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# Variation in neural development as a result of exposure to institutionalization early in childhood

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## Abstract

We used structural MRI and EEG to examine brain structure and function in typically developing children in Romania ( $n = 20$ ), children exposed to institutional rearing ( $n = 29$ ), and children previously exposed to institutional rearing but then randomized to a high-quality foster care intervention ( $n = 25$ ). In so doing, we provide a unique evaluation of whether placement in an improved environment mitigates the effects of institutional rearing on neural structure, using data from the only existing randomized controlled trial of foster care for institutionalized children. Children enrolled in the Bucharest Early Intervention Project underwent a T1-weighted MRI protocol. Children with histories of institutional rearing had significantly smaller cortical gray matter volume than never-institutionalized children. Cortical white matter was no different for children placed in foster care than never-institutionalized children but was significantly smaller for children not randomized to foster care. We were also able to explain previously reported reductions in EEG  $\alpha$ -power among institutionally reared children compared with children raised in families using these MRI data. As hypothesized, the association between institutionalization and EEG  $\alpha$ -power was partially mediated by cortical white matter volume for children not randomized to foster

care. The increase in white matter among children randomized to an improved rearing environment relative to children who remained in institutional care suggests the potential for developmental “catch up” in white matter growth, even following extreme environmental deprivation.

## Footnotes

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- Author contributions: M.A.S., N.A.F., C.H.Z., and C.A.N. designed research; M.A.S. and C.A.N. performed research; M.A.S. and N.A.F. contributed new reagents/analytic tools; M.A.S. and K.A.M. analyzed data; and M.A.S., K.A.M., and C.A.N. wrote the paper.
- The authors declare no conflict of interest.
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Supporting information: [heimkinderstudie\\_rumaenien\\_supporting\\_information\\_pnas.pdf](#)