Early Childhood Development Interventions -
Scaling up and remaining effective

With material from Attanasio, Fernandez, Fitzsimons,
Grantham-Mcgregor, Meghir and Rubio-Codina (BMJ)

Costas Meghir

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There has now been a substantial amount of research on various early childhood interventions.

Prominent studies include:

- The Perry pre-school experiment in the US (3-5 year olds; pre-school and home-visiting. Successful in improving labor market attachment and lowering crime).
- The Abecedarian program in the US (1972 - 111 children from low income families - successful in improving educational outcomes).
- Other experiments with both home visiting and pre-schools in the US.

In developing countries:

- The Guatemala nutrition intervention.
- The Jamaica study (129 undernourished children in Kingston, Jamaica).

These programs have demonstrated the potential of early interventions to produce sustained outcomes for children from disadvantaged backgrounds.
The Jamaica Experiment

- The Jamaica experiment included three treatments and a control group
- The treatments were:
  - Infant Stimulation
  - Nutrition (calories)
  - Both
- The stimulation followed a structured curriculum, that we will discuss later
- It was delivered by professional health assistants
- It targeted children from 9-24 months and the intervention lasted 2 years
The Jamaica Experiment

- Grantham-McGregor and colleagues have demonstrated using the Jamaica experiment that cognition effects are sustainable.

- Recently Gertler, Heckman, McGregor et al. (2012) have shown that the effects are as important in labor market outcomes.

- Indeed the treatment group is indistinguishable from the “non-stunted” less disadvantaged comparison group.
Some Important Questions

- The Jamaica experiment has demonstrated the potential of early childhood interventions for improving human capital and indeed labor market outcomes as well.
- However we need to address two key questions:
  - How can we design scaleable interventions that are cost effective and sustainable
  - How do these interventions affect household behavior, in terms of investments in children, crowding-in or crowding-out of resources
  - What kind of spillovers do these interventions have in the family and the broader community/network
- We set out to answer at least some of these questions
An Intervention in Colombia

What follows is material from Attanasio, Fernandez, Fitzsimmons, Grantham-McGregor, Meghir and Rubio Codina

- We designed a stimulation and micronutrient supplementation intervention in Colombia
- The basic structure was guided by the Jamaica experiment by Sally Grantham-McGregor et al. 1991 - Lancet (SGM)
- However there are two important new elements:
  - Intervention: the emphasis on designing the program using local resources in a scalable fashion
  - Research Design: collect detailed household data to allow modeling the behavioral impact of the intervention to identify mechanisms
Scalability

- Rather than using professional health workers, we select local women to implement the intervention.
- We target our intervention to the beneficiaries of Familias en Accion - a CCT program.
  - The target population belong to the lowest economic group in terms of poverty as classify by the SISBEN system
- This group is represented by elected women - Madres Lideres (MLs)
  - The MLs are better educated, more pro-active but still they are part of the community they are intended to serve.
- This is the key element for the scalability of the program.
We adapted the Jamaica curriculum to the Colombian context.
We trained 6 professionals, each was assigned to 8 villages.
Our professionals (supervisors) trained 3/4 ‘madre lideres’ in each village.
The MLs were trained for three weeks.
  - This is perhaps insufficient
Intervention Design

- MLs were hired on a part time basis by us.
- A scaled up intervention could do better and would have to have a regular update to the training.
- After training, the supervisors kept going to the villages on a regular basis:
  - monitoring the implementation, giving feedback and counseling.
- The monitors/ supervisors were in constantly in touch with the MLs sent them motivational messages and short information.
## Characteristics of Home Visitors

<table>
<thead>
<tr>
<th></th>
<th>Home Visitor</th>
<th>Mother</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of Education</td>
<td>8.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Age</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>Working</td>
<td>56%</td>
<td>47%</td>
</tr>
<tr>
<td>Madre Lider</td>
<td>63%</td>
<td>-</td>
</tr>
<tr>
<td>Married/Cohab</td>
<td>70%</td>
<td>78%</td>
</tr>
<tr>
<td>Kids&lt;6</td>
<td>53%</td>
<td>All</td>
</tr>
<tr>
<td>No Kids</td>
<td>35%</td>
<td>-</td>
</tr>
<tr>
<td>Peabody PVT</td>
<td>28.2 (8.7)</td>
<td>26.9 (8.8)</td>
</tr>
</tbody>
</table>

T-stat for difference in PPVT scores 1.87
The Design

- Each ML visited 5-6 children and their mothers and distributed the micronutrients.
  - weekly visits of one hour each.
- The intervention lasted for 18 months.
  - Two years would probably be better but we had inadequate funds.
- The intervention is cheap:
  - US$ 500 per year per child.
  - 50% of cost is monitoring and supervision.
  - At scale it can be reduced to US$300.
The Grantham-McGregor Curriculum for Colombia

- Promote child-development in an integrated manner:
  - motor, language, cognitive, socio-emotional
- Encourage mothers to teach her children based on events surrounding daily routine activities
- Involve other children or members of the family where possible – this could generate important spillovers.
Types of Activities – Culturally adapted

- Picture Books
- Pictures to stimulate conversation
- Puzzles
- Cubes/Blocks and patterns
- Toys from recycled material
- Language games and songs.
Puzzles

Rompecabezas Pallaso
(21 meses en adelante)

Rompecabezas Muñeca
3 piezas (31 meses +)
6 piezas (41 meses +)
Toys
Home Visits
To answer these questions we designed an RCT and collected rich household data:
- 96 municipalities in 3 regions
- ~1440 children from 12 to 24 months at the start of the intervention
- Semi-urban localities with 5000 to 50000 inhabitants
Evaluation Design

- Random Assignment to four different groups
  - Stimulation
  - Micronutrient Supplementation
  - Stimulation and Micronutrients
  - Control (nothing - just observation)
The Random Assignment

DISTRIBUCIÓN MUESTRA POR TIPO DE MUNICIPIO - ESTIMULACIÓN

Convenciones
TIPO DE MUESTRA
- Estimulación
- Estimulación + Nutrición
- Nutrición
- Control
Evaluation

- Choosing the children/families:
- In both treatment and control we drew randomly 5 MLs
- The families with children in the 1-2 year age group became our subject families (in both treatment and control)
- If the ML refused to participate we still kept the families so there is no selection bias between treatment and control. We just replaced the ML and kept the same families
Evaluation

- February – May 2010: Baseline Data Collected; Socio-Economic questionnaire; Developmental measures for the children; Information about the mothers and child-rearing practices.
- All baseline data was completed before the start of the intervention
- September - December 2011: End of intervention and collection of follow up data
- Focus Groups
Data and Measurement

- Extensive socio-economic, psychometric and anthropometric data collection at:
  - baseline (Jan – March 2010): ~1400 children ages 12 to 24
  - after 18 months (June – Sept 2011): ~1400 children ages 30 to 42 months
- Phase-in of intervention (train facilitators) as baseline data is collected.
Child Questionnaire

- Motor and Cognitive Development: Bailey Test
- Socio-emotional Development: Bates Temperament
- Language Development: MacArthur-Bates
- Height, weight, haemoglobin and Morbidity
- Food Intakes (target child and <6 children in household)
- Child care arrangements & Time Use (target child and <6 children in household)
Mother Questionnaire

- General Household Socio-economic Characteristics
- Education, labour supply and time use
- Reproductive History
- Health Condition
- Height, weight and haemoglobin
- Aversion to Inequality and to Risk
- Depression (CESD)
- Knowledge on Parenting
- Parenting Practices & the Home Environment
Home Visitor Questionnaire

- Education, labour supply and time use
- Health Condition
- Aversion to Inequality and to Risk
- Knowledge on Parenting & Children
### Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Control (n =318)</th>
<th>Stimulation (n =318)</th>
<th>Supplementation (n =308)</th>
<th>Both Interventions (n=319)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in months</td>
<td>18.27 (4.02)</td>
<td>18.07 (3.76)</td>
<td>17.96 (3.60)</td>
<td>18.01 (3.73)</td>
</tr>
<tr>
<td>Male</td>
<td>49.69%</td>
<td>46.86%</td>
<td>53.90%</td>
<td>51.10%</td>
</tr>
<tr>
<td>Premature</td>
<td>19.13%</td>
<td>13.53%</td>
<td>17.56%</td>
<td>11.64%+</td>
</tr>
<tr>
<td>Birthweight in g</td>
<td>3222.48 (554.20)</td>
<td>3266.94 (476.39)</td>
<td>3244.75 (499.36)</td>
<td>3247.15 (514.63)</td>
</tr>
<tr>
<td>Stunted: Z-score height-for-age &lt; -2SD</td>
<td>15.86%</td>
<td>13.56%</td>
<td>10.49%+</td>
<td>13.65%</td>
</tr>
<tr>
<td>Anaemic</td>
<td>46.13%</td>
<td>47.47%</td>
<td>45.57%</td>
<td>44.59%</td>
</tr>
<tr>
<td>First-Born</td>
<td>42.14%</td>
<td>35.85%</td>
<td>42.21%</td>
<td>36.05%</td>
</tr>
<tr>
<td><strong>Maternal Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>27.63 (6.96)</td>
<td>28.34 (6.95)</td>
<td>27.50 (6.23)</td>
<td>27.92 (6.55)</td>
</tr>
<tr>
<td>Education in years</td>
<td>7.70 (3.51)</td>
<td>7.21 (3.41)</td>
<td>7.41 (3.53)</td>
<td>7.48 (3.43)</td>
</tr>
<tr>
<td>Married</td>
<td>68.63%</td>
<td>70.06%</td>
<td>69.54%</td>
<td>65.81%</td>
</tr>
<tr>
<td>Divorced</td>
<td>8.82%</td>
<td>11.46%</td>
<td>17.22%</td>
<td>13.42%</td>
</tr>
<tr>
<td>Single</td>
<td>22.55%</td>
<td>18.47%</td>
<td>13.25%</td>
<td>20.77%</td>
</tr>
<tr>
<td>Depression Score: CES-D 10</td>
<td>9.43 (5.54)</td>
<td>8.38 (5.60)</td>
<td>9.51 (5.47)</td>
<td>8.82 (5.24)</td>
</tr>
<tr>
<td><strong>Household Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td>5.22 (2.20)</td>
<td>5.38 (2.31)</td>
<td>5.23 (2.15)</td>
<td>5.22 (2.17)</td>
</tr>
<tr>
<td>Crowding: number of rooms over household size</td>
<td>0.60 (0.30)</td>
<td>0.57 (0.29)</td>
<td>0.59 (0.27)</td>
<td>0.62 (0.32)</td>
</tr>
<tr>
<td>Home Ownership</td>
<td>33.96%</td>
<td>38.99%</td>
<td>40.26%</td>
<td>36.05%</td>
</tr>
<tr>
<td>Wealth Index</td>
<td>-0.08 (0.92)</td>
<td>0.04 (0.98)</td>
<td>0.07 (1.06)</td>
<td>0.03 (1.04)</td>
</tr>
<tr>
<td><strong>Home Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Play Materials - Number of Varieties</td>
<td>3.34 (1.59)</td>
<td>3.41 (1.51)</td>
<td>3.19 (1.61)</td>
<td>3.10 (1.47)</td>
</tr>
<tr>
<td>Play Activities Over Last 3 Days - Number of Varieties</td>
<td>3.69 (1.76)</td>
<td>3.70 (1.71)</td>
<td>3.71 (1.65)</td>
<td>3.62 (1.67)</td>
</tr>
</tbody>
</table>

Data are % or mean (SD). +P value of difference with respect to control group <0.10; *P value of difference with respect to control group <0.05; P values for difference in means adjusted for clustering and standard errors at the municipality level. Wealth Index is the first principal component of the following household asset and characteristics: dirt floor, solid walls, crowding index, home ownership, sewage, and ownership of car, computer, blender, fridge, washing machine and cellphone. Varieties of Play Materials include: toys that make/play music; toys/objects meant for stacking, constructing or building; things for drawing, writing, colouring, and painting; toys for moving around; toys to play pretend games; picture books and drawing books for children; and toys for learning shapes and colours. Varieties of Play activities include: reading books or looking at picture books, telling stories to child, singing songs with child, taking child outside the home place/going for a walk, playing with the child with toys, spending time with child scribbling/drawing/colouring, and spending time with child naming things or counting.
Wealth Gap - Age and Cognition

This descriptive graph shows how the gap in cognitive development between the median (top) and lower decile (bottom) of the wealth distribution increases with age.

Comparison with Bogota Study Data on Wealth Gradient

Source: Attanasio, Sally Grantham-McGregor, Meghir, Rubio Codina and Varela - (JHR)
Attrition

- Sample Loss between household survey and Bayley test Baseline: 9 children (0.62%).
- Attrition between survey rounds (18 months): Household Survey: 3.52%.
- Spatial correlation is about 0.04 or less (depending on the outcome).
Attrition

- Sample Loss between household survey and Bayley test Baseline: 9 children (0.62%).
- Attrition between survey rounds (18 months): Household Survey: 3.52%.
- Spatial correlation is about 0.04 or less (depending on the outcome).
## Results of the intervention - Cognition

<table>
<thead>
<tr>
<th>Bayley-III Scores</th>
<th>N</th>
<th>β</th>
<th>95% CI</th>
<th>P value&lt;sup&gt;1&lt;/sup&gt;</th>
<th>D&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>1,263</td>
<td>1.139</td>
<td>(0.538 to 1.776)</td>
<td>0.002</td>
<td>0.260</td>
</tr>
<tr>
<td>Receptive Language</td>
<td>1,263</td>
<td>0.776</td>
<td>(0.270 to 1.332)</td>
<td>0.032</td>
<td>0.218</td>
</tr>
<tr>
<td>Expressive Language</td>
<td>1,263</td>
<td>0.455</td>
<td>(-0.286 to 1.250)</td>
<td>&gt;0.50</td>
<td>0.084</td>
</tr>
<tr>
<td>Fine Motor</td>
<td>1,262</td>
<td>0.567</td>
<td>(-0.060 to 1.247)</td>
<td>0.34</td>
<td>0.122</td>
</tr>
</tbody>
</table>

- P-values from Romano and Wolf stepdown procedure. 12 hypotheses tested.
- No effects of Nutrition or of the interaction of the programs
Mother reported outcomes

**Effects on Expressive Language: MacArthur-Bates (maternal report)**

<table>
<thead>
<tr>
<th>NUMBER WORDS CHILD CAN SAY</th>
<th>All</th>
<th>12-18 mths</th>
<th>18-24 mths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulation Only</td>
<td>4.238*</td>
<td>1.232</td>
<td>5.266*</td>
</tr>
<tr>
<td></td>
<td>(2.116)</td>
<td>(2.754)</td>
<td>(2.592)</td>
</tr>
<tr>
<td>Mean Dep Var (Controls)</td>
<td>55.46</td>
<td>48.04</td>
<td>61.20</td>
</tr>
</tbody>
</table>

n =1325; *significant at 5%

<table>
<thead>
<tr>
<th>NUMBER OF COMPLEX SENTENCES</th>
<th>All</th>
<th>12-18 mths</th>
<th>18-24 mths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulation Only</td>
<td>0.365</td>
<td>0.0582</td>
<td>0.275</td>
</tr>
<tr>
<td></td>
<td>(0.381)</td>
<td>(0.526)</td>
<td>(0.533)</td>
</tr>
<tr>
<td>Mean Dep Var (Controls)</td>
<td>5.43</td>
<td>4.53</td>
<td>6.69</td>
</tr>
</tbody>
</table>

n =1325
Parental Investments

First Hint at Mechanisms: Increased Parental Investment in Children

<table>
<thead>
<tr>
<th></th>
<th>Home Made Toys</th>
<th>Bought Toys</th>
<th>Play Materials</th>
<th>Play Activities (previous 3 days)</th>
<th>Books for Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stimulation</strong></td>
<td>0.914**</td>
<td>0.284*</td>
<td>0.556**</td>
<td>0.564**</td>
<td>0.0188</td>
</tr>
<tr>
<td></td>
<td>(0.180)</td>
<td>(0.134)</td>
<td>(0.128)</td>
<td>(0.152)</td>
<td>(0.081)</td>
</tr>
<tr>
<td><strong>Stim + Micronutrients</strong></td>
<td>0.719**</td>
<td>0.167</td>
<td>0.452**</td>
<td>0.731**</td>
<td>0.140</td>
</tr>
<tr>
<td></td>
<td>(0.189)</td>
<td>(0.133)</td>
<td>(0.137)</td>
<td>(0.153)</td>
<td>(0.087)</td>
</tr>
<tr>
<td><strong>Micronutrients</strong></td>
<td>0.0886</td>
<td>0.337*</td>
<td>0.213</td>
<td>0.217</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>(0.187)</td>
<td>(0.151)</td>
<td>(0.167)</td>
<td>(0.153)</td>
<td>(0.087)</td>
</tr>
</tbody>
</table>

n = 1329; *significant at 5%; **significant at 1%
New experiments

• Reported above is our initial experiment
• Since then We have designed and implemented three more interventions:

1. Home Visiting in the urban slums of Cuttack (Odisha) for 1 year olds (Private Donation and the Waterloo Foundation)
   • Data being analyzed.

2. Center based intervention with home visiting in Colombia (FAMI) Grand Challenges Canada
   • Data being prepared

3. Group based and Home visiting in rural Odisha (NIH funded)
   • Ongoing
Group based and Home visiting in rural Odisha

- The key innovation are the group based stimulation sessions
- We are bringing together mothers with their children and introducing activities in a playgroup setting
- We will be comparing to home visits and to the control
- Also nutrition education to achieve improved nutrition with local materials
ECD versus pre-School versus both

- Following this our next project (subject to funding) will randomize the children at the end of ECD to high quality structured pre-school
- This project will allow us to investigate formally the importance or otherwise of starting early.
- Experimental arms
  1. Intervention from 1-5
  2. Intervention from 3-5 only
  3. Intervention from 1-3 only
  4. No intervention