Abstract Title Page

Title:
Home environment quality mediates the effects of an early intervention on children's social-emotional development in rural Pakistan

Authors and Affiliations:
Jenna E. Finch, *Stanford University*
Jelena Obradović, *Stanford University*
Aisha Yousafzai, *Aga Khan University*

Home Environment Quality Mediates the Effects of an Early Intervention on Children's Social-Emotional Development in Rural Pakistan

Background / Context:
Over 200 million children under the age of 5 are not fulfilling their developmental potential due to poverty, poor health, and lack of cognitive stimulation (Grantham-McGregor et al., 2007). Experiences in early childhood have long term-effects on brain development and thus the cognitive and social-emotional skills that promote children's school success (Phillips & Shonkoff, 2000; Wachs, Georgieff, Cusick, & McEwen, 2014; Yoshikawa, Aber, & Beardslee, 2012). Further, early childhood development is linked longitudinally to children's educational outcomes in low- and middle-income (LAMI) contexts (Gandhi et al., 2013; Stith, Gorman, & Choudhury, 2003; Walker, Chang, Powell, & Grantham-McGregor, 2005). Although the international community has aimed to provide all children with a primary education by 2015, the number of out-of school primary school children has risen to 59 million globally (UNESCO, 2015). Given the social and economical consequences of low educational attainment, researchers have begun to focus on interventions that might foster children's school readiness (Engle et al., 2011). School readiness encompasses children's physical well-being and motor development, social-emotional development, approaches to learning, language development, and cognition and general knowledge (Kagan, Moore, & Bredekamp, 1998). It is particularly challenging to devise ways of promoting school readiness in rural regions where parental education and literacy levels are low and access to preschool programs is limited.

It is possible that social-emotional skills may be particularly important for school adjustment in regions where average educational attainment is low, and thus most children begin school with few pre-academic skills. Social-emotional skills allow children to engage positively with peers and teachers in classroom environments and focus on academic material. Several studies in LAMI countries have shown positive effects of home-based parenting interventions on children's behavior problems and social skills (Baker-Henningham, 2014; Hamadani, Huda, Khatun, & Grantham-McGregor, 2006). Research in developed contexts have demonstrated that increased social-emotional skills in the preschool years benefit children's academic achievement at school entry (Malecki & Elliot, 2002; McClelland, Morrison, & Holmes, 2000; Nix, Bierman, Domitrovich, & Gill, 2013).

Further, little research has explored the mechanisms through which early interventions impact children's social-emotional development. Given the importance of these skills for school success, more work is needed to understand what kinds of early interventions promote social-emotional skills for children in LAMI contexts and how they work. I explore these questions using a large sample of disadvantaged preschoolers and their caregivers from rural Pakistan.

Purpose / Objective / Research Question / Focus of Study:
The present study seeks to explore the impacts of an early responsive stimulation intervention on children's behavior problems and social skills at age four in rural Pakistan. Further, we examined whether home environment quality mediated the effects of the intervention on children's behavior problems and social skills.

Setting:
Pakistan, a lower-middle-income country, is sixth most populous in the world and ranked 146 out of 187 on the Human Development Index (UNDP, 2014). A majority of the population (51%) lives on less than $2 USD per day, and Pakistan reports poor health indicators including high rates of infant mortality (74 per 1,000) and under-five mortality (89 per 1,000) (NIPS and ICF International, 2013). Pakistan is noted as one of the main countries lagging in access to education (UNESCO, 2015). Twenty-nine percent of primary school-age children are out of school and 58% of these are girls (Malik et al., 2015). Despite efforts to meet the Millennium Development Goal of all children enrolled in primary education, recent reports have shown decreases in primary school enrollment for both boys and girls over the past six years (Malik et al., 2015). Educational disparities are further amplified by family wealth and residential location, as school attendance is even lower among rural and poor children (UNICEF, 2013). Low levels of education are reflected in the overall adult literacy rate of 56% (UNICEF, 2013), which is significantly lower in rural areas (33%; UNICEF, 2014). Data for the current study was collected in the Naushero Feroze, a predominantly rural and disadvantaged district of Sindh province in southern Pakistan.

Population / Participants / Subjects:
Our study included 1302 children and their primary caregivers who were enrolled in the Pakistan Early Child Development Scale-Up (PEDS) Trial and followed up at age four. On average, the sample was exposed to high levels of poverty. The monthly household income averaged $100 (*SD*= $140 USD) and many families experienced food insecurity (37%). A significant number of children in our sample were malnourished (11 %), stunted (16 %), or wasting (5%) at age four. Primary school attendance in area was low and 68 % of mothers in the sample were illiterate.

Intervention / Program / Practice:
The current study is a four-year-old follow-up of the PEDS trial, a 2x2 factorial intervention with responsive stimulation and enhanced nutrition interventions. The PEDS trial was a community-based cluster-randomized control trial administered by local community women (Lady Health Workers. The Lady Health Workers delivered intervention treatments to a birth cohort of children until age two. The four intervention groups were control (no intervention; $N = 331$), enhanced nutrition only ($N = 311$), response stimulation only ($N = 354$), and a combination of response stimulation and enhanced nutrition ($N = 315$). All four intervention groups continued to receive the standard health-care services provided by the LHW program and intervention services were integrated within existing services through home visits and group meetings.

The control group continued to receive standard-of-care services provided by Lady Health Workers including health, hygiene, and basic nutrition education. The enhanced nutrition group received nutrition education, and children in this group were given a multiple micronutrient powder, which contained iron, folic acid, vitamin A, and vitamin C. Lady Health Workers in the response stimulation group delivered an adaptation of the UNICEF and WHO Care for the Child Development package (United Nations Children's Fund & World Health Organization, 2009), which promotes caregivers' sensitivity and responsiveness through developmentally appropriate play activities. Primary caregivers were instructed to try an age-appropriate activity with the child, while the Lady Health Workers coached them and provided feedback on their behaviors to enhance the quality of their interactions. This curriculum was also delivered in monthly group

community meetings. The present study focuses on the response stimulation intervention, which was designed to promote responsive parenting, children's cognitive development, and thus their school readiness. The enhanced nutrition intervention is controlled for in all models.

Research Design:
To examine the direct and indirect effects of the responsive stimulation on children's social-emotional outcomes, we conducted a path analysis model in Mplus 7.3 (Muthén & Muthén, 2014). The model included the responsive stimulation intervention as a predictor, two measures of the home environment (24 and 48 months), and two social-emotional outcomes (behavior problem sand social skills). The model clustered children within the 80 Lady Health Workers who administered the original intervention. All pathways controlled for family wealth, food insecurity, child gender, maternal education, family size, and the enhanced nutrition intervention. A robust maximum likelihood estimator was used to account for non-normality of some variables.

Data Collection and Analysis:
Comprehensive child and maternal assessments were conducted during a three-hour home visit. The assessment team consisted of community-based data collectors who received extensive specialized training in interacting with families, understanding the constructs being evaluated, administering measures, and addressing various assessment barriers.

The quality of the *home environment* was assessed using the early childhood version of the Home Observation for Measurement of the Environment Inventory (HOME; Caldwell & Bradley, 1984), which consists of 54 items across eight dimensions: (1) learning materials; (2) language stimulation; (3) physical environment; (4) responsivity; (5) academic stimulation; (6) modeling; (7) variety; and (8) acceptance. Each item was given a score of 0 = absent or 1 present based on mothers' descriptions of family living patterns and habits, observation of spontaneous mother-child interactions, and orderliness and enrichment potential of the physical home environment. The home environment quality composite is the sum of all items.

An adapted version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was used to measure children's social-emotional behaviors. The SDQ was administered to mothers by well-educated members of the local community in an interview format, given the low literacy rates in the sample. Mothers verbally responded to the items on a three-point Likert scale (0=not true, 1=somewhat true, and 2= certainly true). A principal components analysis with varimax rotation was conducted, yielding two factors with eigenvalues greater than one. The first factor, reflecting the *behavior problems* composite, included five items with factor loadings greater than .40 (e.g., "often has temper tantrums," "often fights with other children or bullies them"; α =.61). The second factor, reflecting the *social skills* composite, included seven items with factor loadings greater than .40 (e.g., "shares readily with other children," "generally obedient, usually does what adults ask"; α =.57).

Findings / Results:
Descriptive statistics are presented in Table 1. Measures of wealth, food insecurity, and maternal education illustrate the variability in socioeconomic disadvantage present in our sample. On average, mothers had relatively little education (*M*= 2.192 years, *SD*= 3.686 years). The home

environment quality had high variability, ranging from very poor to very high quality. Children had relatively few behavior problems and strong social skills.

A path analysis model examining the unique contributions of the responsive stimulation intervention on children's social-emotional skills, as well as the indirect effects through the impact of the intervention on home environment quality demonstrated strong model fit (CFI = 0.994, TLI = 0.983, RMSEA= 0.019). Figure 1 presents the significant unidirectional pathways in the model with standardized beta coefficients and standard errors in parentheses. Table 2 shows all direct and indirect effects for the main study variables. Controlling for all covariates, the responsive stimulation intervention was significantly associated with children's home environment quality at age 2 (β = 0.385, *SE* = 0.028, *p* <.001) and social skills (β = 0.104, *SE* = 0.031, *p* =.001) at age four. As expected, home environment quality at age 2 was significantly associated with home environment quality at age four (β = 0.378, *SE* = 0.030, *p* <.001). Further, home environment quality at age two predicted children's social skills (β = 0.101, *SE* = 0.037, *p* =.007) and home environment quality at age four negatively predicted children's behavior problems (β =- 0.139, *SE* = 0.037, *p* <.001) and positively predicted children's social skills (β = 0.236, *SE* = 0.035, *p* <.001).

Next, we examined whether the intervention effects on home environment quality significantly mediated the effects of the intervention on children's social-emotional outcomes at age four. Significant indirect effects from the intervention via both measures of home environment quality emerged for both behavior problems (β = -0.020, *SE* = 0.006, *p* =.001) and social skills (β = 0.034, *SE* = 0.007, *p* <.001).

Conclusions:
This study demonstrates the value of an early responsive stimulation intervention on children's social-emotional skills in LAMI contexts. Further, it extends previous literature by highlighting the importance of home environment quality in mediation associations between the intervention and children's development. Despite the disadvantaged nature of the sample, we found sustained impacts of a zero-to-two intervention on children's social skills and problem behaviors in the preschool period. The intervention improved home environment quality at age two which was then linked to social skills and behavior problems via home environment quality at age four. These findings suggest that parenting interventions can have lasting and meaningful impacts on children's school readiness, even in highly disadvantaged contexts where parents have low levels of education themselves. Future analyses seek to explore whether the intervention effect on children's social-emotional development was moderated by child- or family-level factors.

Appendices

Appendix A. References

Baker-Henningham, H. (2014). The role of early childhood education programmes in the promotion of child and adolescent mental health in low- and middle-income countries. *International Journal of Epidemiology*, *43*(2), 407–433. http://doi.org/10.1093/ije/dyt226

Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*. Little Rock: University of Arkansas.

Engle, P. L., Fernald, L. C., Alderman, H., Behrman, J., O'Gara, C., Yousafzai, A., … Iltus, S. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *The Lancet*, *378*(9799), 1339–1353. http://doi.org/10.1016/S0140-6736(11)60889-1

Gandhi, M., Teivaanmaki, T., Maleta, K., Duan, X., Ashorn, P., & Cheung, Y. B. (2013). Child development at 5 years of age predicted mathematics ability and schooling outcomes in Malawian adolescents: *Early child development and cognitive outcomes*. *Acta Paediatrica*, *102*(1), 58–65. http://doi.org/10.1111/apa.12021

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry*, *38*(5), 581–586. http://doi.org/10.1111/j.1469-7610.1997.tb01545.x

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet*, *369*(9555), 60–70. http://doi.org/10.1016/S0140-6736(07)60032-4

Hamadani, J. D., Huda, S. N., Khatun, F., & Grantham-McGregor, S. M. (2006). Psychosocial stimulation improves the development of undernourished children in rural Bangladesh. *The Journal of Nutrition*, *136*, 2645–2652.

Kagan, S. L., Moore, E., & Bredekamp, S. (1998). *Reconsidering children's early development and learning toward common views and vocabulary*. National Education Goals Panel: DIANE Publishing.

Malecki, C. K., & Elliot, S. N. (2002). Children's social behaviors as predictors of academic achievement: A longitudinal analysis. *School Psychology Quarterly*, *17*(1), 1–23. http://doi.org/10.1521/scpq.17.1.1.19902

Malik, A. B., Amin, N., Irfan, Y., Kakli, M. B., Piracha, Z. F., & Zia, M. A. (2015). *Pakistan Education Statistics*. Islamabad, Pakistan.: Ministry of Federal Education and Professional Training, Government of Pakistan.

McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: the role of learning-related social skills. *Early Childhood Research Quarterly*, *15*(3), 307–329. http://doi.org/10.1016/S0885-2006(00)00069-7

Muthén, L. K., & Muthén, B. O. (2014). *Mplus (Version 7.3)*. Los Angeles, CA.

NIPS and ICF International. (2013). *Pakistan Demographic and Health Survey 2012-2013*. Islamabad, Pakistan and Calverton, Maryland, USA: National Institute of Population Studies (NIPS) and ICF International.

Nix, R. L., Bierman, K. L., Domitrovich, C. E., & Gill, S. (2013). Promoting Children's Social-Emotional Skills in Preschool Can Enhance Academic and Behavioral Functioning in Kindergarten: Findings From Head Start REDI. *Early Education & Development*, *24*(7), 1000–1019. http://doi.org/10.1080/10409289.2013.825565

Phillips, D. A., & Shonkoff, J. P. (Eds.). (2000). *From neurons to neighborhoods: The science of early childhood development*. National Academies Press.

Stith, A. Y., Gorman, K. S., & Choudhury, N. (2003). The Effects of Psychosocial Risk and Gender on School Attainment in Guatemala. *Applied Psychology*, *52*(4), 614–629. http://doi.org/10.1111/1464-0597.00154

UNDP. (2014). *Human Development Report 2013: Pakistan The Rise of the South: Human Progress in a Diverse World*. Washington, D.C.: United Nations Development Programme.

UNESCO. (2015). *A growing number of children and adolescents are out of school as aid fails to meet the mark* (Policy Paper No. 22). Washington, D.C.

UNICEF. (2013). *Out-of-school children in the Balochistan, Khyber Pakhtunkhwa, Punjab and Sindh provinces of Pakistan*. Islamabad, Pakistan: UNICEF Pakistan.

UNICEF. (2014). *Pakistan Annual Report 2013*. Islamabad, Pakistan: UNICEF Pakistan.

United Nations Children's Fund, & World Health Organization. (2009). *Care for Child Development*. New York, NY: UNICEF and WHO.

Wachs, T. D., Georgieff, M., Cusick, S., & McEwen, B. S. (2014). Issues in the timing of integrated early interventions: contributions from nutrition, neuroscience, and psychological research: Timing of integrated early interventions. *Annals of the New York Academy of Sciences*, *1308*(1), 89–106. http://doi.org/10.1111/nyas.12314

Walker, S. P., Chang, S. M., Powell, C. A., & Grantham-McGregor, S. M. (2005). Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study. *The Lancet*, *366*(9499), 1804–1807. http://doi.org/10.1016/S0140-6736(05)67574-5

Yoshikawa, H., Aber, J. L., & Beardslee, W. R. (2012). The effects of poverty on the mental, emotional, and behavioral health of children and youth: Implications for prevention. *American Psychologist*, *67*(4), 272–284. http://doi.org/10.1037/a0028015

Appendix B. Tables and Figures

Table 1

Descriptive Statistics

	Valid *N*	***M* (*SD*) / %**	**Range**
Gender (male)	1302	53.91 %	0 – 1
Wealth (6 months)	1294	- 0.002 (0.988)	-1.006 – 4.605
Wealth (48 months)	1302	0.068 (0.019)	-1.349 – 6.598
Food insecurity (24 months)	1301	1.600 (0.963)	1 – 4
Food insecurity (48 months)	1302	1.671 (0.982)	1 – 4
Number of children	1302	4.158 (2.253)	1 – 13
Maternal education	1302	2.192 (3.686)	0 – 16
Home (24 months)	1273	30.811 (5.444)	16 – 44
Home (48 months)	1295	32.071 (6.741)	5 – 51
Behavior problems (SDQ)	1298	0.951 (0.523)	0 – 2
Social skills (SDQ)	1298	1.529 (0.366)	0 – 2

Note. RS= Responsive Stimulation intervention, Home= Home environment quality.
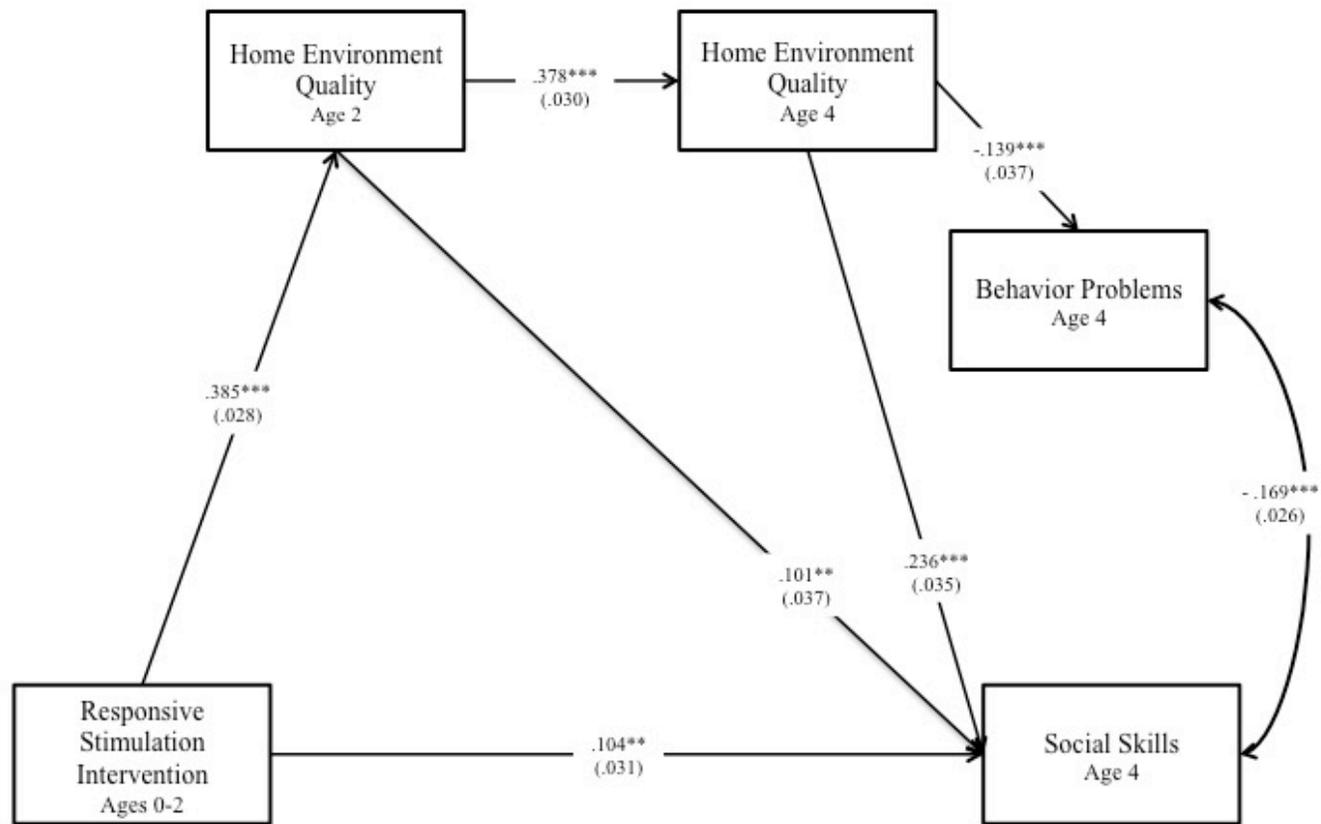
Figure 1. Path modeling show the effects of a Responsive Stimulation intervention on children's behavior problems and social skills , as mediated by the intervention's effects on the home environment quality.

Table 2

Direct and indirect pathways

Pathway	β	(S.E.)	p-value
Direct Effects			
RS → Home (24 mos)	0.385	(0.028)	< .001
RS → Home (48 mos)	-0.065	(0.034)	.054
RS → Behavior Problems	0.007	(0.034)	.833
RS → Social Skills	0.104	(0.031)	.001
Home (24 mos) → Home (48 mos)	0.378	(0.030)	< .001
Home (24 mos) → Behavior Problems	0.052	(0.034)	.127
Home (24 mos) → Social Skills	0.101	(0.037)	.007
Home (48 mos) → Behavior Problems	-0.139	(0.037)	< .001
Home (48 mos) → Social Skills	0.236	(0.035)	< .001
Covariation			
Behavior Problems with Social Skills	-0.169	(0.026)	< .001
Indirect Effects			
RS→ Behavior Problems (sum of indirect)	0.029	(0.016)	.062
RS→ Home (24 mos) → Home (48 mos) → BPs	-0.020	(0.006)	.001
RS→ Home (24 mos) → BPs	0.020	(0.013)	.133
RS→ Home (48 mos) → BPs	0.009	(0.005)	.100
RS→ Social Skills (sum of indirect)	0.023	(0.016)	.150
RS→ Home (24 mos) → Home (48 mos) → SSs	0.034	(0.007)	< .001
RS→ Home (24 mos) → SSs	0.039	(0.015)	.008
RS→ Home (48 mos) → SSs	-0.015	(0.008)	.054

Note. RS= Responsive Stimulation intervention, Home= Quality of the home environment (HOME), BPs= Behavior Problems, SSs= Social Skills.