The process of human development:

Research, Measurement and Policy Questions.

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Co-authors and research projects

- Most work I will refer to derives from joint projects with:
  - Sally Grantham McGregor
  - Costas Meghir
  - Marta Rubio-Codina
- The work on estimating the process of human development is done in collaboration with:
  - Sarah Cattan
  - Emily Nix
- The work on measuring and characterising the role of beliefs is joint with:
  - Flavio Cunha
  - Pamela Jervis

Co-authors and research projects

- The various Colombian projects included as co-coauthors:

  Raquel Bernal, Helen Henningham, Camila Fernández, Emla Fitzsimmons , Michele Giannola and Alison Andrew.

- For the projects in India co-authors include:

  Alison Andrew, Britta Augsburg, Jere Behrman, Monimalika Day, Pamela Jervis, Fardina Mehri, Smriti Pahwa and Angus Phimister.

- For the projects in Ghana co-authors include:

  Sarah Cattan, Bet Cayers, Sonya Krutikova, Peter Leighton, Chris Lewis, Alison Naftaline.

Outline

Outline

Introduction

- In studying human development and in designing poliies to improve it we need to understand the biology and the psychology of the process.
- We want to understand the role played by various inputs in the process.
  - Environmental factors
  - Parents
  - Schools
- Why economics?
- Many key insights come from different disciplines
- It may be useful to think of the process as a whole.
- Individual choices and their drivers.
  - Resources
  - Attitudes
  - Interactions
- Genuine interdisciplinarity is key.

Outline

Research Challenges

- Much attention has been devoted to ECD in recent years.
- Much has been learned:
  - The multidimensionality of skills
  - The importance of the early years.
  - The importance of parental inputs.
- Much needs to be learned.
- I will mention three themes/ research challenges:
  1. The process of human development.
  2. Interventions and their scalability.
  3. Measurement.

Outline

The Process of Human Development

- The process of human development (what economists call human capital) is a very complex one:
  - Multidimensional
  - Complex interactions
  - It starts very early in life
- The early years are important and have long run consequences.
  - Vulnerability / Malleability
  - Salient for policy
  - ... it does not mean every thing is fixed by age 3!

Human development in developing countries.

- Children vulnerability and policy interventions can be particularly relevant in developing countries where risk factors are particularly salient.
- According to the Lancet (2007, 2011) series, 200m children are at risk of not developing their full potential.

Research challenges.

There are still many key questions for which we do not have full answers:

- What are the key periods for investment and other environmental factors?
- What is the persistence of the process and how does that change over time?
- What is the role of different dimensions and skills in the developmental process?
- What is the role of parental investment and what drives it?
- How do we measure the relevant concepts?

Characterising the evolution of the process

- Indentifying causal links between different factors (current development, parental inputs, other factors) is very useful for different reasons;
- The nature of dynamics is particular important
  - How persistence changes with age;
  - The interactions among domains;
  - The interaction with parental investment.
- All these elements are crucial in the design of optimal policies.

Identifying the role of parental investment

- Parent choose investment, possibly in reaction to shocks and children development.
- Establishing the causal link from investment to child development is hard.
- It is useful to frame the question within a model of behaviour:
  - parents make choices to optimise some objective function;
  - their choice will depend on their taste, their resources and their perceptions;
  - it may be useful to collect information on factors that affect choices (prices?) without affecting directly child development.

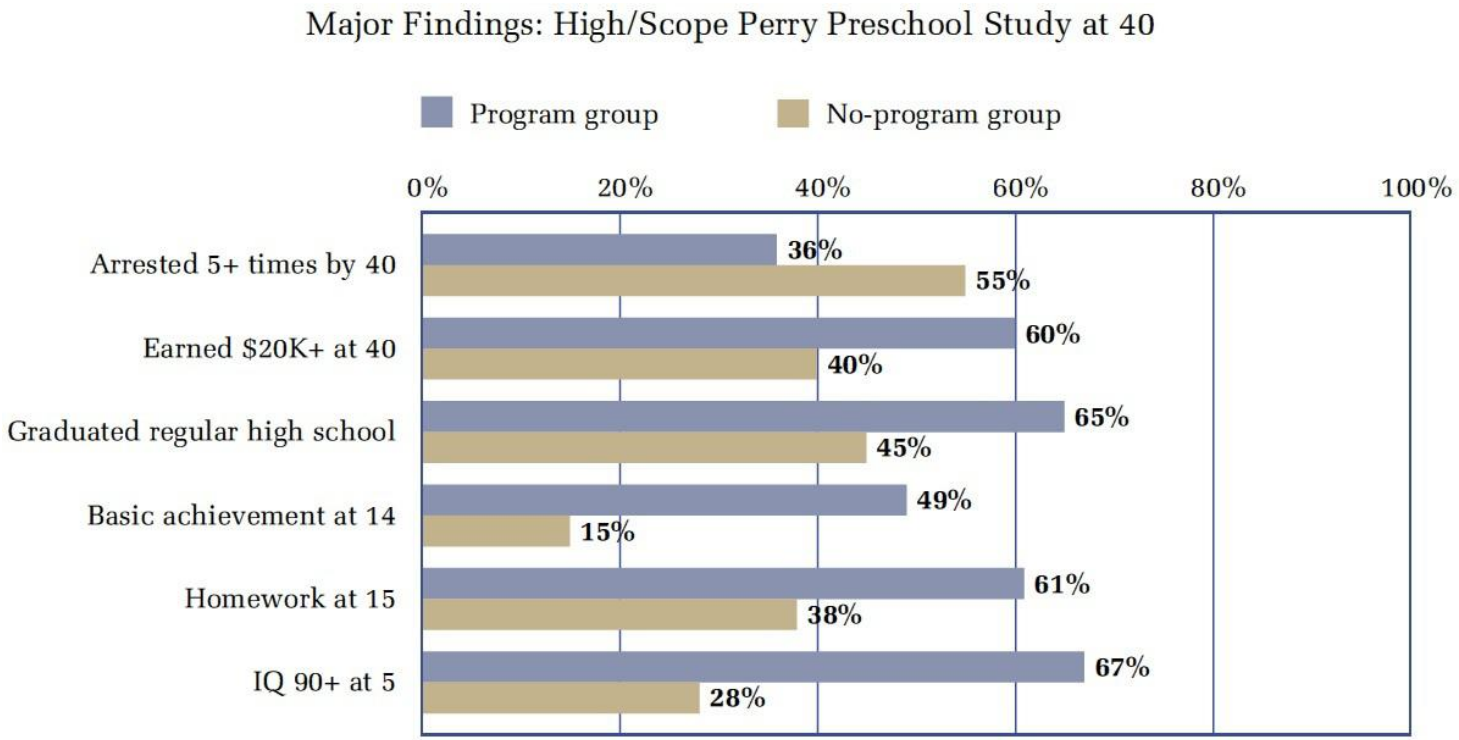
Outline

Successful interventions

- Several early interventions have been proved to be effective and successful
- This has been shown both in developed and developing countries:
  - The Perry Pre-School Program
  - The Abecedarian Program
  - The Nurse Family Partnership
  - The Jamaica Study

The Perry Pre-School program in Ypsilanti.

- 58 of 123 high risk children aged 3 and 4 were assigned to a high quality preschool program in the early 1960s.
- These children were followed into adulthood.



Schweinhart et al (2005) The High/Scope Perry Preschool Study through age 40.

The Carolina Abecedarian Project (ABC)

- ABC was designed as a social experiment to test the impacts of high quality early years education.
- 111 disadvantaged children in Chapel Hill randomly assigned between treatment (57) and control (54).
- Two stages: early years (0 to 5) and school age years (6-8)
- Very intense early: cognitive and stimulation activities as well as supervised playing for a full 8-hours day!
- Emphasis on language, cognitive skills and self-regulation.

The ABC impacts on health: Biomedical Sweep (Mid 30s)

from Campbell, Conti, Heckman et al. Science, 2014 .

Variable	Control Mean	Treatment Mean	Condit. TE	Blk. IPW P. *p*-val	Stepd.
Systolic Blood Pressure (mmHg)	143.333	125.789	24.828	**0.018**	**0.029**
Diastolic Blood Pressure (mmHg)	92.000	78.526	19.220	**0.024**	**0.024**
Hypertension (S.>140 & D.>90)	0.444	0.105	0.537	**0.010**	**0.018**
Hypertension (S.>140 or D.>90)	0.556	0.211	0.404	**0.038**	**0.038**
Obesity & Hypertension	0.500	0.111	0.529	**0.016**	**0.016**
Severe Obesity & Hypertension	0.375	0.000	0.502	**0.005**	**0.012**
Hypertension & Dyslipidemia	0.333	0.000	0.435	**0.006**	**0.012**
Metabolic Syndrome (NCEP Def.)	0.250	0.000	0.465	**0.007**	**0.014**
Framingham Risk Score	7.043	4.889	3.253	**0.038**	**0.038**

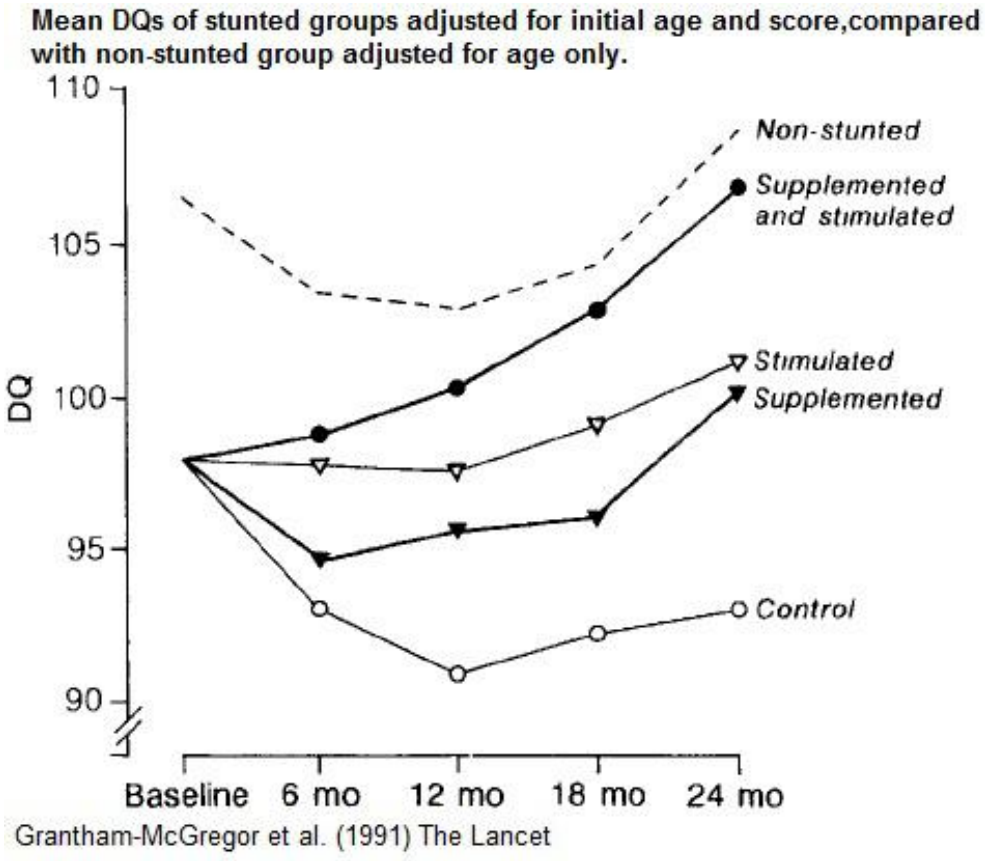
Notes: The fourth column "Condit. TE" presents the conditional treatment effect controlling for cohort, number of siblings, mother's IQ and high-risk index at birth, and accounting for attrition using IPW.

The Jamaica study.

- 129 stunted children, aged between 9 and 24 months at baseline were randomly divided into 4 groups:
  - Stimulation group;
  - Nutrition group;
  - Nutrition + Stimulation group;
  - Control group.
- The intervention lasted 2 years and the children were observed:
  - at the end of the intervention;
  - at age 7-8;
  - at age 11-12;
  - at age 17-18;
  - at age 22-23.

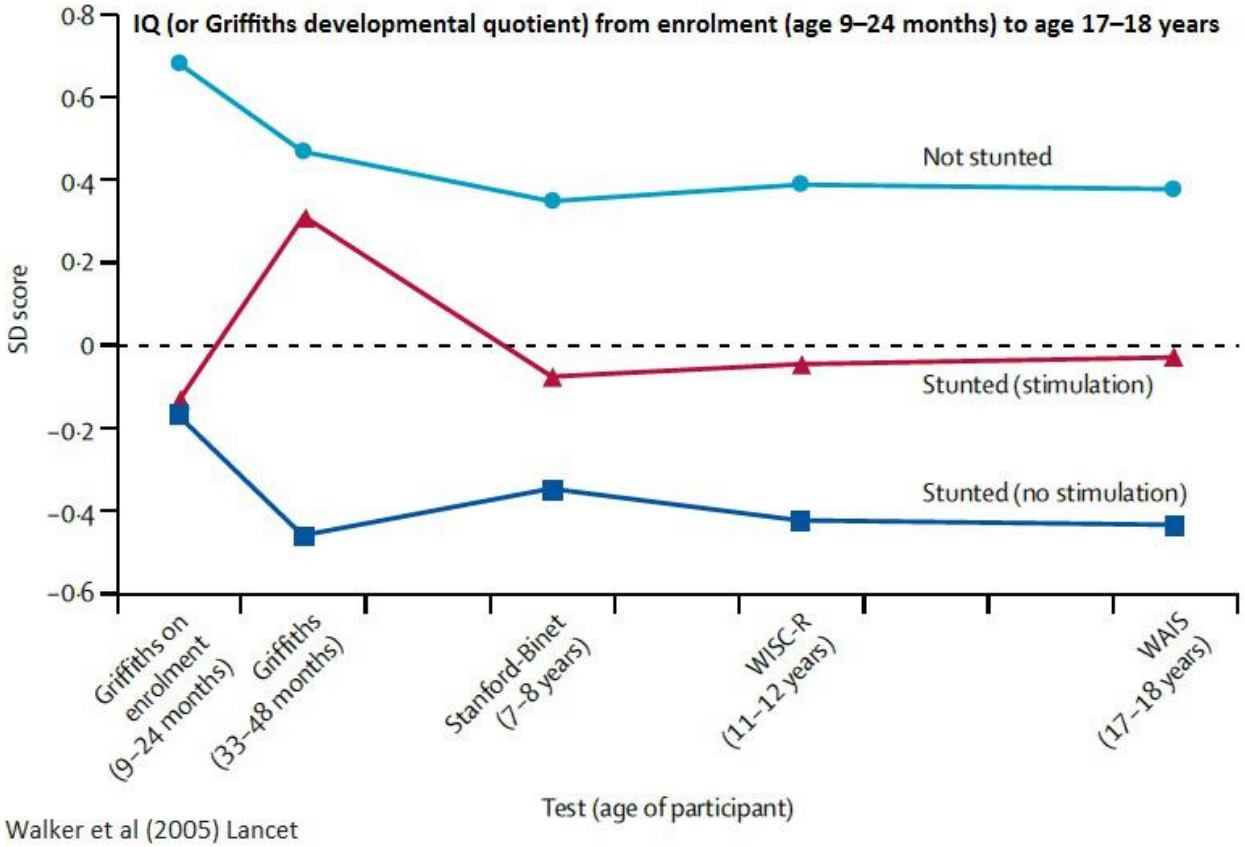
The Jamaica study.

The results were stunning:
(Grantham Mc Gregor et al., Lancet 1991)



The Jamaica study.

The results were stunning: (Walker et al., Lancet 2005)



The Policy Challenge

- This experiment and other similar and successful experiments are small scale efficacy trials tightly supervised.
- As such they are not scalable
- To better understand how these ideas can form the basis of policy we need to implement scalable versions
- This involves addressing the sustainability of the program, understanding changes in parental behavior and understanding how the ideas propagate and take root in a community.

Some Important Questions

- The key presumption of such interventions is that directly targeting families with parenting interventions is more effective than some kind of transfer program.
- So shifting parental beliefs and practices is at the center of how these operate.
- 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?
- Can they be scaled up?

Scalability

- What makes an intervention scalable?
- Available financial and other resources;
- Ownership and community participation.

Outline

Measurement issues

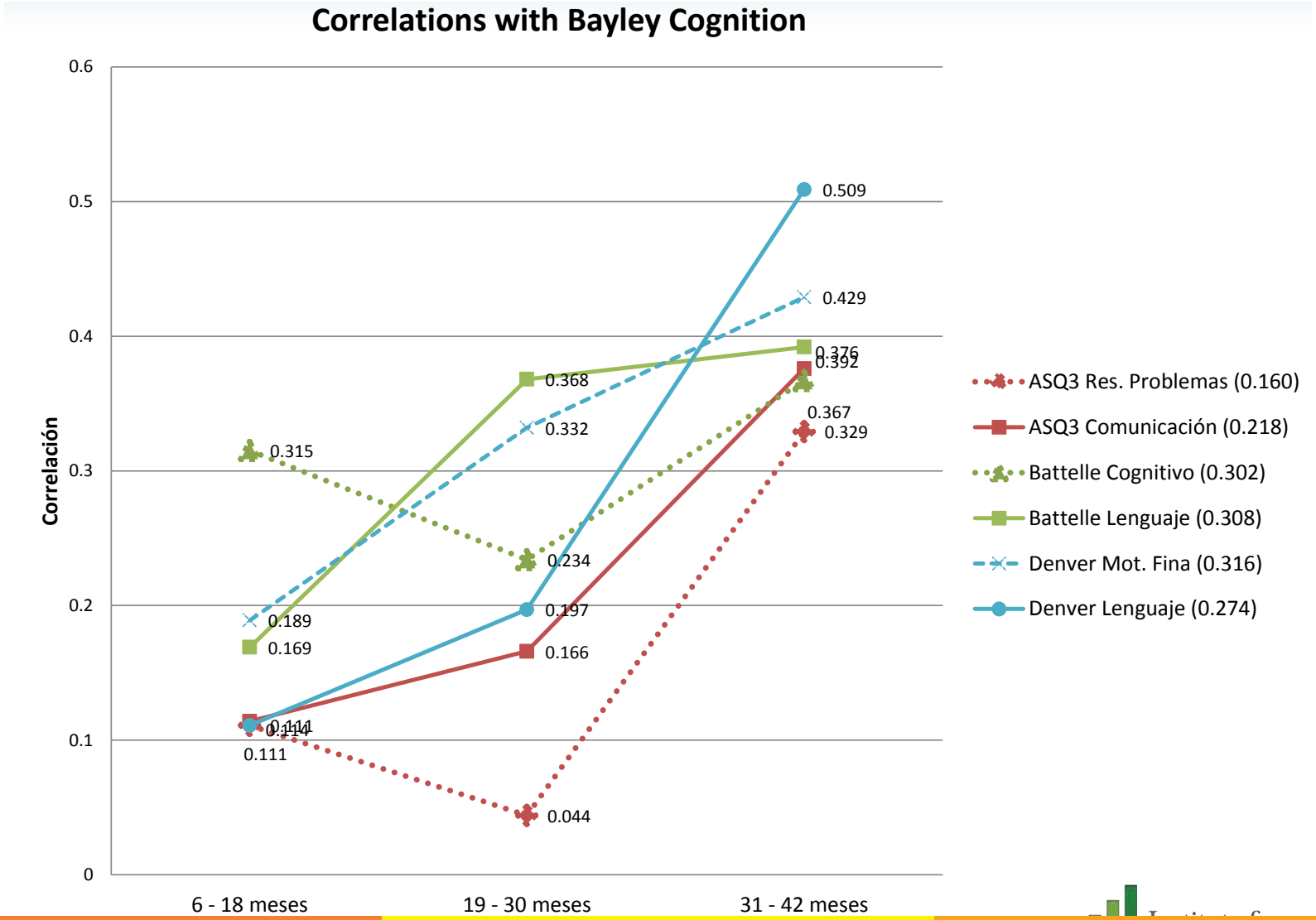
- Measurement is central to the approach we have taken.
- Appropriate measurement can be used to solve identification problems and estimate richer and more realistic models.
- Much has to be learned in terms of developing appropriate measures:
  1. Much work needs to be done in developing measures in some crucial areas.
  2. New technologies can and should play a central role in developing new measures.
  3. Theory should inform the development of suitable measures.
  4. It might be worthwhile to go beyond the standard 'revealed preference' approach.

Measuring child development is hard

- Measuring young children development accurately is very hard.
- Some of the measures that are considered the 'gold standard' are very expensive
  - The Bayleys scales of infant development (BSID) take about 1.5 hours to administer
  - They need to be administered by a specially trained psychologist
  - They cannot be administered in the child's home but in standardised settings.
- Unfortunately alternative 'cheap' measures can be very noisy.

How good are cheap measures?

Results from Araujo, Attanasio, and Rubio-Codina (2016)



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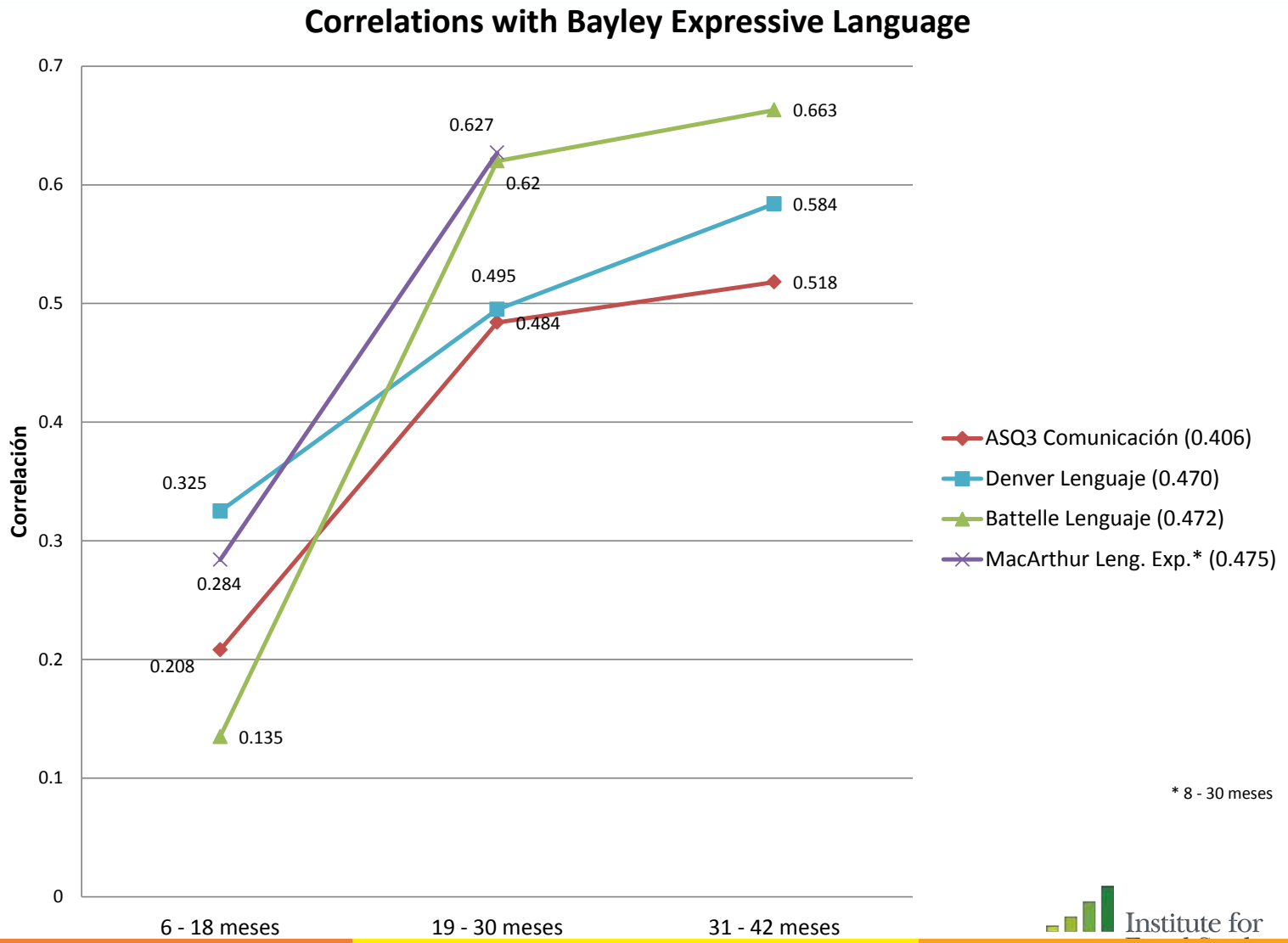


New technologies

- Much is happening and new tools are being developed.
- Some examples:
  - Neil Marlowe's PARCA-R, originally developed for premature babies, claims correlation with the Bayleys of 0.8. (Martin et al. Arch.Child.Dis. 2012)
  - Anne Fernald's eye tracking test seems to be very predictive of later academic outcomes. (Fernald et al. Dev. Psych. 2006)
  - Functional near infrared spectroscopy (fNIRS) with portable devices: Fox-Lloyd et al. (Nature, 2014) implemented it in the Gambia.
  - Elizabeth Spelke lab and her measurements in India and Ghana.
- There might be some low hanging fruits to be reaped.

Theory should inform the choice of measurement tools

- Appropriate measurement tools can solve identification problems.
- This is obvious when some specific 'unobservables' become (partially) observable.
- There is a more subtle sense in which appropriate design can help identification.
- In the factor models we have used, non-parametric identification requires multiple measures with uncorrelated measurement errors.
- This has been discussed in the literature:
  - Schennach (ECA, 2004)
  - Browning and Crossley (2009) "Are Two Cheap, Noisy Measures Better Than One Expensive, Accurate One?," AEA P&P

Theory should inform the choice of measurement tools

- The assumption of uncorrelated measurement errors in different measures can be made realistic by specific design:
  - In the case of the Colombia study we have different measures of cognitive development (Bayleys' scales, MacArthur Language tests, ASQ, etc.)
  - Some of them are administered by different individuals in different days.
  - Some of them are based on the observation of the child , other are based on maternal reports.
- Additional examples can be constructed with respect to the loading of different factors.

Beyond revealed preferences: observing unobservables

- Another dimension in which measurement tools can be developed is by eliciting individual responses on:
  - tastes, preferences, attitudes
  - expectations
  - beliefs
- This approach involves often going beyond 'revealed preferences'.
- In addition to choices, questionnaires elicit other dimensions often based on hypotheticals.
- This approach has not been used in the profession....
- ... but it has been pioneered by a number of scholars:
  - Tom Juster and researchers in Michigan
  - Chuck Manski on subjective expectations.
  - Willingness to pay.

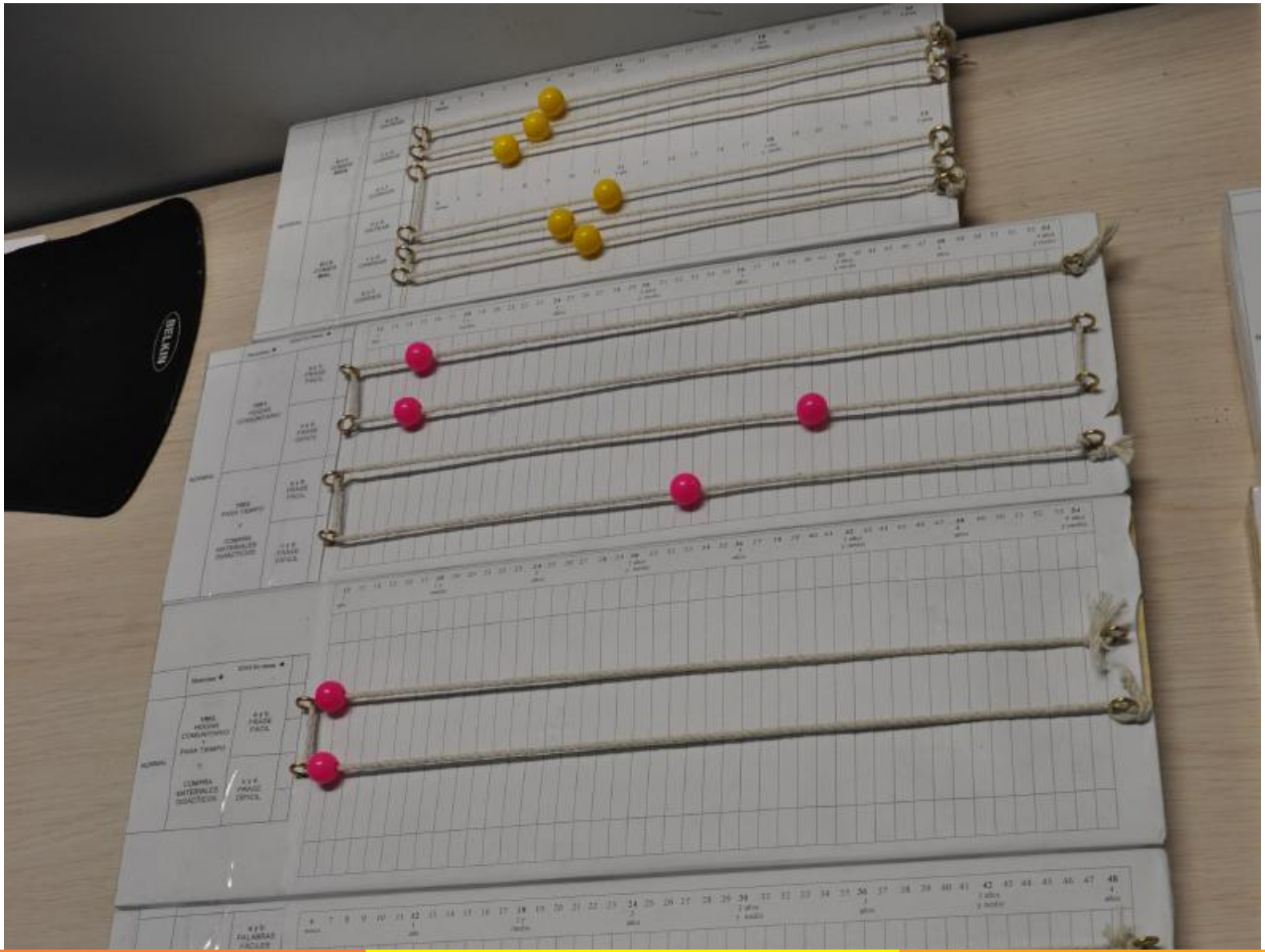
Beyond revealed preferences: observing unobservables

- In a simple model of parental investment, choices are driven by:
  - Parental Resources
  - Parental Tastes
  - Parental Beliefs about the process of human capital
- In collaboration with Flavio Cunha and Pamela Jervis, we have been eliciting beliefs on the returns to parenting in Colombia and in India.
- This avoids using the assumptions that parents know the true 'production function' of human capital.
- The idea is to present mothers with scenarios about initial conditions and investments and map them into developmental outcomes.

Beyond revealed preferences: observing unobservables

- We assume that mothers relate developmental outcomes to certain variables
  - The ability of saying certain words.
- We use factor analysis on existing data to choose appropriate words.
- Analogously to construct investment scenarios and outomes.
- We then ask mothers to map initial conditions and investment scenarios into outomes.

Beyond revealed preferences: observing unobservables



Beyond revealed preferences: observing unobservables

Outline

Our Interventions - Scaling Up

Table: Child Stimulation and Early Education studies by our group.
All Interventions are cluster randomized at the community level

Country	Intervention	Nutrition	Duration	Start Age	Sample Size	Population	Status
Colombia	Home Visiting	Yes	18 m	12-24m	96 Towns 1420 children	CCT Beneficiaries	Published BMJ & PLOS Med.
Colombia	Play groups	Yes	10 m	0-12m	87 towns 1456 children	Lowest two SE strata	Completed
India/Odisha	Home Visiting	No	18 m	12-24m	54 slums 378 children	Migrants in slums	Completed
India/Odisha	Home Visiting and Playgroups	Yes	24 m	7-16m	192 Villages 1400 children	Rural	Completed
India/Odisha	Daycare centers	No	24 m	31-40m	as above Re- Randomized	Rural	Starting
Colombia	Child care centres	Yes	6 m	48 m	120 centres 1500 children	Lowest two SE strata	Completed
Ghana	Child care centres	No	24 m	36 m	80 villages 1600 children	Rural	Running

Outline

The basic Structure of the studies

- The basic structure was guided by the Jamaica experiment by Sally Grantham-McGregor et al. 1991 - Lancet (SGM)
- However there are important new elements:
  - **Intervention**: the emphasis on designing the program using local resources in a scalable fashion
  - **Large scale implementation** over a broad geographical area with a large number of clusters and children.
  - **Mimic scalable delivery** at implementation.
  - Whenever possible use existing **government structures**.
  - **Research Design**: collect detailed household data to allow modeling the behavioral impact of the intervention to identify mechanisms.

Reach up and Learn : the Grantham-McGregor Curriculum

- Much of our work is based on the curriculum first developed by Grantham-McGregor and her team, including Sue Walker.
- Promote child-development in an integrated manner:
- Cognitive, Language, Socio-Emotional, Motor
- 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 reinforce the intervention by extending play activities and also generate important spillovers.

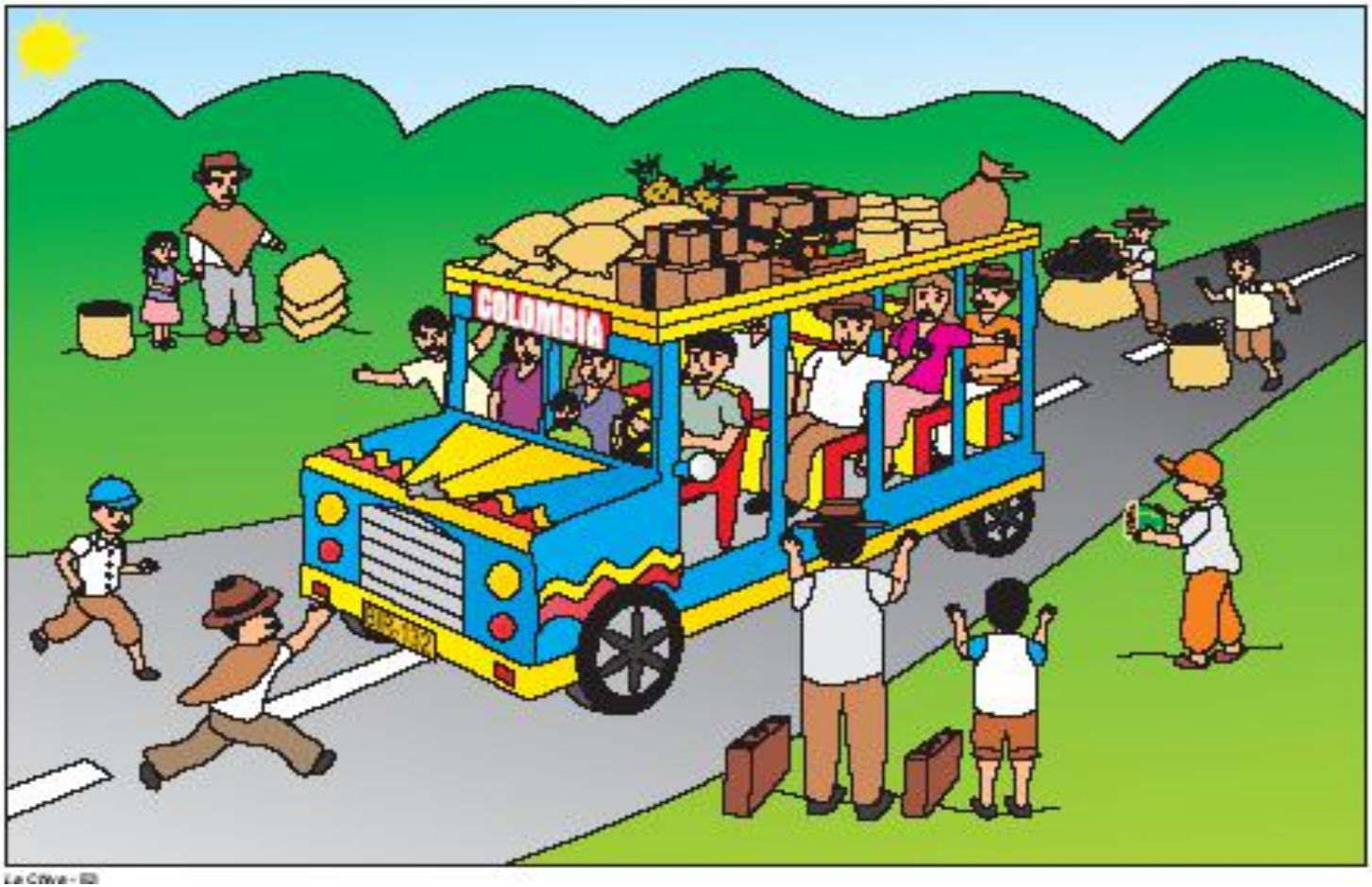
Types of Activities – Culturally adapted

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

Conversation Scenes and Puzzles

Conversation Scenes - example from Colombia

Material from Attanasio, Fernandez, Fitzsimmons, Grantham McGregor, Meghir and Rubio Codina



Toys made from waste materials

Home Made Toys by Mothers

Intervention Design: Home Visits

- We adapted the *Reach up and Learn* curriculum to the relevant local context.
- The delivery of the curriculum relied on
  1. **Mentors**: College graduates that would supervise the implementation
  2. **Home visitors**: Women from the local community who are trained by the mentors
- In Colombia the HVs were local elected representatives for the CCT program
- In India these are community workers hired by Pratham
- Local women are important because:
  - They are well connected in their communities and thus well placed to build trust
  - They may act as a conduit for the broader acceptance and propagation of the intervention
  - They solve the HR problem of who will deliver the intervention

Intervention Design - Home Visits

- The home visitors were hired full time.
- After training, the mentors kept going to the communities on a regular basis for monitoring the implementation, giving feedback and counseling
- The mentors were constantly in touch with the Home Visitors and helped them solve problems with the visits
- In the HV modality we treat all children in a community within a pre-specified age range
- Question: when is the optimal age to start?

The Design

- Each Home Visitor visited the household once a week for one hour approximately
- The session began with a review of the activities from the previous week
- Materials were then replaced with those supporting the new set of activities
- The intervention lasted for 18-24 months (depending on the case).

Home Visits

Alternative Intervention: Play groups

- We have also been experimenting with playgroups in two contexts:
  1. Introduce structured curriculum in local day-care centers
  2. Create weekly playgroups in villages
- The playgroups offer a cheaper model
- They may also foster the creation of networks that could reinforce the practices.

Evaluation Design

- All our interventions have used a cluster RCT
- We use a cluster design to avoid the possibility of spillovers
- We collect data from all children, even if they drop out (unless they migrate)
- Negligible attrition

Characteristics of the population in small-town Colombia

Table: Child and Maternal characteristics

	Control	Stimulation	Supplementation	Both Interventions
Child Characteristics				
Age in months	18.3	18.1	18.0	18.0
Male	49.7%	46.9%	53.9%	51.1%
Birthweight in g	3,222	3,267	3,245	3,247
Stunted: Z-score height-for-age <-2SD	15.9%	13.6%	10.5%	13.7%
Anaemic	46.1%	47.5%	45.6%	44.6%
First-Born	42.1%	35.9%	42.2%	36.1%
Maternal Characteristics				
Age	27.6	28.3	27.5	27.9
Education in years	7.7	7.2	7.4	7.5
Married	68.6%	70.1%	69.5%	65.8%
Depression Score: CES-D 10	9.4	8.4	9.5	8.8
Sample (towns/children)	24/318	24/318	24/308	24/319

Characteristics of the population for the urban slums experiment - Odisha

Table: Odisha: Child and Maternal characteristics

	Control Mean	Treatment Mean	P-value	Stepdown P-value
Child Characteristics				
Age in months	15.1	14.7	0.22	0.88
Male (%)	48.7	56.0	0.24	0.82
Firstborn %	46.5	47.6	0.82	1.00
Length-for-age WHO Z-score	-1.14	-0.87	0.07	0.32
Weight-for-length WHO Z-score	-0.58	-0.46	0.33	0.83
Parental Characteristics				
Mother's years of education	6.8	8.02	0.03	0.21
Sample size 54 slums, 378 children				

Results of the Stimulation Interventions - Main Outcomes

Table: Impacts of child stimulation

	Odisha		Colombia	
	Treatment Effect	Stepdown P-value	Treatment Effect	Stepdown P-Value
Bayley-III Z-Scores				
Cognition	0.36	0.016	0.26	0.002
Receptive language	0.26	0.058	0.22	0.032
Expressive language	0.21	0.079	0.084	>0.50
Fine motor	0.13	0.149	0.122	0.34
Factor Index	0.31	0.015	-	-

- No impact of micronutrient supplementation (Colombia)

Heterogeneity of Impacts: who benefits most

Table: Odisha: Results by gender and by mother's education

	Treatment Effect	Stepdown P-value	Treatment Effect	Stepdown P-value	Stepdown P-value for difference
	Girls		Boys		
Cognition	0.25	0.17	0.45	0.008	0.637
Receptive Language	-0.023	0.84	0.51	0.009	0.037
Expressive Language	0.17	0.094	0.24	0.16	0.90
Fine Motor	0.17	0.37	0.12	0.24	0.83
Factor Index	0.17	0.55	0.45	0.011	0.17
	Mothers Education is Lower		Mothers Education is Higher		
Cognition	0.19	0.31	0.38	0.04	0.33
Receptive Language	-0.037	0.76	0.37	0.035	0.14
Expressive Language	0.094	0.53	0.16	0.11	0.99
Fine Motor	-0.21	0.90	0.28	0.077	0.043
Factor Index	0.027	0.44	0.37	0.011	0.082

Mechanisms: Colombia

First Hint at Mechanisms: Increased Parental Investment in Children

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

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

stars based on Standard p-values for separate hypotheses

Mechanisms: Odisha

Table: Potential mediators for the impacts

	Treatment Effect	Stepdown P-value	N
Quality of the home environment	0.288	0.032	361
Maternal depressive symptoms	-0.216	0.04	348
Maternal knowledge of child development	0.141	0.21	350

The Cost

- India: $ 170 per year per child.
- GDP per capita US$1,700 at the time.
- 50% of cost is monitoring and supervision.
- At scale it can be reduced to

- Colombia: $500 per year and child
- GDP per capita $6,300 (2010)

Outline

Play Groups

- One question is whether ECD programs can work in groups
- The advantages of groups are that they are likely to be cheaper
- By fostering the creation of networks they may help sustain the practices propagated by interventions
- It is also possible that ECD practices are better implemented when there is greater social support, which may well be the case in groups
- On the other hand the one-on-one support for the mothers is weakened.

Play Groups - FAMI Intervention, Colombia

- We implemented an intervention for groups in Colombia
- We used an existing ECD infrastructure, which ensures our program is fully scalable
- The intervention consisted of weekly meetings of mothers with their children at the "FAMI" center
- We modified the *Reach-Up and Learn* curriculum and implemented in the groups
- We also implemented a monthly home visit
- Finally the intervention also included offering food intended for the children.

Play Groups - Intervention

- Intervention lasted about 10 months
- It involved 87 towns and a total of 1456 children.
- The children were 0-1 years of age at beaseline

FAMI Intervention: Main Outcomes

Table: Main Outcomes

	Beta (95% CI)	Stepdown P Value
Total Bayley (Factor of Z-Scales)	0.152 (0.030, 0.274)	0.048**
ASQ:SE Total Score (Z)	0.060 (-0.067, 0.187)	0.346
Height for age Z-Score	0.093 (-0.045, 0.230)	0.330

- To put things in context:
  - 74% of the children measured participated at least once
  - 28/55 sessions attended on average
  - In our home-visiting intervention we get about 55/72 sessions with near full participation
  - Depending on definition of compliance TOT is 0.3SD-0.4SD

FAMI Intervention: Further Outcomes

Table: Long term nutrition - Effects on height

	Beta (95% CI)	RW P value
Height-for-age between -5 SD and -1 SD	-0.058 (-0.115,0.000)	0.098*
Height-for-age between -1 SD and 1 SD	0.068 (0.012,0.124)	0.046**
Height-for age between 1 SD and 5 SD	-0.011 (-0.035,0.014)	0.39

- The nutritional subsidy did stick with the children. Not (all) crowded out

Child Care centres in Ghana and Colombia

- Data are being analysed for the two interventions.
- The intervention in Colombia is finished and delivers some sizeable impacts on cognitive development. pause
- The intervention seems to indicate that the aim of this type of interventions should be to change *processes* rather than *structures*.
- For the intervention in Ghana we have midline data after only 6 months of interventions which seem to indicate good impacts of several measures of cognition despite the short duration and some teething problems in implementing the intervention.
- It is important to stress that both interventions are designed to be scalable.

Outline

Modeling the Mechanisms

- It is important to understand how the various interventions deliver the observed impacts.
- One can consider human development as a function of certain inputs.
- Some of these inputs are chosen by the relevant actors in reaction to several events and under certain constraints.
- Parental investment will depend:
  - Resources
  - Taste
  - Beliefs

Incorporating the role of the intervention in the framework

- We use the theoretical framework to interpret these results.
  - from Attanasio, Cattan, Fitzsimons, Meghir and Rubio (2017)
- The purpose is to establish how the intervention obtained the observed impacts.
- Within this framework one can see the impacts as:
  1. induced by changes in the parameters of the production function
  2. induced by changes in some inputs such as parental investments
- Changes in the production function may capture
  1. Parental behavior, not reflected in the observables
  2. The direct impact of the intervention as a new input
- Within the production function approach, the intervention could have affected the formation of skills:
  - By shifting the distribution of investments
  - By shifting the productivity of the inputs

Incorporating the role of the intervention in the framework

- The production function we estimate is:

$$\theta^{j}_{i,t+1} = A^{j}_{\kappa}[\gamma^{j}_{1,\kappa}{\theta^{c}_{i,t}}^{\rho_j} + \gamma^{j}_{2,\kappa}{\theta^{s}_{i,t}}^{\rho_j} + \gamma^{k}_{3,\kappa}{\theta^{m,c\rho_j}_{i,t}} + \gamma^{j}_{4,\kappa}{\theta^{m,s\rho_j}_{i,t}} + \gamma^{j}_{5,\kappa}{I^{M}_{i,t+1}}^{\rho_j} + \gamma^{j}_{6,\kappa}{I^{T}_{i,t+1}}^{\rho_j}]^{\frac{1}{\rho_j}} e^{\eta^{j}_{i,t}} \quad j = c, s$$

The joint distribution of factors $(\theta_{t+1}, \theta_t, I_{t+1}, P)$ *is allowed to differ between the treatment and control samples.*

Incorporating the role of the intervention in the framework

- We consider the impact of stimulation ($\kappa = 1$) vs. no stimulation ($\kappa = 0$) and let the investment functions and the production functions to depend on the intervention.
- The investment functions are specified as:

$$\begin{aligned} \ln(I_{i,t}^{\tau}) \quad = \quad & \lambda_{\kappa,0}^{\tau} + \lambda_{\kappa,1}^{\tau} \ln(\theta_{i,t}^{c}) + \lambda_{\kappa,2}^{\tau} \ln(\theta_{i,t}^{s}) + \lambda_{\kappa,3}^{\tau} \ln(\theta^{m,c}) + \\ & \lambda_{\kappa,4}^{\tau} \ln(\theta^{m,s}) + \lambda_{\kappa,5}^{\tau} \ln(Z_{i,t}) + u_{i,t}^{\tau}, \qquad \tau = M, T \end{aligned}$$

- where Z are variables that determine investment but have no direct impact in the production function:
  - Prices, wages
  - Family resources
  - Family composition (but we do allow them in the prod. fun.)

The Investment Equations

	Material Investment	Quality Time Investment
Intercept	-0.016	0.001
	[-0.114,0.078]	[-0.089,0.089]
Treat	0.204	0.333
	[0.038,0.365]	[0.155,0.48]
Baseline cognition	0.13	0.067
	[0.016,0.246]	[-0.044,0.18]
Baseline SE	-0.032	0.021
	[-0.133,0.087]	[-0.083,0.145]
Mother's cognition	0.754	0.367
	[0.582,0.939]	[0.162,0.498]
Mother's SE	0.071	0.024
	[-0.008,0.139]	[-0.06,0.108]
Number of kids	-0.129	-0.134
	[-0.18,-0.077]	[-0.186,-0.072]
Toy prices	-0.095	-0.02
	[-0.168,-0.027]	[-0.085,0.037]
Food price	0.096	0.042
	[0.006,0.178]	[-0.026,0.121]
Conflict	-0.011	-0.096
	[-0.08,0.063]	[-0.139,-0.032]
Rank test	0.011	
Joint Significance Tests - p-values		
Toy price, Food price, Conflict	0.028	0.008
Toy price, Food price	0.013	0.455

The Production Function for Cognitive Skills

Table: Production function for cognitive skills - selected Coefficients

	OLS	IV			
TFP * Treatment	0.084	0.058	0.027	-	-
	[-0.025, 0.192]	[-0.116, 0.389]	[-0.149, 0.226]		
Baseline cognition	0.67	0.651	0.64	0.701	0.7
	[0.589, 0.77]	[0.542, 0.794]	[0.549, 0.757]	[0.564, 0.805]	[0.607, 0.811]
Baseline SE	-0.004	0.015	0.004	-0.012	-0.026
	[-0.091, 0.087]	[-0.095, 0.147]	[-0.101, 0.11]	[-0.126, 0.112]	[-0.118, 0.091]
Number of kids	0.041	0.081	0.083	0.059	0.056
	[-0.01, 0.092]	[-0.066, 0.154]	[-0.006, 0.174]	[-0.006, 0.136]	[-0.005, 0.131]
Material investment	0.08	0.577	0.481	0.49	0.384
	[0.016, 0.157]	[0.02, 1.179]	[-0.187, 0.975]	[0.009, 1.118]	[0.023, 0.796]
Time investment	0.04	-0.167	-	-0.082	-
	[-0.051, 0.129]	[-1.23, 0.312]		[-0.781, 0.344]	
Goodness-of-fit: Gap in output between treated and control					
(a) Measured in the data			0.121		
(b) Predicted by the model	0.114	0.120	0.125	0.073	0.078

The Production function for Socio-emotional skills

Table: Production function for Socio-Emotional skills - selected coefficients

	OLS	IV			
TFP * Treatment	-0.012	-0.092	-0.114	-	-
	[-0.124, 0.093]	[-0.322, 0.155]	[-0.339, 0.133]		
Baseline cognition	0.105	0.072	0.085	0.094	0.098
	[0.018, 0.192]	[-0.013, 0.209]	[-0.021, 0.19]	[-0.004, 0.212]	[0.003, 0.192]
Baseline SE	0.51	0.503	0.507	0.51	0.523
	[0.403, 0.659]	[0.384, 0.668]	[0.39, 0.659]	[0.402, 0.673]	[0.413, 0.67]
Number of kids	0.098	0.131	0.133	0.107	0.111
	[0.047, 0.153]	[0.016, 0.235]	[0.033, 0.229]	[0.031, 0.178]	[0.045, 0.174]
Material investment	0.142	-0.068	-	-0.108	-
	[0.06, 0.256]	[-0.642, 0.455]		[-0.664, 0.402]	
Time investment	0.119	0.589	0.558	0.347	0.269
	[-0.006, 0.213]	[-0.169, 1.295]	[-0.05, 1.283]	[-0.184, 0.944]	[-0.098, 0.632]
Goodness-of-fit: Gap in output between treated and control					
(a) Measured in the data			0.082		
(b) Predicted by the model	0.0566	0.0903	0.0718	0.0935	0.0896

Outline

Conclusions

- The study of human development is important, especially in the context of developing countries.
- We know much:
  - Early years are important.
  - Early years are malleable.
  - Targeted and well-designed interventions can be effective.
- There is much we do not know.
  - The process of HK formation is complex: dynamics, the role of nutrition, genetics and epigenetics.
  - What do parents do and why?
  - How to build scalable interventions?
- A research agenda:
  - Better measurement tools.
  - Use of structural models to identify the production function and parental behaviour.
  - Instrumental to the design of effective policies.