Cognitive Development among Young Children in Low-Income Countries

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Early childhood development encompasses children’s cognitive development as well as their physical growth and well-being and socioemotional development. While endorsing the broad view of early childhood development highlighted in the introduction to this book, this chapter focuses on the cognitive domain, reflecting recent advances in the measurement of cognitive development in low-income countries. The objective of this chapter is to review the evidence that cognitive delays in early childhood can quickly accumulate among the poorest children and that indicators of cognitive development in early childhood strongly correlate with socioeconomic status.

The first part of the chapter takes stock of existing evidence on cognitive development in early childhood. A large share of evidence originates from developed countries, with more recent evidence coming from lower-middle-income countries in Latin America (in particular Ecuador and Nicaragua) as well as Madagascar. The second part of the chapter presents new evidence on patterns in cognitive development in Cambodia and Mozambique, two low-income countries. The chapter documents that young children in Cambodia and Mozambique are exposed to large cognitive delays that increase with age. It shows that cognitive development is associated with socioeconomic status as proxied by wealth and caregiver education, and
that these gradients remain even when accounting for mediating factors such as nutrition and parenting. Overall, the patterns observed in Cambodia and Mozambique are remarkably consistent with those in the existing literature, suggesting that the prevalence of cognitive delays and socioeconomic gradients in early childhood development are likely to affect many children across low-income countries. The important policy implications of these findings are outlined in the conclusion.

A Review of the Literature

Long-Term Consequences of Cognitive Delays in Early Childhood

Low levels of cognitive and overall development in early childhood influence performance in school and throughout an individual’s life. A substantial body of research suggests that delays in cognitive development during the early years of a child’s life lead to negative consequences both in the short term, particularly regarding school readiness and performance, and in the long term through reduced employability, productivity, and overall well-being. Indeed, children who experience low levels of cognitive development in early childhood are more likely to repeat grades and to drop out of school early than those whose cognitive skills and overall school readiness were higher upon primary school entry (Feinstein 2003; Currie and Thomas 1999; Pianta and McCoy 1997). They are also more likely to have worse health and to engage in risky behavior such as smoking, risky sexual behavior, substance use and addiction, and criminal and violent activity as they become older (for a review on these topics, see Naudeau and others 2010).

These negative effects seriously undermine the social and economic benefits expected from the investment that parents and governments (in the case of publicly funded education and health policies) make in children. Moreover, these effects raise a fundamental question with regard to the quality of human resources available in the labor market and their capacity to make an effective contribution to facing the challenges of competitiveness and overall development of their country (Heckman and Masterov 2007).

Determinants of Cognitive Development

A range of environmental factors are likely to impact children’s cognitive development in the early years. Research demonstrates that cognitive abilities are as strongly affected by the quality of the environment as they are by genetics, with genetic influences accounting for about half of the
variance in cognitive abilities (for a review, see Fernald and others 2009; Plomin 1994). In the United States, several studies show that low socio-economic status (SES), as measured by low income, wealth, or parental education, is associated with poor child development outcomes, including cognitive development (Aughinbaugh and Gittleman 2003; Baum 2003; Berger, Paxson, and Waldfogel 2005; Blau 1999; Guo and Harris 2000; Rhum 2004; Smith, Brooks-Gun, and Klebanov 1997; Taylor, Dearing, and McCartney 2004; Waldfogel, Han, and Brooks-Gun 2002). A large body of research also shows that a wide range of variables or “risk factors” associated with poverty may act as “pathways” or “mediating variables” from low SES to poor cognitive development (Bradley and others 2001; Brooks-Gunn and Duncan 2007; Conger and Donnellan 2007; Evans and Miguel 2004). These risk factors include less responsive parenting, less stimulating learning environments, higher incidence of maternal depression and stress, lack of access to adequate nutrition, higher incidence of intrahousehold violence, poor housing, dangerous neighborhood, and pollution, among others.

**SES and Cognitive Development in High- and Middle-Income Countries**

There is evidence for a positive association between SES and cognitive development in high- and middle-income countries. Differences between children coming from households with low and high SES have been documented consistently in developed countries, especially in the areas of linguistic development and executive function. See, for example, Bradley and Corwyn (2002), in the United States; Hackman and Farah (2009), also in the United States; and Siddiqi and others (2007), across 22 Organisation for Economic Co-operation and Development (OECD) countries.

In Turkey, a recent World Bank report (2009b) documents that both quality of the home environment for learning purposes and cognitive development among 36- to 47-month-old children significantly vary by SES. Figure 1.1 shows that children from various SES backgrounds receive starkly different inputs in support of their cognitive and overall development, including availability of learning materials in the home and parenting quality (as measured by the mother’s responsiveness and language stimulation).

In turn, figure 1.2 shows that children from a wealthier background score much higher than those from lower SES in the areas of short-term memory and language comprehension (as measured by the Corsi and Tifaldi tests, respectively).4 Several studies from developed countries also reveal that early delays get worse as poor children get older. Findings also show that income gradients
widen as children get older, at least in terms of children’s health, and it is now understood that these trends are at least partly due to the timing of development of various regions of the brain (see Fernald and others [forthcoming] for a review).

Prevalence of Early Childhood Delays in Low-Income Countries

Given general socioeconomic conditions, the prevalence of cognitive delays is likely to be high among young children in low-income countries. A recent study (Grantham-McGregor and others 2007) estimates that 219 million children under the age of five are disadvantaged. Although this number represents 39 percent of all children under five in the developing world, the prevalence reaches a staggering 61 percent in the predominantly low-income region of Sub-Saharan Africa.

These children often experience a multiplicity of risk factors at the same time, including lack of access to basic water and sanitation infrastructure, lack of access to quality health services, inadequate nutritional inputs,
parents with low education levels, and lack of access to quality day care centers and preschools (Naudeau and others 2010).

As a result, poor and otherwise disadvantaged children are likely to experience deficits in several areas of development, including in the cognitive domain. They are less likely than their peers to enroll in school at the right age, and they are also more likely to attain lower achievement levels or grades for their age (Vegas and Santibanez 2010).

**Importance of Documenting Cognitive Delays in Low-Income Countries**

Documenting the prevalence and magnitude of cognitive delays among young children in low-income countries is critical to design well-targeted, effective, and timely interventions. Early delays in cognitive and overall development can be costly to both individuals and societies. As mentioned above, children with early delays are likely to experience poor school performance and high morbidity rates, all of which contribute to costly inefficiencies in the public education and health sectors. As they get older, these
children are also more likely to have low productivity and income, to provide poor care for their children, and to contribute to the intergenerational transmission of poverty. They are also less likely to contribute to the growth of their country’s economy (see Naudeau and others 2010 for a review).

Developmental delays before age six are difficult to compensate for later in life because early childhood is a particularly sensitive period for brain formation. Indeed, neurological studies have shown that synapses (connections or pathways between neurons) develop rapidly during this period to form the basis of cognitive and emotional functioning for the rest of the child’s life (Shonkoff and Phillips 2000). Both proper nutrition, especially from conception to age two, and early childhood stimulation in the first five years of life play a critical role in the process of brain formation and development (Nelson, de Hahn, and Thomas 2006; World Bank 2006). Some early stimulation inputs are particularly critical during specific subperiods (or windows of opportunity). For example, the capacity of a child to absorb language and to differentiate between sounds peaks at around nine months of age, well before the child can actually talk, thus indicating that it is critical for parents and other caregivers to verbally interact with children from birth onward (for a review, see Naudeau and others 2010). In turn, lack of proper nutrition and stimulation in the early years can lead to dramatic abnormalities in brain development (Shonkoff and Phillips 2000).

If wealth gradients can be documented among young children in low-income countries, then intervention strategies can be designed early to target beneficiaries accordingly. In addition, data can also be gathered on the relationship between cognitive development and other variables such as health and parenting quality that are likely to play a mediating role toward cognitive development. When such data are available, specific aspects of the child’s environment can also be addressed in the design of early childhood development (ECD) interventions.

Recent Evidence from Ecuador, Nicaragua, and Madagascar

Although comparatively little is known about the link between SES and cognitive development in developing countries and about age-specific trends in this link, several recent studies are making important progress in these areas. Until recently, research on developing countries had placed greater emphasis on documenting the relationship between child health, particularly malnutrition, and cognitive development (for a review, see Paxson and Schady 2007), and little was known about whether socio-economic gradients in cognitive development also existed among young children in developing countries (Schady 2006). In the last few years, however, several new studies taking place in developing countries, including
in Ecuador, Madagascar, and Nicaragua, made great and consistent strides in this important area of research. As further documented below, all three studies demonstrate that (1) socioeconomic gradients also exist in low-income countries when it comes to cognitive development and (2) delays in cognitive and other areas of development increase quickly with age, to a point at which many poor children display signs of considerable delays well before primary school entry.

**Ecuador.** A study of cognitive development among young children in Ecuador shows that household wealth and parental education are associated with higher scores on a test of receptive language, and that development gaps are larger among older children. The study (Paxson and Schady 2007) uses a sample of more than 3,000 Ecuadorian children coming from predominantly young, poor families (98 percent had no school-age siblings, 82 percent were in the bottom two quintiles of the wealth distribution, and none had received social transfers in the six months preceding the survey, which took place in 2003–04). The main outcome measure for the analysis is a child’s score on the Test de Vocabulario en Imágenes Peabody (TVIP: Peabody Picture Vocabulary Test), a test of receptive language further described in box 1.1. An important finding of the study, as shown in figure 1.3, is that steep socioeconomic gradients exist in this sample between children’s cognitive development and their households’ wealth. Similar associations are found with other measures of SES, including maternal and paternal education.

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**BOX 1.1**

**TVIP**

The TVIP (Test de Vocabulario en Imágenes Peabody) is a version of the Peabody Picture Vocabulary Test (PPVT) that was adapted and normalized for Spanish-speaking populations in low-income settings. The test is administered by showing a child a series of plates containing four pictures. For each plate, an enumerator says a stimulus word and asks the child to identify the corresponding picture. The items are increasingly difficult, and the test stops when the child makes six errors out of eight consecutive items. The TVIP has been used in a range of studies in developing countries (Fernald and others 2009). While the TVIP is a measure of receptive language (a subdomain of language development), it is often used as a proxy for cognitive development because the two domains are closely interrelated in early childhood.
Moreover, the damaging effect of poverty appears to increase with the age of the child. Indeed, although differences in the age-adjusted scores of three-year-old children in this sample are generally small, by age six children in the poorest 25 percent households have fallen far behind their counterparts in wealthier ones (richest 25 percent).\textsuperscript{7} This pattern is likely to be causal because poor children tend to receive less speech directed toward them and because the speech they do hear tends to have reduced lexical richness and sentence complexity (Fernald and others 2009).

The Ecuador study also shows that child health and parenting quality are associated with test performance, although they account for only a small fraction of the association between SES and cognitive development. The results suggest that although four measures of health (height-for-age, weight-for-age, hemoglobin level, and number of months of breast feeding after birth) are jointly significant in their association with TVIP scores, only the measures of height-for-age and hemoglobin levels are individually significant. The results also indicate that all three variables included to measure parenting quality (that is, number of children living in the household, scores on the HOME scale,\textsuperscript{8} and whether children are read to) are associated with
children’s performance on the TVIP. However, large associations between SES and cognitive development remain even after controlling for child health and parenting quality (together, these two constructs reduce the coefficient on wealth by only 13 percent).

**Nicaragua.** Another study documents low levels of cognitive development among poor children in Nicaragua. The study (Macours, Schady, and Vakis 2008; Macours and Vakis 2010) uses a longitudinal dataset built from a sample of 4,000 households with 2,086 young children between 36 and 72 months old. The data were collected in 106 rural communities in six Nicaraguan municipalities that were eligible to receive cash and productive transfers from a pilot program. The six municipalities were particularly disadvantaged in that they met the two criteria: (1) they had been affected by a drought the previous year and (2) they had a high prevalence of extreme rural poverty based on the national poverty map. Data collected in 2005 (before any intervention) and in 2006 (in a control group of households that did not receive any transfers) indicate that children in this sample exhibit serious signs of developmental delays, particularly in the areas of language development and short-term memory. On average, 97 percent of children in the sample scored in the lowest quartile of the normed distribution of the TVIP, and 85 percent scored in the lowest decile. Children in this sample also scored poorly (85 percent in the lowest quartile of the normed distribution and 61 percent in the lowest decile) on the McCarthy test of short-term memory, a test in which the enumerator reads increasingly long sequences of numbers to the child and asks him or her to repeat them.

The Nicaragua study also shows that age-adjusted cognitive scores get worse as children near primary school entry. In the case of language, the fraction of children who scored in the lowest decile of the TVIP normed distribution increased from 70 percent for children aged 36–59 months to 97 percent for children aged 60–83 months. Similar patterns can be observed for the McCarthy memory test.

**Madagascar.** A third study shows similar trends, this time among poor children in Madagascar. The study (Fernald and others forthcoming) uses a nationally representative sample of 1,332 young children across 150 communities in Madagascar, a low-income country with a gross national income per capita of US$340 (World Bank 2007). Data collected in 2007 indicate that socioeconomic gradients exist in this sample, especially in the areas of receptive language, working memory, and memory of phrases (as measured by adapted versions of the PPVT, a subtest of the Stanford Binet Intelligence Scales for Early Childhood [5th edition], and a subscale
from the Woodcock-Munoz assessment, respectively), all of which can be mapped to the broader area of cognitive and linguistic development. Indeed, children in the poorest socioeconomic quintile of the sample scored significantly lower than children in the richest quintile across these three areas of development.

Further, as in the Ecuador study, the difference between children in the highest and lowest SES categories (as measured by household wealth and maternal education) increased as children got older. The largest gaps by age six were in the areas of receptive language and sustained attention (as measured by the nonverbal Leiter International Performance Scales). Indeed, the difference in children’s age-adjusted score in receptive language between children of mothers with high education and those with low education was nearly three times higher among six-year-olds than among three-year-olds. For sustained attention, the difference in age-adjusted scores between the richest and poorest children was 2.4 times greater among six-year-olds than it was in the three-year-olds.

**Taking Stock.** The above results show strikingly similar patterns across three countries, but the extent to which these trends can be documented in a broader range of low-income countries remains to be seen. In the second part of this chapter, we present new data from two additional studies in low-income countries, one in East Asia (Cambodia) and the other in Sub-Saharan Africa (Mozambique). Both studies validate the trends previously established in Ecuador, Madagascar, and Nicaragua. These two new studies also offer important insights regarding the cognitive development of poor young children in these countries and about the associations that exist between cognitive development, SES, nutrition, and parenting quality.

**New Evidence from Cambodia and Mozambique**

As we have reviewed above, a large share of existing evidence on cognitive development in early childhood originates from high- and upper-middle-income countries, with new evidence coming from samples of predominantly poor children in lower-middle-income countries, mainly in Latin America and, more recently, from Madagascar.

In this section, we present new evidence on patterns in cognitive development in low-income countries by analyzing large-scale datasets collected in Cambodia and Mozambique. We measure cognitive development by using the TVIP test of receptive language for children aged 36 to 59 months. First, we assess the extent to which young children in the Cambodian and Mozambican samples show signs of cognitive delays and
if these delays increase with age. Second, we consider whether there are socioeconomic gradients by analyzing whether cognitive development is associated with SES as proxied by household characteristics such as wealth and caregiver education. Finally, we study whether other inputs into cognitive development such as nutrition and parenting are also correlated with SES, and to what extent they account for the association between SES and cognitive development. In other words, we test whether SES influences cognitive development through channels other than nutrition and parenting. We also consider whether socioeconomic gradients are larger for older children.

Overall, by providing a snapshot of cognitive development in Cambodia and Mozambique, the contribution of this second part of the chapter is to document the degree to which patterns previously discussed in the review of the literature also hold in these two low-income countries in East Asia and Sub-Saharan Africa, respectively.

The Cambodian and Mozambican Datasets

The Cambodian and Mozambican datasets illustrate patterns in young children’s cognitive development before ECD interventions are implemented. They constitute large-scale baseline surveys from ongoing impact evaluations of ECD interventions. Both datasets were collected in 2008 and allow measuring of cognitive development for children aged 36 to 59 months based on the TVIP receptive language test. The surveys also include a broad range of covariates such as individual, household, and caregiver characteristics.

The Cambodian and the Mozambican datasets contain samples of predominantly poor children. The Mozambican sample contains information on 2,000 children aged 36 to 59 months. The data were collected in 76 communities eligible to participate in a center-based ECD program in three districts of Gaza Province (Bruns and others 2010). Poverty is estimated at 59.7 percent in Gaza Province, which is above the Mozambican average of 54.1 percent, according to the latest national figures (Fox, Bardasi, and Van den Broeck 2005).

The Cambodia survey was collected in the most disadvantaged areas of the country (Filmer and Naudeau 2010). The sample contains data for 4,072 children aged 36 to 59 months in 141 communities across seven provinces. Those communities were surveyed because they were eligible to receive either a formal preschool intervention or informal ECD services. Eligibility criteria to receive these new services included incomplete primary schools, a poverty rate exceeding 30 percent, and the presence of high numbers of children between birth and age five. Because the national poverty rate was estimated at 30.1 percent in 2007 (World Bank 2009a),
the Cambodian dataset is best seen as containing a sample of children poorer than the national average.

Overall, both samples contain predominantly poor children that have no access to ECD interventions. The top panel of table 1.1 provides descriptive statistics on basic characteristics of the Cambodian and Mozambican datasets: 82.1 percent of children live in rural areas in the Cambodian

Table 1.1 Descriptive Statistics for Cambodian and Mozambican Samples

<table>
<thead>
<tr>
<th></th>
<th>Cambodia</th>
<th></th>
<th></th>
<th>Mozambique</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Basic characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td>4,072</td>
<td>47.0</td>
<td>6.8</td>
<td>2,000</td>
<td>46.6</td>
</tr>
<tr>
<td>Male</td>
<td>4,070</td>
<td>51.5%</td>
<td></td>
<td>2,000</td>
<td>50.6%</td>
</tr>
<tr>
<td>Urban</td>
<td>4,072</td>
<td>17.9%</td>
<td></td>
<td>2,000</td>
<td>13.9%</td>
</tr>
<tr>
<td>Caregiver education (years)</td>
<td>4,039</td>
<td>2.9</td>
<td>2.7</td>
<td>1,981</td>
<td>3.3</td>
</tr>
<tr>
<td>Caregiver without education</td>
<td>4,039</td>
<td>28.5%</td>
<td></td>
<td>1,981</td>
<td>30.3%</td>
</tr>
<tr>
<td>Number of adults in household</td>
<td>4,072</td>
<td>2.8</td>
<td>1.3</td>
<td>2,000</td>
<td>2.8</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>4,072</td>
<td>3.0</td>
<td>1.4</td>
<td>2,000</td>
<td>3.8</td>
</tr>
<tr>
<td>Caregiver age</td>
<td>4,061</td>
<td>34.3</td>
<td>10.4</td>
<td>1,950</td>
<td>34.5</td>
</tr>
<tr>
<td>Mother in household</td>
<td>4,072</td>
<td>95.8%</td>
<td></td>
<td>2,000</td>
<td>86.7%</td>
</tr>
<tr>
<td>Father in household</td>
<td>4,072</td>
<td>91.5%</td>
<td></td>
<td>2,000</td>
<td>70.4%</td>
</tr>
<tr>
<td>Nutritional status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height-for-age z-score</td>
<td>4,011</td>
<td>−1.96</td>
<td>1.0</td>
<td>1,944</td>
<td>−1.78</td>
</tr>
<tr>
<td>Stunted</td>
<td>4,011</td>
<td>47.6%</td>
<td></td>
<td>1,944</td>
<td>43.1%</td>
</tr>
<tr>
<td>Cognitive development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw TVIP score</td>
<td>4,015</td>
<td>8.6</td>
<td>6.4</td>
<td>2,000</td>
<td>5.7</td>
</tr>
<tr>
<td>Standardized TVIP score</td>
<td>4,015</td>
<td>82.7</td>
<td>10.9</td>
<td>1,996</td>
<td>78.7</td>
</tr>
<tr>
<td>Parenting indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household has paper or pen</td>
<td>4,070</td>
<td>84.1%</td>
<td></td>
<td>1,990</td>
<td>74.9%</td>
</tr>
<tr>
<td>Household has book</td>
<td>4,071</td>
<td>14.7%</td>
<td></td>
<td>1,735</td>
<td>75.4%</td>
</tr>
<tr>
<td>Child plays with purchased toy</td>
<td>4,070</td>
<td>73.9%</td>
<td></td>
<td>1,980</td>
<td>28.4%</td>
</tr>
<tr>
<td>Child plays with homemade toy</td>
<td>4,068</td>
<td>67.2%</td>
<td></td>
<td>1,996</td>
<td>55.1%</td>
</tr>
<tr>
<td>Linguistic Stimulation Index (0–3)</td>
<td>4,071</td>
<td>1.40</td>
<td>1.0</td>
<td>2,000</td>
<td>1.50</td>
</tr>
<tr>
<td>Caregiver thinks punishment is necessary</td>
<td>4,032</td>
<td>48.2%</td>
<td></td>
<td>1,990</td>
<td>24.7%</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

Note: N = number of observations; SD = standard deviation; TVIP = Test de Vocabulario en Imagenes Peabody.
dataset, 86.1 percent in the Mozambican dataset; 47.6 percent of children are stunted in the Cambodian data, 43.1 percent in Mozambique. The gender composition of both samples is balanced. A noteworthy feature of the Mozambican dataset is that a large share of parents do not live in the same household as their children (13.3 percent of mothers, 29.6 percent of fathers), reflecting a high prevalence of HIV/AIDS as well as frequent migration. The indicators of cognitive development and parenting presented in table 1.1 will be discussed in the next sections.

Cognitive Development in Cambodia and Mozambique

The TVIP test was used to measure the cognitive development of young children in both the Cambodian and Mozambican datasets (see box 1.1 for more details). In Mozambique, the TVIP test was translated and administered in Changaña (the local spoken language). In Cambodia, the TVIP test was translated and administered in Khmer. Raw TVIP test scores are obtained by adding the number of words correctly recognized by a child until the test is suspended.

TVIP scores are best not compared across countries. Indeed, although the same version of the test was translated and applied in both Cambodia and Mozambique, the mere fact of translating the test and using it in different cultural settings can introduce variations in the relative difficulty level of each item. Accordingly, we focus on highlighting common patterns that hold across datasets, without comparing the specific scores of children in Cambodia and Mozambique.

By the same token, in this chapter we prefer presenting raw TVIP scores (interpreted as the number of words correctly recognized by a child until the test is suspended) instead of externally standardized TVIP scores. Externally standardized TVIP scores would explicitly benchmark the scores of children in the samples to the scores obtained by children in the reference sample used to norm the test. In box 1.2 we highlight issues with the standardization and the reference sample that explain why we chose to use the raw TVIP score in this chapter. In graphical representations, we present raw TVIP scores for children in the Cambodian and Mozambican samples while displaying in parallel the average raw score for the normed population. This allows documenting the likely exposure to cognitive delays without making explicit cross-country comparisons.

Figure 1.4 presents average raw TVIP scores in Cambodian (top panel) and Mozambique (bottom panel). The mean raw score of children in the reference sample used to norm the test is presented in each graph. The upward dashed line in figure 1.5 describes the trajectory of cognitive development for an “average” child in the reference sample, showing the indicative rate at which children are expected to increase their language comprehension over time.
Externally standardized TVIP scores are obtained by comparing raw TVIP scores in the study samples with the score distribution in a reference sample used to norm the test. However, the reference sample consists of Mexican and Puerto Rican children for whom a Spanish version of the TVIP was conducted. Because the cross-cultural relevance of the test is not guaranteed and the characteristics of the populations may differ, the normed sample may not be the appropriate comparison group to benchmark cognitive development among very disadvantaged children in Cambodia or Mozambique. Fernald and others (2009) or Cueto and others (2009) discuss the many unresolved issues related to measurement of cognitive development across countries.

Figure 1.4 illustrates patterns in standardized TVIP scores for children in the Cambodian and Mozambican samples. The normed distribution has a mean of 100 and a standard deviation of 15 for each age group. By contrast, figure 1.4 shows that standardized scores in the Cambodian and Mozambican samples are well below the norm at age 36 months, and that there is a significant downward trend in standardized scores.

Figure 1.4 also illustrates structural issues with the standardized scores. First, the downward-sloping dashed line represents the lower bound in the reference distribution, that is, the lowest possible standardized score a child can be assigned. The structure of the test implies that the lowest possible standardized score a child can achieve decreases with age: as children grow older, the scope for delays increases. Second, as another sign that the structure of the TVIP test may not fully translate to developing country datasets, the standard deviation of the test remains consistently below the norm of 15 across studies and varies by age instead of remaining constant. Third, some children in the Cambodian or Mozambican samples cannot make any progress with the test and have a raw score of 0, which is below the minimum raw score that can be normed. If these children are assigned the lower bound of the reference distribution, their standardized score is censored and overestimates their level of cognitive development. Censoring may imply that the standardized scores of low-performing children are artificially inflated, which can create biases when trying to estimate differences in test scores due to covariates such as socio-economic status.

Sources: Cueto and others (2009); Fernald and others (2009); Paxson and Schady 2007; Schady 2010.
The distance between the raw TVIP score in the Cambodian or Mozambican data and the mean score in the reference sample indicates the extent to which children in these two countries lag behind the reference sample. Figure 1.5 shows that there are strong signs of cognitive delays for children in both countries. Signs of delays are already apparent at age 36 months, when TVIP scores from the Khmer and Changaña tests appear significantly below the mean score in the reference sample. The exposure to delays...
increases with age in the Cambodian and Mozambican samples, as shown by the widening gap between average raw scores in the samples and the mean score in the reference sample. In other words, although children are universally expected to demonstrate an increased understanding of language between ages three and five (as evidenced in the TVIP by the
increasing number of words that a child can understand), five-year-old children in our Cambodian and Mozambican samples show only limited increased language understanding compared with their three-year-old peers.

Figure 1.5 displays average TVIP scores measured for different cohorts of children from a cross-sectional survey, not for a panel following the same cohort of children over time. As such, figure 1.5 illustrates cohort effects, not age effects. Conceptually, cohort effects may be driven by other factors that change over time and may explain differences in cognitive development between cohorts. However, the patterns in figure 1.5 are strikingly similar to those from the published literature documented earlier in this chapter, such as Paxson and Schady (2007) in Ecuador; Macours, Schady, and Vakis (2008) or Macours and Vakis (2010) in Nicaragua; or Fernald and others (forthcoming) in Madagascar. Taken together, these studies provide strong evidence that young children in developing countries show signs of large cognitive delays. In addition, that similar trends emerge across countries strongly suggests that observed cohort effects are not simply driven by other time-varying factors. Cognitive delays, indeed, appear to accumulate over time.

The Cambodian and Mozambican data also show that there are very large variations in cognitive development between children of the same age in each sample. Even children in the high end of the distribution in the Cambodian and Mozambican samples are showing substantial signs of delays.22 At the same time, some children perform much better than their peers within each sample. The next section discusses a series of covariates that explains part of the large observed variation in raw TVIP scores, hence suggesting which factors contribute to improved cognitive development.

**Socioeconomic Status and Cognitive Development**

As we have discussed above, a variety of inputs and risk factors affect children’s cognitive development (Fernald and others 2009; Naudeau and others 2010). SES, taken as including a set of household characteristics such as wealth and caregiver education, constitutes one of these inputs or risk factors. A pathway from SES to cognitive development raises important policy questions because it suggests that cognitive delays contribute to the intergenerational transmission of poverty from parents to their children. This section illustrates how correlates that proxy for SES are associated with cognitive development in early childhood. This association may capture the effect of other inputs that are also correlated with SES but not explicitly accounted for. Still, this section documents the overall association between SES and cognitive development. The next section will
explicitly analyze the role of parenting and nutrition, two potential mediating factors that could account for part of the overall correlation between SES and cognitive development.

We use two proxies for SES: a wealth index and caregiver education. In the absence of comprehensive data on per capita household expenditures
in the Cambodian and Mozambican datasets, we use a wealth index to proxy for per capita household expenditures. The asset indices are derived from principal component analysis on ownership of household assets and durables. Filmer and Scott (2008) show that asset indices constitute a good proxy for per capita household expenditures. Caregiver education is defined as the number of completed years of education from primary school onward. The measure of caregiver education essentially captures parental education for the broad majority of children who live with their parents. However, we prefer using a measure of caregiver education instead of parental education, given that many parents are absent, particularly in the Mozambican sample.

Figure 1.6 plots raw TVIP scores for the bottom and the top quartiles of the asset distribution in the Cambodian and Mozambican samples. Raw TVIP scores are, on average, higher for the top quartile of the asset index compared with the bottom quartile. In other words, differences in SES account for part of the large variation in test scores within each sample. As we have discussed, similar socioeconomic gradients have been found in Ecuador, Madagascar, and Nicaragua. Still, it is quite remarkable to observe socioeconomic gradients in cognitive development in the Cambodian and Mozambican data, particularly because they contain rather homogeneous samples of mostly poor children in low-income countries. These results show that socioeconomic gradients in cognitive development appear even at very low levels of economic development.

Figure 1.7 displays raw TVIP scores by caregiver education, contrasting children whose caregiver has no primary education or only partial primary school education (one to four years of education) or has completed five or more years of primary school. The evidence on the role of caregiver education in cognitive development is more mixed. Patterns suggest some association between cognitive development and caregiver education in Cambodia, but not in Mozambique.

Table 1.2 presents a simple multivariate regression of the raw TVIP scores on SES, including wealth and caregiver education. The regression is estimated with the raw TVIP scores as an explanatory variable. Age fixed effects are included, so that results show how socioeconomic characteristics determine average TVIP scores across age groups. We impute the mean average education or age for caregiver when the variable is missing. We also include a dummy if the education or age variable is missing, which mostly occurs if parents do not reside in the household. All regressions include district fixed effects to account for constant differences between districts. Finally, standard errors are clustered at the village level.

Although these regression coefficients cannot be interpreted causally, they confirm the significance of descriptive patterns in figures 1.6 and 1.7. In Cambodia, children in the second, third, and fourth wealth quartiles
Figure 1.7 Raw TVIP Score by Age and Caregiver Education

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

Note: The “mean raw score in the normed sample” is the mean raw TVIP score achieved by children in the reference population used to norm the test (see box 1.2). Comparisons between raw TVIP scores in Cambodia and Mozambique and the norm should be undertaken carefully. The norm may not be fully appropriate because it was established based on a Spanish version of the TVIP in a sample of Mexican and Puerto Rican children whose characteristics may differ. TVIP = Test de Vocabulario en Imagenes Peabody.

have significantly higher average TVIP scores than children in the bottom quartile. In Mozambique, children in the fourth quartile have significantly higher average TVIP scores than children in the bottom quartile. In short, significant socioeconomic gradients in cognitive development are present in both samples.
Table 1.2 Cognitive Development and Socioeconomic Status

<table>
<thead>
<tr>
<th>Socioeconomic status</th>
<th>Raw TVIP score (Cambodia)</th>
<th>Raw TVIP score (Mozambique)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second wealth quartile</td>
<td>0.67*** (0.25)</td>
<td>0.10 (0.36)</td>
</tr>
<tr>
<td>Third wealth quartile</td>
<td>0.98*** (0.24)</td>
<td>0.78 (0.68)</td>
</tr>
<tr>
<td>Fourth wealth quartile</td>
<td>2.42*** (0.34)</td>
<td>1.29** (0.51)</td>
</tr>
<tr>
<td>Caregiver education (years)</td>
<td>0.17*** (0.05)</td>
<td>-0.03 (0.06)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control characteristics</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male child</td>
<td>0.19 (0.18)</td>
<td>0.09 (0.31)</td>
</tr>
<tr>
<td>Urban household</td>
<td>-0.49 (0.41)</td>
<td>-0.02 (0.21)</td>
</tr>
<tr>
<td>Number of adults in household</td>
<td>-0.19** (0.08)</td>
<td>0.04 (0.08)</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>-0.19*** (0.07)</td>
<td>0.06 (0.04)</td>
</tr>
<tr>
<td>Caregiver age (years)</td>
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<td>0.02 (0.02)</td>
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<tr>
<td>Missing mother</td>
<td>0.30 (0.53)</td>
<td>-0.89** (0.31)</td>
</tr>
<tr>
<td>Missing father</td>
<td>-0.39 (0.39)</td>
<td>-0.13 (0.27)</td>
</tr>
<tr>
<td>Age fixed effects</td>
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<td>Yes</td>
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<tr>
<td>District fixed effects</td>
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<td>Yes</td>
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<tr>
<td>Constant</td>
<td>5.20*** (0.61)</td>
<td>3.25*** (0.62)</td>
</tr>
<tr>
<td>Number of observations</td>
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</tr>
<tr>
<td>Adjusted $R^2$</td>
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<td>0.066</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

Note: Numbers in italics = coefficient/SE. Estimates and standard errors clustered at the community level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. Regression also includes a series of dummies to account for some variables that were missing and had to be imputed (mother/caregiver’s education, mother/caregiver’s age, has paper and pen, has book, has bought toy, believes in punishment, and so on). SE = standard error; TVIP = Test de Vocabulario en Imagenes Peabody.
Results regarding the association between caregiver education and cognitive development are not robust across samples and confirm the mixed evidence presented in figure 1.7. In Cambodia, caregiver education is positively and significantly associated with TVIP scores. Caregiver education is not associated with TVIP scores in the Mozambican sample. However, the absence of the mother is statistically and negatively correlated with cognitive development. This result is particularly noteworthy because it suggests that the protective effect of nurturing caregivers may outweigh the role of caregiver education in settings with high prevalence of conflicts or epidemics. Chapter 3 will discuss in more details the impact of extreme events such as conflicts, epidemics, and orphanhood on outcomes in early childhood.

Socioeconomic Status, Nutrition, Parenting, and Cognitive Development

Despite the robust association between SES (particularly wealth) and cognitive development documented in the last section, substantial unexplained variation in raw TVIP scores remains. In addition, the association between SES and cognitive development may capture the effects of mediating variables that can be explicitly accounted for. For instance, nutrition and parenting are two of the channels through which SES can indirectly affect cognitive development. In this section, we consider whether nutrition and parenting are also determined by SES and whether socioeconomic gradients in cognitive development remain once differences in nutrition and parenting between households are controlled for.

Nutrition and parenting are proxied as follows. We use height-for-age to measure a child’s nutritional status. As displayed in table 1.1, 47.6 percent of children are stunted in the Cambodian sample, and 43.1 percent of children in the Mozambican sample. We use a series of indicators that aim to measure parenting quality. First, four indicators measure if households have (1) paper or a pen or (2) a book and whether children play with (3) a homemade toy or (4) a purchased toy. Second, we build an index to measure the intensity of language stimulation a child receives in the household. The index ranges from zero to three and aggregates three variables that indicate whether anyone in the household sometimes (1) reads or looks at pictures with the child, (2) tells stories to the child, and (3) sings songs to the child. Finally, we also include a variable that captures whether the caregiver thinks that physical punishment is necessary to raise a child properly. All these proxies for parenting quality are measured consistently in the Cambodian and Mozambican surveys. Table 1.1 reveals some differences between samples in the parenting indicators. For instance, Mozambican households are much more likely to have a book in the household, and
Cambodian households are much more likely to have a purchased toy in the household.

SES is a significant determinant of both nutritional status and parenting quality. For instance, the language stimulation index is significantly associated with the wealth index and caregiver education in both the Cambodian and Mozambican samples. Nutritional status (as measured by height-for-age or stunting status) is significantly associated with the wealth index in Cambodia and Mozambique. In contrast, the correlation between nutritional status and caregiver education is statistically significant only in the Cambodian sample. In general, the fact that SES codetermines nutritional status and parenting suggests that these two mediating variables may explain part of the association between SES and cognitive development observed in the previous section.

Figure 1.8 shows the degree of correlation between cognitive development and stunting, and figure 1.9 plots cognitive development by level of language stimulation. Although nutrition, parenting, and cognitive development are codetermined by SES, figures 1.8 and 1.9 show that the correlation between those variables remains limited. There is substantial unexplained variation in TVIP scores even if nutritional status and parenting are accounted for.

Table 1.3 presents a multivariate regression with a full specification, including proxies for SES, nutrition, parenting, as well as a set of control characteristics, age, and district fixed effects. Results show that height-for-age is significantly associated with TVIP scores in both samples. In Cambodia, parenting variables such as the stimulation index and ownership of a book or a purchased toy are also significantly associated with cognitive development. In contrast, ownership of a purchased toy is significant and positive in the Mozambican sample, although a positive attitude toward punishment is negatively associated with cognitive development. Overall, the results show that parenting and nutrition account for part of the socioeconomic gradients observed in table 1.2.

Still, socioeconomic gradients in cognitive development remain, even accounting for the mediating effects of nutrition and parenting. The estimated coefficients for asset quartiles and parental education are of smaller magnitudes in table 1.2 than in table 1.3, however. In Cambodia, the coefficient for the second quartile in table 1.3 decreases by 30 percent, the coefficient of the third quartile by 39 percent, and the coefficient of the fourth quartile by 25 percent compared with table 1.2. In parallel, the coefficient of caregiver education decreases by 18 percent. In Mozambique, the coefficient of the fourth asset quartile variable decreases by 20 percent. In the end, although nutrition and parenting account for a significant share of the association between SES and cognitive development, SES also affects cognitive development through other pathways. These results are remarkably
consistent with the findings of Paxson and Schady (2007) in Ecuador and suggest that the patterns found in lower-middle-income countries are robust in low-income countries as well.

Finally, additional results suggest that socioeconomic gradients as proxied by wealth quartiles increase with age. For example, in Cambodia, children
Figure 1.9 Raw TVIP Score by Age and Level of Language Stimulation

a. Cambodia (Khmer)

![Graph showing raw TVIP score by age and level of language stimulation for Cambodia.]

b. Mozambique (Changaña)

![Graph showing raw TVIP score by age and level of language stimulation for Mozambique.]

**Source:** Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

**Note:** The “mean raw score in the normed sample” is the mean raw TVIP score achieved by children in the reference population used to norm the test (see box 1.2). Comparisons between raw TVIP scores in Cambodia and Mozambique and the norm should be undertaken carefully. The norm may not be fully appropriate because it was established based on a Spanish version of the TVIP in a sample of Mexican and Puerto Rican children whose characteristics may differ. TVIP = Test de Vocabulario en Imágenes Peabody.

Aged 48 to 59 months from the second and third quartiles have higher TVIP scores than children from the bottom quartile, but no significant differences in TVIP scores appear for children aged 36 to 47 months in the bottom three quartiles. In Mozambique, only in the older age group do children in the top asset quartile have higher TVIP scores than children in the bottom
Table 1.3 Cognitive Development, Socioeconomic Status, Nutrition, and Parenting

<table>
<thead>
<tr>
<th></th>
<th>Raw TVIP score (Cambodia)</th>
<th>Raw TVIP score (Mozambique)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socioeconomic status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second wealth quartile</td>
<td>0.47* (0.24)</td>
<td>0.04 (0.36)</td>
</tr>
<tr>
<td>Third wealth quartile</td>
<td>0.60** (0.25)</td>
<td>0.59 (0.70)</td>
</tr>
<tr>
<td>Fourth wealth quartile</td>
<td>1.81*** (0.33)</td>
<td>1.03* (0.51)</td>
</tr>
<tr>
<td>Caregiver’s education (years)</td>
<td>0.14*** (0.05)</td>
<td>-0.06 (0.07)</td>
</tr>
<tr>
<td><strong>Nutrition and parenting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height-for-age z-score</td>
<td>0.61*** (0.11)</td>
<td>0.32* (0.14)</td>
</tr>
<tr>
<td>Stimulation index</td>
<td>0.30*** (0.11)</td>
<td>0.20 (0.13)</td>
</tr>
<tr>
<td>Has paper and pen</td>
<td>0.25 (0.20)</td>
<td>0.10 (0.22)</td>
</tr>
<tr>
<td>Has book</td>
<td>0.64** (0.30)</td>
<td>-0.46 (0.32)</td>
</tr>
<tr>
<td>Plays with purchased toy</td>
<td>0.68*** (0.21)</td>
<td>0.80** (0.26)</td>
</tr>
<tr>
<td>Plays with homemade toy</td>
<td>-0.20 (0.22)</td>
<td>-0.47 (0.26)</td>
</tr>
<tr>
<td>Believes in punishment</td>
<td>-0.25 (0.22)</td>
<td>-0.60*** (0.19)</td>
</tr>
<tr>
<td><strong>Control characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male child</td>
<td>0.19 (0.19)</td>
<td>0.18 (0.35)</td>
</tr>
<tr>
<td>Urban household</td>
<td>-0.40 (0.40)</td>
<td>-0.17 (0.22)</td>
</tr>
<tr>
<td>Number of adults in household</td>
<td>-0.21*** (0.08)</td>
<td>0.03 (0.09)</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>-0.15** (0.07)</td>
<td>0.07** (0.03)</td>
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<tr>
<td>Caregiver’s age (years)</td>
<td>0.00 (0.01)</td>
<td>0.02 (0.02)</td>
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(continued next page)
Table 1.3 (continued)

<table>
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<th>Raw TVIP score (Cambodia)</th>
<th>Raw TVIP score (Mozambique)</th>
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</thead>
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<tr>
<td>Missing mother</td>
<td>0.39 (0.52)</td>
<td>-0.90** (0.28)</td>
</tr>
<tr>
<td>Missing father</td>
<td>-0.33 (0.39)</td>
<td>-0.17 (0.28)</td>
</tr>
<tr>
<td>Age fixed effects</td>
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<td>Yes</td>
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<tr>
<td>District fixed effects</td>
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<td>Yes</td>
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<td>Constant</td>
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<td>4.01*** (0.50)</td>
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<td>Number of observations</td>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.169</td>
<td>0.080</td>
</tr>
</tbody>
</table>

**Source:** Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

**Note:** Numbers in italics = coefficient/SE. Estimates and standard errors clustered at the community level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. Regression also includes a series of dummies to account for some variables that were missing and had to be imputed (mother/caregiver’s education, mother/caregiver’s age, has paper and pen, has book, has bought toy, believes in punishment, and so on). SE = standard error; TVIP = Test de Vocabulario en Imagenes Peabody.

The evidence on age patterns in socio-economic gradients in Cambodia and Mozambique is not as strong as the evidence provided by Paxson and Schady (2007) or Fernald and others (forthcoming) based on a sample representative of a larger share of the national population in Ecuador and Madagascar. Still, the Cambodian and Mozambican samples contain a rather homogeneous subset of the national population and as such the evidence remains noteworthy in suggesting that socioeconomic gradients are likely to increase with age, even at a very low level of economic development.

**Conclusion and Policy Implications**

The patterns observed in the Cambodian and Mozambican samples are remarkably consistent with those previously discussed in the literature, particularly in Ecuador, Madagascar, and Nicaragua. In all five countries, significant socioeconomic gradients appear at an early age, and the poorest children exhibit serious signs of developmental delays by the time they reach age five. In the Cambodian and Mozambican samples, as in those from Ecuador, nutrition and parenting are also determined by SES and play
a mediating role between SES and cognitive development, though only to a small extent.

Although we cannot extrapolate universal patterns from only five country-specific datasets, the fact that the findings described above are so consistent across low-income populations in five countries located in three different regions of the world (East Asia, Latin America, and Sub-Saharan Africa) suggests that similar patterns also exist in a wide range of low-income countries, or among low-income populations within wealthier countries. In other words, the external validity of these findings is likely to be high.

The chapter highlights pathways through which shocks and ECD interventions may affect cognitive development, as subsequent chapters will further discuss. To the extent that the associations between SES, nutrition, parenting, and cognitive development documented in this chapter are causal, any negative shock further affecting SES, nutrition, or parenting is likely to negatively affect cognitive outcomes as well (see chapters 2 and 3 for a review). In turn, policies and interventions that improve the welfare of young children in these areas (including center-based ECD programs, home-based programs designed to promote behavior changes among parents/caregivers, and cash transfers for families with young children) are likely to improve children’s cognitive and overall development outcomes (see chapters 4 and 5 for a discussion). As chapter 4 further documents, interventions for very young children (below age three) are particularly critical.

As mentioned at the beginning of this chapter, early delays in children’s cognitive and overall development lead to costly inefficiencies in the public health and education sectors because these children are more likely to be ill, to repeat grades, to drop out of school, and to engage in risky behaviors as they become older (see Naudeau and others 2010 for a review).

The questions of whether high-quality primary schools can counteract earlier delays and, if so, to what extent remain largely empirical in the developing world, and more research is needed in this area. Remedial interventions at older ages, such as education equivalency programs for school dropouts or therapeutic interventions for violent youth, can also compensate for some early delays. However, the longer a society waits to intervene in the life cycle of a disadvantaged child, the more costly it is to remediate the disadvantage (Heckman 2008a).

As the broader literature has shown, ECD interventions have not only a high cost-benefit ratio, but also a higher rate of return for each dollar invested than interventions directed at older children and adults (Heckman 2008b; Heckman, Stixrud, and Urzua 2006). Evidence suggests a potential rate of 7–16 percent annually from high-quality ECD programs targeting
vulnerable groups (Heckman and others 2009; Rolnick and Grunewald 2007; see Naudeau and others 2010 for a review of the literature on the effectiveness of various types of ECD investments for different types of beneficiaries; see also chapter 5). Another economic advantage of ECD intervention is that it enhances both efficiency and equity: It offers a cost-efficient way to produce a well-trained and capable workforce, and leads to better outcomes for those at a greater disadvantage (see chapter 4 for a review on this topic).

Accordingly, some countries have begun to invest public resources in ECD, with a focus on the poorest children. For instance, in Cambodia, the government is using part of a Fast Track Initiative Catalytic Fund awarded for the period 2008–12 to scale up three different types of ECD programs among 1,500 of the poorest communities, including (1) formal preschools, (2) community-based preschools, and (3) home-based parenting programs. In Mozambique, the government is currently preparing a new ECD project that will aim to provide services to the most vulnerable communities.

In many other low-income countries, however, governments continue to underinvest in children’s early years. Although little data exist on the magnitude of the cognitive and overall delays that young children are likely to face in each of these countries, we can confidently hypothesize that the trends documented in this chapter for five countries across three continents are likely to hold there as well. In the absence of ECD interventions, poor children in these countries are likely to show serious signs of developmental delays by the time they enter primary school and to “play catch-up” for the rest of their lives.
Annex

Figure A.1 Quintiles 1, 3, and 5 of Raw TVIP Score Distribution by Age

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

Note: The “mean raw score in the normed sample” is the mean raw TVIP score achieved by children in the reference population used to norm the test (see box 1.2). Comparisons between raw TVIP scores in Cambodia and Mozambique and the norm should be undertaken carefully. The norm may not be fully appropriate because it was established based on a Spanish version of the TVIP in a sample of Mexican and Puerto Rican children whose characteristics may differ. TVIP = Test de Vocabulario en Imagenes Peabody.
Figure A.2 Height-for-Age by Age and Wealth Quartile

a. Cambodia

b. Mozambique

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).
Figure A.3 Height-for-Age by Age and Caregiver Education

a. Cambodia

b. Mozambique

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).
Figure A.4 Language Stimulation by Age and Wealth Quartile

a. Cambodia

b. Mozambique

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).
Figure A.5 Language Stimulation by Age and Caregiver Education

a. Cambodia

b. Mozambique

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).
### Table A.1 Correlates of Nutrition and Parenting in Cambodia and Mozambique

<table>
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<th>Cambodia</th>
<th>Mozambique</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Height-for-age z-Score</td>
<td>Parenting (stimulation index)</td>
</tr>
<tr>
<td>Socioeconomic status</td>
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</tr>
<tr>
<td>Second wealth quartile</td>
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<td>0.12** (0.05)</td>
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<td>Third wealth quartile</td>
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<tr>
<td>Fourth wealth quartile</td>
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<td>Control characteristics</td>
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<tr>
<td>Male child</td>
<td>0.03 (0.03)</td>
<td>-0.02 (0.03)</td>
</tr>
<tr>
<td>Urban household</td>
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<td>-0.14* (0.08)</td>
</tr>
<tr>
<td>Number of adults in household</td>
<td>0.00 (0.01)</td>
<td>0.03** (0.01)</td>
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<tr>
<td>Number of children in household</td>
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<td>0.09*** (0.01)</td>
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(continued next page)
Table A.1 Correlates of Nutrition and Parenting in Cambodia and Mozambique (continued)

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<th>Cambodia</th>
<th>Mozambique</th>
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<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>Constant</td>
<td>-1.92*** (0.10)</td>
<td>0.71*** (0.11)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>4,010</td>
<td>4,069</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.033</td>
<td>0.084</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on data from Bruns and others 2010 (Mozambique) and Filmer and Naudeau 2010 (Cambodia).

Note: Numbers in italics = coefficient/SE. Estimates and standard errors clustered at the community level in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%. Regression also includes a series of dummies to account for some variables that were missing and had to be imputed (mother/caregiver’s education, mother/caregiver’s age, has paper and pen, has book, has bought toy, believes in punishment, and so on). SE = standard error.
Notes

1. Evidence distinguishing between genetic and environmental factors comes primarily from developed countries.

2. Risk factors are defined as “Personal characteristics or environmental circumstances that increase the probability of negative outcomes for children” (Cole and Cole 2000).

3. Executive function processes include impulse control, the ability to initiate action, the ability to sustain attention, and persistence, all of which are likely to significantly influence an individual’s capacity to succeed in life. Executive function is often included in cognitive development, although both cognitive and socioemotional processes are typically involved. For more information, see Fernald and others (2009).

4. The Corsi test is an internationally standardized short-term memory test. The Tifaldi language test is designed specifically for Turkish language comprehension.

5. In this study, children are considered disadvantaged if they are stunted, living in poverty, or both.

6. Ecuador and Nicaragua are currently classified as lower-middle-income countries by the World Bank, whereas Madagascar is classified as a low-income country.

7. The broader literature summarized in this volume, and particularly in chapter 4, highlights the fact that delays in cognitive and overall development can accumulate quickly among poor children well before they reach the age of three. A limitation of the TVIP is that it can be used only for children aged 30 months and older, hence precluding the authors from presenting data for younger age groups.

8. The Home Observation for Measurement of the Environment (HOME) scale has been used in several countries to assess the quality of the home environment and parent-child interactions.

9. In this subtest, the child is scored based on his or her ability to find hidden objects or to reproduce a sequence according to a given model.

10. In this subscale, the child is scored based on his or her ability to repeat words and sentences spoken by the enumerator and that are increasingly long and difficult.

11. The three districts are Manjacaze, Xai Xai, and Bilene. The 76 communities were chosen from a total of 252 villages in the provinces, of which 167 villages were deemed eligible to receive the intervention. Bruns and others (2010) discuss the site selection procedure in detail.

12. The Cambodian datasets also include children aged 24 to 35 months old, but this chapter focuses on children aged 36 to 59 months for analysis for Cambodia and Mozambique to be consistent.

13. The following provinces are included: Battambang, Bantey Manchey, Kampong Cham, Kampong Thom, Kampot, Prey Veng, and Takeo.

14. In this context, informal ECD services include community preschools and home-based programs.

As previously mentioned, scores on the TVIP are often used as a proxy for cognitive development (rather than linguistic development only).

The research teams decided to use the TVIP rather than the PPVT in both Cambodia and Mozambique because the TVIP was considered to be more appropriate for children in low-income settings. In both countries, steps were taken to translate and pilot the test. This was done in collaboration with a local child psychologist in Mozambique and with key informants (experts from the survey firm and teachers) in Cambodia.

In Mozambique, the TVIP test was also conducted in Portuguese after it was conducted in Changaña. However, Mozambican children in our sample were not exposed to the Portuguese language at baseline (they typically learn Portuguese upon primary school entry or in the context of ECD interventions). Therefore, we present only Changaña results in the following analyses.

One of the appealing features of externally standardized scores is that they can be used to compute the number of months children in the Cambodian and Mozambican data lag in comparison with an “average” child in the reference sample used to norm the test (see box 1.2). Such age equivalencies provide striking results. For instance, 59-month-old Cambodian children perform at the level that would be expected of 41-month-old children in the reference sample. This suggests that by the time Cambodian children are 59 months old, their cognitive development exhibits an average delay of a year and a half (18 months). Mozambican children who are 59 months old display signs of an average cognitive delay of two years (24 months), meaning that 59-month-old children perform at the level that would be expected of 35-month-old children in the reference sample. Those figures are staggering. However, they should be interpreted very carefully, given serious issues with the standardized score discussed in box 1.2 and the implicit cross-country comparisons it relies on.

Patterns in standardized TVIP scores are fully consistent with the patterns in raw TVIP scores discussed below.

The figures presented are smoothed by locally weighted regressions.

Figure A.1 shows the distribution of raw TVIP scores for each age group by displaying average scores for the bottom quintile, middle quintile, and top quintile of the score distribution. Figure A.1 shows that there are large variations in TVIP scores within the Cambodian and Mozambican samples.

Filmer and Scott (2008) discuss the degree of congruence in rankings between per capita expenditures and an asset index. Importantly, we do not use the asset indexes to compare socioeconomic gradients between countries. Rather, we use those indices to compare cognitive development between the most wealthy and the least wealthy in each sample.

The construction of asset indices, following the methodology proposed in Filmer and Pritchett (2001), is detailed in Bruns and others (2010) and Filmer and Naudeau (2010).

Fathers are the primary caregiver for 212 children in the Cambodian sample and 290 children in the Mozambican sample.

All results in the rest of this chapter are presented for raw TVIP scores. Results are robust if internally standardized TVIP scores are used instead.
27. See figure A.1.
28. The Cambodian dataset pools two different samples drawn using different methodologies (see Filmer and Naudeau 2010), and we also include a dummy for the formal sample to control for any constant differences between the two samples.
29. To repeat, the magnitude of coefficients should not be compared between countries, given potential cultural sensitivity of the TVIP test as well as the fact that the asset index varies between countries.
30. We use height-for-age because our measure of cognitive development is cumulative, so that short-term measures such as weight-for-height would not be appropriate. In addition, weight data are not available for the Cambodian sample.
31. A child with a height-for-age $z$-score below $-2$ is considered stunted.
32. Evidence on the association between SES, nutritional status, and parenting is presented in annex figures A.2 to A.5, as well as table A.1.
33. See figures A.4 and A.5, as well as table A.1.
34. See figures A.2 and A.3, as well as table A.1.
35. No significant negative trend is seen in language stimulation or height-for-age over time, in contrast with the patterns observed for cognitive delays, which accumulate over time.
36. Accounting for parenting only (without nutrition) leads to the following changes in the SES coefficient: In Cambodia, the coefficient for the second quartile in table 1.3 decreases by 14.9 percent, the coefficient of the third quartile by 23.5 percent, and the coefficient of the fourth quartile by 16.5 percent compared with table 1.2. The coefficient of caregiver education decreases by 17.6 percent. In Mozambique, the coefficient of the fourth asset quartile variable decreases by 13.2 percent. The coefficients of the first and second quartiles, as well as caregiver education, are not significant in table 1.2.
37. In both countries, similar patterns are found if the internally standardized TVIP score is used instead of the raw TVIP score. In both samples, coefficients for the 2nd asset quartile are also statistically higher for the older age group than for the younger age group.
38. It is also consistent with results from the literature in developed countries.
39. The OECD research study Starting Strong II (OECD 2006) suggests that 1.0 percent of GDP is the minimum public investment required to ensure provision of quality ECD services.

References


