted from Romania after 6 months of age between age of adoption and IQ (Castle et al., 1999). While initial reports from this study suggested that children adopted between the ages of 6 and 24 months had higher IQ scores compared to those adopted at a later age, subsequent follow-up of this sample at age 11 found that the gains by the group adopted between 6 and 24 months did not persist. Although children who were adopted prior to 6 months of age exhibited 'typical' IQ scores at age 11, those adopted after 6 months displayed low IQ scores similar to those adopted after 24 months of age. The researchers concluded that early psychosocial neglect as a result of institutional deprivation had a broad and lasting impact upon cognitive functioning.

Though the ERA study is notable in many respects, a number of questions remain regarding the effects of early psychosocial neglect. First, the ERA study recruited infants and young children living in Romanian institutions who were adopted by families in the UK. Like all studies of internationally adopted children, there may have been a selection bias in the choice of who was adopted or selected from the institutions and who remained. Second, the ERA was only able to assess children once they were already adopted. There were no assessments prior to entry into intervention. Since infants were not randomly assigned to interventions (i.e., the adoptive family), the lack of baseline assessments did not allow for examination of change scores from time in the institution to intervention. Finally, children older than 1 year who were adopted into British homes entered an environment that was linguistically and culturally different from their previous context. There was no comparison/control sample of children raised in Romania.

In order to address some of the unanswered questions regarding the effects of early deprivation, the Bucharest Early Intervention Project (BEIP) was initiated in 2001 (Zeanah et al., 2003). Infants and young children who were between 6 and 31 months of age and living in institutions in Bucharest, Romania, were randomly assigned either to receive care as usual (continued institutional rearing) or be placed into foster care homes, with both groups of children then followed prospectively at 30, 42, and 54 months of age. The intervention ended formally at the 54-month assessment when support of the foster care network was assumed by the local government in Bucharest. Ethical issues were an important consideration from the outset of the study and have been discussed by us (Nelson et al., 2007; Zeanah et al., 2006) and by others (Millum & Emanuel, 2007; Nature Neuroscience, 2008) in some detail.

The initial report of children's IQ scores revealed significant delays and deficits for Romanian children raised in institutions prior to randomization (Smyke et al., 2007). The effects of the foster care intervention and timing of placement on children's cognitive development were observed when the children were 30, 42, and 54 months (Nelson et al., 2007). Results indicated that children removed from institutions and placed in foster care displayed higher IQ scores compared to those children randomized to remain in institutions and that those removed prior to 24 months fared best of all.

The current study examined the IQ scores of the two groups of children when re-assessed at 8 years of age, three and a half years after the intervention was completed. There were four sets of analyses. The first set of analyses examined the outcome of the intervention using an 'intent-to-treat' approach. That is, children's scores were analyzed according to their originally assigned groups (care as usual and foster care groups) across the eight years of study, despite subsequent changes in group status. The power of this analysis rests on the strength of the experimental design of the BEIP, which randomized children to an intervention or care as usual. Comparisons were made between the care as usual and foster care groups, as well as between the foster care group and a group of never-institutionalized children recruited from the community. The second set of analyses was conducted amongst the foster care group only to examine the effects of timing of placement into foster care homes. In the third set of analyses stability of placement over the ensuing time period was examined to determine if it would influence cognitive outcome for both the care as usual and foster care samples. Thus, analyses were completed that compared those children who remained in the institution through 8 years of age to those who remained in BEIP foster care to which they were initially assigned. Finally, change in IQ scores over time was examined in a number of ways. Change scores were computed between the 54-month assessment point and their IQ score at age 8, examining the pattern of change in both groups of children. As well, profiles of IQ scores from all available age points (30, 42, 54 months and 8 years) were created to characterize the trajectories of all children with a history of early institutional rearing.

We examined membership in these profiles, and predictors of group membership. We had three classes of predictors: early physical characteristics (birthweight, gestational age, head circumference and weight at baseline assessment); socio-environmental factors (security of attachment at 42 months; positivity in the caregiver at 42 months); and cognitive factors (language ability).

Method

Participants

Participants were selected from 187 children who were less than 30 months of age and living in one of six institutions for young children in Bucharest, Romania (Zeanah et al., 2003). At baseline assessment, the children ranged in age from 5 to 31 months. An additional group of 72 children were recruited from pediatric clinics in communities throughout Bucharest to act as a control group (Never Institutionalized Group, NIG), and were matched to the initial institutional group on sex and age. Details on the sample and follow-up through 54 months can be found in Nelson et al. (2007).

By 8 years of age, many children initially assigned to either foster care (FCG) or care as usual (CAU) had changed living arrangements. Figure 1 presents a 'consort' diagram in which the initial status of the children, as well as their status at age 8 years, is displayed. At 8 years, 53 FCG children and 50 CAU children remained in the study, had IQ data available, and were the subjects of the present analyses. In addition, 38 children from the NIG were included as a comparison group.

Informed consent was signed by the Commissioner for Child Protection for each child participant living in his sector of Bucharest, as dictated by Romanian law. Further assent for each procedure was obtained from each caregiver who accompanied the child to the visit.

Measures and procedures

Initial child characteristics. At baseline, information was collected from either record review (CAU and FCG) or from primary caregivers (NIG) on child characteristics, including gestational age and birthweight. Prior to randomization, physical measurements of weight and head circumference were obtained by the BEIP staff.

Duration of deprivation. Because the age at which children were first placed in an institution varied, as did the age at which they were placed in foster care, a variable was created to indicate the duration of time spent in institutional care ('Duration of Deprivation'). This was computed by subtracting the age at which children were first placed in an institution from the age at which they were first placed in a foster care home. Note that some newborn infants were not immediately placed in institutions. Some remained in maternity hospitals. This stay was considered part of the deprivation experience since the biological mother was not present. Other newborns remained in maternal homes with their biological mother for some period of time and this period was considered time with biological parent. All but 9 children in the study were placed into institutions prior to 3 months of age.

IQ. At 8 years of age, IQ was assessed in the BEIP laboratory using the Wechsler Intelligence Scale for Children (WISC-IV; Wechsler, 2003). The WISC-IV uses 10 subtests to assess intellectual functioning in four domains: verbal comprehension, perceptual reasoning, working memory, and processing speed. In addition, a full-scale IQ composite score is calculated based on the 10 subtest scores, scaled for age. The four subscale scores and full-scale IQ scores were used in the present analyses. In addition, cognitive development and IQ were assessed at 30, 42, and 54 months of age (see Nelson et al., 2007, for details). All of the IQ scales were administered by trained and reliable Romanian psychologists.

Change in IQ. In order to examine the degree of change in children's IQ scores between the current assessment (8 years of age) and the previous assessment (54 months of age), a composite variable was created by subtracting WPPSI-R full-scale IQ scores at 54 months from WISC-IV full-scale IQ scores at 8 years ('Change in IQ Score'). Positive scores indicated increases in IQ over time, while negative scores indicated decreases in IQ over time.

Attachment. Attachment security was assessed when children were 42 months of age in the BEIP laboratory using the preschool version of the Strange Situation Procedure (Cassidy & Marvin, 1992). A complete presentation of these data may be found in Smyke, Zeanah, Fox, Nelson, and Guthrie (2010). For the purposes of the present analyses, a continuous rating of security was used, whereby coders assigned a security score to each child using a scale from 1 to 9, with 1 = no security evident and 9 = most secure (Cassidy et al., 1992).

Relationship with primary caregiver. To assess the child's relationship with his/her primary caregiver, either in the institution or home environment, an adapted version of the Observational Record of the Caregiving Environment (ORCE; NICHD Early Child Care Research Network, 1996) was administered when

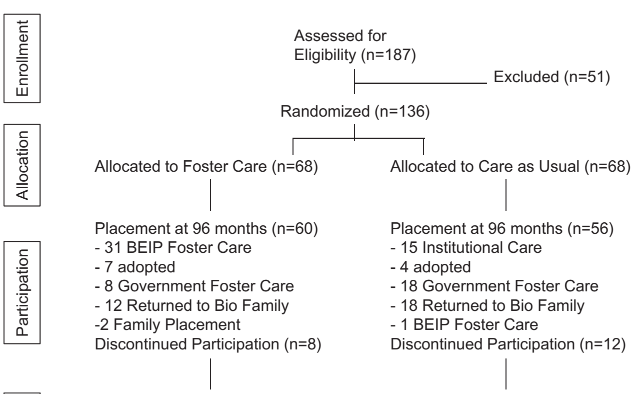

Figure 1 Group assignment over time: current status at 8 years of age

children were 42 months of age. A qualitative rating score was given to indicate the overall level of positivity in the relationship with the primary caregiver for each child, with ratings ranging from 1 (no evidence of special, loving relationship) to 4 (strong, positive relationship). A complete presentation of these data may be found in Smyke et al. (2010).

Language. Parents or caregivers reported on the expressive language skills and comprehension of the children at 42 months of age by completing the Receptive-Expressive Emergent Language Scale (REEL; Bzoch & League, 1971). The questionnaire includes 132 items that assess a variety of speech-language abilities including following directions, recognizing common names and producing new words. The REEL yields an expressive and a receptive language quotient, which were combined into a single score for use in the present study. Complete presentation of these data may be found in Windsor et al. (in press).

Data analytic plan

Data were analyzed for the present study in three ways: first, analyses are presented that use an intent-to-treat approach, whereby the CAU, FCG and NIG were compared at 8 years on the four WISC-IV subscales (verbal, perceptual reasoning, working memory, processing speed) and WISC full-scale IQ, as well as Change in IQ scores. Second, analyses are presented that use a current placement approach, whereby children's IQ scores at 8 years were examined in various groups of children based on their current placement or living status (e.g., still living in MacArthur foster care, moved to government foster care, etc.). Third, latent profiles were estimated using a structural equation mixture model (SEMM), which explored the longitudinal patterns of IQ from 30 months to 8 years in the CAU and FCG. Predictors of profile membership were also examined.

SEMM was chosen as a method for examining developmental patterns in IQ from 30 months to 8 years because it allows for the estimation of qualitatively different groups (i.e., latent profiles) when group membership cannot be determined a priori (Bauer & Curran, 2004). Data in the current study were analyzed using Version 4.1 of Mplus (Muthén & Muthén, 2007). Bayesian information criteria (BIC) were used to determine the best model fit, where the smallest negative number indicates the best fit. In addition, the Lo–Mendell–Rubin likelihood ratio test was used as a secondary test of model fit (Lo, Mendell, & Rubin, 2001), which compares the significance of the –2 log likelihood difference between the models.

Results

Mean IQ data at age 8

Table 1 presents the means and standard deviations for the four WISC subscales and for full-scale IQ at age 8 for the two groups. Inspection of the distribution of the full-scale scores revealed that 16 children in the CAU group had full-scale scores of 85 or above while 28 of the FCG children had scores at or above 85 on full-scale IQ. On the other hand, 16 CAU children had scores of 70 or below at age 8 on full-scale IQ, and 12 FCG children had similar low scores on full-scale IQ at age 8.

Is there a continuing effect of the early intervention on IQ at age 8?

Intent-to-treat analysis. In order to examine the effects of early intervention of foster care on previously institutionalized children, FCG children were compared to CAU children on the four subscales of the WISC and on the full-scale IQ scores. A 2 (CAU, FCG) × 4 (verbal, perceptual, working memory, processing speed) multivariate analysis of variance (MANOVA) was conducted with a Bonferroni correction for multiple comparisons. The multivariate test of differences between groups using the Wilks Lambda criteria only approached significance ($F(4, 99) = 1.77$; $p = .14$, partial $\eta^2 = .07$). However, follow-up multivariate comparisons revealed a significant effect of group on the verbal subscale ($F(1,104) = 4.53$, $p = .036$, partial $\eta^2 = .04$), indicating that children in the FCG scored higher on this subscale than those children in the CAU. Scores on the perceptual ($F(1,104) = .29$, *ns*), working memory ($F(1,104) = 1.84$, *ns*) and processing speed ($F(1,104) = 1.34$, *ns*) subscales were not significantly different for the two groups. A univariate analysis of variance (ANOVA) was conducted in order to compare full-scale IQ scores of the two groups. The result revealed a marginal group difference ($F(1,103) = 3.40$, $p = .07$, partial $\eta^2 = .03$). Means and standard deviations are displayed in Table 1.

How do children in the intervention group compare to typically developing community children?

Table 1 presents the mean IQ data for the NIG for the four WISC subscales and the full scale IQ.

Table 1 Descriptive statistics for WISC scores at 8 years of age

	FCG (n = 54)	CAU (n = 51)	NIG (n = 38)
Variable	*M (SD)*	*M (SD)*	*M (SD)*
Verbal comprehension	87.48 (15.87)	81.22 (13.98)	110.18 (18.95)
Perceptual reasoning	83.81 (13.87)	82.30 (14.61)	106.79 (15.32)
Working memory	87.80 (15.49)	83.88 (13.87)	108.92 (16.29)
Processing speed	81.19 (12.92)	78.38 (11.72)	91.76 (14.16)
Full-scale IQ	81.46 (15.32)	76.16 (14.11)	107.00 (16.54)

Comparisons were made between FCG and NIG children at 8 years of age, in order to determine whether children living in foster care homes had 'caught up' to their non-institutionalized peers in terms of IQ. A 2 (FCG, NIG) × 4 (verbal, perceptual, working memory, processing speed) MANOVA was conducted with a Bonferroni correction for multiple comparisons. The multivariate test of differences between groups using the Wilks Lambda criteria was statistically significant ($F(4, 87) = 14.39$; $p < .001$, partial $\eta^2 = .40$). Follow-up multivariate comparisons revealed a significant effect of group for the verbal ($F(1,92) = 38.84$, $p < .001$, partial $\eta^2 = .30$), perceptual ($F(1,92) = 56.11$, $p < .001$, partial $\eta^2 = .38$), working memory ($F(1,92) = 39.76$, $p < .001$, partial $\eta^2 = .31$) and processing speed ($F(1,92) = 13.82$, $p < .001$, partial $\eta^2 = .13$) subscales, indicating that children in the NIG scored significantly higher on all subscales. A univariate analysis of variance (ANOVA) was conducted in order to compare full-scale IQ scores of the two groups. The result revealed a significant difference between the two groups ($F(1,92) = 58.02$, $p < .001$, partial $\eta^2 = .39$), indicating that children in the NIG had higher scores than children in the FCG.

Were there any changes in IQ scores between 54 months and 8 years of age?

The CAU and FCG were compared on the degree of change in their full-scale IQ scores between 54 and 8 years of age. A univariate ANOVA with Change in IQ Score entered as the dependent variable was conducted. The result revealed a marginally significant effect of group ($F(1,100) = 3.64$, $p = .059$), suggesting that children in the CAU showed greater change in IQ ($M = 4.77$, $SD = 9.64$) than did children in the FCG ($M = .04$, $SD = 14.45$). Specifically, children in the CAU showed modest increases in full-scale IQ scores over time, while children in the FCG showed little change. Full-scale IQ scores at 54 months and 8 years were significantly intercorrelated in each group (CAU, $r = .74$, $p < .001$; FCG, $r = .63$, $p < .001$).

In addition, the correlation between children's Change in IQ score and their scores at baseline assessment were significant for the CAU ($r = -.31$, $p = .03$), indicating that children with lower scores at baseline showed greater gains in IQ between 54 months and 8 years of age. These relations were not significant for the FCG group.

Are there effects of age of placement amongst the FCG with respect to 8 year IQ?

To determine whether age at entry into foster care had an effect on the IQ scores at 8 years of age for the FCG, dichotomous grouping variables were created for entry cutoffs at 20, 22, 24, and 26 months of age. Children in each group were compared on their verbal, perceptual, working memory, and processing speed using a series of MANOVAs, and full-scale IQ using a series of ANOVAs. Results revealed the multivariate test of differences between groups using the Wilks Lambda criteria to be only marginally significant ($F(4, 47) = 2.23$; $p = .08$, partial $\eta^2 = .16$). Follow-up multivariate comparisons revealed significant differences in processing speed at the 26-month cutoff ($F(1,52) = 4.89$, $p = .03$, partial $\eta^2 = .09$), indicating that children placed into foster care *before* 26 months of age had significantly higher scores than children placed *after* 26 months of age. Pearson correlations were also performed between the duration of deprivation variable and each of the subscale scores and full-scale IQ for the FCG group. There were no significant findings.

What are the effects of current placement at age 8 on IQ?

Because of the large number of changes in placement over the 8-year duration of the study, two sets of analyses were conducted to examine IQ at 8 years in groups of children in different current placements (e.g., institutional care, BEIP foster care, government foster care, or other placement).

First, children currently living in BEIP foster care (FCG, $n = 27$) were compared to children currently living in an institution (CAU, $n = 12$) and children currently living in government foster care (CAU, $n = 16$; FCG, $n = 6$). A 3 (group) X 4 (verbal, perceptual, working memory, processing speed) MANOVA was conducted. The multivariate test of differences between groups using the Wilks Lambda criteria was statistically significant ($F(8, 110) = 3.09$; $p = .004$, partial $\eta^2 = .18$). Follow-up multivariate comparisons revealed a significant effect of group for verbal ($F(2,61) = 3.73$, $p = .03$, partial $\eta^2 = .11$) and processing speed ($F(2,61) = 7.91$, $p < .001$, partial $\eta^2 = .21$), and an effect of group at the trend level for working memory ($F(2,61) = 2.70$, $p = .075$, partial $\eta^2 = .09$). Children living in BEIP foster care scored significantly higher than children living in institutions on the verbal subscale, and higher than children living in government foster care on the working memory and processing speed subscales of the WISC. A univariate ANOVA with full scale IQ entered as the dependent variable revealed a significant group difference ($F(2,61) = 3.65$, $p = .03$, partial $\eta^2 = .11$) as well. Post-hoc pairwise comparisons indicated that children living in BEIP foster care had higher full scale sores compared to children living in government foster care. These results are displayed in Figure 2.

Second, two groups of children who had originally been assigned to BEIP foster care (FCG) were compared: those still living in BEIP foster care at age 8 ($n = 22$) and those now living in other contexts (e.g., government foster care, reunited with their biological

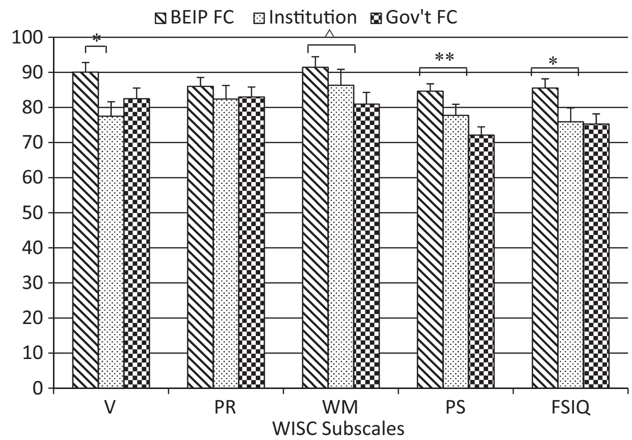

Figure 2 WISC Scores at 8 Years of Age for Children Currently Living in BEIP Foster Care, Children Currently Living in Institutions, and Children Currently Living in Government Foster Care. Note: V = Verbal, PR = Perceptual, WM = Working Memory, PS = Processing Speed, FSIQ = Full Scale IQ; Mac FC, n = 28, Institutions, n = 12, Gov't FC, n = 24; $^{**}p < .01$, $^{*}p < .05$, $^{\wedge}p < .10$

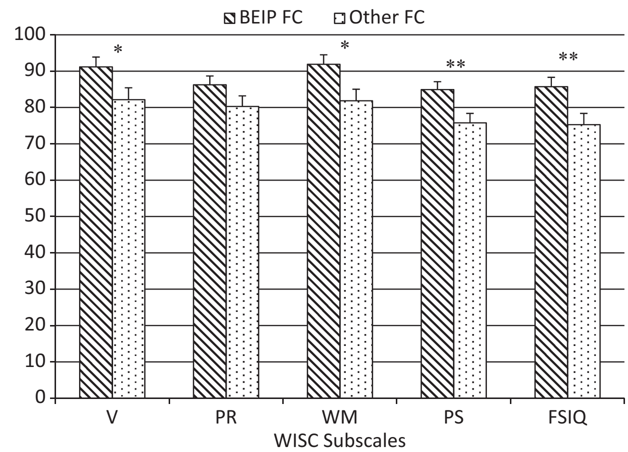

Figure 3 WISC Scores at 8 Years of Age for FCG Children Currently Living in BEIP Foster Care and FCG Children Currently Living in Other Arrangements. Note: V = Verbal, PR = Perceptual, WM = Working Memory, PS = Processing Speed, FSIQ = Full Scale IQ; BEIP FC, n = 27, Other FC, n = 27; $^{**}p < .01$, $^{*}p < .05$

family) (n = 32). A 2 (group) × 4 (verbal, perceptual, working memory, processing speed) MANOVA was conducted. The multivariate test of differences between groups using the Wilks Lambda criteria was marginally significant ($F(4, 49) = 2.40$; $p = .06$, partial $\eta^2 = .16$). Follow-up multivariate comparisons revealed a significant effect of verbal ($F(1,54) = 4.49$, $p = .04$, partial $\eta^2 = .08$), working memory ($F(1, 54) = 5.96$, $p = .02$, partial $\eta^2 = .10$) and processing speed ($F(1,54) = 7.44$, $p = .01$, partial $\eta^2 = .13$). A univariate ANOVA with full-scale IQ at 8 years entered as the dependent variable also revealed a significant group difference ($F(1,54) = 6.72$, $p = .01$, partial $\eta^2 = .11$). Children initially assigned to the intervention who were currently living in BEIP foster care scored significantly higher on these subscales, compared to those who left the intervention placement context. The results are displayed in Figure 3.

Further to these analyses, and in order to determine whether changes in placement for FCG children were confounded with age at placement or attachment security, univariate ANOVAS were computed. Results revealed no significant differences in age at placement ($F(1,51) = .88$, *ns*) or attachment security ($F(1,53) = 2.54$, *ns*) for FCG children who remained with their foster family over the course of the study compared to those FCG children who changed living contexts.

What are the longitudinal profiles of IQ amongst children with a history of institutionalization?

The longitudinal patterns of IQ across 30, 42, 54 and 8 years were examined separately in the CAU and FCG. This was done by fitting latent profile models with one through three profiles to the DQ and FSIQ data from each of the four age assessment points and comparing them within the group (CAU or FCG).

CAU profiles of IQ. The BIC was 1756.28 for the one-profile CAU model, 1738.20 for the two-profile CAU model, and 1716.11 for the three-profile CAU model. In addition, the two-profile model fit significantly better than the one-profile model ($p = .008$), and the three-profile model fit significantly better than the two-profile model ($p = .04$). Although the three-profile model had the smallest BIC and fit significantly better than the two-profile model, the third group included only four participants and, therefore, was suspected of resulting in spurious effects. Thus, the two-profile model was chosen as the best representation of the data.

An examination of the two-profile model revealed that it had an acceptable number of members in each profile (n's of 43 and 19), and the average posterior probabilities of membership were both greater than .92. The first IQ profile, labeled 'CAU very low,' displayed very low IQ scores across time (30 months, $M = 73.65$; 42 mos, $M = 72.71$; 54 mos, $M = 70.64$; 96 mos, $M = 75.26$). The second IQ profile, labeled 'CAU low average,' displayed IQ scores in the lower range of average at the first two time points (30 mos, $M = 83.68$; 42 mos, $M = 87.46$), followed by lower scores at subsequent points (54 mos, $M = 79.07$; 96 mos, $M = 78.36$). The two profiles are displayed in Figure 4. Individuals' scores reflecting their probability of membership in each profile were used in subsequent analyses.

FCG profiles of IQ. The BIC was 1972.72 for the one-profile model, 1917.49 for the two-profile model, and 1912.24 for the three-profile model. The two-profile model fit significantly better than the one-profile model ($p = .004$) but the three-profile model did not fit significantly better than the two-profile model ($p = .18$). Thus, the two-profile model was chosen as the best representation of the data.

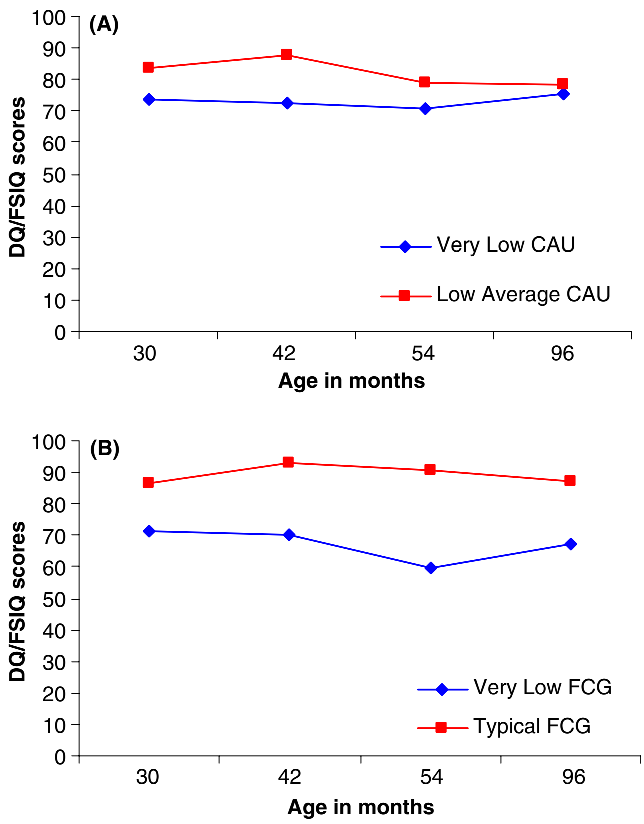

Figure 4 A. Two profiles of CAU children's IQ scores across childhood. *Note*: Class 1 = CAU very low; Class 2 = CAU low average. B. Two profiles of FCG children's IQ scores across childhood. Note: Class 1 = FCG very low; Class 2 = FCG typical

An examination of the two-profile model revealed that it had an acceptable number of members in each profile (*n*'s of 21 and 43), and the average posterior probabilities of membership were both greater than .95. The first IQ profile, labeled 'FCG very low,' displayed very low IQ scores across time (30 mos, $M = 71.58$; 42 mos, $M = 69.99$; 54 mos, $M = 59.65$; 96 mos, $M = 67.39$). The second IQ profile, labeled 'FCG typical,' displayed more average IQ scores across time (31 mos, $M = 86.73$; 43 mos, $M = 93.07$; 55 mos, $M = 90.75$; 96 mos, $M = 86.87$). We distinguish between the CAU and FCG profiles because the CAU low average profile was lower overall than the FCG typical profile. The two profiles are displayed in Figure 4. Individuals' scores reflecting their probability of membership in each profile were used in subsequent analyses.

What factors predict longitudinal profiles of IQ for each of the two groups of institutionalized children?

Predictors of the probability of membership in each of the three IQ profiles were examined in the CAU and FCG using linear regression analyses. Three categories of predictors were examined separately: first, predictors that would indicate effects on IQ profiles from early physical characteristics of the child (birthweight, gestational age, head circumference at baseline, and weight at baseline); second, predictors that would indicate contextual effects on IQ trajectories (attachment security and positivity in caregiving at 42 months of age); finally, language ability at 42 months was examined as a predictor of IQ profiles.

CAU profiles. Early physical characteristics of the child: A linear regression analysis was performed to examine the relations among birthweight, gestational age, head circumference at baseline, and weight at baseline and IQ profile membership for the CAU group. None of these factors predicted IQ profile membership in this group.

Socio-environmental factors: A linear regression analysis was performed to examine the relations between attachment security and the degree of positivity in the relationship with the primary caregiver, and IQ profile membership for the CAU group. Results revealed no significant relations between socio-environmental factors and profile membership.

Cognitive factors: The correlations between receptive and expressive language abilities and profile membership were examined and results revealed a significant relation between language and IQ, suggesting that children with poorer language abilities were significantly more likely to have a very low IQ profile ($r = .44$, $p = .002$).

FCG profiles. Early physical characteristics of the child: A linear regression analysis was performed to examine the relations between birthweight, gestational age, head circumference at baseline, and weight at baseline and IQ profile membership for the FCG group. Results revealed no significant relations between any of these factors and profile membership.

Socio-environmental factors: A linear regression analysis was performed to examine the relations between attachment security and the degree of positivity in the relationship with the primary caregiver, and IQ profile membership for the FCG group. Results revealed a significant relation between attachment security and profile membership ($b = .29$, $t = 2.35$, $p = .023$). Amongst the FCG children, there was a significant association between security of attachment to the primary caregiver at 42 months of age and membership in the typical IQ profile. Similarly, results revealed a relation between positivity and profile membership at the trend level ($b = .23$, $t = 1.84$, $p = .07$), indicating an association between positivity in the caregiver relationship with membership in the typical IQ profile.

Cognitive factors: The correlations between receptive and expressive language abilities at 42 months and profile membership were examined and revealed that children with greater language abilities were significantly more likely to have a typical IQ profile ($r = .59$, $p < .001$).

Were there timing effects within the FCG related to trajectories of IQ?

Analyses were conducted on the FCG to determine whether the age at which children were placed into foster care and the duration of deprivation (amount of time spent in institutional care before placement into foster care) were predictors of their IQ profiles. A univariate ANOVA revealed a significant effect of group (F (1,51) = 4.95, p = .031), indicating that children placed in foster care *before* 26 months of age were significantly more likely to have a typical IQ profile, while children placed *after* were significantly more likely have a very low profile. Duration of deprivation was significantly and positively correlated with the probability of membership in the very low IQ profile (r = .43, p = .002).

Discussion

The IQ data from the assessment of children at 8 years of age in the Bucharest Early Intervention Project present an interesting set of results with regard to the effects of early experience and early intervention. On the one hand, using a conservative intent-to-treat approach to assess intervention effects, children randomized to BEIP foster care displayed significantly higher scores on the Verbal Comprehension subscale of the WISC at age 8, as well as marginally higher full-scale IQ scores, compared to those children randomized to remain in the institution. On the other hand, these results, overall, were not as strong as found in our previous report of IQ at 42 and 54 months (Nelson et al., 2007). Two points are important to highlight: first, the IQ scores of the children randomized to the foster care intervention remained remarkably stable over the period of 54 months to 8 years of age. Second, changes over time in IQ were most obvious for the children randomized to remain in the institution whose mean IQ score increased over time. This suggests that the initial intervention effects reported for the FCG group have not disappeared and the lack of significant group difference is likely due to the modest gains in IQ of the CAU children. Therefore, the intervention and timing effects found early in the study were partially sustained in the present study. There are a number of reasons for this mixed picture. First, the intervention sponsored and supervised by BEIP ended when children were 54 months of age. This intervention included intensive contact plus material and psychological support by BEIP staff of the families in the intervention group. Thus, the quality of the intervention experienced may have changed for many children as a result of the changes in supervision of foster care. Second, at the same time, the Romanian government created a foster care system of their own and began placing institutionalized children with families. Thus, children in our study who were initially randomized to remain in institutions were placed into government foster homes over the 3½-year period between 54-month and 8-year assessments and some of these children appear to have gained in cognitive performance. Third, some of the children originally assigned to BEIP foster care were reunited with their biological families or other kin. Consequently, there were changes in the family living status of both the FCG and CAU children that undoubtedly affected their cognitive development. It is actually remarkable, then, that using the intent-to-treat approach there remain significant differences in verbal IQ between intervention and comparison groups, reflecting the importance of early intervention.

The timing effects on the current foster care IQ data suggest that early intervention is best sustained with consistent high-quality environmental experience. The pattern of data here are somewhat different from those reported by Rutter and colleagues but not inconsistent. In their study of post-institutionalized children in the UK, Rutter and colleagues report that infants placed into adoptive homes below the age of 6 months of age showed sustained increases in IQ but those older than 6 months (but younger than 24 months of age) did not sustain gains in IQ as a result of being adopted out of institutions and placed in British families. In the BEIP there were no children who were less than 6 months of age at the time of placement into foster care. Thus, we cannot directly compare timing (age) of intervention in the BEIP to the Rutter pattern of findings. Nevertheless, the timing effects in the current data suggest that in high-quality environments, initial gains by infants 24 months of age in the BEIP are somewhat sustained but not robust. It is interesting as well that age of placement in the intervention was significantly related to only one of the sub-scales on the WISC, processing speed. Although these subscales are modestly correlated, it is not surprising that there may be different sensitive periods for different aspects of cognition. Not all cognitive functions tapped by the WISC may be dependent upon on a sensitive period and of those functions that are, there will be variation in the bandwidth of that sensitive period.

Given the complicated life histories of children in both the care as usual and foster care samples in BEIP, we decided to examine whether stability of context or 'enriched' environment might make a difference in IQ outcomes at age 8. We compared children who remained in the BEIP foster homes to both those who were randomized to care as usual and in a separate analysis to those initially placed into BEIP homes but who over the course of the study left for other placements. The findings strongly suggest that stability of placement in the BEIP homes enhanced IQ scores. Children who remained in the BEIP homes displayed higher scores on verbal, working memory, processing speed and full-scale IQ compared to those who either remained in the institution or were placed into government foster homes. A similar pattern emerged comparing those initially assigned to BEIP foster care who remained to those who left. Both analyses suggest that to sustain the effects of early intervention it is critical to maintain the child in a stable enriched environment. They also suggest that simply providing enrichment at a young age and not maintaining such contexts does not provide a foundation to sustain early IQ differences.

A final set of analyses brought together all of the available IQ data collected over the course of the study by first examining change scores within each group of institutionalized children and then examining the longitudinal trajectories of IQ of both the foster care and care as usual groups from 30 months of age to 8 years of age. With regard to the change scores we found that there was a significant positive change (increase in IQ) for the CAU group but not for the FCG, indicating that the early intervention effects remained stable while most probably the changes in life circumstances for the majority of the institutionalized children led to small increases in IQ over time. Second, two trajectories were found for each group: one describing more typical IQ scores and the second describing lower scores over time. In addition, this approach allowed us to examine predictors of patterns of children's IQ scores across childhood, including early physical characteristics of the child, contextual factors, and cognitive abilities. Significant predictors of IQ profiles in the CAU group included security of attachment at 42 months and language abilities. In the FCG group, attachment security, positivity in the caregiving relationship, language ability, all measured at 42 months, were significantly predictive of IQ profile membership. These data again suggest the importance of the quality of the environment in sustaining IQ scores amongst previously institutionalized children. It is not surprising that language facility was the best predictor of class membership for both groups. IQ assessment with the WISC at age 8 is heavily language dependent, thus making individual differences in language facility an important factor in IQ trajectories. The lack of prediction from children's early physical characteristics is also not surprising. Prior to the baseline assessment, a large sample of institutionalized children was screened carefully for obvious neurological and genetic anomalies. In contrast, Rutter and colleagues could not do this type of screening, since they began their study when children were already adopted into UK homes. Thus, Rutter and colleagues (2004) found that these indicators (birthweight, head circumference) were positively associated with IQ gains. The differences may be attributable to sample differences in the two studies.

The profile analyses revealed two additional findings. First, amongst the foster care sample, timing of intervention was a significant predictor of profile membership. Children removed earlier (before 26 months) were more likely to be in the typical profile compared to those foster care children in the low profile. This timing effect indicates the continued importance of early experience in laying the foundation for positive gains in cognitive development. It may be that infants provided with this early experience gain more if the enriched context is maintained. Evidence from other domains in developmental research would support this notion. For example, Sroufe (2005) found that quality of attachment was most predictive for children who lived in a consistent quality of environment across childhood. Second, amongst the CAU group, IQ over age either remained low but stable or tended to increase. Prior studies using cross-sectional approaches have concluded that IQ continues to decrease over time in institution. But this does not appear to be the case. Of course, in our sample, by the time children were 8 years of age, the majority of those randomized to remain in the institution were no longer living in these settings, suggesting perhaps that the lack of continued significant decrease may also be a result of change in placement.

It is worth providing some cautionary notes to these results. With respect to the profile analyses, the relatively small sample size may have restricted our ability to find more than two profiles of IQ. Other studies with larger samples and thus larger variance in IQ might find additional profiles across childhood. Although SEMM is a useful analysis for longitudinal data, the classes (profiles) do not necessarily represent qualitatively distinct groups in the general population. Instead, they represent patterns that exist within the sample examined (Bauer & Curran, 2004). Second, the relatively small sample size may account for the modest effect sizes reported in the paper.

In sum, the data from the 8-year assessment of IQ scores in the BEIP sample provide a number of important findings regarding the effects of early experience and intervention in this high-risk sample. First, they suggest that to maintain initial gains in IQ among neglected children placed into positive family care, it is critical to sustain the enriched environments over the period of early childhood and into the time of entry into elementary school. Second, they suggest that the composition of these enriched environments includes contexts in which positive social relationships between the child and significant caregivers are critical. And third, they provide some evidence that timing of early intervention remains as an important factor in sustaining the positive IQ trajectories of previously neglected children. Thus, for children raised in extremely adverse environments, these results underscore the importance of both early experiences and the enduring quality of care for their cognitive development.

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Key points

- There are now a substantial number of studies that indicate that children raised in institutions exhibit lower IQ scores compared to age-matched, typically raised children.
- These studies suggest that age of placement into the institution is a key predictor of IQ score.
- The Bucharest Early Intervention Project is the first randomized clinical trial of a foster care/family intervention in which children were removed from institutions and placed into family care.
- Follow-up of the children in the BEIP at age 8 revealed that the intervention continued to have a significant effect upon children's IQ scores, particularly for those children who, over time, remained in the intervention homes.
- Timing of placement and attachment status to a caregiver early in life were predictors of better IQ scores amongst those children in the intervention group.

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