

Effects of Early Childhood Development Interventions on Parental Behaviour: Evidence from a Home-Visiting Programme in Peru

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Abstract

Home-visiting interventions aim at improving child outcomes by shifting caregivers' parenting skills so they can offer better stimulation opportunities to their children. Despite this explicit objective, there is little evidence from the developing world regarding the effects of the home-visiting model on the provision of stimulation by caregivers. There is also a lack of evidence from programmes working at scale and little attention paid to the mechanisms through which these interventions affect parental behaviour. This analysis seeks to contribute to the literature on ECD interventions in two ways. First, it provides causal evidence about the effects of a scaled-up home-visiting programme on caregiver behaviour. Second, it explores the constraints that limit this behavioural change and offers a way of thinking about its mechanisms that is consistent with the evidence. I use the cluster-randomised design of the home-visiting component of programme *Cuna Mas* in Peru to collect data from 20 control and 20 treatment rural districts on parenting practices and caregivers' beliefs regarding the importance of parent-child interactions for child development. Results reveal that: (i) treatment effects on the quality of the home environment are positive, statistically significant ($p < 0.01$) and have a size ($d = 0.5$) comparable to that found for other interventions of much more smaller scale conducted in the developing world; (ii) the intervention has caused an increase in the variety of play activities offered to the child by the caregiver in addition to those occurring during home visits ($d = 0.3$; $p < 0.01$); (iii) low levels of wealth can render the intervention ineffective in changing these behaviours and the effect exhibits a positive gradient for most of the support of the wealth distribution; and (iv) caregivers' beliefs exhibit a similar pattern of heterogeneity as their behavioural change. This suggests there are constraints besides the lack of parenting skills that determine the effect of the intervention and which can be related to the information available to caregivers regarding the importance of parent-child interactions for child development.

JEL codes: I38, O15, D10.

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1. Introduction and motivation

Developmental gaps between children from disadvantaged backgrounds and those belonging to more affluent families emerge early and persist over time (Heckman, 2006, 2007; Paxson and Schady, 2007; Schady et al., 2014). Evidence suggests that such differences are difficult to overcome later in life, and limit these children's future economic opportunities and wellbeing. Numerous studies have found a strong causal relationship between developmental indicators during childhood and later-life outcomes such as schooling, employment status, wages, and participation in crime (Almond and Currie, 2011; Cunha et al., 2006).

The lack of adequate early stimulation at home has recently captured attention as a major constraint preventing children in socioeconomically disadvantaged families from reaching better developmental outcomes (Heckman, 2006; Walker et al., 2007). It is well established that parent-child interactions are crucial in shaping child development during their first years of life (Huberman and Mendelsohn, 2012) and evidence suggests that parental engagement in educational play activities with their children is a crucial input for child development (Fiorini and Keane, 2014).

Early childhood development (ECD) interventions aim at improving one or more dimensions of child development¹ by enhancing the inputs received by the child during her first years of life. This can be attempted directly (for example, by providing food supplementation or offering an enriched play environment at a day care centre) or indirectly (for example, by offering caregivers the skills and materials for them to provide an enriched environment to their children).

The home-visiting model constitutes a prominent example of an ECD intervention that combines a direct and an indirect effect. It offers direct stimulation and materials during home visits carried out by a trained paraprofessional or community member, usually once per week and for a period of 1 to 2 years. Importantly, home visits also seek to improve caregivers' parenting skills for them to be able to offer better stimulation opportunities and enriched interactions to their children. This type of interventions are therefore classified among those focused on parent-child interactions (PCI) (Huberman and Mendelsohn, 2012).

The literature offers strong evidence to support that ECD interventions can deliver improvements in child outcomes (Nores and Barnett, 2010). Four systematic reviews of ECD interventions in the developing world also provide strong evidence to support that the home-visiting model can cause this type of improvements (Walker (2011), Engle et al. (2011), Baker-Henningham and Lopez-Boo (2010), Engle et al. (2007)). There is, however, much less evidence regarding the effects of these interventions on the quality of the home environment and, in particular, on parental behaviour conducive to the provision of better stimulation opportunities to the child. In addition, and to the best of my knowledge, no evaluation so far has assessed the impacts of a scaled-up home-visiting programme and there have been no attempts so far to use evaluation results to try to understand the mechanisms behind caregivers' behavioural change.

In light of the above, this analysis seeks to contribute to the literature on ECD in two ways. First, it provides causal evidence about the effects of a scaled-up home-visiting intervention

¹ The early childhood development literature distinguishes at least three developmental outcomes or skills: motor, cognitive and socio-emotional (Boyden and Dercon, 2012; Grantham-McGregor et al., 2007).

on parental behaviour. And, second, it explores the constraints that limit parents' behavioural change and proposes a way of thinking about the mechanisms behind it. For this, the paper is organized around three research questions: (i) can a home-visiting ECD intervention working at scale in rural Peru deliver an improvement in the quality of the home environment?; (ii) can a home-visiting ECD intervention working at scale in rural Peru change parental behaviour so as to increase the amount of stimulation offered to the child; and (iii) what constraints faced by the caregiver limit the effect of this intervention on caregiver engagement in educational play activities with the child?

The rest of the paper is organized as follows. Section 2 provides an overview of the available evidence regarding the effect of home-visiting ECD interventions on parental behaviour and introduces some key concepts. This should serve to justify and locate my research questions within the relevant literature. Section 3 describes the intervention considered for this study and explains the research design. The effects of the intervention on the quality of the home environment and parental behaviour are presented in Section 4. Section 5 addresses the issue of constraints and mechanisms. In particular, I explore the heterogeneity of treatment effects on caregiver behaviour and relate this to the heterogeneity found in parental beliefs regarding the importance of parent-child interaction for child development. I also propose a simple model to interpret these findings and offer a way of thinking about the mechanisms behind caregivers' behavioural change. Finally, concluding remarks are presented in Section 6.

2. Home-visiting ECD interventions, the home environment and parental behaviour: evidence from the developing world

A review of the ECD literature on home-visiting interventions in the developing world reveals three features that this research seeks to address: (i) scant evidence about the effect of these interventions on parental behaviour, together with the fact that its measurement can be problematic because instruments will typically pick-up the effect of the home visit which does not imply a change in parental behaviour; (ii) lack of evidence from programmes or interventions working at scale; and (iii) little attention paid to the mechanisms through which these interventions affect parental behaviour and a strong emphasis on the transference of parenting skills to caregivers (or "parenting education"). This emphasis carries the implicit assumption that caregivers' lack of knowledge about certain activities that can be performed with their children and of the ability to engage in them are the only binding constraint preventing parents from providing more stimulation opportunities to their children.

The literature on ECD interventions provides strong evidence to support the claim that the home-visiting model can deliver positive results in terms of child outcomes in the developing world. Four systematic reviews ((Walker (2011), Engle et al. (2011), Baker-Henningham and Lopez-Boo (2010), Engle et al. (2007)) identify 16 different studies that have evaluated the effects of home visits on early child development outcomes (ages between 0 and 3) and all of them report benefits in at least one domain of childhood development. In addition, results from the recent evaluation of a home-visiting intervention in Colombia also reveal positive results on child outcomes (Attanasio et al., 2012; Attanasio et al., 2013).

Home-visiting interventions have the explicit objective of improving caregivers' parenting practices by demonstrating to them how to engage in play activities with their children and how to be more sensitive and responsive during daily interactions. This seeks to ensure an

improvement in the quality of the home environment additional to that directly offered during the home visit, and which might even extend beyond the duration of the intervention.

In the developing world, the provision of better stimulation opportunities at home constitutes an important component of home-visiting interventions in response to the significant cognitive skill setbacks found among children belonging to disadvantaged families (Grantham-McGregor et al., 2007). In fact, the literature identifies the lack of adequate early stimulation at home as one of the main risk factors preventing poor children from reaching better developmental outcomes (Walker et al., 2007).

Despite this explicit interest in parenting practices and stimulation opportunities, there is much less evidence regarding the effects of the home-visiting model on the home environment or the provision of stimulation by parents. In only 9 out of the 17 studies mentioned above, the evaluation comprised measurement of the effects on the quality of the home environment. Moreover, while aggregate positive results were found in 7 of these 9 studies, only 3 report positive effects in terms of stimulation opportunities offered to the child by the caregiver².

Instruments commonly employed to account for the effect of ECD interventions on the home environment include culturally adapted versions of items from the Home Observation for Measurement of the Environment (HOME) inventory (Caldwell and Bradley, 1984) or from the Family Care Indicators (FCI) early childhood development module (UNICEF, 2011). Based on the structure of these instruments and the information usually collected in the studies referred above, we can conceive the quality of the home environment as a concept that involves at least one of the following two aspects: (i) the amount of stimulation opportunities offered to the child (which can include child's engagement in particular activities, her access to play material and the organization of the child's personal space); and (ii) the degree of caregivers' sensitivity and responsiveness (which refer to caregivers' ability to understand her child's needs and cues and her ability to respond to these needs and cues, respectively). Caregiver sensitivity and responsiveness are usually evaluated in terms of the verbal and affective interactions between the caregiver and the child (Totsika and Sylva, 2004).

This way of understanding the quality of the home environment is closely related to the concept of parenting practices. In fact, Hoff et al. (2002) refer to the HOME inventory when discussing how are parenting practices defined and measured. These authors acknowledge there is little consensus on how to conceptualize "parenting practices" and decided to focus on caregiver-child interactions when discussing the relation between these practices and socioeconomic status. They organized their analysis considering three aspects: (i) verbal interaction; (ii) direct control practices (how controlling, restrictive and punitive parents are with their children); and (iii) managerial control (which refer to the experiences and physical environments parents provide to their children).

The concept of behavioural change I propose for this analysis implies a shift in parenting practices that leads to an improvement in the quality of the home environment additional to that offered during home visits, which is sustained, at least, for the duration of the

² These three studies are: Attanasio et al. (2013) (significant effect in the variety of play activities and play material offered to the child), Powell et al. (2004) (significant effect on mothers' childrearing practices), and Walker et al. (2004) (significant effect on maternal involvement with the child). See Appendix 1 for the complete list of studies.

intervention. Based on this, and despite being closely related, it is better to keep the concepts of home environments and parenting practices (or parental behaviour) separate when studying the effects of a home-visiting intervention. This is especially relevant if follow-up data is collected while the intervention is still ongoing (as in this study) or at the same time as it is being phased out. This is because the intervention offers a direct improvement in the quality of the home environment through home visits that can involve the caregiver, but which do not necessarily imply that the caregiver is providing an additional and sustained improvement.

From the above it follows that an increase in the amount of stimulation offered to the child at home that is provoked by an on-going home-visiting intervention does not necessarily imply there has been a behavioural change among caregivers. The HOME inventory and the FCI collect information about the stimulation opportunities offered to the child by observation (confirming the presence of play material) and by direct report of the primary caregiver (regarding her or other adults' involvement in particular activities with the child). During the intervention or while it is being phased out, changes can be observed or reported in these two aspects only because of what has happened during the home visits. The timing of the follow-up survey, the source of the play material, and the frequency and people involved in the interactions are, therefore, important elements that have to be considered when analysing the effects of home-visiting interventions on parental behaviour. It is not clear from the 3 studies referred above if these elements were considered when measuring the effects of the intervention³.

It should also be noted that none of the 9 studies that analysed the effects of the home-visiting model on the home environment used results from an intervention working at scale. Most of the studies can be classified as efficacy trials that worked with a limited number of children and families (samples sizes below 150) and delivered treatment under ideal or highly controlled conditions (e.g. working with a small group of trained professionals or paraprofessionals as home-visitors). The intervention more akin to a scaled-up programme is that evaluated in Attanasio et al. (2013)⁴. Generating evidence from scaled-up interventions is important for policy because it provides a more realistic appraisal of what can be accomplished with a large target population. This is especially relevant in the developing world because targeted groups (e.g. families living below a poverty line) are usually large and the home-visiting model is highly dependent on the personal skills of home-visitors, which means that the quality of delivery can be particularly sensitive to scale.

Finally, and despite the obvious emphasis that home-visiting and other PCI-focused interventions have on parental behaviour, little is explicitly said in the studies referred above about the mechanisms through which they affect parenting practices. Most studies that address the issue of mechanisms focus on the channels linking the intervention with child

³ In two of the three studies, follow-up data was collected at the same time as the intervention was being phased out (Attanasio et al., 2013; Powell et al., 2004). In one study, information regarding the home environment was collected midway through the intervention (Walker et al., 2004). None of the studies explicitly acknowledge if the provision of play material and caregivers' engagement in play activities was additional to that occurring during home visits.

⁴ The intervention was linked to the administrative capacity and community networks of the Colombian conditional transfer programme (*Familias en Accion*) and home-visits were carried out by community members for whom special training and material were prepared. This intervention also targeted a large sample of children (1,429).

development⁵. This emphasis is surely relevant in terms of policy outcomes, but it tends to overlook a process which is far from mechanical and which determines, at least in part, the success of these interventions.

Despite the literature's lack of explicit attention to the mechanisms behind caregivers' behavioural change, a review of its emphasis in terms of the characteristics of successful interventions can provide some clues regarding the implicit assumptions being made about the process. What we find in this regard is a strong emphasis on the transference of skills to parents.

For example, in one very influential Lancet review on ECD, the authors conclude that parenting interventions have larger effects when they include systematic curricula and training opportunities for home visitors and parents, as well as "active strategies to show and promote caregiving behaviours – e.g. practice, role play, or coaching to improve parent-child interactions" (Engle et al., 2011; p. 1343). Other authors also stress the importance of designing programmes to be participatory and interactive with parents (Huberman and Mendelsohn, 2012).

Parenting skills or ability, understood in this case as knowledge of particular play activities to engage with children and of how to implement them, are surely necessary for parents to be able to offer more stimulation opportunities to their children. However, a strong emphasis on this sole component implicitly assumes that the lack of these skills is the only binding constraint preventing parents in poor families from having a more active role in influencing their children's early environment. This is a strong assumption to make if resources, in general, are scarce, as is the case among the populations these programmes are meant to serve.

In this regard, Huberman and Mendelsohn (2012) note that PCI-focused programmes have produced larger benefits with relatively better educated families. These authors cite Bronfenbrenner (1974) on the role of living conditions, who notes that "in many homes, the conditions of life are so harsh that, so long as they persist, the parent has neither the will nor the capacity to participate in educational activities with the child" (Bronfenbrenner, 1974; p. 36). Of course, "disadvantaged", "at risk" or "harsh conditions" can describe a rather wide range of circumstances when referring to household resources. Further analysis of the constraints limiting caregivers' behavioural change is therefore required, and this analysis involves an exploration of the possible mechanisms explaining this phenomenon.

3. The intervention and research design

3.1 *Cuna Mas* home-visiting programme

⁵ In Baker-Henningham and Lopez Boo (2010), for example, the authors highlighted: (i) how early stimulation can ameliorate the negative effects associated to living in disadvantaged circumstances; (ii) the benefits on mothers' parenting behaviour; (iii) the benefits to maternal mental health; and (iv) improvements in children's ability to take advantage of other educational opportunities (increased school readiness). Nothing was explicitly said, however, about how changes in mothers' parenting behaviour are produced. In a recent study, Attanasio et al. (2015) acknowledge that these interventions can modify parental investment decisions by making them aware of the importance of early investments. Their analysis, however, does not explicitly consider this or other potential channels for caregivers' behavioural change. In fact, these authors focus on the mechanisms that explain the shift in child outcomes and use reduced form parental investment equations with parameters that are allowed to vary with treatment status.

The rural component of the *Cuna Mas* ECD programme in Peru (called *Servicio de Acompañamiento a Familias*) is based on the Jamaica Home Visiting Model developed by Sally Grantham-McGregor and Christine Powell (Huberman and Mendelsohn, 2012). It comprises the provision of 1-hour home visits every week for a period of one and a half years.

Home visits are carried out by specially trained community members or *facilitadoras*. Each *facilitadora* is in charge of approximately 10 families. They follow a structured curriculum (PNM, 2013) to: (i) show caregivers how to interact in a more sensitive and responsive way with their children during basic care routines; (ii) demonstrate to caregivers how to engage in age-appropriate play activities with their children; and (iii) show caregivers book sharing techniques. The intervention also comprises the delivery of children's books, illustrations, and simple toys such as puzzles.

The intervention was focalized at the district level. Districts selected are those: (i) where monetary poverty incidence is above 50%; (ii) that fall within the scope of intervention of the conditional cash transfer programme *Juntos*; (iii) that exhibit a rate of chronic malnutrition for children aged 0-5 above 30%; and (iv) where more than 50% of the population lives in a rural community. These criteria yielded a total of 531 districts comprising 31,828 rural communities. Children between 0 and 3 years of age living in these communities represent the target population of the intervention, which will be progressively expanded seeking full coverage by year 2016. The first scaling-up effort of the programme occurred between May and June 2013, and it is currently serving approximately 40,000 families across 14 regions. The data for this study was collected between February and March 2014.

3.2 Evaluation design

The intervention was scaled-up planning for an evaluation with experimental design. In particular, 60 districts were randomly allocated to each of the following groups: home visits (treatment 1), home visits and group sessions (treatment 2) and no intervention (control)⁶. The two largest rural communities in terms of target population were selected within each district and, from each community, a total of 15 children-caregiver dyads were randomly selected to participate in a baseline survey collected between April and May 2013 (MIDIS, 2013). Follow-up data collection for the evaluation of *Cuna Mas*'s effects on child development is programmed for 2015.

This study is based on the cluster-randomised design described above, and has the objective of estimating the effectiveness of the intervention in changing the quality of the home environment and caregivers' behaviour. Following power calculations, it was decided to randomly select 20 districts from the control and treatment 2 groups already created. Within each district, in turn, 15 caregivers were randomly selected from the baseline sample. This yielded a total planned sample of 600 caregivers, 300 from the control group and 300 from the treatment group. This sample size and distribution ensured a minimum detectable size of 0.26 standard deviations for a statistical power of 80%. This was judged as a conservative minimum effect size considering the values found in the studies referred above (where effect sizes ranged between 0.32 and 0.65).

⁶ The map presented in Appendix 2 shows the distribution of districts. It was planned that districts assigned to the control group will receive the service starting in year 2015. Group sessions were discontinued in early 2014 following very low coverage due to implementation problems.

Before the random selection of 20 districts from the control and treatment groups already created, some regions and treatment districts were excluded. The exclusion of regions (3 out of 11) was to prevent an excessive geographical dispersion of the sample and implied losing 14 districts in the control group and 8 districts in the treatment group.

The Programme had the specific requirement that the sample should include those caregivers who have been offered treatment, and this had to be combined with the condition of having an average of 15 caregivers surveyed per district. These conditions determined the exclusion of 30 treatment districts which had fewer than 15 baseline caregivers who had been offered treatment by the time fieldwork was implemented. An intention to treat analysis would have prevented these exclusions. Unfortunately, this was not possible due to the implementation requirement in place.

After these exclusions, 20 districts were randomly selected from the remaining control and treatment groups. In each selected district, in turn, 15 caregivers were randomly selected for interview while the rest, if any, were randomly allocated to a replacement list (Table 1.1 in Appendix 2 presents the final list of districts and regions involved in this study).

In principle, the exclusions described above could have introduced bias in the results. There is, however, no evidence of this since there are no significant differences in terms of baseline household, child and caregiver characteristics and, more importantly, in terms of outcome measures, between: (i) control and treatment districts available after the exclusion of regions; (ii) included and excluded districts within the treatment group after consideration of there being a minimum of 15 baseline caregivers who had been offered treatment; (iii) included districts within the treatment group and districts in the control group; and (iv) excluded districts within the treatment group and districts in the control group (see Appendix 2). The fact that these groups share the same pre-treatment outcome measures provides stronger evidence to support the absence of bias. This is because the presence of unobservable confounders affecting treatment estimates would likely manifest by producing unbalanced pre-treatment behaviours.

It is also worth saying that the main reason why some caregivers had not been offered treatment by the time fieldwork was implemented was that the programme had not been launched yet in their communities. In fact, by the time fieldwork was implemented, 45 out of the 120 treatment communities had not started receiving the intervention. It is worth noting that communities were in this situation mainly because of administrative delays in regional offices, a reason which is, in principle, unrelated to the behaviours I aim to analyse. In addition, the exclusion rule was also influenced by the requirements of power calculations and this meant that the criteria for not being part of the treatment sample at the caregiver level amounted to inhabiting a district where the intervention has not yet started in, at least, one of its two communities. In most of the cases, excluded districts had only one community that had not started to receive the intervention. This reduced the likelihood of exclusion being driven by a characteristic shared by all district members.

Departure from a pure random design means that the absence of unobservable confounders is not assured. It is, however, a reasonable assumption based on the arguably exogenous nature of the phenomenon driving exclusion (living in a district where the intervention has not yet started in, at least, one of its communities) and on the fact that districts included in the

treatment group share the same pre-treatment characteristics and outcome measures as those excluded, and as those belonging to the control group.

An analysis of baseline information for the control and treatment caregivers actually surveyed in the districts that were finally selected is presented in the next section. This confirms that both groups shared balanced behaviours and characteristics prior to the intervention.

Administrative records available for the treatment sample contain information on the number of visits provided and the date of the first and last visit delivered until December 2013. These records reveal that caregivers in the treatment sample had received an average of 25 visits until December 2013, a figure consistent with the fact that nearly 6 months had passed since the programme was scaled up (between May and June 2013). A refusal rate can be estimated considering those caregivers living in communities that have started to receive treatment that register zero visits. This figure is close to 8%. A dropout rate can be approximated considering those caregivers whose last visit occurred before December 2013. According to this criterion, 3% of caregivers were no longer receiving treatment by that date.

3.3 Survey instruments

A questionnaire was prepared to measure the quality of the home environment as well as caregivers' beliefs regarding the importance of early parent-child interactions for child development (see Appendix 4).

Items included in this questionnaire allow one to characterize the quality of the home environment on the basis of four aspects: (i) interaction and play activities (variety of caregiver-child interactions during basic care and variety of play activities offered to the child); (ii) responsiveness and control practices (communicative and affective caregiver-child interactions and how the caregiver disciplines the child); (iii) play material and home conditioning (variety of play materials present at home and the conditions of the child's play area); and (iv) personal care and hygiene (overall child and caregiver appearance in terms of hygiene). Figure 4.1 in Appendix 4 provides more detail on these specific components and indicates whether the information was collected through caregivers' report or enumerators' observation during the interview. This information was used to build a quality of the home environment index (with values ranging 0-1) given by the simple average of the scaled scores obtained in each of the four components described above⁷.

It should be noted that the abovementioned components comprise the two basic aspects of the concept of quality of home environment discussed in section 2; i.e. (i) the amount of stimulation opportunities offered to the child; and (ii) the degree of caregiver sensitivity and responsiveness. In addition, the information organized under these four components encompasses all the aspects considered by the six subscales of the HOME infant-toddler questionnaire as well as most of the information collected by the FCI early childhood development module. In fact, specific items used to measure caregivers' responsiveness and control practices and the variety of play material are adapted versions of the items contained in the *Emotional and verbal responsivity*, *Avoidance of restriction and punishment*, and *Provision of appropriate play materials* subscales of the HOME inventory. Items used to measure the variety of play activities are based on the FCI.

⁷ Figure 2.1 in Appendix 2 also indicates the raw scores that can be obtained in each component. Note that maximum raw scores are not the same across components. Scaling with respect to the maximum score in each component ensures they have equal weights in the aggregate index.

In terms of characterizing the quality of the home environment, the questionnaire employed for this study includes two novel elements with respect to the HOME inventory and the FCI: (i) specific items aimed at capturing the variety of caregiver-child interactions during feeding and basic care routines; and (ii) a modified version of the play activity table used in the FCI that allows one to identify both the frequency of the interaction and the person interacting with the child. As will be discussed later, both elements are important to account for the effects of the intervention on the stimulation opportunities offered to the child in addition to those provided during the home visit.

Caregiver beliefs regarding the importance of parent-child interactions for child development were captured through an eight-item scale (see items 550 and 551 in the survey questionnaire presented in Appendix 2). During the interview, caregivers were asked about the ideal educational attainment and occupation they would like their child to achieve and were then asked to what extent they agree or disagree with eight statements about the relation between early parent-child interaction and these goals. Measurement of these beliefs is also one of the novel features of this analysis and will serve to provide evidence regarding the mechanisms behind caregivers' behavioural change.

The questionnaire was piloted in three rural districts with similar socioeconomic characteristics to those involved in the evaluation. Interviews were conducted in the language commonly used by caregivers (around 35% spoke Quechua). Informed consent was obtained from all participants without revealing that the study was related to *Cuna Mas*. In fact, this information (as well as treatment status) was also concealed from enumerators to prevent them from making reference to the programme during the interview.

3.4 Balance between treatment and control groups at baseline

Examination of control and treatment groups' observable characteristics prior to treatment can provide evidence to support the claim that there are no confounders influencing the results obtained after comparing outcome measures between these two groups. As already noted, evidence is even stronger if these groups share the same pre-treatment outcome measures as the presence of unobservable confounders affecting treatment estimates would likely manifest by producing unbalanced pre-treatment behaviours.

Table 1 summarizes mean values in the control and treatment group for pre-treatment outcome measures related to the quality of the home environment and several household, caregiver and child characteristics relevant for caregivers' child-rearing practices. Measures were built using baseline data collected between April and May 2013. A quality of the home environment index was built organizing baseline data under the four components described above. The specific information entering each component, however, is not exactly the same as the one considered in this study because the baseline survey was not as rich as our instrument in terms of measuring caregiver behaviour (for example, it did not collect information on the variety of caregiver-child interactions during basic care). The household wealth index was built combining information on dwelling characteristics, access to basic services and availability of durable goods, as described in Escobal et al. (2003).

Table 1: Outcome variables and household, caregiver and child characteristics at baseline

	Control	Treatment	Difference
<i>Outcome variables</i>			
Quality of home environment index (0-1)	0.599	0.604	0.005 (0.02)
Interaction and play activities (0-1)	0.425	0.434	0.009 (0.028)
Responsiveness and control practices (0-1)	0.708	0.717	0.009 (0.024)
Play material and home conditioning (0-1)	0.348	0.363	0.015 (0.03)
Personal care and hygiene (0-1)	0.914	0.902	-0.012 (0.026)
<i>Household, caregiver and child characteristics</i>			
Household wealth index (0-1)	0.481	0.460	-0.021 (0.036)
Household members	5.425	5.395	-0.030 (0.175)
Caregiver's age	29.334	28.221	-1.113 (0.732)
Caregiver's educational attainment (years)	6.214	6.827	0.612 (0.593)
Caregiver is married (yes = 1)	0.306	0.221	-0.085 (0.057)
Caregiver worked outside household last week (yes = 1)	0.619	0.769	0.150* (0.078)
Number of children under caregiver's care	1.034	1.044	0.010 (0.014)
Caregiver's first language is Spanish (yes = 1)	0.650	0.629	-0.021 (0.131)
Caregiver is the mother (yes = 1)	0.975	0.973	-0.002 (0.015)
Child's age (months)	12.863	13.129	0.267 (0.595)
Child is male (yes = 1)	0.531	0.476	-0.055 (0.044)
Number of observations	320	294	

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

In general, we can say control and treatment characteristics and outcome measures were balanced prior to the intervention. It should also be noted from Table 1 that the final sample comprises 614 observations, 320 (52%) belonging to the control group and 294 (48%) belonging to the treatment group. As planned, data was collected from 20 control districts and

20 treatment districts with an average of 15.4 observations per district. Accordingly, all standard errors are corrected to consider that the data is arranged in 40 clusters.

4. Treatment effects on the quality of the home environment and parental behaviour

4.1 Estimation of treatment effects

Treatment effects were calculated using OLS estimates of parameters β and β^C in equations (1) and (2) given below.

$$y_i = \alpha + \beta T_i + \mu_i \quad (1)$$

$$y_i = \alpha^C + \beta^C T_i + x_i' \gamma + \varepsilon_i \quad (2)$$

In these equations, y_i is the outcome measure under analysis, T_i is the treatment status of the caregiver ($T_i = 1$ if she belongs to the treatment group, $T_i = 0$ if she belongs to the control group), and x_i is a vector containing pre-treatment characteristics and outcome measures.

Balanced pre-treatment characteristics and outcome measures should translate into similar estimates for β and β^C . Estimates provided by equation (2), however, are usually preferred because they can produce more precise estimates of the causal effect of interest (Angrist and Pischke, 2009). Note that the fact that covariates are not correlated with the treatment implies that their exclusion will not bias the estimate of β . However, this does not imply they have no explanatory power for y_i and, therefore, their inclusion can reduce the residual variance.

At this point is worth recalling that the empirical goal of this analysis is to estimate the effectiveness of treatment in changing the quality of the home environment and caregivers' behaviour. In addition, there is a difference between the actual and the original treatment status of caregivers caused by delays in the implementation of the programme. This implies that the parameter of interest is the "effect of the treatment on the treated". That is, the effect of the intervention itself and not the effect of being assigned to treatment (Duflo et al., 2007).

As argued in the previous section, absence of unobservable confounders affecting the estimates of the "effect of the treatment on the treated" is a reasonable assumption. This is based on the evidence presented so far and on the fact that the rule determining exclusion from the treatment group can be regarded as exogenous (in the sense of not being correlated with the error terms in equations (1) and (2)).

4.2 Effects on the quality of the home environment

Table 2 presents treatment effects on the quality of the home environment index and the scaled scores of each component (complete regression results are reported in Appendix 5). Effects are reported in terms of the simple difference between control and treatment group means and as the difference controlled for pre-treatment outcome values and household, caregiver and child characteristics considered in Table 1. Results for the aggregate index are reported considering the average over all components. This implies losing observations from caregivers not responding all items or for whom all characteristics could not be observed

during the interview⁸. It is worth mentioning that pre-treatment characteristics and outcome measures are also balanced for this subsample of caregivers. In addition, results are robust to building the aggregate index averaging only over those components with complete information⁹.

Table 2: Treatment effects on the quality of the home environment

	Obs.	Mean control group	Mean treatment group	Difference	Controlled difference	d
<i>Aggregate index (0-1)</i>						
Average over all components	486 (C=238; T=248)	0.610	0.671	0.062*** (0.019)	0.059*** (0.013)	0.534
<i>Index components (0-1)</i>						
1. Interaction and play activities	614 (C=320; T=294)	0.363	0.438	0.074*** (0.019)	0.068*** (0.013)	0.382
2. Responsiveness and control practices	548 (C=283; T=265)	0.644	0.707	0.063*** (0.021)	0.062*** (0.021)	0.424
3. Play material and home conditioning	537 (C=264; T=273)	0.490	0.592	0.101*** (0.03)	0.098*** (0.023)	0.511
4. Personal care and hygiene	558 (C=290; T=268)	0.939	0.945	0.006 (0.016)	0.01 (0.011)	0.101

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Controlled difference is the estimated effect including pre-treatment controls.
Effect size (d) calculated as the standardized controlled difference.

Overall, evidence shows that the treatment has a positive and significant effect on the quality of the home environment. Its effect size (standardized treatment effect around 0.5) can be regarded as moderate (Cohen, 1992) and lies between the values found in the literature for effective trials based on the home-visiting model: d = 0.65 in Jamaica (Powell et al., 2004); d = 0.53-0.54 in Colombia (Attanasio et al., 2013); d = 0.49 in Jamaica (Grantham-McGregor et al., 1991); d = 0.37 in Jamaica (Walker et al., 2004); d = 0.32 in India (Bentley et al., 2010).

It should be noted that the abovementioned interventions had between 1 and 2 years of duration. This is significantly above the average exposure of the *Cuna Mas* treatment group at the time this data was collected (around 6 months or an average of 25 visits). It is reasonable to assume, however, that longer or more intense exposures are more related to larger treatment effects in terms of child outcomes than in terms of caregiver behaviour¹⁰.

⁸ Most missing observations are due to the fact that some characteristics of the environment could not be observed because the caregiver was not willing to show the play material or particular areas of the house to the enumerator. Rejection was low (around 10%) but its effect gets compounded when building an aggregate score.

⁹ Averaging over those components with complete information allows one to use the complete sample of 614 caregivers. Results are as follows: mean control group = 0.597; mean treatment group = 0.657; controlled difference = 0.057 (0.014); d = 0.466.

¹⁰ In Powell and Grantham-McGregor (1989) the evaluation design allowed one to compare the effects of having biweekly vs. monthly visits for a period of 2 years. Larger effects on child outcomes were found for biweekly visits. Unfortunately, no measurements of caregiver behaviour were taken.

Table 2 also reveals that the improvement in the quality of the home environment is explained by positive treatment effects on every component except in “personal care and hygiene”. It should be noted that the score obtained in this component in the control group is already high (0.94 out of 1) leaving little space for an improvement.

4.3 Effects on caregiver behaviour

Achieving behavioural change among caregivers is important because it implies an enriched environment is being offered to the child in a continuous way and not only during home visits. A change in caregivers’ behaviour also increases the likelihood of this improvement being sustained even after the intervention is phased out.

As already noted, an increase in stimulation opportunities offered to the child (either in terms of play activities or play materials) does not imply there has been a change in parental behaviour if results stem from follow up data that has been collected while home visits are still being carried out. This is the case of this particular evaluation. In addition, it is also prudent to refrain from considering increases in access to play material when talking about changes in caregiver behaviour if the intervention has directly provided materials and it is not possible to account for their origin from survey data.

To measure the effect of the intervention on caregiver behaviour we will focus on caregiver-child interactions happening in addition to the home visit. The instruments used for this analysis allows one to do this by looking at two subcomponents of the quality of the home environment index: (i) the number of types (or variety) of interactions during basic care and play; and (ii) the number of types (or variety) of play activities offered to the child. The first one is built considering interactions that take place independently of the home visit (e.g. verbal communication that happens during feeding, bathing and clothes change routines). As shown in the first row of Table 3, there is a positive and significant effect in this outcome variable.

The second outcome variable is of particular interest for this analysis because it is related to activities with a direct and explicit stimulation purpose. This indicator is built considering the number of types of activities (out of 7 possible types) carried out by the caregiver with the child at least twice per week. Conditioning on a minimum frequency of 2 implies that the variety is measured excluding those types of activities carried out only once per week. This is important because it allows one to approximate the increase in the variety of play activities that take place in addition to what happens during the home visit¹¹. Results obtained for this indicator confirm that the treatment has produced an increase in the variety of play activities offered to the child by the caregiver, over and above the stimulation provided during the home visit (see the second row in Table 3).

¹¹ Excluding those activities carried out with frequency 1 when building the indicator implies excluding the effect of treatment on the number of activities carried out once per week. This provides a good approximation to the effect of treatment on the number of activities offered to the child that take place in addition to what happens during the home visit, based on the notion that the main effect of the intervention is to allow caregivers to start doing activities they were not offering to the child, a certain number of times per week. If these additional activities are performed twice per week or more, it means they are being carried out in addition to what takes place during the home visit. Also note that the results (presented in the second row of Table 3) are robust to measuring treatment effects after subtracting 1 from the frequencies reported by treatment caregivers for activities that are likely to happen during a home visit (one obtains 0.49 for the controlled difference; $p < 0.01$). This is a conservative estimate because not all the activities are necessarily carried out during each home visit.

Table 3: Treatment effects on caregivers' interaction with child and on the variety of play activities offered by the caregiver

	Mean control group	Mean treatment group	Difference	Controlled difference	d
Number of types of interactions during basic care (0-12)	5.069	5.813	0.744*** (0.235)	0.747*** (0.208)	0.301
Number of types of play activities carried out at least twice last week by the caregiver (0-7)	1.838	2.500	0.663*** (0.214)	0.537*** (0.135)	0.310

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Effect size (d) calculated as the standardized controlled difference.

Another benefit of collecting information about the frequency and person involved in play activities is that one can shed light on how the change in the child's environment is occurring. One can think of the nature of the environment to which the child is exposed during play as something that depends, at least, on the type of activity being carried out and the people involved with the child during the activity. In principle, changes can occur through either channel.

When we asked about child engagement in particular play activities and its weekly frequency we also recorded who was the person usually sharing the activity with the child and if there was somebody else involved. This allows one to decompose the total effect on the variety of play activities carried out with a minimum frequency of f ($\Delta V(f)$) in the following way:

$$\Delta V(f) = \Delta V(f|without\ caregiver\ involvement) + \Delta V(f|with\ caregiver\ involvement) \quad (3)$$

Notice that caregiver involvement implies that the caregiver was either identified first as the person usually sharing the activity with the child or was identified as the one accompanying the interaction between the first person and the child. This implies that the effect on the variety of play activities carried out with the child with caregiver involvement can be further decomposed following:

$$\begin{aligned}
\Delta V(f|with\ caregiver\ involvement) & \\
&= \Delta V(f|caregiver\ identified\ first) \\
&+ \Delta V(f|caregiver\ identified\ as\ accompanying)
\end{aligned}
\tag{4}$$

Table 4 presents the results of these two decompositions. As explained below, they reveal that increased stimulation offered to the child (additional to that occurring during the home visit) is occurring through greater caregiver involvement in play activities rather than through the introduction of more types of play activities.

Table 4: Effects on the variety of play activities offered to the child (number of types of play activities)

Person involved	Minimum frequency	
	1	2
(a) Anyone ($\Delta V(f)$) [(b) + (c)]	0.73*** (0.113)	0.274** (0.116)
(b) Without caregiver involvement	-0.272* (0.150)	-0.508*** (0.137)
(c) With caregiver involvement [(d) + (e)]	1.001*** (0.15)	0.782*** (0.137)
(d) Caregiver identified first as the person usually sharing the activity	0.666*** (0.159)	0.537*** (0.135)
(e) Caregiver identified as the person accompanying the interaction between the first person and the child	0.340*** (0.079)	0.249*** (0.061)

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The first row in Table 4 shows there is only a small effect of around 0.27 on the number of types of activities offered to the child that are additional to those that take place during the home visit (i.e. with a minimum frequency of 2). Moreover, if we compare columns 1 and 2 for indicator (a) we would realise that most of the effect on the variety of play activities is concentrated on frequency 1, something that could cast doubt on the effectiveness of the intervention beyond the home visit¹².

This result, however, masks the fact that there is greater caregiver involvement in play activities, something that could not have been identified in absence of information regarding the people involved in these activities. In fact, the effect of the intervention on the variety of play activities carried out with a minimum frequency of 2 raises from 0.27 to 0.78 when we condition it to have caregivers' involvement (see indicator (c) in Table 4). According to equation (3), for this to be possible, the variety of play activities offered without caregiver

¹² The effect on the variety of play activities carried out with a minimum frequency of f ($\Delta V(f)$) can be decomposed as the sum of the effects on each particular frequency starting in ($\Delta V(f) = \Delta V_f + \Delta V_{f+1} + \dots + \Delta V_7$). Following the results presented in the first row of Table 4, this implies that the effect on the variety of play activities carried out only once per week is given by $\Delta V_1 = \Delta V(1) - \Delta V(2) = 0.73 - 0.27 = 0.46$.

participation must be falling by $0.27 - 0.78 = -0.51$, as confirmed by the results reported for indicator (b)¹³.

These results imply that the nature of the environment to which the child is exposed during play, in addition to the home visit, is being transformed mainly through the engagement of their caregivers (i.e. a shift in the people involved) and less because of the introduction of more types of activities.

It is also worth noting that the indicator proposed to measure the variety of play activities offered to the child by the caregiver when accounting for changes in caregiver behaviour (reported in Table 3 above) corresponds to that conditioned on the caregiver being identified first as the person usually sharing the activity with the child (indicator (d) in Table 4). This is to ensure that the caregiver has a leading role in the activity carried out with the child.

The effect on the number of types of play activities is equal to the sum of the effects on the proportion of caregivers who engage in each of the activities considered. This allows one to analyse if there are certain activities that account for the majority of the overall effect on the variety of play offered to the child.

Table 5 allows this analysis by showing the effect on the proportion of caregivers who engage in each of the 7 types of play activities considered. Three types of activities explain most of the effect on the variety of play offered to the child by the caregiver: telling stories to the child (10 percentage point increase), singing songs to or with the child (12 percentage point increase), and playing with the child and her toys (16 percentage point increase). No significant effect has been found in activities such as reading or looking at books, drawing or painting, and taking the child outside the house. The proportion of caregivers who carry out this last activity, however, is already relatively large in the control group (around 60%).

¹³ This result should not be taken to imply that a substitution effect is in place. Greater caregiver involvement does not necessarily mean that other household members are no longer taking part of the activity.

Table 5: Treatment effects on each type of play activity (proportion of caregivers)

Play activities		Mean control group	Mean treatment group	Controlled difference
<i>Play activities</i>				
1	Read books, look at pictures from a book with (NAME)	0.200	0.252	0.032 (0.031)
2	Told stories to (NAME)	0.100	0.208	0.102*** (0.03)
3	Sang songs to or with (NAME), including lullabies	0.303	0.439	0.122** (0.048)
4	Took (NAME) outside the house	0.606	0.605	-0.007 (0.045)
5	Played with (NAME) with his/her toys	0.166	0.350	0.161*** (0.04)
6	Drew, painted or scribbled with (NAME)	0.169	0.245	0.054 (0.035)
7	Played with (NAME) to name objects, colours or numbers	0.294	0.401	0.073* (0.038)
			Sum /a	0.537
			d	0.310

/a The sum of effects corresponds to the overall effect on the variety of play activities carried out by the caregiver at least twice per week.

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5. Constraints influencing treatment effects on parental behaviour

Results so far show that a home visiting ECD intervention working at scale can provoke a change in caregiver behaviour conducive to the provision of more stimulation opportunities for her child. In particular, it is possible to identify an increase in caregiver engagement in educational play activities with her child in addition to those occurring during the home visits. This effect is positive, statistically significant and has a size of 0.3 standard deviations.

In Section 2, I highlighted the literature's lack of attention to the mechanisms behind caregivers' behavioural change and how its strong emphasis on parenting skills implicitly assumes that caregivers' lack of knowledge about certain activities that can be performed with their children and of the ability to engage in them are the major binding constraint. I argued this assumption can be rather strong especially if we are working with poor families who, by definition, face scarcity in many dimensions.

In this section I propose an analysis of the potential constraints limiting the effect of the intervention on caregiver participation in play activities with their children. The objective is

to determine if the available evidence is consistent with poor parenting skills being the main binding constraint limiting caregiver participation in play activities or if the evidence suggests there are other limiting factors.

I start from the premise that treatment is transferring skills to caregivers that enable them to engage in more educational play activities with their children. Therefore, if caregivers exhibit a heterogeneous incremental engagement due to the intervention, it is either because there has been an unequal transference of skills or because they respond differently to these skills. If the lack of parenting skills is the major constraint preventing caregivers from engaging in more play activities, heterogeneity in treatment effects must respond to the first possibility. In other words, some caregivers have ended up with more additional skills than others and this has determined different treatment effects in terms of their engagement in play activities. If there are other elements besides skill conditioning caregivers' response, then heterogeneity in treatment effects can be present even if the shift in parenting skills has been homogeneous across caregivers. In this case, a similar pattern of heterogeneity should be present in those elements conditioning caregivers' response.

Based on these notions, the analysis is organised in three parts. The first presents empirical evidence about the presence of heterogeneous treatment effects by caregivers' wealth and educational attainment. Household wealth provides a broad view of the degree of scarcity faced by caregivers and their families. A positive wealth gradient in treatment effects would suggest that the intervention is requiring parents to input resources of their own that poorer caregivers are finding more difficult to forgo.

A positive wealth gradient in treatment effects can also be the consequence of an unequal shift in parenting skills if the process of skill acquisition is influenced by some variable that correlates with wealth. Caregivers' educational attainment usually correlates with wealth and can determine the effectiveness with which new information and knowledge regarding educational play activities is transmitted to them. Therefore, the first part of the analysis also evaluates if treatment effects differ by caregivers' education in an effort to produce evidence consistent with an unequal transference of parenting skills to caregivers.

The second part of the analysis discusses results obtained when assessing caregivers' beliefs about the importance of parent-child interactions for child development, and presents treatment effects on this variable. This is one of the novel features of the analysis which aims at exploring if these beliefs play a role as a conditioning factor for caregivers' response to the transference of parenting skills. As already discussed, conditioning factors should exhibit the same pattern of heterogeneity as treatment effects on caregiver behaviour. Finally, the third part of the analysis presents a simple model to rationalise the empirical findings and provide a way of thinking about the mechanisms behind caregivers' behavioural change.

5.1 Heterogeneity of treatment effects: the role of caregivers' wealth and educational attainment

Three different techniques are employed to determine whether the effects of the intervention differ depending on caregivers' wealth and educational attainment. The first consists in estimating different treatment effects for different groups within the wealth and education distributions. If we divide these distributions into K groups, this can be easily accomplished using the following specification:

$$y_i = \alpha_1 + \beta_1 T_i + \beta_2 T_i G_{i2} + \dots + \beta_k T_i G_{ik} + \alpha_2 G_{i2} + \dots + \alpha_k G_{ik} + x_i' \gamma + \varepsilon_i \quad (5)$$

Where T_i denotes individual i treatment status, G_{ik} indicates membership to group k , and x_i' is a vector of pre-treatment controls. The treatment effect for the first group is given by $\hat{\beta}_1$, while the treatment effect for group k is given by $\hat{\beta}_1 + \hat{\beta}_k$. This specification has the advantage of allowing one to directly assess the significance of the difference of treatment effects with respect to the first group by simply looking at the significance of coefficients $\hat{\beta}_1, \hat{\beta}_2, \dots, \hat{\beta}_k$.

The second technique allows wealth and education to affect treatment effects in a continuous way. This is tested by introducing an interaction between treatment status and caregivers' wealth or educational attainment. Formally:

$$y_i = \alpha_1 + \lambda_1 T_i + \lambda_2 T_i z_i + x_i' \gamma + \varepsilon_i \quad (6)$$

$$y_i = \alpha_1 + \lambda_1 T_i + \lambda_2 T_i z_i + \lambda_3 T_i z_i^2 + x_i' \gamma + \varepsilon_i \quad (7)$$

Where z_i refers to caregivers' household wealth or educational attainment, depending on the source of heterogeneity under analysis. In specifications (6) and (7), the estimated effect of the treatment is given by $\hat{\lambda}_1 + \hat{\lambda}_2 z_i$ and $\hat{\lambda}_1 + \hat{\lambda}_2 z_i + \hat{\lambda}_3 z_i^2$, respectively. Specification (7) allows for a non-linear effect of z_i on the treatment's impact ($\hat{\lambda}_2 + 2\hat{\lambda}_3 z_i$).

Finally, a non-parametric fit of the relationship between the variety of play activities offered by the caregiver and her educational attainment or household wealth provides an even more flexible way of evaluating the presence of heterogeneity in treatment effects. For this, we need to assess the difference between the non-parametric fit built using data from the control and treatment groups. Systematic changes in this difference will be indicative of heterogeneity in treatment effects. If we suspect treatment effects exhibit a positive or negative gradient according to a certain variable, the behaviour of this difference can serve to evaluate the robustness of such gradient.

Tables 6 and 7 and Figure 1 present the results obtained from the three techniques explained above. Estimations following specification (5) were obtained after dividing the wealth and education distributions in four groups (quartiles). Results are presented in Table 6. Table 7 reports estimates from specifications (6) and (7). Panel A in Figure 1 shows the behaviour of treatment effects according to caregiver wealth and education, estimated from the non-linear specification given in (7)¹⁴. Finally, Panel B in Figure 1 presents a non-parametric fit by treatment status of the relationship between play activities and caregiver wealth and educational attainment.

¹⁴ Upper and lower bounds for the x-axis variables were set at the mean values in the first and fourth quartiles of the wealth and education distributions.

Table 6: Treatment effects by household wealth and caregiver education quartiles on the variety of play activities offered by the caregiver at least twice per week

(a) Household wealth				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.207 (0.186)	0.461* (0.268)	1.131*** (0.240)	0.239 (0.239)
Difference w.r.t Q1		0.254 (0.316)	0.924*** (0.288)	0.031 (0.305)
(b) Caregiver education				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.439** (0.174)	0.621** (0.272)	0.591* (0.335)	0.632** (0.241)
Difference w.r.t Q1		0.182 (0.326)	0.152 (0.386)	0.193 (0.273)

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Treatment effects and differences estimated using an interaction between treatment status and membership to each wealth or caregiver education quartile. All regressions include pre-treatment controls.

Table 7: Interactions between treatment status, household wealth and caregivers' educational attainment

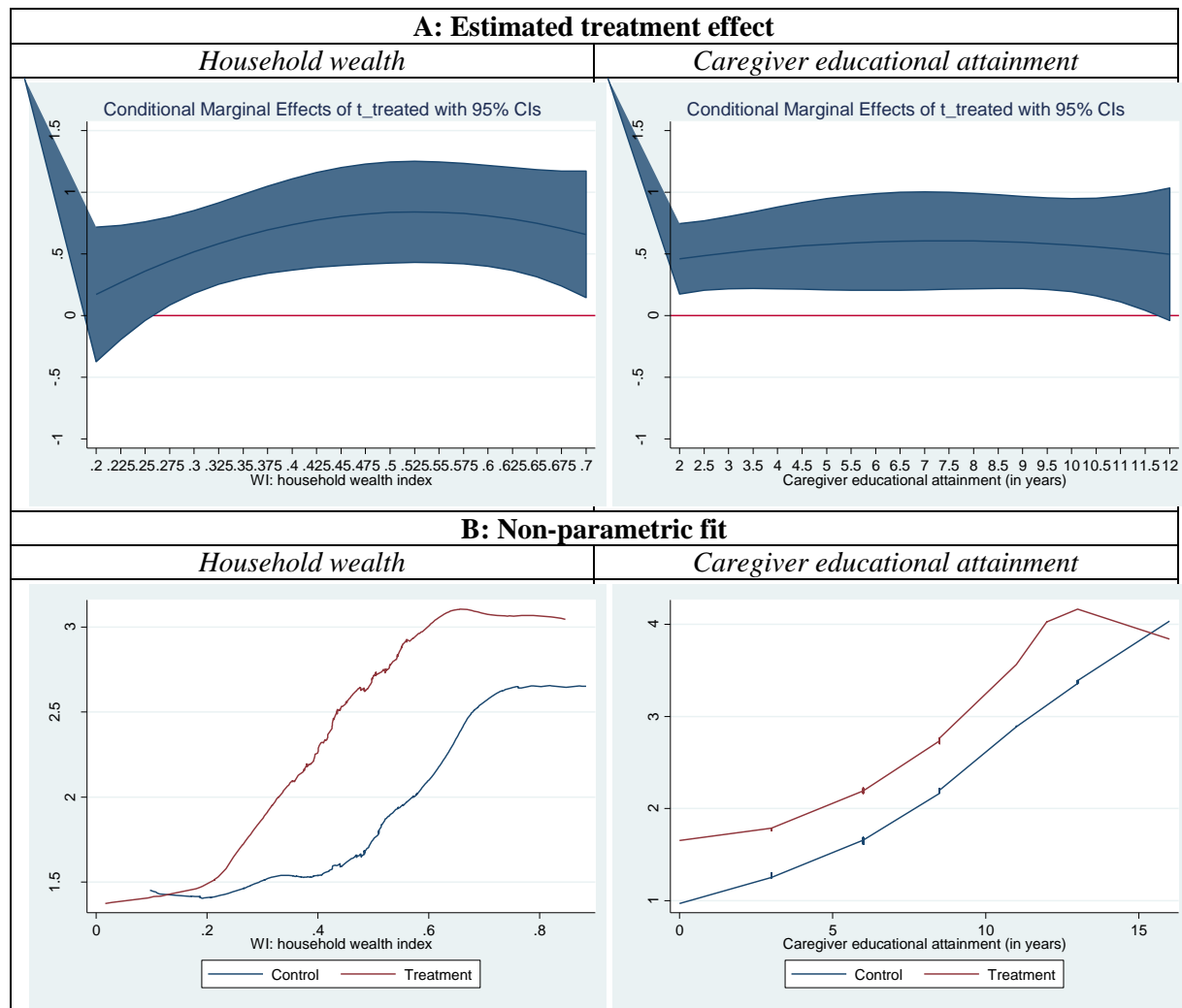
	z(i) = household wealth		z(i) = caregiver's educational attainment	
	<i>Linear effect</i>	<i>Non-linear effect</i>	<i>Linear effect</i>	<i>Non-linear effect</i>
Treatment	0.251 (0.329)	-1.210 (0.843)	0.411* (0.213)	0.331 (0.252)
Treatment*z(i)	0.611 (0.691)	7.650* (3.956)	0.019 (0.031)	0.0765 (0.110)
Treatment*z(i)^2	--	-7.553* (4.115)	--	-0.005 (0.009)
z(i)	0.781* (0.406)	-2.320 (2.184)	0.097*** (0.022)	-0.069 (0.059)
z(i)^2	--	3.193 (2.028)	--	0.013*** (0.005)

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

All regressions include pre-treatment controls.

Figure 1: Treatment effects by household wealth and caregiver educational attainment



Panel A depicts estimated treatment effects ($\hat{\lambda}_1 + \hat{\lambda}_2 z_i + \hat{\lambda}_3 z_i^2$) and 95% confidence intervals obtained from the following specification: $y_i = \alpha_1 + \lambda_1 T_i + \lambda_2 T_i z_i + \lambda_3 T_i z_i^2 + x_i' \gamma + \varepsilon_i$, where z_i refers to caregivers' household wealth (left hand side graph) and educational attainment (right hand side graph). Panel B depicts a locally weighted scatterplot smoothing of play activities on household wealth and caregiver education. In each graph, results are presented for the control and treatment groups. Therefore, treatment effects are given by the vertical distance between the two functions.

Several important results emerge from the analysis presented in the tables and figures above.

- (i) Household wealth has a significant effect on the impact of the intervention.
- (ii) There is evidence suggesting that treatment effects are a non-linear function of wealth. There is, however, a monotonic and significant increase in treatment effects as household wealth raises, up until to the 75th percentile of the wealth distribution.
- (iii) There is no evidence of significant treatment effects in the lower 25% of the wealth distribution. This result is robust to all the specifications considered.
- (iv) There is no evidence of heterogeneity in treatment effects on the variety of play activities by caregivers' educational attainment. In particular, impacts are positive, significant and amount to approximately 0.5 activities across the entire education distribution.

5.2 Measurement and treatment effects on caregivers' beliefs regarding the importance of parent-child interactions for child development

Caregivers' beliefs regarding how important are parent-child interactions for the development of their children play an important role in shaping parenting practices. Under the premise that parents try to provide what they believe is best for their children, variation in these beliefs should conduce to variation in observed behaviour. As discussed in Bornstein and Putnick (2012), "variation on childrearing philosophies, values and beliefs mediates differences in childrearing practices vis-à-vis local and larger physical and social environments" (Bornstein and Putnick (2012), p. 57). Caregivers' understanding of the significance of their role and of particular activities that can be carried out during their children's early years are part of these set of beliefs (Hoff et al., 2002).

The programme has no explicit objective in terms of caregivers' beliefs about the importance of parent-child interactions for child development. Despite this, *facilitadoras* are expected to offer messages about the importance of parenting practices for the child's wellbeing (PNCM, 2013). It is therefore reasonable to postulate that the intervention can affect caregivers' beliefs regarding their role and the importance of certain activities for child development. In fact, this effect could be one of the channels through which behavioural change is achieved as these beliefs can condition caregivers' response to the transference of parenting skills.

As already mentioned, this study aimed at collecting information on caregivers' beliefs about the importance of parent-child interactions for child development by means of an eight-item scale. Each item proposed a statement and the caregiver had to indicate (through a visual aid) to what extent does she agree or disagree with that statement. In order to ensure that caregivers shared a meaningful and concrete idea of "child development" when completing the scale, they were first asked about the ideal educational attainment and occupation they would like their child to achieve. The statements of the scale make reference to these goals and how their accomplishment relates to early childhood as a sensitive period for development, caregivers' role during this period, and caregivers' engagement in educational play activities. The specific items are presented in Appendix 2.

Results in terms of the internal consistency and validity of this instrument are mixed. On one hand, the scale exhibited low internal consistency with a Cronbach alpha estimate that ranged between 0.46 (with the full sample) and 0.5 (if we focus on caregivers with more than completed primary education -45%-, or those who have Spanish as their mother tongue -64%-).

During the pilot exercise, it was noted that caregivers had difficulties understanding the statements and the nature of the exercise (i.e. that they had to communicate an opinion regarding what was being said). These difficulties can be related to caregivers' limited verbal communication skills, as confirmed by the fact that the internal consistency of the instrument is sensitive to the educational attainment of the participant. Caregivers' mother tongue also played a role, possibly because of noise introduced when the statements were translated to the local idiom (Quechua).

After the pilot exercise, efforts were made to simplify the statements and train enumerators to guide the process. As a result, seven out of the original eight items exhibited the expected

correlation with the rest¹⁵ but, as already mentioned, overall consistency ended up being low (Cronbach alpha = 0.5), although still above the range of values judged as “unacceptable” (Gliem and Gliem, 2003).

On the other hand, in terms of validity, the scores obtained from the final 7-item scale exhibit the expected positive socioeconomic gradient and, importantly, also predict the scores obtained in the quality of the home environment index. Table 6.1 in Appendix 6 documents the relation between the scores that can be obtained from the scale¹⁶, household wealth and caregiver education. We encounter a positive relation consistent with what has already been documented for the beliefs parents hold about their role in achieving the goals they value for their children: lower-SES parents believe they have less control over the outcome and should play a more passive role (Bornstein and Putnick, 2012; Hoff et al., 2002).

Tables 6.2-6.4 in Appendix 6 present results for the partial correlation between the scores obtained in the scale and those obtained in the quality of the home environment index, its subcomponents and the variety of play activities. There is a positive and statistically significant partial correlation (after holding observable pre-treatment characteristics constant) between our measure of caregivers’ belief about the importance of parent-child interactions for child development and caregivers’ parenting practices. Remarkably, this positive partial correlation is significant for the two subcomponents more closely related to caregivers’ actions and attitudes towards their children (“interaction and play activities” and “responsiveness and control practices”). Within the first subcomponent, partial correlation is also significant with the variety of play activities offered by the caregiver.

In Table 8 below, I present treatment effects for the two outcome measures built with the final 7-item scale. There is no evidence of significant average treatment effects on caregivers’ beliefs regarding the importance of parenting activities for child development. An analysis by wealth and education groups, however, reveals the existence of positive and significant effects among the wealthiest caregivers (see Table 9). A comparison between treatment and control groups of the relationship between caregivers’ beliefs and household wealth (see Figure 2) confirms the presence of consistently larger treatment effects in the upper part of the wealth distribution. This same pattern is not apparent if we evaluate treatment effects by caregivers’ education. These results are robust to considering the aggregate score of the scale and to restricting the sample to those caregivers that have Spanish as their mother tongue, for whom the internal consistency of the scale is larger (see tables 6.5-6.8 in Appendix 6).

¹⁵ The last item was excluded because it exhibited a negative correlation with the rest.

¹⁶ The two outcome measures are: (i) an average score (with values between 1 and 4); and (ii) an aggregate score (with values between 7 and 28). The aggregate score is built using the information of those caregivers that answered all seven items.

Table 8: Treatment effects on caregivers' beliefs regarding the importance of parent-child interactions for child development

	Obs.	Mean control group	Mean treatment group	Difference	Controlled difference	d
Average score (1-4)	614 (C=320; T=294)	2.951	2.995	0.044 (0.039)	0.034 (0.032)	0.097
Aggregate score (7-28)	579 (C=304; T=275)	20.776	21.076	0.300 (0.266)	0.219 (0.230)	0.089

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Controlled difference is the estimated effect including pre-treatment controls.

Effect size (d) calculated as the standardized controlled difference.

Table 9: Treatment effects by household wealth and caregiver education quartiles on caregivers' beliefs regarding the importance of parent-child interactions for child development (scale average score)

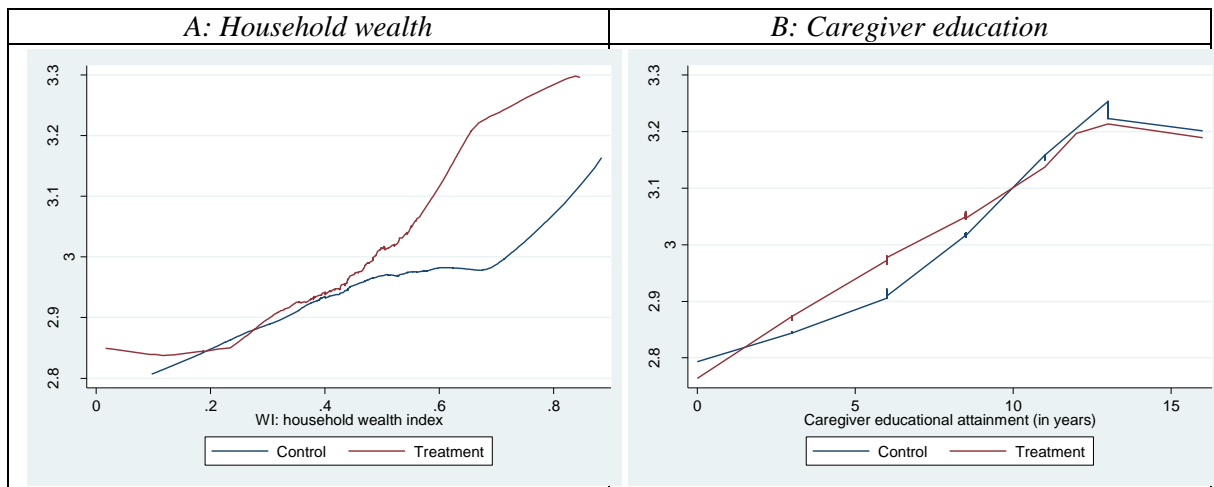
(a) Household wealth				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	-0.013 (0.047)	0.058 (0.051)	-0.056 (0.060)	0.144*** (0.058)
Difference w.r.t Q1		0.070 (0.060)	-0.043 (0.085)	0.157** (0.075)
(b) Caregiver education				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.025 (0.049)	0.126*** (0.044)	0.057 (0.057)	-0.045 (0.077)
Difference w.r.t Q1		0.101 (0.068)	0.032 (0.076)	-0.070 (0.088)

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Treatment effects and differences estimated using an interaction between treatment status and membership to each wealth or caregiver education quartile. All regressions include pre-treatment controls.

Figure 2: Relationship between caregivers' beliefs regarding the importance of parent-child interactions for child development (average score) and caregivers' household wealth and education



Figures depict a locally weighted scatterplot smoothing of the average score obtained in the beliefs scale on household wealth (panel A) and caregiver education (panel B). In each graph, results are presented for the control and treatment groups. Therefore, treatment effects are given by the vertical distance between the two functions.

5.3 A simple time allocation model to explore the mechanisms

In the previous sections I have shown that the intervention has caused a heterogeneous shift in caregiver behaviour. In fact, the size of treatment is positively related to caregivers' wealth and is not significant among the poorest caregivers. In addition, I have not found evidence that this heterogeneity is driven by an unequal shift in parenting skills. Caregivers' educational attainment correlates with wealth and can condition the transmission of skills, but treatment effects are homogenous across the entire caregiver education distribution¹⁷. Finally, positive treatment effects on caregivers' beliefs regarding the importance of parent-child interactions for child development have been found only in the upper 25% of the wealth distribution.

In this section I aim at rationalising these findings by means of a simple time allocation model. With this model, I also seek to provide a way of thinking about the mechanisms behind the effects of parent-child focused interventions on caregivers' engagement in cognitively stimulating activities with their children.

The model rests on the following premises: (i) treatment transfers parenting skills to caregivers and can also shift their beliefs regarding the importance of parent-child interactions; (ii) parenting skills allow caregivers to engage in more educational play activities with their children; (iii) from the point of view of caregivers, parenting skills are

¹⁷ An unequal acquisition of parenting skills by caregivers could also be caused by different intensities of treatment. In this regard, there is no evidence of heterogeneity in the intensity of treatment by caregiver wealth. In particular, the number of home-visits received until the follow-up survey is equal to 25 across the entire wealth distribution. The expansion in play materials is also homogenous across the wealth distribution (see Appendix 7). Also notice that treatment effects are insignificant among the poorest caregivers. Given the evidence just presented, it is implausible that this absence of effect is entirely explained by a failure to convey parenting skills.

given which means that these skills cannot be purchased in the market¹⁸; and (iv) to produce more play activities caregivers also need to input time.

Regarding this last assumption, the literature offers evidence showing that family wealth, parental time devoted to childcare and parenting activities relevant for child development are all positively related. In fact, it has been documented that the amount of time that parents devote to their children increases with families' socioeconomic status (Guryan et al., 2008) and there is strong causal evidence linking the amount of time that parents and children spend together in play activities to child development (Fiorini and Keane, 2014). Based on this evidence and the nature of the outcome variable under analysis (the number of types of play activities offered to the child at least twice per week) it is reasonable to assume that parenting skills need to be complemented with caregiver time in order to produce a shift in caregiver behaviour¹⁹.

The model proposes one to understand parenting skills as an input that enables a certain behaviour (in this case, caregiver engagement in educational play activities). Behavioural change, however, is not guaranteed because in addition to being able to engage in this behaviour, caregivers also have to understand it as something desirable. Under the logic of an economic model of rational behaviour, the latter will depend on the expected costs and benefits of allocating more time to childcare activities. Importantly, I will assume that the expected benefits of such decisions are reflected by caregivers' beliefs regarding the importance of parent-child interactions and are, therefore, susceptible to being affected by the intervention.

Another important implication of postulating that parenting skills and time are complementary to each other and that there is no market for parenting skills is that the actual amount of time allocated to childcare can be below the amount that equalizes marginal returns across all competing activities. As will be explained below, this situation is consistent with the existence of a binding constraint in parenting skills.

The model follows Kimmel and Connelly (2007) and Guryan et al. (2008) time allocation frameworks, but extends their original formulation to describe more explicitly the process through which childcare time is transformed into child-services. This is done by introducing a "parenting technology". As in Cunha et al. (2013), I also introduce uncertainty in caregivers' choices. In particular, caregivers do not know for certain the effect of their parenting activities on child outcomes. As already explained, the expected benefits of these actions are reflected by their beliefs regarding the importance of parent-child interactions.

Consider a static model where caregivers value consumption (C) and child-services (S). In principle, the concept of child services is broad enough to encompass the possibility that parents derive process utility from interacting with their children, and also outcome utility related to their children's human capital. For this analysis I will focus on the latter, which is

¹⁸ Absence of a market for these skills is a reasonable assumption given that the supply of play groups or nurseries is very limited in rural areas. In fact, it is this limited supply what *Cuna Mas* seeks to tackle.

¹⁹ More types of educational play activities for a given frequency could be produced without inputting more time to childcare if we assume caregivers are already engaged in activities with their children but these are irrelevant for child development. This assumption is questionable. If the lack of early stimulation in low-SES homes were due to the fact that parents are inputting time but offering activities to their children that are not appropriate for child development, we would not observe the positive SES gradient in childcare time nor the positive relation between the amount of time parents devote to children and child outcomes documented in the literature.

true if parents are altruistic and care about the children's future consumption, and also if they are selfish and care about future transfers that can be received from their children.

Consumption goods can be produced by combining time devoted to home production (t_{HP}) and market purchases (X). To ease manipulation, assume that child's human capital depends exclusively on parenting practices (PA). These practices comprise the educational play activities analysed in previous sections and are produced by combining time devoted to childcare (t_C) and parenting skills (PS). The caregiver can also devote time to market production (t_{MP}) in exchange for a wage (w).

Because caregivers face uncertainty regarding the outcome of their parenting practices, they maximize expected utility conditional on the information available to them at the time choices are made (I). The problem can be stated as follows.

$$\max E(U|I) = U(C, E(S|I)) \quad (8)$$

Given:

$$C = C(t_{HP}, X; \theta) \quad (9)$$

$$E(S|I) = S(PA; E(\phi|I)) \quad (10)$$

$$PA = P(t_C, PS) \quad (11)$$

And subject to:

$$T = t_{HP} + t_{MP} + t_C \quad (12)$$

$$P_X X = wt_{MP} + V \quad (13)$$

Equation (9) indicates the technology for the production of consumption goods, where θ is an efficiency parameter. Equations (10) and (11) play an important role in this analysis and describe the processes and technologies involved in the production of child human capital. Function $S(\cdot)$ in equation (10) can be viewed as a simplified version of an early childhood skill formation technology²⁰. Caregivers' uncertainty regarding the returns to parental investments in children is captured through the expected value of the parameter governing the elasticity of child's human capital to parenting activities ($E(\phi|I)$).

The function indicated in (11) captures the parenting technology: time and parenting skills are combined to produce an activity (e.g. sharing a book with the child). Consistent with the definition used in the preceding sections, parenting skills refer to caregivers' knowledge of particular educational play activities that can be carried out with their children and the ability to perform them. Finally, equations (12) and (13) define the time and monetary budget constraints, respectively. In (13), variable V captures other sources of income.

In this model, the allocation of time between the three competing activities will depend on preferences regarding consumption goods and child human capital, and caregivers' productivity in the goods and child services sectors. Under this setting, a home-visiting intervention can be viewed as one that seeks to increase the productivity of caregivers in the child services sector in order to promote better child outcomes. This is pursued by increasing parenting skills which means shifting PS .

²⁰ Since this analysis focuses on early childhood (ages 0-3) it is reasonable to assume that the main inputs for skill formation during this transition are provided at home.

One key feature governing the outcomes of the model is the degree of complementarity assumed between caregiver time and skill for the production of PA . As explained above, this analysis will assume there is high degree of complementarity. An important implication of this assumption is that we are understanding the home-visiting intervention as one that provides skills to caregivers that allow them to engage in time-consuming activities that improve child outcomes.

Consistent with the abovementioned assumption, let the parenting technology be given by: $PA = \min(\varphi t_C, \gamma PS)$ where, as already explained, the amount of parenting skills inputted is not a choice variable. In addition, assume that all the other functions are concave and continuously differentiable. Because of the nature of PS , the observed amount of childcare time will depend on whether parenting skills represent a binding constraint or not.

Let us start considering the case where PS are non-binding. Assume that PS are sufficiently large such that, for a given choice of t_C , $\min(\varphi t_C, \gamma PS) = \varphi t_C$. Under these circumstances, the optimal amount of time devoted to the production of PA (t_C^*) will be such that the expected marginal returns are equated across the three time use alternatives. This implies that (t_C^*) must satisfy the following condition:

$$\begin{aligned} U_S^* [S(P(t_C^*, PS); E(\phi|I)) - S(P(t_C^*, PS); E(\phi|I))] \\ = U_C^* \left[C \left(t_{HP}^*, \left(\frac{W}{P_X} \right) t_{MP}^* + \frac{V}{P_X}; \theta \right) - C \left(t_{HP}^*, \left(\frac{W}{P_X} \right) t_{MP}' + \frac{V}{P_X}; \theta \right) \right] \end{aligned} \quad (14)$$

where U_S^* and U_C^* are the marginal utilities of child human capital and consumption, respectively, evaluated at the time allocations ($t_C^*, t_{HP}^*, t_{MP}^*$). This expression states that the optimal amount of time devoted to childcare will be the amount that guarantees that the expected utility gain from shifting time towards childcare to produce one more activity (at the left hand side of the equation, where $t_C' - t_C^* = 1/\varphi$) is equal to the utility loss produced by the fall in consumption resulting from the decline in time devoted to either home or market production (at the right hand side of the equation, where $t_{HP}' \leq t_{HP}^*, t_{MP}' = T - t_C' - t_{HP}'$).

A situation where PS are binding means that for a given PS and t_C^* , $\min(\varphi t_C^*, \gamma PS) = \gamma PS$. Notice that, in this case, the maximum amount of time that could be rationally devoted to producing PA (t_C^{max}) will be such that $\varphi t_C^{max} = \gamma PS$,²¹ which means that:

$$t_C^{max} = \gamma PS / \varphi \quad (15)$$

If we combine both scenarios, we obtain the following solution for the actual time devoted to childcare:

$$t_C = \begin{cases} t_C^* & \text{if } \min(\varphi t_C^*, \gamma PS) = \varphi t_C^* \\ t_C^{max} & \text{if } \min(\varphi t_C^*, \gamma PS) = \gamma PS \end{cases} \quad (16)$$

Let us use the solution to this model to explore the effects of the home-visiting intervention on the production of PA and, in particular, to offer an explanation for the empirical evidence

²¹ If PS are binding then $PA = \min(\varphi t_C, \gamma PS) = \gamma PS$. Therefore, allocating an amount of t_C such that $\varphi t_C > \gamma PS$ would not be consistent with the utility maximizing principle of the model because part of the time devoted to PA is not contributing to its production but has an opportunity cost.

presented in the previous sections. For this, denote pre-treatment parenting skills as PS^C and assume that treatment effectively shifts these skills to a level $PS^T > PS^C$.

Two key elements determining the effect of this shift on the production of PA are the pre-treatment difference between t_C^* and t_C^{max} , and the possibility that the intervention is inducing a change in some other determinant of caregiver behaviour. As already mentioned, I will consider the possibility of a shift in the expected return to parenting activities ($E(\phi|I)$).

In what follows, I will consider two scenarios in terms of the abovementioned determinants of treatment effects, and contrast how these scenarios fare in explaining the evidence. The first scenario will illustrate a situation where caregivers' lack of parenting skills is the major constraint preventing them from offering a more cognitively stimulating environment to their children. This is consistent with the emphasis given in the literature to the transference of parenting skills when addressing the effectiveness of this type of interventions.

The second scenario will also give a role to parenting skills but will draw attention to the fact that these skills need to be complemented with time and that reallocating time towards childcare faces an opportunity cost and has an expected return. As will be discussed below, giving an explicit role to the expected return to childcare time in caregiver time allocation decisions will allow one to explain the available evidence on treatment effects in a more coherent way.

Panels A and B in Figure 3 illustrate these two scenarios. Both panels illustrate the relation between childcare time and household wealth before and after treatment. Superscript C denotes childcare time before treatment and superscript T indicates post-treatment childcare time. The positive slopes are consistent with the positive SES gradient in childcare time already documented in the literature (Guryan et al., 2008)²². Given the solution for the amount of time devoted to childcare expressed in (16), there is a direct relationship between childcare time and the variety of play activities offered to the child by the caregiver (PA). In this regard, the positive wealth gradient in parenting activities implicit in Figure 3 is consistent with the evidence presented in Figure 1 and has been extensively documented in the literature (Hoff et al., 2002).

Panel A in Figure 3 presents the scenario where the transference of parenting skills plays the main role in determining treatment effects. Accordingly, this first scenario only considers that treatment produces a positive shift in parenting skills so that $PS^T > PS^C$. In addition, it postulates a pre-treatment situation where $t_C^C = t_C^{Cmax} < t_C^{C*}$, so that a positive shift in parenting skills will suffice to induce a change in behaviour. Notice that as long as parenting skills are binding ($t_C^{C*} > t_C^{Cmax}$), caregivers will find it optimal to devote more time to childcare provided they are able to produce more activities. Therefore, panel A also introduces a sufficiently large difference between t_C^{C*} and t_C^{Cmax} so that parenting skills remain binding after treatment. In particular $t_C^T = t_C^{Tmax} < t_C^{C*}$.

²² It is not the objective of this analysis to explain the positive wealth gradient in childcare time. In the model, the positive wealth gradient in t_C^{max} can be accommodated if we allow a positive correlation between household wealth and parenting skills (recall $t_C^{max} = \gamma PS / \phi$). The positive wealth gradient in t_C^* can be accommodated if we allow larger household wealth to be accompanied by a sufficiently large expansion in V . Notice that, other things equal, an increase in V exogenously raises consumption levels, reduces the marginal utility of consumption and, thus, reduces the utility loss derived from allocating time away from market or home production and towards childcare.

Under this setting, the possibility of a wealth gradient in treatment effects depends entirely on there being a wealth gradient in the acquisition of parenting skills. In fact, the effect of treatment is given by $t_C^T - t_C^C = t_C^{Tmax} - t_C^{Cmax} = \gamma/\varphi(PS^T - PS^C)$. As already discussed, however, there is no evidence of a heterogeneous transference of skills that correlates with wealth. As shown in panel A of Figure 3, a homogenous increase in PS (depicted as a parallel shift in the t_C^{max} function) will not be able to produce a positive wealth gradient in treatment effects. To see this, notice that the effect of the intervention on childcare time in Figure 3 is given by the vertical distance between the two functions that define the area shaded in grey. Also recall there is a direct relationship between childcare time and PA .

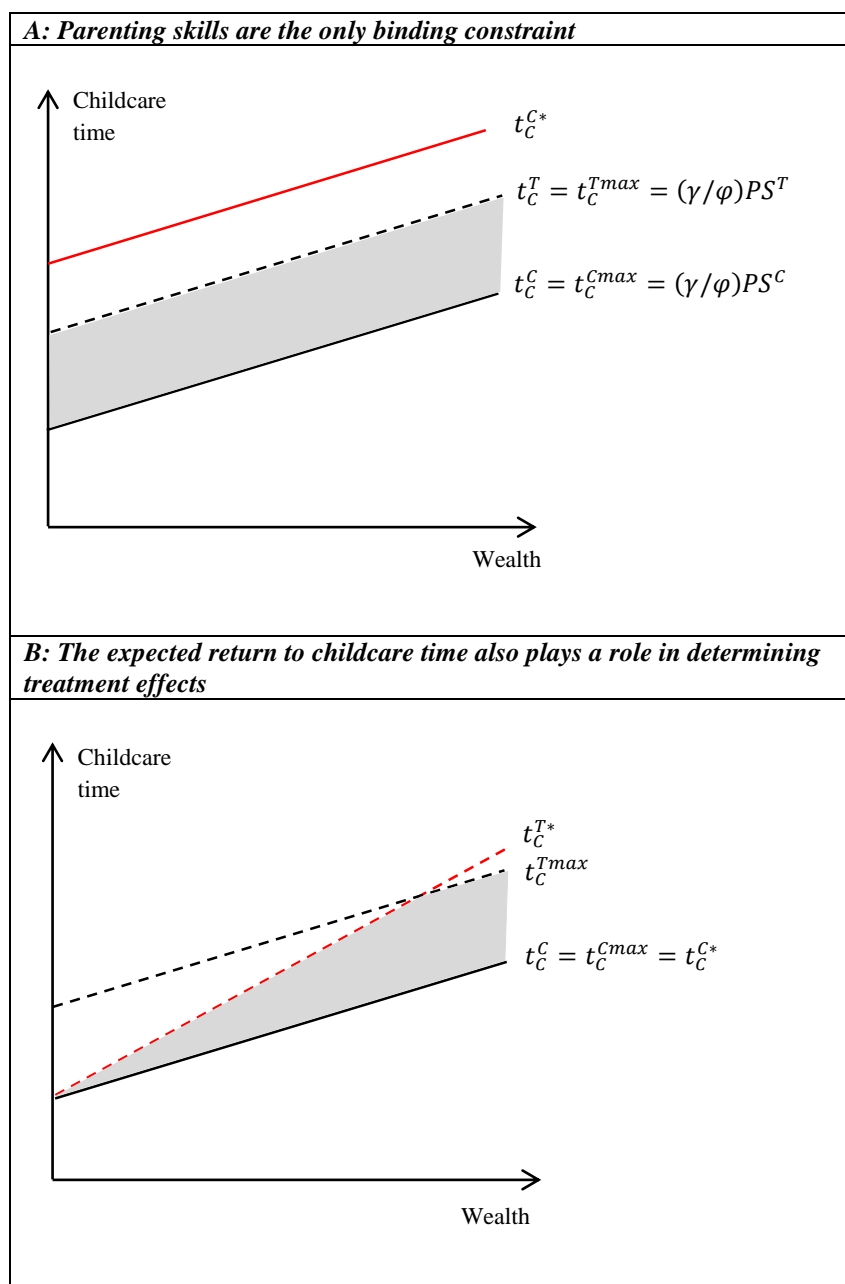
Panel B in Figure 3 presents an alternative scenario where the increase in PS is accompanied by a positive shift in the expected return to childcare time caused by a change in the information set available to caregivers. In particular: $E(\phi|I^T) > E(\phi|I^C)$. This interpretation of the mechanisms behind the observed treatment effects also gives a role to parenting skills and that is why skills are binding before treatment. The objective, however, is to draw attention to the expected return to childcare time and, therefore, the pre-treatment situation is represented as $t_C^C = t_C^{Cmax} = t_C^{C*}$. In other words, to produce more parenting activities caregivers need more skills but just having the skills will not imply that the outcome obtained from the additional childcare time is worth the forgone consumption.

Consistent with the evidence discussed above, the increase in PS is homogeneous across the wealth distribution (represented as a parallel shift in the t_C^{max} function) but the change in $E(\phi|I)$ is concentrated among the richest caregivers. This is represented by an increase in the slope of the t_C^* function²³. As shown in panel B of Figure 3, this scenario is capable of producing a positive wealth gradient in treatment effects on the variety of play activities offered by the caregiver. This explanation postulates that the observed heterogeneity in caregivers' behavioural change is consistent with a homogenous shift in parenting skills because a similar pattern of heterogeneity is present in caregivers' beliefs regarding the importance of parent-child interactions, and these beliefs condition caregivers' response to the transference of parenting skills²⁴.

²³ Notice that larger $E(\phi|I)$ directly increases the expected utility gain from shifting time towards childcare in (14) and therefore causes an increase in t_C^* .

²⁴ A sufficiently large slope in the t_C^* function prior to treatment $\left(\frac{\partial t_C^*}{\partial wealth} > \frac{\partial t_C^{max}}{\partial wealth}\right)$ would also produce a positive wealth gradient in treatment effects without requiring a shift in caregiver beliefs. In this case, caregiver beliefs regarding the importance of parent-child interactions would be acting as a moderator of treatment effects.

Figure 3: Two scenarios for treatment effects on childcare time



6. Concluding remarks

Despite the explicit interest that home-visiting ECD interventions implemented in the developing world have in enhancing stimulation opportunities for children, there is scant evidence regarding their effect on the home environment and, especially, on caregivers' engagement in educational play activities with their children. Moreover, there is a lack of evidence from interventions working at scale while the potential populations to be targeted are large and the home-visiting model can be especially sensitive to size as it is heavily dependent on the proficiency of home-visitors. In addition, the literature tends to overlook the mechanisms behind caregivers' behavioural change and places a strong emphasis on the

transference of parenting skills. This carries the implicit assumption that caregivers' lack of knowledge about certain activities that can be performed with their children and of the ability to engage in them, are the major binding constraint to be confronted.

This analysis aimed at contributing to the ECD literature by providing causal evidence about the effects of a scaled-up home-visiting intervention on parental behaviour, and by exploring the constraints limiting this behavioural change. For this, three research questions were proposed: (i) can a home-visiting ECD intervention working at scale in rural Peru deliver an improvement in the quality of the home environment?; (ii) can a home-visiting ECD intervention working at scale in rural Peru change parental behaviour so as to increase the amount of stimulation offered to the child; and (iii) what constraints faced by the caregiver limit the effect of this intervention on caregiver engagement in educational play activities with the child?

The answers to the first two research questions follow directly from the average treatment effects found in the analysis. In particular, estimated treatment effects of the *Cuna Mas* home-visiting programme on the quality of the home environment are positive, statistically significant ($p < 0.01$) and have a size ($d = 0.5$) comparable to that found for other interventions of much more smaller scale and efficacy trials conducted in the developing world (Attanasio et al., 2013; Bentley et al., 2010; Grantham-McGregor et al., 1991; Powell et al., 2004; Walker et al., 2004).

Treatment effects on caregiver behaviour related to the provision of stimulation opportunities for the child are also positive and statistically significant. In fact, it was possible to identify an increase in the variety of play activities offered to the child by the caregiver in addition to those occurring during home visits ($d = 0.3$; $p < 0.01$). Positive evidence of a shift in caregiver behaviour is important because this change increases the likelihood of an enriched environment being offered to the child beyond the duration of the programme. This would help sustain and even bolster the effect of the intervention on child development.

Regarding the third research question, results presented in this analysis indicate that there are elements besides a successful transference of parenting skills that determine the effect of the intervention on caregiver behaviour and, thus, limit caregiver participation in play activities with their children. The evidence shows these constraints are related to household wealth and seem associated to the information available to caregivers regarding the importance of parent-child interactions for child development.

In this regard, I have found heterogeneous treatment effects on caregivers' engagement in play activities by household wealth. In fact, low levels of wealth can render the intervention ineffective in changing these behaviours, while the effect exhibits a positive gradient for most of the support of the wealth distribution. I have found no evidence suggesting this heterogeneity is driven by an unequal transference of parenting skills to caregivers. In fact, caregivers' response is not conditioned by their educational attainment while the number of visits and the expansion in play materials are the same regardless of caregivers' wealth.

What differ according to caregivers' wealth are their beliefs regarding the importance of parent-child interactions for child development. The pattern of heterogeneity found in the data is similar to that exhibited by caregivers' behavioural change. In fact, caregivers' beliefs not only show a positive wealth gradient but also exhibit positive treatment effects concentrated among the richest caregivers. This evidence is consistent with caregivers'

response to treatment being positively influenced by their beliefs regarding the importance of parent-child interactions.

A simple time-allocation model was proposed to formalize these notions and offer a way of thinking about the mechanisms behind caregivers' behavioural change. Importantly, the model proposes one to think about the parenting skills provided by the intervention as an enabling factor. These skills allow caregivers to produce more play activities provided they are willing to input time, which means that the effect of the intervention on caregiver behaviour depends on the expected costs and benefits of reallocating time to childcare²⁵. By giving a role to the expected return to childcare time and relating this expectation to caregivers' beliefs regarding the importance of parent-child interactions, this model is capable of producing results coherent with the available evidence. The same is not true if one solely relies on parenting skills to explain caregivers' response to treatment.

This analysis has drawn attention to the resources that caregivers need to input to produce stimulation opportunities for their children. This has been useful not only in terms of allowing one to explain the available evidence in a more coherent way, but also in terms of policy implications. In fact, the evidence discussed here indicates that introducing a shift in parental beliefs through the information set available to caregivers as an explicit objective of home-visiting interventions can prove fruitful in terms of enhancing caregivers' behavioural change. While this analysis has shown this shift is possible, it remains to be determined why it seems harder to achieve among poorer caregivers. Improving measurement of these beliefs and analysing its heterogeneous response stand out as promising avenues for future research.

²⁵ A different view is one in which the intervention is understood as providing skills that will increase the productivity of caregiver time for the production of play activities. The view proposed in this study is not only more coherent with the outcome variable under analysis (the number of types of play activities) but also consistent with recent evidence found for a similar intervention. In fact, a recent study by Attanasio et al. (2015) which refers to the effects of home-visiting intervention in Colombia shows that child outcomes improved through an increase in the resources invested by parents in their children rather than through an increase in the productivity of these resources.

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Appendix 1: Studies that have evaluated interventions with a home-visiting component

	Study	Country	Duration	Child outcomes		Quality of home environment	
				Measured effects	Positive results	Measured effects	Positive results
1	Cooper et al. (2002)	South Africa	0.5 years	Height and weight	Yes	Sensitivity and responsiveness	Yes
2	Cooper et al. (2009)	South Africa	5 months	Socio emotional development	Yes	Sensitivity and responsiveness	Yes
3	Gardner et al. (2003)	Jamaica	8 weeks	Cognitive development	Yes	No	NA
4	Powell and Grantham-McGregor (1989)	Jamaica	1.5 years	Cognitive development	Yes	No	NA
5	Powell (2004)	Jamaica	1 year	Cognitive development	Yes	Stimulation opportunities	No
6	Magwaza & Edwards (1991)	South Africa	10 weeks	Cognitive development	Yes	No	NA
7	Powell et al. (2004) Baker Henningham et al. (2005)	Jamaica	1 year	Cognitive development	Yes	Stimulation opportunities	Yes
8	Walker et al. (2004) Walker et al. (2010)	Jamaica	2 years	Cognitive and socio emotional development	Yes	Stimulation opportunities	Yes
9	Grantham McGregor et al. (1983) (1987) (1989) (1994)	Jamaica	3 years	Cognitive development	Yes	Stimulation opportunities	No
10	Grantham-McGregor et al. (1991)	Jamaica	2 years	Cognitive and socio emotional development	Yes	Aggregate HOME score	Yes
11	Bentley et al. (2010)	India	NA	Cognitive development and motor skills	Yes	Aggregate HOME score	Yes
12	Janssens & Rosemberg (2011)	St Lucia	1 year	Cognitive development	Yes	No	NA
13	Attanasio et al. (2013)	Colombia	1.5 years	Cognitive development	Yes	Stimulation opportunities	Yes

	Study	Country	Duration	Child outcomes		Quality of home environment	
				Measured effects	Positive results	Measured effects	Positive results
14	Eickmann et al. (2003)	Brazil	5 months	Cognitive and motor development	Yes	No	NA
15	Hamadani et al. (2006)	Bangladesh	1 year	Cognitive development	Yes	No	NA
16	Nahar et al. (2009)	Bangladesh	6 months	Cognitive and motor development	Yes	No	NA
17	Nair et al. (2009)	South India	1 year	Cognitive and motor development	Yes	No	NA

Appendix 2: Geographical distribution of the districts involved in the evaluation

Figure 2.1 Districts selected for the evaluation exercise of the rural component of programme Cuna Mas

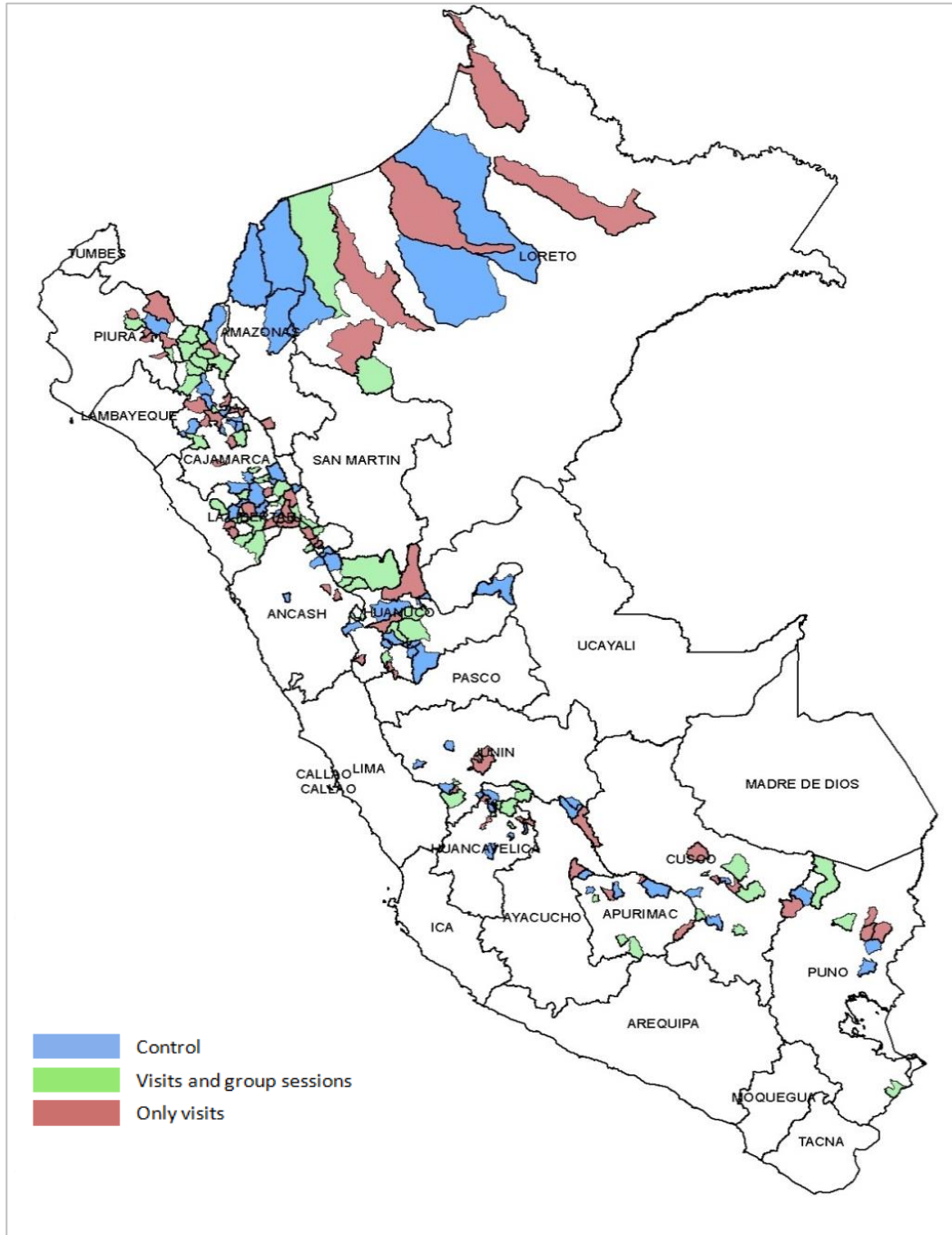


Table 2.1 Districts and regions in the final sample

	Control group			Treatment group		
	Region	Province	District	Region	Province	District
1	Apurimac	Andahuaylas	Santa Maria de Chicho	Apurimac	Antabamba	Juan Espinoza Medrano
2	Cajamarca	Cajabamba	Cachachi	Apurimac	Aymaraes	Caraybamba
3	Cajamarca	Cajamarca	Cospan	Cajamarca	Cutervo	Santo Domingo de la Capilla
4	Cajamarca	Cajamarca	Jesús	Cajamarca	Hualgayoc	Bambamarca
5	Cajamarca	Jaen	Colasay	Cajamarca	Jaen	Chontali
6	Cajamarca	San Ignacio	San Jose de Lourdes	Cajamarca	Jaen	San Jose Del Alto
7	Cusco	Paucartambo	Huancarani	Cajamarca	San Ignacio	La Coipa
8	Huancavelica	Acobamba	Anta	Cajamarca	Santa Cruz	Catache
9	Huancavelica	Huancavelica	Huachocolpa	Cusco	Canas	Yanaoca
10	Huancavelica	Tayacaja	Acraquia	Cusco	Chumbivilcas	Capacmarca
11	Huanuco	Huamalies	Monzón	Cusco	Paucartambo	Paucartambo
12	Huanuco	Huánuco	Santa Maria del Valle	Huanuco	Huacaybamba	Huacaybamba
13	Huanuco	Leoncio Prado	Hermilio Valdizan	Huanuco	Huacaybamba	Pinra
14	Huanuco	Pachitea	Umari	Huanuco	Huamalies	Miraflores
15	Junin	Huancayo	Pucara	Huanuco	Leoncio Prado	Mariano Damaso Beraun
16	Junin	Tarma	Tapo	Junin	Chupaca	Yanacancha
17	Junin	Yauli	Huay-huay	Junin	Concepcion	Chambara
18	La Libertad	Sánchez Carrion	Sanagoran	La Libertad	Santiago De Chuco	Quiruvilca
19	Puno	Carabaya	Ollachea	Piura	Huancabamba	Sondorillo
20	Puno	San Antonio De Putina	Quilcapuncu	Puno	Carabaya	Usicayos

Appendix 3: Quality of home environment, household, caregiver and child characteristics in the districts considered for the evaluation

	Control (a)	Treatment (b)	Diff. (a) – (b)	Treatment Included (c)	Treatment Excluded (d)	Diff. (c) – (d)	Diff. (a) – (c)	Diff. (a) – (d)
Quality of home environment index (0-1)	0.583	0.595	-0.012 (0.012)	0.608	0.585	0.022 (0.019)	-0.024 (0.015)	-0.002 (0.014)
Household wealth index (0-1)	0.442	0.443	-0.001 (0.019)	0.459	0.432	0.027 (0.026)	-0.017 (0.024)	0.01 (0.023)
Household members	5.495	5.384	0.111 (0.1)	5.406	5.368	0.039 (0.153)	0.089 (0.125)	0.127 (0.11)
Caregiver's age	28.365	28.144	0.221 (0.31)	28.118	28.163	-0.045 (0.386)	0.247 (0.421)	0.202 (0.367)
Caregiver's educational attainment (years)	6.250	6.636	-0.386 (0.33)	6.989	6.376	0.613 (0.479)	-0.739* (0.408)	-0.126 (0.377)
Caregiver is married (yes = 1)	0.253	0.221	0.031 (0.03)	0.214	0.227	-0.013 (0.039)	0.039 (0.038)	0.026 (0.037)
Caregiver worked outside household last week (yes = 1)	0.635	0.689	-0.054 (0.042)	0.757	0.639	0.118** (0.053)	-0.121** (0.052)	-0.004 (0.05)
Number of children under caregiver's care	1.023	1.031	-0.007 (0.006)	1.036	1.027	0.009 (0.008)	-0.012* (0.007)	-0.003 (0.006)
Caregiver's first language is Spanish (yes = 1)	0.584	0.639	-0.055 (0.081)	0.592	0.673	-0.081 (0.115)	-0.008 (0.104)	-0.089 (0.093)
Caregiver is the mother (yes = 1)	0.970	0.979	-0.009 (0.007)	0.983	0.975	0.008 (0.008)	-0.014 (0.009)	-0.006 (0.009)
Child's age (months)	12.738	13.011	-0.273 (0.275)	13.280	12.814	0.467 (0.358)	-0.542 (0.363)	-0.076 (0.32)
Child is male (yes = 1)	0.490	0.511	-0.021 (0.021)	0.506	0.515	-0.008 (0.031)	-0.016 (0.027)	-0.025 (0.023)
Number of observations	46	52	--	22	30	--	--	--

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix 4: Survey questionnaire and characterization of the quality of the home environment

Survey questionnaire

A Parenting practices		
> Let us talk about the activities you carry out with (NAME)		
1. Responsive breastfeeding and feeding		
501	Enumerator, indicate: ¿Is the child 6 months old or more?	1 Yes >> skip to question 510
		2 No >> continue with question 502
502	Are you currently breastfeeding or bottle-feeding (NAME)?	1 Yes, breastfeeding >> continue with question 503
		2 Yes, bottle-feeding >> continue with question 503
		3 No >> skip to question 513
503	What do you do with (NAME) while you breastfeed him/her? Enumerator > do not read the options, mark all that apply	1 Looks at the child
		2 Talks to the child, sings or reads to him/her
		3 Caresses child
		4 Other (specify) _____
		5 Does nothing with child
504	Do you perform any other activity (housework, for example) while you breastfeed (NAME)?	1 Yes, while breastfeeding the child, she also... Specify _____
		2 No, no other activity, she only breastfeeds the child
505	Between yesterday afternoon and today's morning, has (NAME) had any liquid or food other than breast milk?	1 Yes Specify _____ >> skip to section 2: Interaction with child
		2 No >> skip to section 2: Interaction with child
510	Are you currently breastfeeding or bottle-feeding (NAME)?	1 Yes, breastfeeding >> continue with question 511
		2 Yes, bottle-feeding >> continue with question 511
		3 No >> skip to question 513
511	What do you do with (NAME) while you breastfeed him/her? Enumerator > do not read the options, mark all that apply	1 Looks at the child
		2 Talks to the child, sings or reads to him/her
		3 Caresses child
		4 Other (specify) _____
		5 Does nothing with child
512	Do you carry out any other activity (housework, for example) while you breastfeed (NAME)?	1 Yes, while breastfeeding the child, she also... Specify _____
		2 No, no other activity
513	Is (NAME) currently eating any solid foods?	1 Yes >> continue with question 514
		2 No >> skip to section 2: Interaction with child
514	Who does usually feed (NAME)?	1 Primary caregiver
		2 Activity is not carried out by primary caregiver > indicate code _____ 2. (NAME)'s mother; 3. (NAME)'s father; 4. (NAME)'s brothers or sisters; 5. (NAME)'s grandparents; 6. Other
		3 The child eats by him/herself
515	What do you do with (NAME) while he/she eats? Enumerator > do not read the options, mark all that apply	1 Talks to the child
		2 Plays or sings with child
		3 Encourages child to participate in the activity, teaches child how to use a spoon or fork
		4 Allows child to participate in the activity, allows him/her to use a spoon or fork
		5 Other (specify) _____
		6 Does nothing with child
516	Do you carry out any other activity (housework, for example) while (NAME) eats?	1 Yes, while the child eats, she... Specify _____
		2 No, no other activity

517	Usually, (NAME) eats: Enumerator, choose all the answers that apply	1	Breakfast					
		2	Mid-morning snack					
		3	Lunch					
		4	Mid-afternoon snack					
		5	Dinner					
		6	Other (specify) _____					
2. Interaction with child								
				Yes	No	With whom?	Anyone else?	No. of days
520	During the last 7 days, has anyone shared with (NAME) the following activities? Enumerator, consider the following codes to identify the person > 1. Primary caregiver <i>If it is someone different than the primary caregiver, use the following codes ></i> 2. (NAME)'s mother 3. (NAME)'s father 4. (NAME)'s brothers or sisters 5. (NAME)'s grandparents 6. Other	1	Read books, look at pictures from a book with (NAME)	1	2			
		2	Told stories to (NAME)	1	2			
		3	Sang songs to or with (NAME), including lullabies	1	2			
		4	Took (NAME) outside the house	1	2			
		5	Played with (NAME) with his/her toys	1	2			
		6	Drew, painted or scribbled with (NAME)	1	2			
		7	Played with (NAME) to name objects, colours or numbers	1	2			
521	What do you do with (NAME) while he/she plays? Enumerator > do not read the options, mark all that apply	1	Talks to the child					
		2	Encourages child to participate in play					
		3	Allows child to play freely					
		4	Introduces challenging situations during play					
		5	Other (specify) _____					
		6	Does nothing with child					
522	Would you like to spend more time reading books, singing or playing with (NAME)?	1	Yes					
		2	No >> skip to question 524					
523	Why can't you spend more time reading books, singing or playing with (NAME)? Enumerator > do not read the options, mark all that apply	1	I have other things to do / I am busy / I need to work					
		2	The child plays with his/her brothers and sisters					
		3	The child gets tired, falls asleep					
		4	I would not know how to play with him/her					
		5	Other (specify) _____					
524	Who does usually bath (NAME)?	1	Primary caregiver					
		2	Activity is not carried out by primary caregiver > indicate code _____ 2. (NAME)'s mother; 3. (NAME)'s father; 4. (NAME)'s brothers or sisters; 5. (NAME)'s grandparents; 6. Other					
		3	The child washes him/herself					
525	What do you do with (NAME) during his/her bath? Enumerator > do not read the options, mark all that apply	1	Talks to the child					
		2	Plays or sings with child					
		3	Encourages child to participate in the activity, teaches child how to wash him/herself					
		4	Allows child to participate in the activity; allows him/her to wash him/herself					
		5	Other (specify) _____					
		6	Does nothing with child					
526	Do you carry out any other activity (housework, for example) during (NAME)'s bath?	1	Yes Specify _____					
		2	No, no other activity					
527	Who does usually change (NAME)'s clothes?	1	Primary caregiver					
		2	Activity is not carried out by primary caregiver > indicate code _____ 2. (NAME)'s mother; 3. (NAME)'s father; 4. (NAME)'s brothers or sisters; 5. (NAME)'s grandparents; 6. Other					
		3	The child changes his/her own clothes					

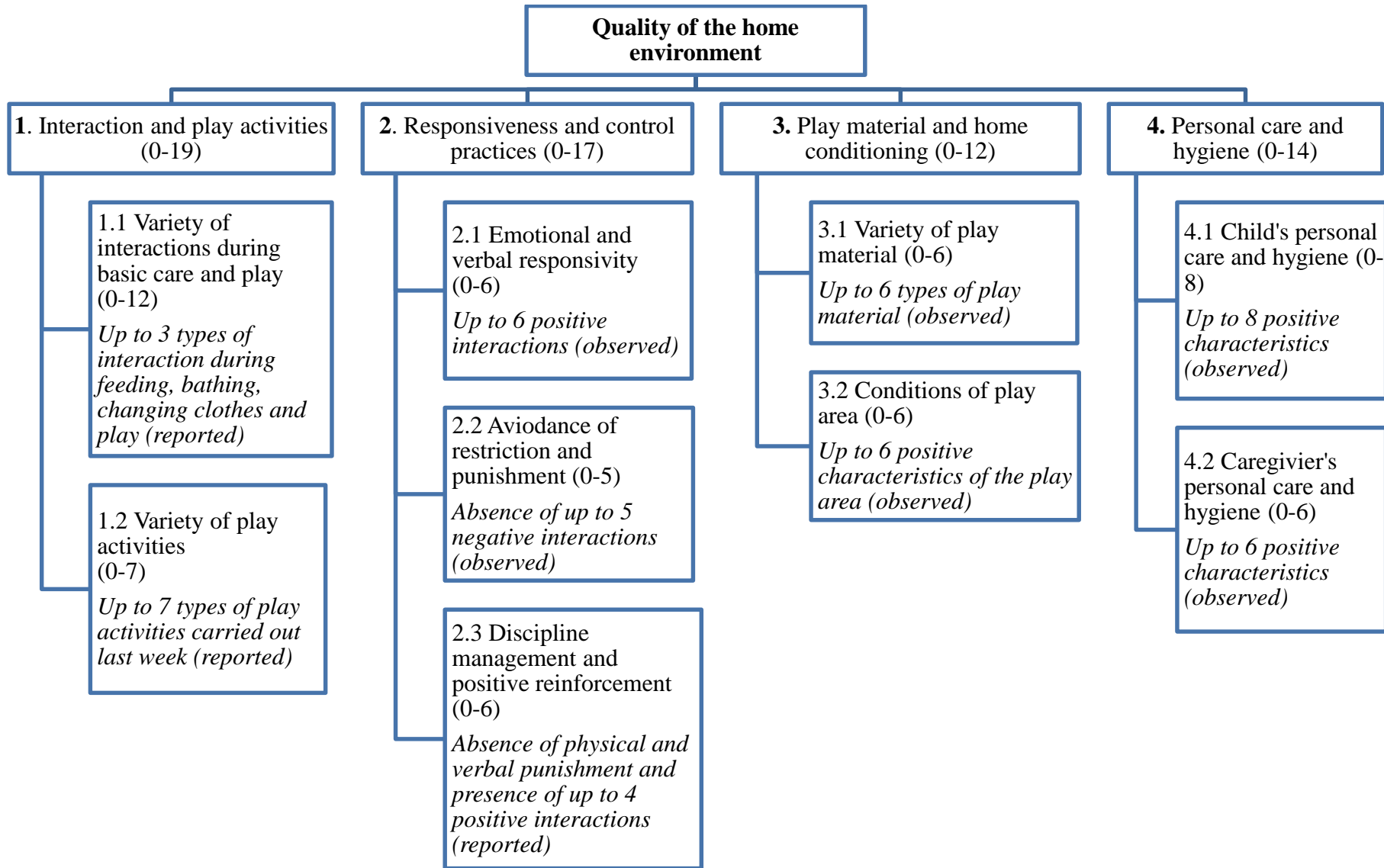
528	What do you do with (NAME) while changing his/her clothes? Enumerator > do not read the options, mark all that apply	1	Talks to the child
		2	Plays or sings with child
		3	Encourages child to participate in the activity, teaches child how to change his/her clothes
		4	Allows child to participate in the activity, allows him/her to change his/her clothes
		5	Other (specify) _____
		6	Does nothing with child
529	Do you carry out any other activity (housework, for example) while (NAME) eats?	1	Yes Specify _____
		2	No, no other activity
3. Home conditioning			
<i>> I would like to know more about the places of the house and objects that (NAME) uses</i>			
530	Could you show me the place where (NAME) usually plays?	1	Yes
		2	No >> skip to question 532
531	Enumerator: observe and choose all characteristics that apply	1	The place is clean (not littered)
		2	It is well illuminated
		3	It is well ventilated
		4	Has a blanket or similar to prevent direct contact with the floor
		5	It is not near fire, objects that might injure the child, stairways, or the road
		6	None of the above
532	Could you show me the toys or objects that (NAME) usually uses to play?	1	Yes
		2	No >> skip to question 534
		3	Has no toys / uses no toys >> skip to question 536
533	Enumerator: observe and choose all types of toys that are present	1	Children books
		2	Materials to draw or paint
		3	Cuddly or role playing toys
		4	Push or pull toys
		5	Building blocks or puzzles
		6	Toys to play music
		7	None of the above
534	Could you show me the place where (NAME)'s toys are stored	1	Yes
		2	No >> skip to question 536
535	Enumerator: observe and choose all characteristics that apply	1	Has a box, bag or similar to store the toys
		2	Has no specific place, toys are around the house
536	Could you show me the place were you usually eat?	1	Yes
		2	No >> skip to question 538
537	Enumerator, observe: is it a place where the family can share a meal?	1	Yes
		2	No
538a	Could you show me the place where you usually wash or clean yourselves?	1	Yes
		2	No >> skip to the next section (question 540)
539a	Enumerator: observe and choose all characteristics that apply Do they have a water tap or bucket with clean water?	1	Yes
		2	No
538b	Could you show me the utensils you use for personal hygiene?	1	Yes
		2	No >> skip to the next section (question 540)
539b	Enumerator: observe and choose all characteristics that apply	1	They have a soap and a soapdish (an element that prevents contact of soap with dirt)
		2	The have a towel or cloth
		3	None of the above

4. Supervision and discipline management		
540	Sometimes, adults taking care of children have to leave the house to go shopping, wash clothes, etc. and have to leave the children. During the last 7 days...	¿How many times was (NAME) left at home without you for more than 1 hour? _____ If the answer is 0 times >> skip to question 542
541	¿Who does usually stay in charge of (NAME) in these cases?	1 Nobody / he/she stays alone
		2 He stays with > indicate code _____ 2. (NAME)'s mother; 3. (NAME)'s father; 4. (NAME)'s brothers or sisters; 5. (NAME)'s grandparents; 6. Other
542	Sometimes children misbehave and parents have different ways of managing discipline. During the last 7 days, when (NAME) misbehaved, how did you disciplined him/her? Enumerator > do not read the options, mark all that apply	1 Slapped, pinched child or used "chicote"
		2 Shouted at child
		3 Threatened child
		4 Child was left alone until he/she stopped crying
		5 Talked to child
		6 Other (specify) _____
		7 Did nothing
543	During the last 7 days, when (NAME) was well-behaved or did something you asked, what did you do? Enumerator > do not read the options, mark all that apply	1 Gave him/her a reward
		2 Hugged, cuddled him/her
		3 Praised him/her verbally, applauded him/her
		4 Did nothing
		5 Other (specify) _____
B Expectations regarding child development		
> Let us now talk about the future of (NAME)		
550	What job would you like (NAME) to do in the future?	Specify: _____
	Which educational attainment would you like (NAME) to achieve?	Primary <input type="checkbox"/> 1 Second. <input type="checkbox"/> 2 Higher <input type="checkbox"/> 3
551	Let us now think about the path that (NAME) needs to follow in order to achieve these goals. How much do you agree or disagree with the following statements?	1 Now that (NAME) is a small child is an important stage if he/she is to achieve (...) education and become (...)
		2 It does not depend on you that (NAME) achieves (...) education and becomes (...)
		3 (NAME) will start learning only after he/she enrolls in school
		4 If you spend more time playing with (NAME), you will help him/her to achieve (...) education and become (...)
		5 You are more important than school teachers for (NAME) to be able to achieve (...) education and become (...)
		6 Now that (NAME) is a small child it is better if he/she learns on his/her own
		7 It is useless to tell stories to (NAME) because he/she does not understand them
		8 Now that (NAME) is a small child he only needs to be clean and well fed

C Interactions during the interview, physical appearance and hygiene

560	Was it possible to observe the interaction between the caregiver and the child during the interview?	1	Yes			
		2	No >> state the reason _____ >> skip to question 562			
					Yes	No
561	Enumerator: choose yes/no according to what you observed regarding the interaction of the caregiver and his/her partner with the child during the interview	1	Gave toys or appropriate activities to the child	1	2	
		2	Child was kept under their supervision	1	2	
		3	They spontaneously vocalized to child at least twice	1	2	
		4	They responded verbally to child's verbalizations at least once	1	2	
		5	They told the child the name of an object or person at least once	1	2	
		6	They spontaneously praised child at least twice	1	2	
		7	Their voice conveyed positive feelings towards child	1	2	
		8	They caressed/kissed/hugged child at least once	1	2	
		9	They did not shout to child	1	2	
		10	They did not express annoyance or hostility to child	1	2	
		11	They did not slap or spank child	1	2	
		12	They did not scold or criticize child	1	2	
		13	They did not interfere or restrict child more than three times	1	2	
562	Enumerator: choose yes/no according to what you observed regarding the physical appearance and hygiene of the caregiver during the interview	1	His/her face is extremely dirty	1	2	
		2	His/her hair is extremely dirty	1	2	
		3	His/her hands are dirty	1	2	
		4	His/her clothes are extremely dirty	1	2	
		5	Has open wounds	1	2	
563	Was it possible to observe the physical appearance and hygiene of the child during the interview?	1	Yes			
		2	No >> state reason _____ >> finish questionnaire			
					Yes	No
564	Enumerator: choose yes/no according to what you observed regarding the physical appearance and hygiene of the child during the interview	1	His/her face is extremely dirty	1	2	
		2	His/her hair is extremely dirty	1	2	
		3	His/her hands are dirty	1	2	
		4	His/her clothes are extremely dirty	1	2	
		5	Has appropriate clothes for the weather	1	2	
		6	Nappies (if any) have not been changed for a long time	1	2	
		7	Has open wounds	1	2	

Figure 4.1: Characterization of the quality of the home environment



Appendix 5: Complete regression results for treatment effects on the quality of the home environment

	Aggregate index		Index components			
	All components (1)	Complete information (2)	Play activities (3)	Responsiveness (4)	Play material (5)	Care and hygiene (6)
Treatment	0.059*** (0.013)	0.057*** (0.014)	0.068*** (0.013)	0.062*** (0.021)	0.098*** (0.023)	0.010 (0.011)
Baseline index	0.244*** (0.048)	0.235*** (0.039)	0.195*** (0.035)	0.062 (0.043)	0.102** (0.047)	0.114*** (0.029)
Household wealth index (0-1)	0.140*** (0.039)	0.080* (0.042)	0.080 (0.049)	0.057 (0.047)	0.256*** (0.078)	0.140*** (0.035)
Household members	0.001 (0.002)	-0.000 (0.003)	-0.004 (0.004)	0.001 (0.003)	0.006 (0.004)	-0.000 (0.001)
Caregiver's age	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Caregiver's educ. attainment (years)	0.004*** (0.001)	0.003 (0.002)	0.009*** (0.002)	0.003 (0.002)	0.008*** (0.003)	0.002 (0.001)
Caregiver is married (yes = 1)	0.003 (0.013)	0.004 (0.013)	0.004 (0.015)	-0.008 (0.020)	0.030 (0.021)	0.020* (0.010)
Hours worked last week by caregiver	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Number of children under caregiver's care	-0.040* (0.020)	-0.034* (0.019)	-0.048* (0.028)	-0.022 (0.028)	-0.096** (0.044)	-0.020 (0.021)
Caregiver first language is Spanish (yes = 1)	0.002 (0.013)	0.012 (0.014)	0.029* (0.015)	-0.017 (0.018)	0.001 (0.024)	0.023* (0.012)
Caregiver is the mother (yes = 1)	-0.038 (0.032)	-0.044** (0.021)	-0.054 (0.039)	0.029 (0.046)	-0.095** (0.045)	-0.043*** (0.012)
Child's age (months)	-0.001* (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.002)	0.001** (0.001)
Child is male (yes = 1)	0.000 (0.008)	0.011 (0.009)	-0.004 (0.015)	0.018* (0.010)	-0.006 (0.014)	0.012 (0.008)
Constant	0.483*** (0.055)	0.482*** (0.046)	0.338*** (0.072)	0.559*** (0.083)	0.491*** (0.081)	0.796*** (0.059)
Observations	486	614	614	548	537	558
R-squared	0.294	0.186	0.196	0.073	0.204	0.171

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 6: Results related to caregivers' beliefs regarding the importance of parent-child interactions for child development

*Table 6.1: Socioeconomic gradients
(by caregiver education and household wealth quartiles)*

(a) Caregiver education	Q1	Q2	Q3	Q4
Caregiver beliefs regarding importance of parent child interactions (average score: 1-4)	2.835	2.95	3.004	3.164
Difference w.r.t Q1		0.115***	0.169***	0.329***
Caregiver beliefs regarding importance of parent child interactions (total score: 7-28)	20.021	20.715	21.016	22.164
Difference w.r.t Q1		0.694***	0.885***	2.143***

(b) Household wealth	Q1	Q2	Q3	Q4
Caregiver beliefs regarding importance of parent child interactions (average score: 1-4)	2.874	2.976	2.979	3.06
Difference w.r.t Q1		0.102**	0.105**	0.186***
Caregiver beliefs regarding importance of parent child interactions (total score: 7-28)	20.295	20.924	20.973	21.443
Difference w.r.t Q1		0.629**	0.678**	1.148***

. *** p<0.01, ** p<0.05, * p<0.1

Table 6.2: Caregivers' beliefs partial correlation with the quality of the home environment (scale average score)

	Aggregate index		Index components			
	All components (1)	Complete information (2)	Play activities (3)	Responsiveness (4)	Play material (5)	Care and hygiene (6)
Treatment	0.057*** (0.013)	0.055*** (0.013)	0.065*** (0.013)	0.060*** (0.021)	0.097*** (0.023)	0.009 (0.011)
Baseline index	0.235*** (0.049)	0.222*** (0.040)	0.175*** (0.032)	0.055 (0.043)	0.103** (0.047)	0.112*** (0.030)
Household wealth index (0-1)	0.132*** (0.037)	0.074* (0.039)	0.071 (0.045)	0.046 (0.043)	0.253*** (0.077)	0.138*** (0.035)
Household members	0.001 (0.002)	-0.000 (0.002)	-0.005 (0.004)	0.000 (0.003)	0.006 (0.004)	-0.000 (0.001)
Caregiver's age	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Caregiver's educ. attainment (years)	0.003** (0.001)	0.002 (0.002)	0.006*** (0.002)	0.001 (0.002)	0.008** (0.003)	0.001 (0.001)
Caregiver is married (yes = 1)	-0.000 (0.013)	0.001 (0.013)	-0.002 (0.015)	-0.013 (0.020)	0.029 (0.021)	0.019* (0.010)
Hours worked last week by caregiver	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Number of children under caregiver's care	-0.041** (0.019)	-0.034* (0.018)	-0.049 (0.029)	-0.022 (0.025)	-0.096** (0.043)	-0.019 (0.021)
Caregiver first language is Spanish (yes = 1)	-0.001 (0.013)	0.008 (0.014)	0.022 (0.015)	-0.022 (0.018)	-0.001 (0.024)	0.021* (0.012)
Caregiver is the mother (yes = 1)	-0.035 (0.032)	-0.043** (0.019)	-0.053 (0.036)	0.028 (0.045)	-0.094** (0.045)	-0.043*** (0.012)
Child's age (months)	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.002)	0.001** (0.001)
Child is male (yes = 1)	-0.000 (0.007)	0.010 (0.009)	-0.004 (0.014)	0.017* (0.010)	-0.006 (0.014)	0.012 (0.008)
Scale average score	0.043*** (0.012)	0.053*** (0.018)	0.089*** (0.018)	0.067*** (0.020)	0.021 (0.020)	0.016 (0.010)
Constant	0.377*** (0.066)	0.352*** (0.058)	0.115 (0.092)	0.397*** (0.099)	0.436*** (0.098)	0.756*** (0.060)
Observations	486	614	614	548	537	558
R-squared	0.309	0.205	0.222	0.094	0.206	0.174

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6.3: Caregivers' beliefs partial correlation with the quality of the home environment (scale aggregate score)

	Aggregate index		Index components			
	All components (1)	Complete information (2)	Play activities (3)	Responsiveness (4)	Play material (5)	Care and hygiene (6)
Treatment	0.057*** (0.013)	0.055*** (0.014)	0.067*** (0.014)	0.059*** (0.021)	0.098*** (0.023)	0.011 (0.010)
Baseline index	0.235*** (0.052)	0.224*** (0.042)	0.181*** (0.033)	0.035 (0.045)	0.104** (0.046)	0.115*** (0.034)
Household wealth index (0-1)	0.141*** (0.039)	0.080* (0.041)	0.080* (0.046)	0.056 (0.046)	0.261*** (0.081)	0.141*** (0.039)
Household members	0.002 (0.003)	0.001 (0.003)	-0.004 (0.004)	0.002 (0.003)	0.007 (0.004)	-0.000 (0.001)
Caregiver's age	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.002 (0.001)	-0.001 (0.001)
Caregiver's educ. attainment (years)	0.004*** (0.001)	0.002 (0.002)	0.006*** (0.002)	0.002 (0.002)	0.009*** (0.003)	0.001 (0.001)
Caregiver is married (yes = 1)	-0.000 (0.014)	0.002 (0.014)	-0.003 (0.016)	-0.011 (0.021)	0.030 (0.022)	0.019* (0.011)
Hours worked last week by caregiver	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Number of children under caregiver's care	-0.039** (0.019)	-0.032* (0.018)	-0.047 (0.030)	-0.019 (0.025)	-0.093** (0.043)	-0.021 (0.021)
Caregiver first language is Spanish (yes = 1)	0.002 (0.013)	0.010 (0.015)	0.026 (0.016)	-0.018 (0.018)	0.007 (0.025)	0.019 (0.012)
Caregiver is the mother (yes = 1)	-0.036 (0.033)	-0.043** (0.019)	-0.054 (0.037)	0.029 (0.044)	-0.103** (0.048)	-0.042*** (0.012)
Child's age (months)	-0.001* (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.003 (0.002)	0.001*** (0.001)
Child is male (yes = 1)	0.003 (0.009)	0.013 (0.010)	0.001 (0.016)	0.021* (0.011)	-0.002 (0.016)	0.010 (0.008)
Scale aggregate score	0.007*** (0.002)	0.008*** (0.003)	0.014*** (0.003)	0.011*** (0.003)	0.004 (0.003)	0.002 (0.002)
Constant	0.351*** (0.071)	0.328*** (0.060)	0.084 (0.094)	0.366*** (0.101)	0.409*** (0.098)	0.783*** (0.062)
Observations	458	579	579	518	504	528
R-squared	0.324	0.210	0.227	0.102	0.226	0.167

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6.4: Caregivers' beliefs partial correlation with the variety of play activities offered by the caregiver

Variety of play activities offered by caregiver	(1)	(2)
Treatment	0.509*** (0.144)	0.527*** (0.141)
Household wealth index (0-1)	1.034*** (0.340)	0.976*** (0.318)
Household members	-0.086*** (0.031)	-0.093*** (0.029)
Caregiver's age	-0.025*** (0.008)	-0.022*** (0.008)
Caregiver's educ. attainment (years)	0.099*** (0.019)	0.099*** (0.018)
Caregiver is married (yes = 1)	-0.192 (0.120)	-0.202* (0.120)
Hours worked last week by caregiver	0.003 (0.003)	0.003 (0.003)
Number of children under caregiver's care	-0.343 (0.285)	-0.364 (0.281)
Caregiver first language is Spanish (yes = 1)	0.089 (0.139)	0.042 (0.141)
Caregiver is the mother (yes = 1)	-0.509 (0.335)	-0.484 (0.343)
Child's age (months)	-0.019* (0.011)	-0.018 (0.011)
Child is male (yes = 1)	0.099 (0.123)	0.053 (0.109)
Baseline score	0.243*** (0.037)	0.238*** (0.036)
Scale aggregate score	0.053** (0.025)	
Scale average score		0.297* (0.170)
Constant	1.073 (0.792)	1.375* (0.805)
Observations	579	614
R-squared	0.290	0.287

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6.5: Treatment effects by household wealth and caregiver education quartiles on caregivers' beliefs regarding the importance of parent-child interactions for child development (scale aggregate score)

(a) Caregiver education				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.173 (0.349)	0.924*** (0.319)	0.314 (0.400)	-0.353 (0.539)
Difference w.r.t Q1		0.751 (0.486)	0.141 (0.516)	-0.525 (0.617)
(b) Household wealth				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	-0.313 (0.365)	0.483 (0.361)	-0.382 (0.429)	1.039** (0.399)
Difference w.r.t Q1		0.796* (0.438)	-0.069 (0.614)	1.353** (0.551)

Number of observations is 579 (C = 304, T = 275).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Treatment effects and differences estimated using an interaction between treatment status and membership to each wealth or caregiver education quartile. All regressions included pre-treatment controls.

Table 6.6: Treatment effects on caregivers' beliefs of the importance of parent-child interactions for child development (caregivers with Spanish as mother tongue)

	Obs.	Mean control group	Mean treatment group	Difference	Controlled difference	d
Average score (1-4)	393 (C=208; T=185)	2.984	3.040	0.056 (0.055)	0.046 (0.046)	0.122
Aggregate score (7-28)	379 (C=199; T=180)	20.965	21.3167	0.352 (0.375)	0.276 (0.331)	0.104

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Controlled difference is the estimated effect including pre-treatment controls.

Effect size (d) calculated as the standardized controlled difference.

Table 6.7: Treatment effects by household wealth and caregiver education quartiles on caregivers' beliefs regarding the importance of parent-child interactions for child development (scale average score; caregivers with Spanish as mother tongue)

(a) Caregiver education				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.007 (0.069)	0.177*** (0.058)	0.088 (0.072)	-0.053 (0.089)
Difference w.r.t Q1		0.170* (0.092)	0.081 (0.097)	-0.060 (0.098)
(b) Household wealth				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	-0.039 (0.058)	0.057 (0.072)	0.005 (0.105)	0.145** (0.066)
Difference w.r.t Q1		0.095 (0.081)	0.043 (0.124)	0.184* (0.091)

Number of observations is 393 (C = 208, T = 185).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Treatment effects and differences estimated using an interaction between treatment status and membership to each wealth or caregiver education quartile. All regressions included pre-treatment controls.

Table 6.8: Treatment effects by household wealth and caregiver education quartiles on caregivers' beliefs regarding the importance of parent-child interactions for child development (scale aggregate score; caregivers with Spanish as mother tongue)

(a) Caregiver education				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	0.042 (0.501)	1.175*** (0.411)	0.515 (0.518)	-0.416 (0.629)
Difference w.r.t Q1		1.133 (0.674)	0.473 (0.690)	-0.458 (0.702)
(b) Household wealth				
	First quartile (Q1)	Second quartile (Q2)	Third quartile (Q3)	Fourth quartile (Q4)
Treatment effect	-0.3996039 (0.425)	0.399 (0.521)	-0.077 (0.754)	1.012** (0.471)
Difference w.r.t Q1		0.799 (0.595)	0.322 (0.888)	1.412** (0.652)

Number of observations is 379 (C = 199, T = 180).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Treatment effects and differences estimated using an interaction between treatment status and membership to each wealth or caregiver education quartile. All regressions included pre-treatment controls.

Appendix 7: Treatment effects on the variety of play material

Table 7.1: Interactions between treatment status, caregivers' educational attainment and household wealth

	z(i) = caregiver's educational attainment		z(i) = household wealth	
	<i>Linear effect</i>	<i>Non-linear effect</i>	<i>Linear effect</i>	<i>Non-linear effect</i>
Treatment	0.778*** (0.228)	0.892*** (0.323)	1.068** (0.421)	0.667 (0.730)
Treatment*z(i)	0.012 (0.038)	-0.026 (0.126)	-0.450 (0.838)	1.454 (3.160)
Treatment*z(i)^2	--	0.002 (0.009)	--	-1.968 (3.169)
z(i)	0.059** (0.023)	-0.032 (0.079)	1.083** (0.489)	-1.306 (2.576)
z(i)^2	--	0.007 (0.006)	--	2.497 (2.658)

Number of observations is 614 (C = 320, T = 294).

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

All regressions included pre-treatment controls.

Figure 7.1: Treatment effects by caregiver educational attainment and household wealth

