

Effects of high versus low quality preschool:

A longitudinal study in Mauritius

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Abstract

We report on a unique randomized control experiment by the Mauritius Joint Child Health Project, a longitudinal study that followed a cohort of children from different socio-economic backgrounds, and test for possible divergent educational outcomes between children in high and low quality preschool. The findings show that the differential quality of education had no significant overall effects. However, the educational performances of children in the experimental group are found to be higher for those with poorly educated fathers, but lower for those with poorly educated mothers. Hence the effects of high quality preschool work in opposing directions: compensating the father's education level (hence producing an equalizing effect), but reinforcing the mother's education level (hence producing a dis-equalizing effect).

Keywords: preschool quality; equality; longitudinal effects; randomized control experiment; Mauritius.

JEL Classification: I2; D3; I3.

1. Introduction

The effects of preschool programs in enhancing the educational achievements of children from a disadvantaged socioeconomic background have been extensively explored in academic research (Almond and Currie, 2011; Attanasio, 2015; Barnett, 2011; Burger, 2010; Currie, 2001; Heckman, 2008 and 2013). This has engendered a narrative on the “early years” as the root of educational opportunity – or, alternatively, inequality. Together with the high rates of return of high quality preschool identified in several studies (Barnett and Masse, 2007; Belfield et al., 2006; Heckman et al., 2010), this resulted in a plea for a redistribution of resources from schooling to early childhood education and care (Barnett, 2011; Gormeley, 2011; Heckman, 2008; Heckman and Masterov, 2007). The evidence in support of this view is based mainly on studies of disadvantaged children, comparing children “at risk” that went to a high quality preschool and children at risk who stayed at home.

We provide additional evidence on the equalizing potential of participating in a high quality preschool and focus on children’s test scores at age 11. Our data come from a randomized controlled experiment conducted by the Mauritius Joint Child Health Project in Mauritius with children from the 1969 birth cohort. Children were randomly assigned to high quality preschools that were set up for the experiment or to existing petites écoles, low quality preschools. The differences with other randomized control trials are twofold. First, we compare a high quality preschool intervention with participation in low quality preschool. Second, as our children are heterogeneous in terms of socio-economic background, we can assess whether high quality preschool compensates or reinforces the effect of socio-economic background. We find high quality preschool manages to compensate for the effect of the father’s education, but reinforces the effect of the mother’s education.

We believe these findings are relevant for the following reasons. First, in many countries the debate nowadays is about universal high quality preschool, not about making such preschool available to disadvantaged children only. Second, the reality of Mauritius in the first part of the 1970s makes the interpretation of the results easier. Fathers worked in more than 95 percent of the households, mothers in less than 20 percent, and the mother was the principal caregiver in more than 95 percent of the households. Hence, father's education is closely related to family resources (income), while the mother's education determines the quality of the principal caregiver.¹ Hence, in line with Duncan and Sojourner (2013), our results suggest that universal high quality preschool can compensate for differences in families' monetary resources. However, and this finding is, as far as we know new, compensation for differences in intellectual resources of the caregiver is more difficult to achieve. The Mauritius experiment shows that a high quality preschool program that increases parental involvement through home visits and establishes active parent-teacher associations can increase the effect of the caregiver's education on schooling outcomes, and replace the income based gap in children's achievement by a caregiver education gap.

Before proceeding, it is important to realize that in this paper we are not identifying the causal effects of characteristics such as father's and mother's education on children's test scores; we only identify reduced form effects, and how they differ between low and high quality preschool. Actually, the entire literature investigating the socioeconomic, wealth, or income gradient in children's test scores or educational achievement is also looking at reduced form effects (Reardon, 2011; Rubio-Codina et al., 2015; Shady et al., 2015). Our paper is in that

¹ Such an interpretation is not possible with recent experiments in developed countries, where both the father and the mother share work and caregiving.

tradition. The equality of opportunity literature generalizes this intuition: it is interested in the extent to which children's test scores correlate with characteristics such as parental education levels and circumstances that should, normatively speaking, have no impact.² High quality preschool can decrease the correlation of test scores with some of these characteristics but increase it with other characteristics. We then say preschool is compensating the former characteristics and reinforcing the latter characteristics; in the Mauritius experiment the high quality preschool was compensating for father's education and reinforcing mother's education.

The structure of the paper is as follows. The next Section describes in detail the experiment we analyze. Section 3 formulates the hypotheses we test. Section 4 describes the data, Section 5 the methodology. The results are found in Section 6 and discussed in Section 7. The final Section concludes.

2. The experiment

Mauritius is a small African island in the Indian Ocean, which gained its independence from the United Kingdom in 1968. It is a multi-ethnic nation, characterized by a stable democracy, rapid socio-economic development and generous public welfare provision (Dommen and Dommen, 1997). During the 1970s, Mauritius achieved universal and free primary education for both boys and girls (Parsuramen, 2006), and primary healthcare for all (Dommen and Dommen, 1997).

² For recent surveys of the equality of opportunity literature, see Ferreira and Peragine (2015), Roemer and Trannoy (2015) and Ramos and Van de gaer (2015).

We study the effects of high quality Early Childhood Education and Care (ECEC), in a unique longitudinal perspective. Data are taken from the Joint Child Health Project of Mauritius (JCHP), an experimental longitudinal study. The 1,795 children in the JCHP cohort are all from the 1969 birth cohort and were drawn from the polio vaccination records of two large cities of Mauritius, Quatre Bornes and Vacoas, which have an ethnical distribution similar to that of the rest of the country (Raine et al., 2010).³ From the original JCHP cohort, 100 children were randomly selected and paired with another child from the cohort on the basis of sex, ethnicity, and electrodermal activity at age 3.⁴ Random number tables were used to assign one member of each pair to a nursery school, a high quality preschool, (the treatment group) and the other to one of the *petites écoles* (the control group). These low quality preschools were the only ones available at the time of the JCHP study's inception (Raine et al., 2001). Owing to a cyclone in 1979, over 7,000 homes were destroyed in Mauritius and some of the children in our sample could not be located at the time of data collection at age 11 (Raine et al., 2001; Raine et al., 2010). As a result, the final sample contains 84 children in the treated group and 91 in the control group. Both treatment and control group contain children from diverse socio-economic and demographic backgrounds.

The children in the treatment group, aged 3–4 years, were placed in two experimental nursery schools for two full academic years until they entered primary schooling. The JCHP intervention included several components of the quality criteria considered, in the present literature, to be beneficial for the educational development of the child (Burchinal et al., 2010; Magnuson and Shager, 2010). The program ran daily from 9 am to 4 pm during weekdays and

³ These 1,795 children make up “almost the entire population of children born in 1969” in these two towns (Raine et al., 2010, p.1443).

⁴ The latter criterion was introduced in accordance with the original aim of the study to investigate early predictors of later psychopathologies.

included outdoor activities (e.g. field trips involving parents). The pupil-educator ratio ranged from 1:5 to 1:10, depending on the activities undertaken during the day (Raine et al., 2001). The program also invested in parental involvement through the setting up of a parent-educator association (Raine et al., 2001). Parents were also required to make regular visits to the nursery schools in order to follow children's daily activities, while school personnel regularly engaged in home visits and counseling services (Raine et al., 2001). The educators received pre-service training in basic kindergarten knowledge, psychology, physical health, social welfare, and practical kindergarten activities. Additional in-service training sessions were organized (Raine et al., 2001).

The control group experienced traditional Mauritian *petites écoles*, community preschools “of poor educational quality, providing traditional and very rudimentary education” (Raine et al., 2001, page 258). These kindergartens, privately owned, were staffed by child-minders with little training, had a median pupil-educator ratio of 1:30, and ran school days of 5 hours, which included 1 hour of play (Raine et al., 2001 and 2010). The curriculum comprised writing, counting, and drawing. Lunch and/or milk were not provided, resulting in children usually going home at lunchtime or bringing packed food, typically rice or bread. A report by the Ministry of Education of Mauritius described the poor conditions of community preschool, most of which, it observed, were not designed for educational purposes (Ministry of Education of Mauritius, 1983). After preschool, all children in both the treatment and control group were enrolled in the standard system of public primary schools, with no differences in terms of quality.

We focus our analysis on children's test score results obtained in the Certificate of Primary Education (CPE) exam of children participating in the high quality preschool program, in

comparison with children who had been enrolled in the *petites écoles*. The CPE exam, taken at the end of primary school when the children were 11 years old, represented a screening mechanism for access to secondary education (MES, 1991). The attainment of the highest grades led either to entry into one of the few existing governmental secondary schools, or to a further exam determining the allocation of government scholarships for enrolment in private establishments. Underachievement inevitably led to poor employment prospects, accompanied by the risk of falling into poverty and social exclusion (MES, 1991).

3. Hypotheses

There is a vast literature on the relations between the socio-economic status of father and mother and children's cognitive development and academic achievement (see, e.g. Sirin, 2005). Parental socio-economic status has different components. After an extensive literature review, Duncan and Magnuson (2012) argue that the major socio-economic determinants for children's cognitive functioning are family income and mother's education. The latter is considered to be a predictor of early language development, influencing later school performance (Coddington, et al., 2014; Hoff and Tian, 2005; Kontos, 1991).⁵ Carneiro et al. (2013) show mother's education not only affects children's cognitive achievement, but also behavior problems and grade repetition. The employment status of parents, as a proxy for the availability and stability of family income, may also play a role in children's educational achievements (Davis-Kean, 2005; Pancsofar and Vernon-Feagans, 2010; Paxson and Schady, 2007). However, after controlling for family income, employment status has no clear effect

⁵ Pancsofar and Vernon-Feagans (2010) find that, after controlling for family income and mother's education, father's education and vocabulary is also significantly associated with children's language development at 36 months. We did not evidence in the literature that that it would have an effect on cognitive skills at the end of primary education.

(Duncan and Magnuson, 2012). It has been found that crowded houses reduce children's educational attainment (Currie and Yelowitz, 2000; Goux and Maurin, 2005). Gender disparities in education have also been documented by international organizations. UNESCO (2015) concludes that gender disparities in primary education remain in almost a third of the countries for which data are available. In Mauritius, gross school enrollment in secondary education was 36,62 percent for males and 27,36 percent for females in 1970, but this gap was virtually closed for our cohort: by 1980 gross school enrollment was 50,95 percent for males and 49,11 percent for females).⁶ In addition, a number of studies illustrate the influence of ethnic background on cognitive development and academic achievement (De Feyter and Winsler, 2009; Tas et al., 2014). Recent economic studies found significant negative effects of birth order on academic achievement (Black et al., 2005; Kantarevic and Mechoulan, 2006; Pavan, 2015).

Based on these findings from the literature, we select as potential risk factors at birth family income, mother's education, crowded houses, ethnic background and birth order. We use the treatment and control group to test three hypotheses:

(1) The *inequality* hypothesis: in the absence of any intervention, poorer school performance is associated with a number of "risk factors" related to conditions determined at birth. We expect that lower family income, a lower educated mother, growing up a crowded house and higher birth order might be associated with poorer academic performances;

⁶ Data are from <http://www.indexmundi.com/facts/mauritius/school-enrollment>. Source: UNESCO.

- (2) The *benefit* hypothesis: controlling for interaction with the risk factors mentioned above, better educational outcomes are observed for children enrolled in the high quality preschool program;
- (3) The *equalizing* hypothesis: the high quality preschool program produces greater benefits for those children who are worse-off in terms of the risk factors that negatively affect their later school performance than for children who are better-off.

4. Data

The education system of Mauritius was conceived as 6 years of primary schooling leading to a Certificate of Primary Education (CPE), followed by 5 years of secondary education leading to the Cambridge School Certificate (SC). The JCHP collected data on children's scores in the CPE exam. The total CPE examination score was calculated as the weighted sum of those subjects' scores: score for English*3 + score for French*2 + score for Math*3 + score for Environmental Studies*2 (MES, 1991), ranging from 0 to 50. The total score in the CPE examination at age 11 was the dependent variable in our analysis. Information on the school performance at age 11 was drawn from the registry of the Mauritius Examination Syndicate (Raine et al., 2010).

In 1972, when children in the cohort were 3 years old, data were collected on key factors believed to be associated with children's developmental outcomes. In our analysis, we consider those factors determined at birth and not altered during the first 3 years of life. We identified those that were most relevant in the previous Section.

The JCHP has no data on family income, but, as in our sample almost all fathers worked and very few mothers worked (Table 1, panel (c)), the variable “Father’s years of schooling” is a good proxy for family income. The JCHP has data on “Mother’s years of schooling” and the number of people per room in the house, a proxy for the degree to which houses were crowded. This variable is labeled “Crowdedness”. In the estimated equation, we use “Ln Crowdedness”, the natural logarithm of this variable as this improved the fit of the regression. Children in the JCHP sample are from Creole, Muslim, Hindu, and Tamil backgrounds. Hindus, Muslims, and Tamils in Mauritius are descendants of the indentured laborers brought to Mauritius under British colonial rule in the 19th century, whereas the Creole are mostly descendants of slaves brought to the island during the 18th and 19th centuries under French colonial rule (Addison and Hazareesingh, 1984; Dommen and Dommen, 1997). Previous research conducted in Mauritius emphasized that the lowest education performance – in the CPE examination – was typically observed among children from a Creole background (Chinapah, 1983; Palmyre, 2007). For this reason, we code the ethnicity variable as a dummy variable “Creole”. We also include the dummy variable “Eldest sibling” to see whether birth order has any effect on CPE test scores.

For the interpretation of the results, the work status of the parents and the identity of the prime caregiver are important. Since most mothers in the sample were housewives, whereas fathers worked, the working status variable is recoded into two dummy variables “Father works” and “Mother works”. For each parent we create a dummy variable in case its employment status is missing. A dummy variable “Mother is caregiver” is equal to one if the mother was the child’s principal caregiver at home and zero otherwise. Finally, we define the child’s gender variable by a dummy variable “Male”.

All data mentioned so far were collected through parents' interviews using the local language, Mauritian Creole, which is derived from French (Raine et al., 2010). During the interviews, also information about mother's opinion on child development, along with additional training of parents and caregiving were gathered. Data on cognitive skills, malnutrition, anaemia, and sociability at age 3 were collected through laboratory tests. These factors can be molded during the first three years of life. As the treatment started only at age 3, differences in composition between the treatment and control groups in terms of these risk factors could interfere with the identification of the treatment's effects. The balance tests, reported in Appendix A, find no statistically significant differences in composition between treatment and control. Table 1 gives the descriptive statistics of the treatment and control groups.

Table 1. Descriptive statistics of children in the sample.

	Nursery school (Treatment)	Pétit école (Control)	Diff	P-value
(a) CPE scores at age 11				
Mean	27.30	26.27	1.03	0.70
Standard deviation	17.49	17.84	-0.38	0.57
(b) Risk factors at birth				
Mother's years of schooling	5.21	4.68	0.53	0.84
Father's years of schooling	5.48	5.52	-0.04	0.47
Crowdedness	3.96	3.92	0.04	0.56
Creole	0.25	0.32	-0.07	0.16
Eldest sibling	0.24	0.28	-0.04	0.29
(c) Other variables				
Mother works	0.15	0.19	-0.03	0.28
Mother works missing	0.07	0.07	0.01	0.56
Father works	0.98	0.95	0.02	0.78
Father works missing	0.02	0.04	-0.02	0.23
Mother is caregiver	0.94	0.97	-0.03	0.20
Male	0.50	0.52	-0.02	0.41

Note: Except for CPE, crowdedness, and mother's and father's years of schooling all variables indicate proportions. In Part (a), the P-value testing for equality of the means is based on Welch's t-test. The P-value for equal variances is based on a standard F-test.

Part (a) of Table 1 shows that the mean CPE score in the treatment sample was slightly higher than in the control sample but, as the first entry in the last column shows, the difference was far from statistically significant. The standard deviation of CPE scores is very similar in both samples. Part (b) shows the statistics of the risk factors at birth. Fathers have more years of schooling than mothers. On average there are about 4 people per room and one quarter of the children is first born. Panel (c) shows other interesting variables. Almost all fathers work, while less than 20 percent of the mothers work. The mother is the prime caregiver in almost all households. About half of the children are male.

5. Method

We model the CPE score of child i , CPE_i , as a linear function of the value of K different risk factors at age 3, X_i^k ($k = 1, \dots, K$), and a dummy variable T_i that indicates whether the child participated in the treatment ($T_i = 1$) or not ($T_i = 0$). In our specification, we include interaction terms between the risk factors and the treatment, and a general idiosyncratic error term ε_i . This results in the following specification:

$$CPE_i = \beta_0 + \gamma_0 T_i + \sum_{k=1}^K \beta_k X_i^k + \sum_{k=1}^K \gamma_k X_i^k T_i + \varepsilon_i. \quad (1)$$

The effect of risk factor X_i^k is β_k for children that were not treated. Therefore, when there is at least one β_k for which the null hypothesis $\beta_k = 0$ is rejected in favor of the alternative $\beta_k \neq 0$, the evidence supports the inequality hypothesis. The intercept for children that are not treated is β_0 , and for children that are treated $\beta_0 + \gamma_0$. Hence γ_0 measures the uniform increase in CPE score for all treated children, irrespective of their risk factors. When the null hypothesis $\gamma_0 = 0$ is rejected in favor of the alternative $\gamma_0 > 0$, the evidence supports the

benefit hypothesis. The effect of the risk factor X_i^k is $\beta_k + \gamma_k$ for children that were treated. Hence, where β_k and γ_k are both significantly different from zero and have opposite signs (and the absolute value of their sum is smaller than β_k), the evidence suggests that the treatment diminished the effect of risk factor k on the CPE score. However, if β_k and γ_k have the same sign, and γ_k is significantly different from zero, then the treatment reinforced the effect of risk factor k . Hence, if we find one or more risk factors whose effects are reinforced by the treatment, the equalizing hypothesis has to be rejected. Equation (1) was estimated with least squares.

6. Results

Table 2 contains the main results obtained from the least squares estimation of Equation (1). Specification 1 gives the results when only the statistically significant risk factors at birth and their interaction with the treatment dummy are included. Specification 2 is similar to Specification 1, but the non-significant interaction between the treatment dummy and “Ln crowdedness” is dropped.

Table 2. Nursery school effect on CPE.

	Specification 1		Specification 2	
	<i>Coef.</i>	<i>SE</i>	<i>Coef.</i>	<i>SE</i>
Nursery school (JCHP program)	-3.83	8.39	1.47	4.33
Ln Crowdedness (#people/room)	-8.92*	3.53	-7.05***	2.45
Mother years of schooling	0.82	.49	0.88	.49
Father years of schooling	1.62***	.45	1.65***	.44
Ln Crowdedness *Nursery school	3.62	4.90		
Mother years of schooling * Nursery school	1.61*	.73	1.51*	.71
Father years of schooling * Nursey school	-1.55*	.64	-1.59**	.63
Constant	24.72***	5.95	21.96***	4.62
Number of Observations		175		175

R ²	0.31	0.31
SSR	37024,09	37144,95

* $p < .05$, ** $p < .01$, *** $p < .001$
SSR: Sum of Squared Residuals.

Inequality hypothesis

Several risk factors identified in the literature do not feature in Specification 1, as for them no statistically significant effect on CPE results could be identified (See Appendix B). This is the case for the dummy variables “Creole” and “Eldest Sibling”. By contrast, in the absence of treatment, children who grew up in a crowded house had a significantly lower CPE score than children who were not in a crowded house, whereas children whose fathers had more years of education had a significantly higher CPE score compared with children of parents with fewer years of education. The effect of mother’s years of education was positive, but not statistically significant. It is easy to verify that the value of the coefficient associated with Ln Crowdedness in Specification 1 implies that without treatment, compared with growing up in a house with 1 person per room, growing up in a house with 2, 3, 4, 5 or 6 people per room, reduced CPE results by 6.2, 9.8, 12.4, 14.4 and 16 points, respectively. Furthermore, for each year of mother’s schooling, CPE scores increased by 0.82 points whereas the increase for each year of father’s schooling was 1.62 points. As the standard deviation of CPE scores was about 17, these effects were not only statistically significant, they were also sizeable. As we found two risk factors that significantly correlated with CPE scores in the absence of treatment (crowdedness and father’s education), the data provide clear support for the inequality hypothesis.

Benefit hypothesis

From the first row of Table 2, we see that, for both specifications, the effect of being treated, γ_0 , is never significantly different from zero. When correcting for the effect of risk factors at birth, the data provide no evidence for the benefit hypothesis.

Equalizing hypothesis

Looking at the *equalizing* hypothesis, enrollment in high quality preschool seemed to compensate for the fact that children with low educated fathers typically had lower CPE results. Specification 1 in Table 2 shows that, without treatment, each additional year of father's schooling increased test scores by 1.62 points, but that, with treatment, the effect was reduced by 1.55 points to an insignificant and negligible 0.07 points. Hence treatment managed to compensate completely for the effect of father's schooling on CPE scores. However, treatment widened the gap between children of mothers separated by the number of years of education. Each additional year of mother's schooling increased CPE scores by 0.82 points in the absence of treatment, whereas treatment increased the effect by 1.61 points to 2.43 points. Hence treatment substantially reinforced the effect of mother's schooling on CPE scores. As a result, the equalizing hypothesis has to be rejected.

7. Discussion

High quality interventions in the early years for children at risk are presented in the literature as potential equalizers. The emphasis on early childhood care and education policy is based on evidence from a few longitudinal studies in the United States (Barnett, 2011; Cunha and Heckman, 2006; Heckman and Masterov, 2007). In particular, two experimental studies that

started in the 1960s and 1970s, respectively, are mainly cited in regard to the longitudinal effects of early childhood care and education: the Perry Preschool Program (PPP) and the Abecedarian Program (ABC) (Magnuson and Shager, 2010). In these studies, preschool interventions were designed to provide high quality services to children at risk.⁷ Quality was achieved through a low pupil-educator ratio – ranging from 3:1 to 6:1 – and extensive training for educators (Magnuson and Shager, 2010). The pedagogy focused on the intellectual and social development of the child, stimulating cognition, language, and adaptive behavioral skills (Magnuson and Shager, 2010). In addition, free transportation, feeding, health care and the services of a family nurse and pediatrician were provided (Cunha and Heckman, 2006). The programs also included parental education, through home visits and counseling.

The findings of these studies underline that children from disadvantaged backgrounds were able to enrich their educational experience by partaking in such well-designed preschool programs, as compared with the children not benefiting from similar types of intervention (Cunha and Heckman, 2006). More in particular, these programs improve IQ test scores by the end of the program (age 5). These gains fade out, and for boys they disappear by age 10.⁸ The evidence for positive long-run effects for males is limited, but consistent positive effects have been found on female teen and adult outcomes (Anderson, 2008). Fading-out of the impact on cognitive skills and long run effects on adult outcomes can be reconciled by the programs' persistent effect on non-cognitive personality skills (Heckman et al., 2013).

⁷ The PPP targeted African American children with low IQ and low parental income and education, the ABC program children with lower educated mothers and mothers with low IQ. Also here almost all children were African American.

⁸ Fading impacts of high quality preschool programs on cognitive skills are well documented by now. See also, for instance, Walters (2015) who uses data from the Head Start Impact Study. Burger (2010) surveys the quasi-experimental literature of studies without random assignment of participants in a treatment and control group, and concludes that short term effects exceed longer term effects on cognitive development.

These studies were designed to investigate the *beneficial* effects of high quality early childhood care and education for relatively homogeneous groups of children “at risk”. They did not purport to ascertain the *equalizing* effects of high quality “universal” early childhood care and education. Achieving this aim requires a comparison of children differentiated with reference to their parents’ socio-economic levels (Ferreira and Gignoux, 2011; Van de gaer et al., 2014).⁹

There are few randomized control studies where children’s parents have divergent socio-economic backgrounds. An example is a recent study by Duncan and Sojourner (2013). They evaluate the Infant Health Development Program, an Abecedarian type of intervention for low birth weight children from diverse ethnic and economic backgrounds and show that the income-based gaps in age three IQ can be substantially reduced or even eliminated completely at age five and eight.¹⁰

The preschool experiment in Mauritius was of a different nature than other randomized control preschool trials. Apart from the fact that both treatment and control group contained children at risk and not at risk, we compare a high quality preschool intervention and a control group with low quality preschool. It is always complicated to generalize findings related to an experiment conducted in a specific context and time. Nevertheless, taking into account these

⁹ Burger (2010), after surveying the quasi-experimental evidence (see previous footnote) concludes that, even though the evidence is program specific, preschool programs offer larger gains in relative terms to disadvantaged children.

¹⁰ The authors convincingly argue that the sample containing only low birth weight children is not an issue. They show that the development of IQs of low birth weight children roughly parallels those of normal birth weight children, and that impacts are, if anything, increasing throughout the birth weight ranges above 2000 grams.

aspects, we claim that the Mauritian study of the 1970s contributes to enriching the current discussion on the question of the equalizing potential of universal and high quality ECEC.

Inequality hypothesis

Inequalities in educational opportunities, measured through differences in the CPE examination scores conducted at age 11, were, in the control group, significantly associated with the educational level of the father and with the prevailing housing conditions when the children were aged three. The effects of these risk factors on CPE scores were considerable: growing up in a house with three people per room decreased CPE scores by 0.56 standard deviations compared with children growing up in a house with 1 person per room. Having a father who completed primary education and had six years of schooling increased CPE scores by 0.55 standard deviations. These findings are in line with mainstream international literature, relating to similar contexts in developing countries, showing that early childhood is the foundation for future learning, and that disadvantage suffered in the period before schooling begets inequalities in educational attainment later in life (Macours et al., 2008; Paxson and Schady, 2007). In addition, other studies conducted in Mauritius have underscored the relation between parents' socio-economic status and the CPE performance of their children (Chinapah, 1983; MES, 1991).

Benefit hypothesis

Our findings do not univocally support the benefit hypothesis, as they do not show significant positive effects on CPE scores of participating in the JCHP experiment at age 11. Recent studies find that the effects of preschool on cognitive test scores fade out after the intervention

(Anderson, 2008; Walters, 2015), such that our rejection of the benefit hypothesis should not come as a surprise. Moreover, it needs to be pointed out that the experiment analyzed in this paper did not involve a comparison between early childhood education and children at home, but between high and low quality preschool provision. The comparative exercise by Walters (2015) shows that the short run advantage of head start centers are smaller when children are drawn from other preschool rather than from home care.

Equalizing hypothesis

Regarding the *equalizing* hypothesis, we found that participation in the JCHP nursery schools at ages 3 to 5 substantially increased educational test scores for children with less well educated fathers. Yet, the intervention also benefited children with more highly educated mothers. The effects were therefore working in opposing directions: compensating for father's education level (hence, producing an equalizing effect), and reinforcing mother's education level (hence, producing a dis-equalizing effect). These findings are actually in line with research based on non-experimental evidence from less intensive and large-scale programs, which have revealed the moderate effects of high quality preschools on the educational attainment of children from diverse socio-economic and ethnic backgrounds (Burger, 2010). It is not possible to disentangle the contribution of each component of the JCHP preschool intervention to later educational outcomes. However, one could argue that the divergent effects of the father and mother's education on children's attainment might relate to the different role of the father and mother's education in Mauritius. This is particularly interesting, as much of the literature on early childhood tends to consider the effects of mother and father's socioeconomic status as complementary (or better, mutually reinforcing). Since, in the context of Mauritius in the 1970s, most fathers were employed and mothers were not,

father's education was closely related to household income. Our results might therefore indicate that, in the case of Mauritius, high quality preschool compensated in part for the effect of income inequality on school results. However, the question then remains why children with more highly educated mothers benefit more from the program than those with poorly educated mothers. A first possible explanation is that the parent-educator associations set up by the program have a greater appeal for or are more responsive to the desires of more highly educated mothers. A second possible explanation is related to the home visits.¹¹ Gelber and Isen (2013) have shown that parental involvement with their children increased both during and after they were enrolled in Head Start.¹² Perhaps the same happened in Mauritius. Since, in Mauritius, it is exceptional for mothers to be at work, independently of their educational level, the home visits may have particularly enhanced interactions between mothers and children, and these interactions have larger effects when mothers are higher educated. Such interactions are particularly pertinent for language development, a key component of the CPE examination. This would mean that children of mothers with lower educational levels benefited less from the home visits and/or that the home visits were poorly adapted to their more precarious situations. This necessarily implies that school results are molded by the educational climate at home and that early childhood care and education can only marginally compensate for this factor (Azzi-Lessing, 2011). On the contrary, where

¹¹ Recent evidence shows the key role of home visiting for the effectiveness of preschools. Walters (2015) establishes that the only characteristics of head start centers that influence their effectiveness are whether they offer full-day service and engage in frequent home visiting. None of the other characteristics (teacher education and licensing, student / staff ratios or director experience) have an effect.

¹² Gelber and Isen (2013) point out that it need not necessarily be the direct features of a program that increases parental involvement. Other possibilities are that parents perceive their involvement as complementary to changes in unobserved child characteristics such as non-cognitive skills, or that their children are more pleasant to be with, or that they perceive their child to have won a lottery.

home visiting programs stress parental involvement, they risk favoring children with more highly educated caregivers over those with poorly educated caregivers.

8. Conclusion

The experiment of the JCHP longitudinal study allows a comparison of high quality ECEC with universal low quality preschool in a diverse population. As a result, it might be particularly informative for contexts, in both developing and developed countries, where no specific targeting is made vis-à-vis the poor, or where access is guaranteed to everyone.

We find that, for children that went to low quality preschool, growing up in crowded houses and having fathers with few years of schooling resulted in lower test scores at age 11. There is no overall effect of the program on test scores at that age. High quality ECEC diminished the negative impact of father's education level, but increased the positive effect of mother's education level. Given that almost all fathers worked, less than 20 percent of mothers worked, and the mother was the caregiver in almost all cases, we argued that father's education measures the families' material resources. Duncan and Sojourner (2012) already showed that ECEC can annihilate the effect of income on IQ scores. One explanation could be that the program compensates or substitutes for lower levels of parental investments in low-income families. That the impact of mother's education is increased is perhaps not a surprise, as parental involvement in the high quality preschool program was much encouraged. In Mauritius, where the mother is the primary caregiver for the child (and most mothers in the sample did not work), this may have enhanced the effect of the educational level of the mother on the test scores. Even if poorly educated mothers' aspirations and motivations to support their children increase as much as for highly educated mothers, they may lack the

capacity to actually support their children, compared to more highly educated mothers. This consideration may need to be taken into account in the design of future programs in this area, as children with poorly educated mothers at home may deserve special attention.

These findings, although they must be considered with caution as they reflect specificities of the study and a particular context and timing, nevertheless confirm the complexity of the nature of the relations between inequalities and early childhood. Further research is needed in order to disentangle the contribution of each component of ECEC to later educational performances, in particular of home visits and parental involvement. While there is robust evidence that high quality centre-based care has beneficial effects though not necessarily on cognitive skills at age 11, parent support programs based on home visits and parent-teacher interaction can have dis-equalizing effects. Organising home visits and parent-teacher interaction such that these dis-equalizing effects do not occur might be a serious challenge.

Acknowledgements

The Joint Child Health Project was originally set up by Peter Venables (University of York), Fini Schulsinger (University of Copenhagen), and Sarnoff Mednick (University of Southern California Los Angeles). The current Principal Investigator is Prof. Adrian Raine (University of Pennsylvania), jointly with Prof. Susan Luczak (University of Southern California). The work was carried out with the support of grants from the Medical Research Council (UK) and the Wellcome Trust. The Ministries of Health and Education of the Government of Mauritius also provided continuing support for the Project.

The authors are grateful to Prof. Peter Venables and Prof Adrian Raine, respectively former

and current Principal Investigators of the JCHP, for permission to access the data. We would also like to highlight the contribution of Cyril Dalais, who worked on the JCHP's educational intervention. Dirk Van de gaer acknowledges financial support from the FWO-Flanders, research project G.0791.12.

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Appendix A. Balance tests.

The JCHP sample contains information on the following other important early risk factors that potentially affect educational achievement:

- Protein energy malnutrition, indicated by the variable “Child malnourished,” which was the z-standardized score of observed height as a percentage of expected height for children at age 3 in Mauritius (Liu et al., 2003; Raine et al., 2002);
- Anemia, indicated by the variable “Concentration of hemoglobin in the blood,” which was a similarly standardized z-score of the concentration of hemoglobin in the blood, measured via laboratory blood tests (Liu et al., 2003);
- Cognitive skills, derived from six sub-tests of the Boehm Test of Basic Concepts – Preschool Version (“BTBC child”). The test, which assesses verbal and visual-spatial abilities, was modified to take account of Mauritian cultural norms and administered in the Creole language, which is in common use amongst the Mauritian population. Test scores were normalized and standardized at mean 100 and SD 15 (Liu et al., 2003; Raine et al., 2002);
- Mother’s health as judged by the interviewer, indicated by a dummy variable “Health status of mothers below average”;
- Serious illness of the child, indicated by a dummy variable “Serious illness of child”, which took a value of 1 where the child suffered a serious illness before the age of 3;
- Child intellectual and physical development as judged by the mother (Raine et al., 2010), measured by two dummy variables, “Child’s intellectual development below average” and “Child’s physical development below average”, respectively;

- Complications during the delivery of the child were assessed through information from birth records collected from hospitals, and the further question of whether the mother suffered from the 1969 Hong Kong influenza epidemic during pregnancy was assessed retrospectively (Raine et al., 2010). The corresponding variables were the dummies: “Delivery without problems” and “Pregnancy without illness episodes”;
- Additional training received by the father or mother. The dummy variables “Father had additional training” and “Mother had additional training” took the value of 1 where the parent in question had additional training.

Table A1. Balance tests.

Risk factors molded before age 3	Nursery school (Treatment)	Pétit école (Control)	Diff	P-value
Child malnourished	-0.03	-0.08	0.05	0.63
Child malnourished missing	0.07	0.07	0.01	0.56
Concentration of hemoglobin in blood	0.02	-0.05	0.06	0.61
Concentration of hemoglobin in blood missing	0.07	0.14	-0.07	0.06
BTBC child	103.30	101.97	1.33	0.70
BTBC child missing	0.26	0.19	0.08	0.88
Health status of mother below average	0.06	0.04	0.03	0.77
Serious illness of child	0.74	0.81	-0.08	0.12
Child’s intellectual development below average	0.05	0.06	-0.01	0.41
Child’s physical development below average	0.05	0.06	-0.01	0.41
Delivery without problems	0.98	0.91	0.06	0.97
Pregnancy without illness episodes	0.87	0.86	0.01	0.59
Mother had additional training	0.78	0.73	0.05	0.77
Mother additional training missing	0.08	0.07	0.02	0.67
Father had additional training	0.90	0.91	-0.01	0.40
Father additional training missing	0.06	0.02	0.04	0.90

Note: Except for concentration of hemoglobin in blood (Anemia), child malnourished, and BTBC, all variables indicate proportions.

The treatment and control sample differ significantly (at 5 percent) in only 1 of the 16 risk factors mentioned in Table A1 (“Delivery without problems”). This is what one can expect in case the samples are balanced. Also observe that the treatment and control sample do not

differ significantly (at 5 percent) in any of the 6 variables mentioned in Table 1, Part (c) of the main text. We conclude that the samples are balanced.

Appendix B. Sensitivity analysis for Nursery school effect on CPE.

This Appendix provides three types of sensitivity analyses. Specification 1 in Table B1 gives the results when also the risk factors at birth “Creole” and “Eldest sibling” and the dummy variable “Crowdedness missing” are included. Clearly, these variables do not significantly predict children’s CPE score. An F-test for the joint effect of these three variables and the interaction terms of “Creole” and “Eldest sibling” with “Nursery school” confirms that their exclusion has no significant effect on the fit of the model at a 10 percent level of significance (The value of the F-test: 0,306 and the critical value at 10 percent $F(4,\infty)= 3,105$).

Equally importantly, comparing the coefficients in Table 2 (main text) with those in Specification 1 (Table B1) makes clear that excluding these non-significant variables had negligible effects on the estimated values of the coefficients and the significance of the coefficients reported in Table 2. Specification 2 replaces “Ln crowdedness” by “Crowdedness”. This variable is somewhat less statistically significant, and the fit of the regression decreases marginally, but the coefficients of the other variables are not affected. Specifications 3, 4 and 5 replace the continuous variables Crowdedness and Mother/Father years of schooling by discrete versions (defined under the Table B1). Again, none of our conclusions is affected.