

Early Childhood

A Modern Approach to Human Capital Theory

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If the race is already halfway run even before children begin school then we clearly need to examine what happens in the earliest years.

Gosta Esping-Andersen (2004:116)

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I Introduction

Human capital as described in the dictionary:

The abilities and skills of any individual, especially those acquired through investment in education and training, that enhance potential income earning.

Already Adam Smith (1776) established a direct connection between the training and the efficiency of workers, and described the reason behind differences in wages as the difference in the level of skills and talents. During the last decade, the focus in research slowly started to shift from schooling to preschool education. Just as Esping-Andersen (2004) points out in the citation at the beginning, early childhood years are probably the most important period of life in the context of ability acquisition and development. Both brain and body growth are most rapid and it is common consensus in literature that influences during early childhood have significant impacts on further development. In this paper I will summarize contributions on the field of early childhood education and care of most recent research. I will also highlight what we can learn from these for our education systems and policy.

II Early Childhood Education

During this chapter I will give a general introduction into the topic of early childhood education and care. Starting from basic facts about skill formation and the nature of abilities, I will then go on to empirical studies on the field of early intervention. The results we can get from these studies will lead us to the determinants of success of intervention programs and their impact on children, family and the overall economy.

Cognitive and Non-Cognitive Skills

Throughout this paper we will see that it is important to distinguish between cognitive and non-cognitive skills, and that both types determine human capital. Cognitive skills are any mental skills that are used in the process of acquiring knowledge, including reasoning, perception, and intuition; in general, they are evaluated by the intelligence quotient (IQ) of a person. Non-cognitive skills are those often referred to as “soft skills”, like motivation, tenacity, trustworthiness, perseverance and adaptability.

Heckman, Stixrud and Urzua (2006) analyze in detail the effects of cognitive and non-cognitive abilities on labor market outcomes and social behavior. By means of the General Education Development (GED) testing program in the United States as an example however, we already can catch the importance of this distinction. The GED program provides a second chance to high-school dropouts. By passing several tests, they can achieve a certificate attesting high-school-level academic skills. Heckman and Rubinstein (2001) assume that the achievement of the GED degree is a “mixed signal”. On the one hand, recipients prove their cognitive skills to be similar to those of high-school graduates. On the other hand, by dropping out of school they show a lack of discipline and perseverance, and thus a lack of non-cognitive skills, since the reason behind cannot be scarce intelligence. Empirical studies¹ support this theory and also show that all signals get prized in the market. GED recipients earn much less than high-school graduates, but a bit more than regular dropouts. However, if we control for the on average higher years of schooling of GED holders, they earn even less than these. Furthermore, GED recipients are much more likely to change their job, and also participate in illegal activities more often than other dropouts. That is even true if we do not consider imprisoned persons². Naturally, all this does not apply to girls who dropped out of high-school for the reason of pregnancy.

From these results we can conclude that non-cognitive skills are just as important as intelligence in determining success on the job market as well as in life. In the next section I will explain why this knowledge is important in the context of early childhood education.

Life-Cycle of Skill Formation

Herrnstein and Murray (1994) showed that cognitive abilities measured during childhood do influence adult socioeconomic success on a variety of dimensions. However, as an explanation for differences in human cognition they assign a primary role to genetics. If that were true, inequality on this field could only be adjusted by compensation payments which would produce a substantial equity-efficiency trade-off.

¹ Heckman, Hsueh and Rubinstein (2000), summarized in Heckman and Rubinstein (2001), examine the *National Longitudinal Study of Youth* (NLSY) and provide empirical evidence to the arguments claimed in this section.

² The GED certificate can also be and is often acquired in prison.

Recent literature on the origins of inequality suggests the interaction between genes and environmental influences as the source of differences in human skill development, rather than genetics alone.³ Genetic expression differs between adult twins who experienced diverse events during childhood; breast-fed children attain higher IQ scores than non-breast fed children, and isolation triggers genetic health issues. These are just some examples showing that ability gaps open up early in life.

In the next section I will present experimental evidence supporting the fact that especially learning and family environments have a large impact on the development of both cognitive and non-cognitive skills. In fact, schooling plays just a minor role in creating ability gaps across socioeconomic groups. Different types of abilities appear to be susceptible to manipulation at different ages. Cunha, Heckman, Lochner and Masterov (2006) summarize empirical evidence on the life-cycle of skill formation and particularly point out the importance of early childhood education and care. Cognitive skills emerge very early in life; according to Kaufman (2009), IQ scores already become stable by the age of 8. Non-cognitive skills can also be attained in later years, but are much more easily acquired while still young.

This is the point where intervention programs come into play. Remediation is much less efficient the later it is provided to a disadvantaged child; disadvantage means here a lack of stimulation and resources to promote child development in comparison to other children. The reason behind is simple: skills beget skills and capabilities foster future capabilities.⁴ The human brain develops most rapidly and almost to its fullest until the age of 8. During this period skills and knowledge are acquired most easily; skills learnt lead to self-reinforcing motivation to learn more and make learning at later ages also more efficient and thus more likely to continue.

As we will see, investment in early childhood education is highly profitable for the overall economy as well as for the individual child. The common trade-off between equity and efficiency of most political interventions targeting inequality does not hold for investments in early education and care of children from disadvantaged environments. In the following I will introduce three experiments providing valuable data that give us deeper insights into the effects of early intervention programs.

³ See Rutter (2006) for an introduction to this topic.

⁴ Cited from Heckman (2008). However, this argument is supported by neuroscience. A certain region of the human brain, the prefrontal cortex which is responsible for emotions and self-regulation, is affected by early childhood education measurements; see Dahl (2004).

The Perry Preschool Project

The Perry experiment is considered as the flagship of early intervention programs. This intensive preschool program was implemented at the Perry Elementary School in Michigan, USA, and started in 1962. Over five years 65 randomly selected black children from poor families⁵ were enrolled, each spending two years attending the program and being followed afterwards until the age of 40; the average age at entry was 3 ½ years. A control group of roughly the same size served as a benchmark to evaluate the effects. The treatment consisted of 2 ½ hour classroom sessions during weekdays and a weekly home visit by the teacher. According to Cunha et al. (2006), if the program were administered today the total costs would amount to \$9,785 per participant per year in 2004 dollars.

Although there was an initial boost in the IQ of participants, it faded by the age of 10; see Table 2 in the appendix. However, the program had substantial effects on educational achievement and non-cognitive skills development, as can be seen in Table 3. Participants had higher grades, spent less time in special education and were more likely to graduate from high-school. Also they earned higher wages and were less dependent on welfare (see Table 4). Above all, Table 5 shows that there was substantially less crime among participants, both in terms of frequency and severity. Heckman, Moon, Pinto, Savelyev and Yavitz (2010) calculate a rate of return in the range of 7% to 10 % to the investments in the project, which is higher than the post-World War II stock market rate of return on equity, which is roughly 5.8%. For their calculations they take into account the initial costs and social benefits. Initial costs consist of operating costs like teacher salaries and administration, and capital costs of classrooms and other facilities. Social benefits consist of educational savings, taxes on earnings, welfare savings and crime savings. Public spending on education is reduced by participants' less special education and more efficient progressing in school. Additional taxes on earnings arise from the higher average wages of participants, who are also less dependent on welfare. Crime reduction is a major benefit of the Perry Program and generates the largest part of social benefits. Here, savings consist mostly of costs for incarceration. For a graphical illustration, take a look at Table 1.

⁵ Poverty status was determined by a formula that considered rooms per person in the child's household, parental schooling and occupational level (Cunha et al. 2006, p. 45).

The Abecedarian Project

During this project, 111 black children from families scoring high on the High Risk Index⁶ received an even more intensive treatment than those of the Perry Program. Participants were born between 1972 and 1977 and the average age of entry was 4.4 months. They were randomly assigned either to a preschool intervention or a control group; at the age of 5, all of the children were reassigned to either a school age intervention or a control group. Thus in total there were four groups of children who experienced different levels of intervention, from full high-quality education and care until the age of 8 to no intervention at all. All children were followed to the age of 21.

During the first stage, the preschool intervention took place every day and all year round. During the second stage, teachers assisted parents to provide supplemental educational activities at home, individually matched for every single child. They also helped the families improving children's environments and assisted them with job-seeking and bureaucracy of social service agencies.

In contrast to the Perry results, the rise in IQ scores of participants in the Abecedarian Project was persistent over time, as shown in Table 6; yet this applies just to the preschool intervention group, and the effect is primarily concentrated among girls. Nonetheless we can see that interventions especially during the first years in life can have a significantly positive effect on children's cognitive development. Reading scores (see Table 7) as well as math achievement scores were higher throughout all intervention groups compared to the control group. Table 8 shows the overall academic outcomes.

Romanian Orphans Study

Rutter and the English and Romanian Adoptees Study Team (1998) studied 165 Romanian orphans who were adopted into families in the UK between 1990 and 1992. These children were raised under horrible conditions during their first period of life, with no toys or other stimulation provided in the state institutions they came from. Hygiene and medical treatment were very poor and many of them were locked in rooms or tied up to keep them under control.

⁶ The factors used to form the index consist of weighted measures of maternal and paternal education levels, family income, absence of the father from the home, poor social or family support for the mother, indication that older siblings have academic problems, the use of welfare, unskilled employment, low parental IQ, and family members who sought counseling or support from various community agencies. Parental income and education were considered most important in calculating the index. (Cunha et al. 2006, p. 47).

Rutter and his colleagues compared the orphans from Rumania to 52 adopted children from within the UK who were all placed before the age of six months. Initially suffering from underweight, malnutrition and substantial underdevelopment, the Romanian children quickly caught up. However, just the ones who were adopted before the age of six months were at the same level of development as the children from the UK when they were six years old. This again shows the importance of the point in time the intervention takes place. Earlier support is much more efficient than later remediation.

Determinants of Success

Almond and Currie (2011) summarize the literature on human capital development during early childhood and point out several factors that have long-run consequences. They distinguish between prenatal environment and early childhood environment, since both growth and development are most rapid in these stages, and disruptions during the development phase have severe consequences.

Maternal health is one factor studied on the field of prenatal environment. In general, the child's birth weight serves as an indicator of his health status and therefore the mother's condition during pregnancy. Empirical results vary greatly, but if any, a positive relationship between birth weight and adult intelligence is found. A second and much less extensively studied topic is the impact of economic shocks around the time of birth on adult health. If any, researchers find negative effects of shocks on life expectancy. Another point of interest is the impact of air pollution, especially smoking, on fetal and infant health. Naturally, negative effects are predominantly found here.

In the course of this paper I concentrate on postnatal environments and influences during early childhood. These factors also have significant effects on long-term development of human capital, but are much easier to analyze since the child can be observed individually and independent of his mother. Of course health status plays an important role also in this context, and the impact of infections, toxic exposures, injuries and traumata during childhood on adult skills and behavior are intensively studied. However, in relation with early childhood education and care, I want to focus on two determinants of success that are explicitly pointed out in corresponding literature. These factors are on the one hand the timing of actions or interventions, and on the other hand the quality of these.

Timing of Intervention

Data from both the Perry Preschool Program and the Abecedarian Project, which have been used by researchers for countless models and empirical studies since their initiation in the 1960's and 70's, report significantly positive longitudinal outcomes of early interventions for participants in the areas of schooling, social behavior and criminal records. Moreover, there is no equity-efficiency trade-off involved since returns to investment are strictly positive and even higher than average returns on the stock market. That does not necessarily hold for later interventions or remediation programs. Especially cognitive abilities, which develop very early in life, are determined and stable by the age of 8 in the sense that adult IQ is highly correlated with the IQ at this age. Already the Perry intervention, which started at the age of 3 to 4, did not succeed in producing higher IQ levels of participants; later interventions are therefore highly inefficient. Nau-deau, Kataoka, Valerio, Neuman and Elder (2011) point out the four most important areas promoting children's development (compare Table 9), of which the first three are to a large extent determined very early in life. As I already mentioned, cognition is one of them. Then, physical (health) status is already very dependent on the mother's health and nutrition; immunizations and regular check-ups facilitate growth and well-being. Language skills also depend greatly on early stimulation through talking, reading and singing. According to Sousa (2006), the speed of first language acquisition is strongly influenced by these early stimulations, as is the individual level of difficulty of learning additional languages in later years.

Non-cognitive, socio-emotional skills can also be acquired and remediated at higher ages. Heckman and Lochner (2000) describe the effects of interventions aimed at adolescents and young adults; most of the time these are either mentoring programs or financial incentives to stay in school and participate in learning activities. Payoffs produced here mainly arise from social skills, motivation and the improved home environment these interventions provide to participants. Some of the programs have proven to influence employment and wages earned by participants, and most of them had positive impact on criminal behavior. However, all these impacts are quite modest, while the costs are high. These interventions can just alleviate, but not reverse damages caused by insufficient early childhood and care, and there exists a substantial equity-efficiency trade-off.

Cunha and Heckman (2010) generate an ideal investment model for human capital development, integrating results from human capital theory up to now. According to them, optimal intervention strategies and timing of investment depend on the outcome being targeted, the stage of life cycle and endowments at each stage. There exists no universal policy to combat the adverse effects of early disadvantages. However, one thing is clear: The earlier an intervention takes place, the more efficient it is. Table 10 illustrates this result. In the next section, I will take a look at the quality of interventions.

Quality of Intervention

Naturally not only the timing of interventions, but also their quality determines success and long-run effects. Inequality arises from different home environments during childhood in terms of family situation, financial endowment, parents' education and immigration background. It is clear that children with a disadvantage in these areas benefit the most from intervention programs.⁷ One problem of efficient policy making is the identification of disadvantaged children, since with universal childcare deadweight losses are produced; investments in further education of well-parented children does not produce any output for society.

In fact, this is the crucial point: although it is closely linked to all the above mentioned factors, the most important determinant of success of child development is the quality of parenting. Empirical studies⁸ show that it is not necessarily correlated with the household's financial endowment or family background. Fritschi and Oesch (2008) analyze the relation between early childhood care and likelihood of attending the highest secondary school (Gymnasium) in Germany. The most important determinants are parental education background and early childhood education, measured by attendance of nursery school and kindergarten. Also migration background, household income and number of siblings have a significant impact in the case of Germany. Another determinant pointed out by Heckman (2008) is family situation, which means employment situation and marital status of parents. According to Heckman (2011), children raised by never-married single mothers receive less cognitive stimulation and emotional support than those from intact families.

⁷ Compare Heckman (2008), summarized in Heckman (2011), Mitchell et al. (2008), Fritschi and Oesch (2008) for empirical evidence and theoretical background.

⁸ Heckman (2008) points out and summarizes several studies on the efficiency of early childhood interventions and influencing factors.

Schütz, Ursprung and Wößmann (2008) measure inequality of educational opportunities by estimating the effect of family background on students' educational performance. As a proxy for family background effects, they use the number of books present in the child's household. Two conclusions are being drawn in their study. First, the earlier students are tracked into different school types, the larger are the impacts of family background effects on performance. Second, longer preschool cycles decrease their impact. These results are perfectly consistent with our findings so far.

Kristen, Edele, Kalter, Kogan, Schulz, Stanat and Will (2011) take a look at the impact of students' migration background on their performance in school. According to them, there are disadvantages as well as benefits arising from migration status. Proficiency in the language of the destination country can have beneficial effects on cognitive development in general, and also supports learning of the second language. However, it certainly has its drawbacks since competencies in the language of instruction are crucial for learning in school. The same goes for ethnic networks. They can promote educational success due to the close relationship between their members and mutual assistance. On the other side, being part of an ethnic network can be a hindrance since the access to resources and information of other groups is more difficult.

In terms of quality, different cultural backgrounds of children lead to a second problem for policy makers. Cultural diversity and values have to be considered, and quality of parenting has to be evaluated in different ways when comparing socio-ethnic groups. Penn (2009) presents the whole complex of problems related to quality of education and care in detail. The two main quality factors however seem to be the child-teacher ratios in preschool institutions, and the level of pedagogic proficiency of the staff.

Impacts of Early Childhood Education

We can summarize the outputs from early childhood education and care in three blocks. The first block deals with outcomes for the children. Outcomes from learning can be described as learning dispositions; these are a combination of cognitive and non-cognitive skills and determine success in schooling. Abilities build on abilities; they are dynamic, and early acquired motivation and customs support further learning. The development of skills like independence, responsibility, curiosity and social competence in early years enriches the child's personal human capital and produce high outputs in terms of income, chances of employment and criminal records. Naturally, these outcomes greatly depend on the quality of childcare experiences.

Low-quality care can produce negative outcomes as a higher level of aggression and antisocial behavior in later years. Positive outcomes can be produced by using qualified teachers who communicate with children in respectful and reasonable ways, teach them values and discipline, and provide a familiar and friendly learning atmosphere.

The second block deals with impacts on parents. One long-term effect can be stated as a decline in “opportunity costs” of children due to a broader institutionalized childcare that starts very early. Career and family planning get more compatible and birth rates are likely to rise. With the same argument we can say that it is a huge step towards gender equality, since long absent periods from work which are the main reason for gender wage gaps decrease drastically. Besides, there are also short-term effects for the parents including improved interactions with their child and greater acceptance of his behavior, as well as more involvement of the father in parenting and an improved knowledge of child learning, development and behavior. All these factors result in a less stressful and more harmonic family environment. Social network gains and cultural connections are a plus.

The third and final block summarizes economic outcomes. The evidence I presented earlier demonstrates that investing in good quality early childhood education and care produces cost savings and benefits to governments and economies. Employment and tax revenues are increased already in the short run, and savings are generated in educational and social expenditure. In the long run, higher birth rates, a greater level of women’s employment and above all a better educated and more skilled population will speed up economic growth and wealth. A decline in criminal activity both lowers public costs for legal proceedings and incarceration, and increases safety and thus quality of life.

III Application to Germany

A direct application of the results and empirical evidence that I presented up to this point to the German political and educational system is hardly possible. That is due to the very specific characteristics of the experiments conducted in the United States.

First, they all aim at very poor families from urban areas with high criminal activity. The average German population is certainly very different from the participants of the Perry and Abecedarian Programs, and outcomes can be assumed to be significantly smaller if similar programs would be implemented in Germany. Especially cost savings in relation to crime reduction would have a totally different dimension.

Second, the American programs were all very intensive, both in time and in costs. Teaching staff was very well trained and parents received intensive advisory on the fields of nutrition, health and caregiving. Fitzpatrick (2008) estimates the costs for one child over the treatment period on \$16.000 to \$41.000 for intervention programs in the US. In comparison, overall costs per child in German kindergarten amount to \$7.000. Third, starting age was lower than in German kindergarten. Studies targeting children of four years and older report much smaller outcomes than those intervention programs targeting one to three year old children.

However, as pointed out by Schütz et al. (2008), preschool education significantly reduces the impact of family background effects on educational performance of students. Since these factors are particularly highly correlated in Germany, preschool education greatly affects inequality in the education system in a positive way. Although there is no significant relationship between years of education and economic growth, cognitive skills measured in standardized tests have a great impact on the growth rate. As shown above, high quality early childhood education positively influences skill development.

By taking a look at studies dealing with early childhood education in Germany⁹, we can see that the main results from American research nevertheless can be applied all over the world. In Germany, a strong impact of the attendance of kindergarten on PISA results is found. Unfortunately there are no experiments conducted in Germany that give rise to distinct conclusions about long-run effects of early interventions. Though expensive, it would lead to more specific and well-grounded recommendations for future policy makers.

IV Summary

In the course of this paper we came to several conclusions which I attempt to summarize here. We saw that both cognitive and non-cognitive skills have large impacts on both learning activities and economic returns to these. They also affect social behavior and criminal activity. In contrast to historical beliefs, abilities are not solely determined by genetics but they are influenced both by genes and the environment. We further saw that ability gaps across individuals and across socioeconomic groups open up early in life, and that they are strongly correlated with parental education and family situation. However, financial endowment of the family is not as an important factor in childcare. The essential points are the quality of parenting and a favorable family environment.

⁹ Main findings of several studies are summarized in Schlotter and Wößmann (2010).

By means of early intervention programs and fully-fledged teaching staff, it is possible to compensate for disadvantages in these areas. Crucial points are the quality and timing of intervention. Different types of abilities appear to be manipulable at different ages. In general, however, the earlier an intervention starts the more effective it is, and the later the remediation, the less effective it is. Economic returns to initial investments at early ages are high. There exists no equity-efficiency trade-off for these kinds of investments, yet there is a substantial trade-off for later investments. Nonetheless early investments must be followed up by later investments in order to be effective.

These conclusions lead us to recommendations for changes in education policy that would produce benefits and cost savings for the overall economy, as well as for future research.

V Policy Recommendations

The first question of policy makers would probably be about who should be targeted. We know that universal childcare produces deadweight losses and that early childhood education generates the highest outcomes for disadvantaged children. Future research should concentrate on developing authentic measures of risky family environments to facilitate efficient targeting. Programs should start in very early years of a child's life in order to be most efficient. Incorporation and advice of parents furthermore creates a favorable family environment. Coping with diverse social and cultural backgrounds of children constitutes a challenge for policy makers. By engaging private firms and involving representatives of social groups, effective and culturally sensitive programs can be created.

In the case of Germany, the public opinion on childhood education and care has to change as a first step.¹⁰ In Germany, jobs related to children and child-care tend to be disrespected and get poorly paid. Nursery schools are still not widely spread and they are attended by just a low percentage of children. Kindergartens focus on simple care-giving rather than education and skill development. These things have to change over time. The focus has to shift to education starting at early ages, and expenses on education-staff training have to be increased.

¹⁰ Compare the following ZEIT ONLINE article: <http://www.zeit.de/gesellschaft/familie/2011-05/kinderpaare-erziehung/>

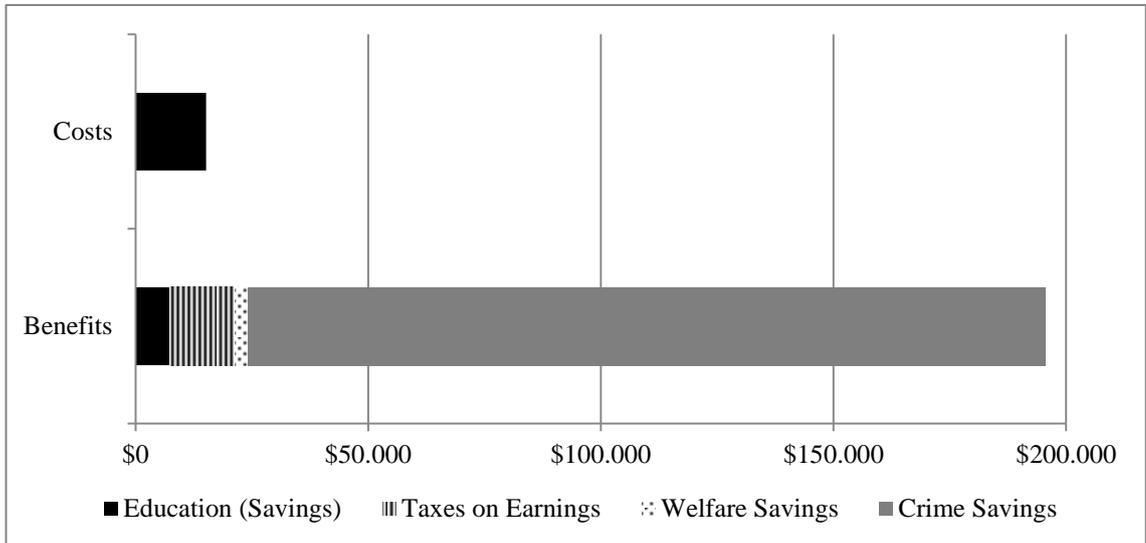
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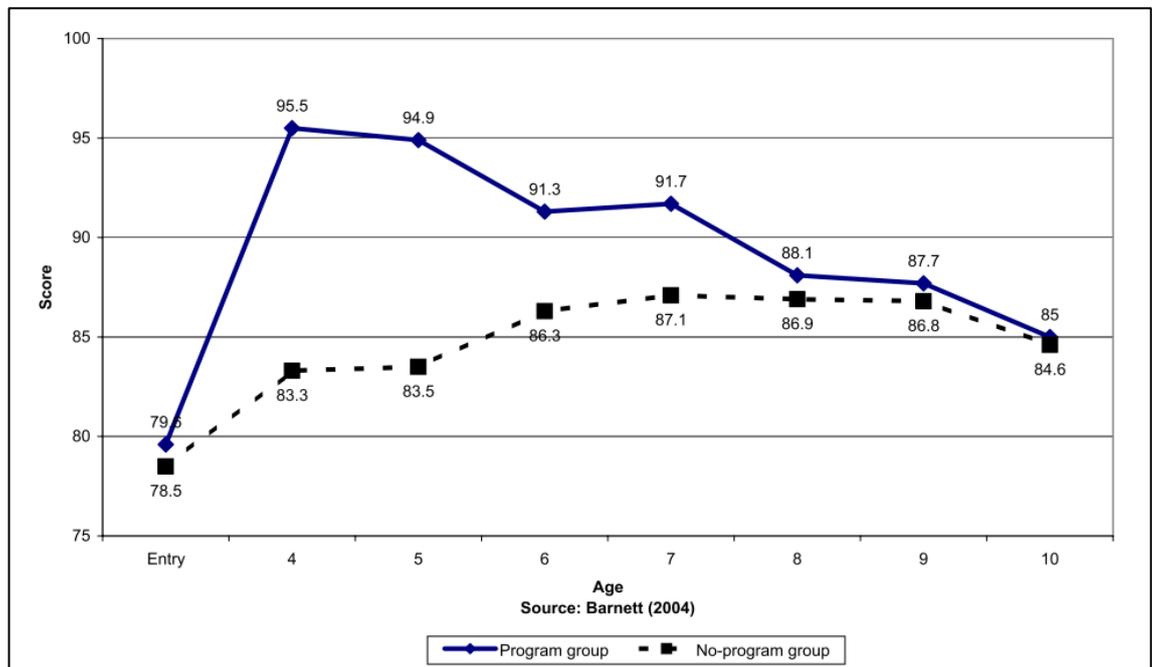
Appendix

Table 1: Perry Preschool Program Public Costs and Benefits



Source: Calman and Tarr-Whelan (2005)

Table 2: Perry Preschool Program IQ over Time



Source: Barnett (2004)

Table 3: Perry Preschool Program Educational Effects

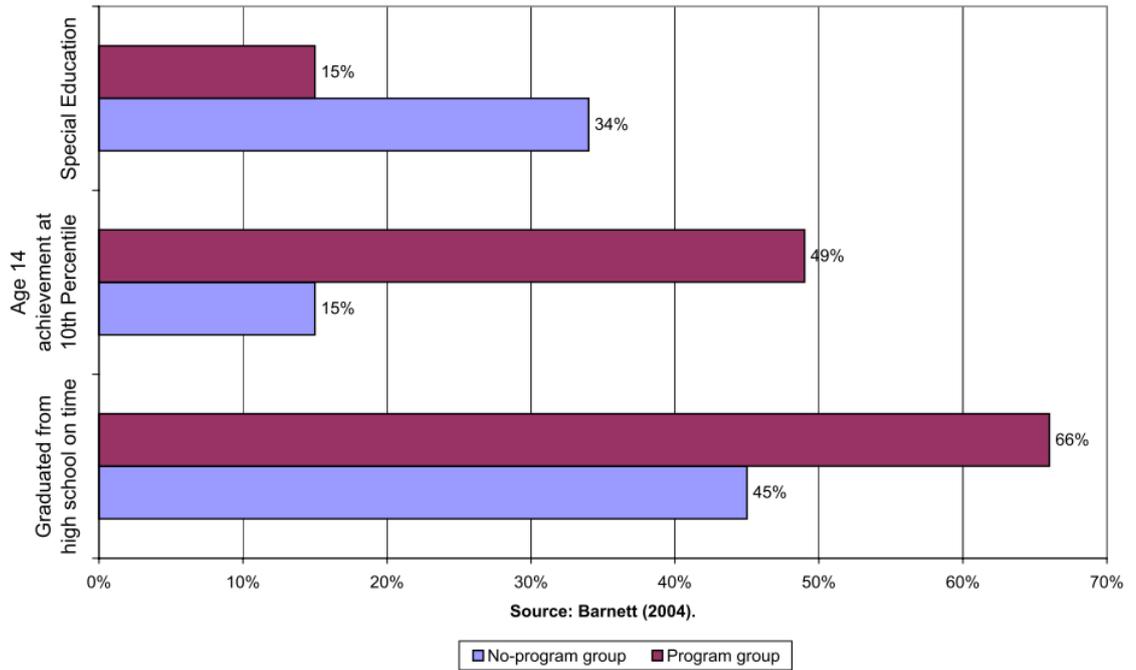


Table 4: Perry Preschool Program Economic Effects at Age 27

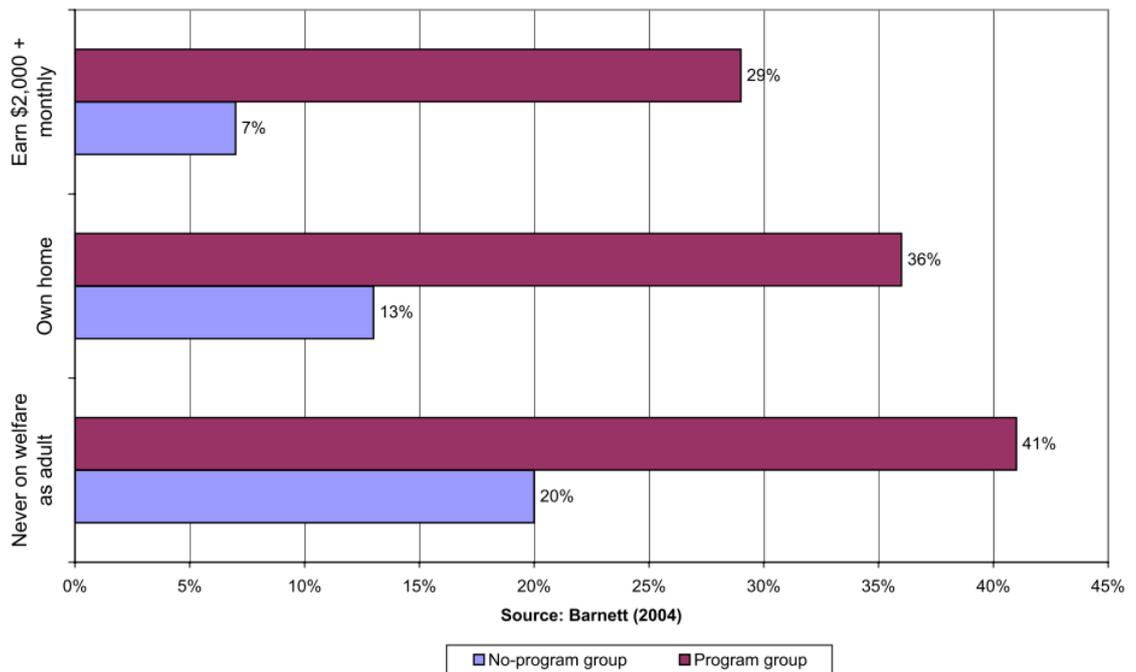


Table 5: Perry Preschool Program Arrests per Person before Age 27

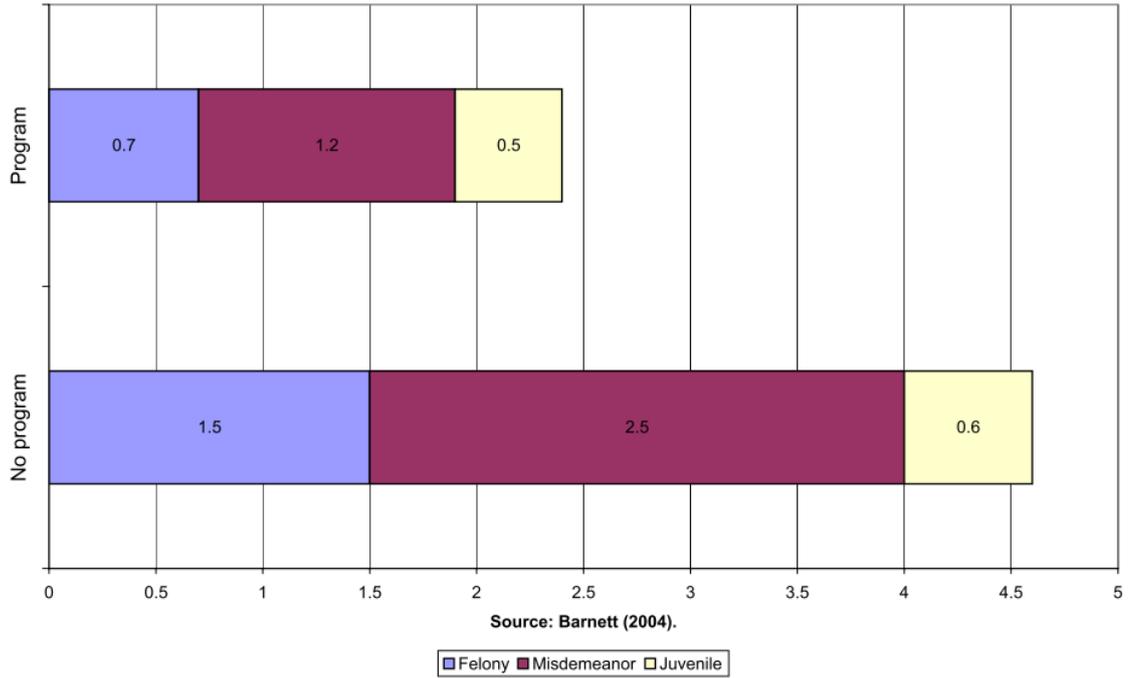


Table 6: Abecedarian Program IQ over Time

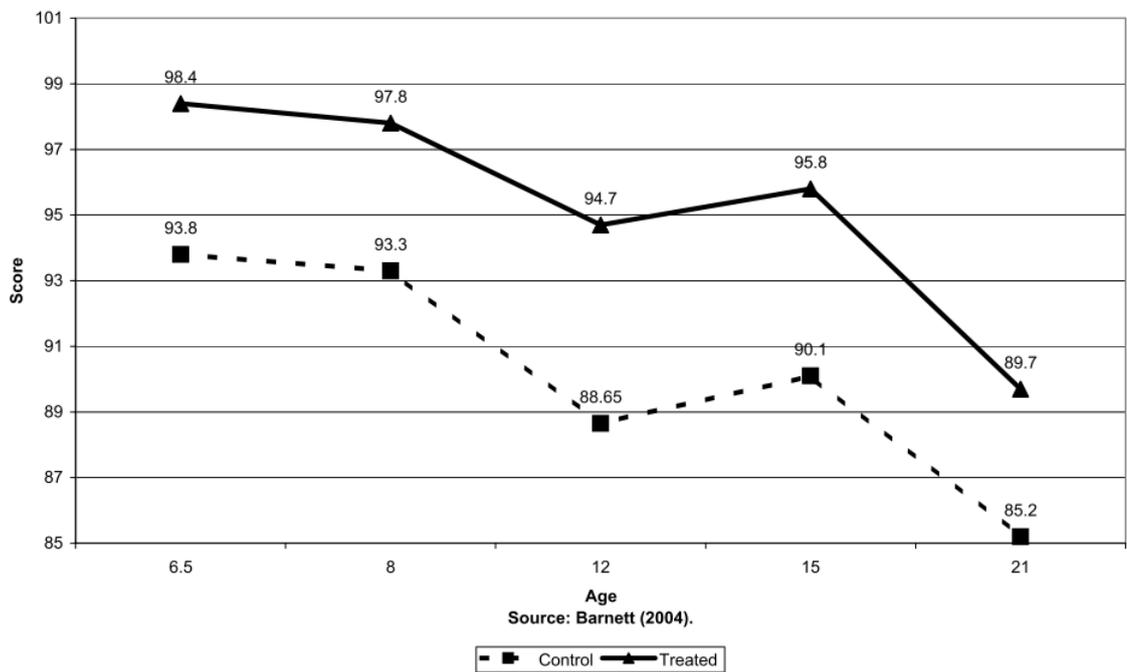


Table 7: Abecedarian Program Reading Achievement over time

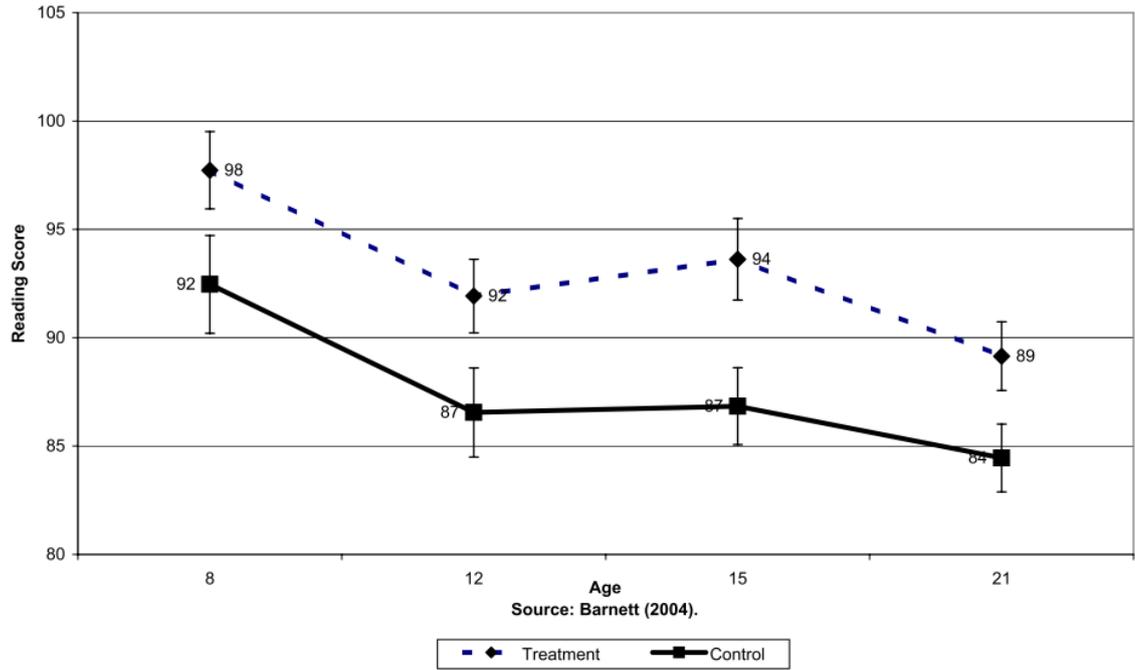


Table 8: Abecedarian Program Academic Outcomes

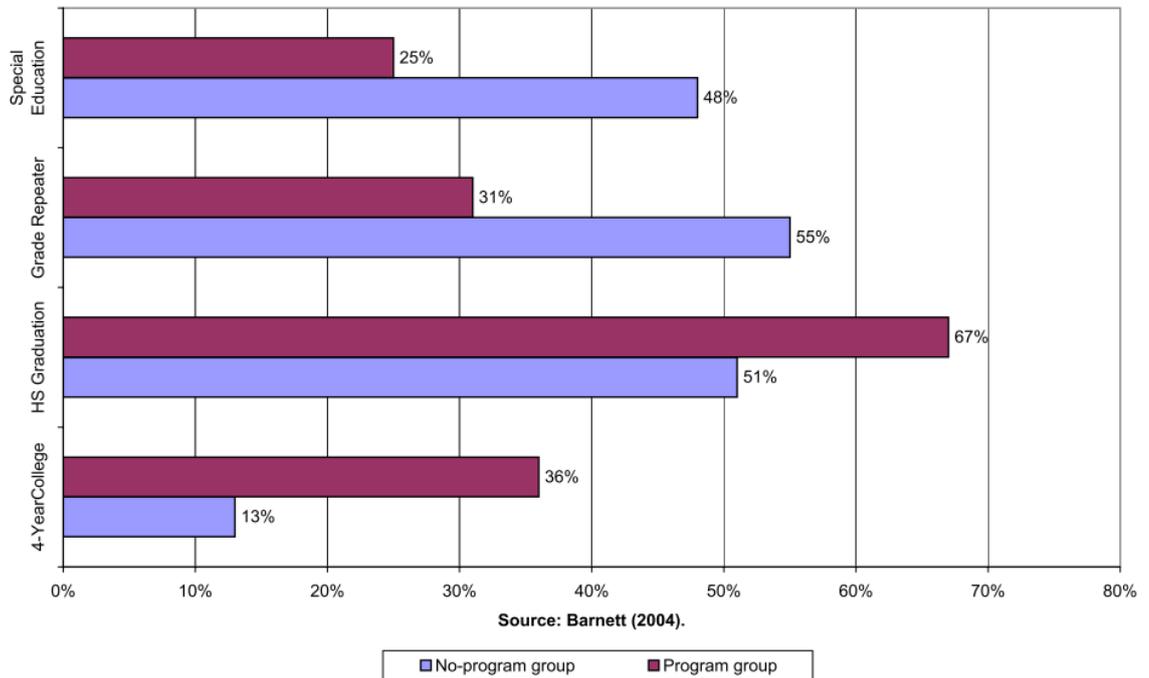
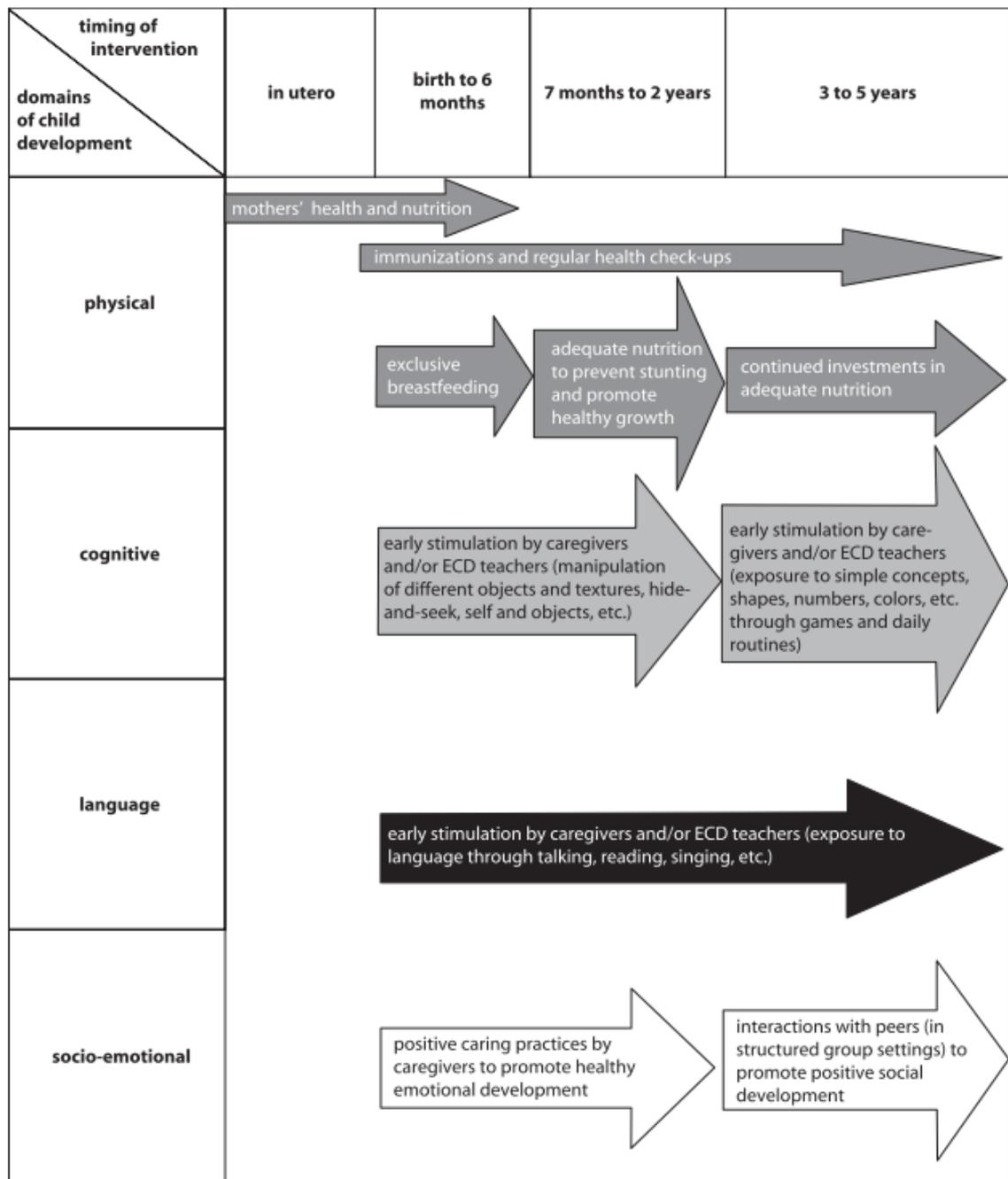


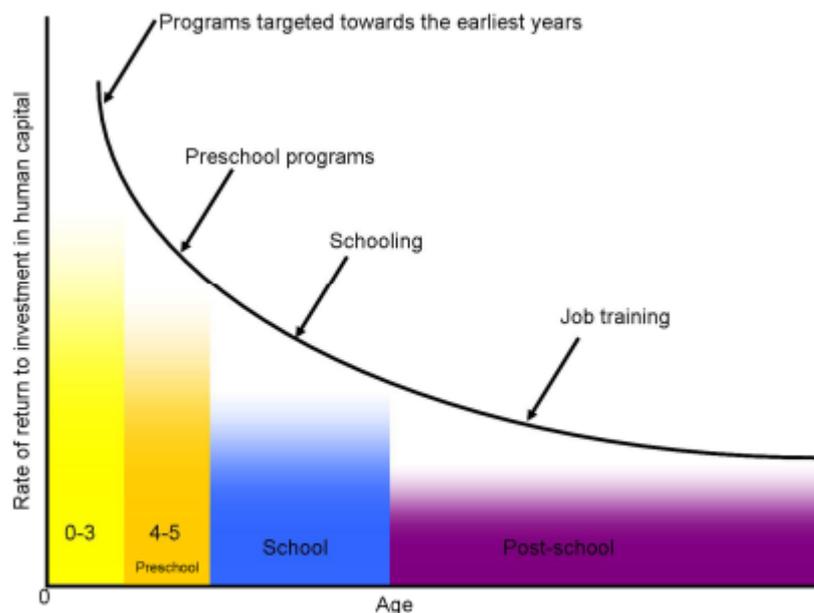
Table 9: Timing Matters -
The Most Important Interventions Vary with Child's Age



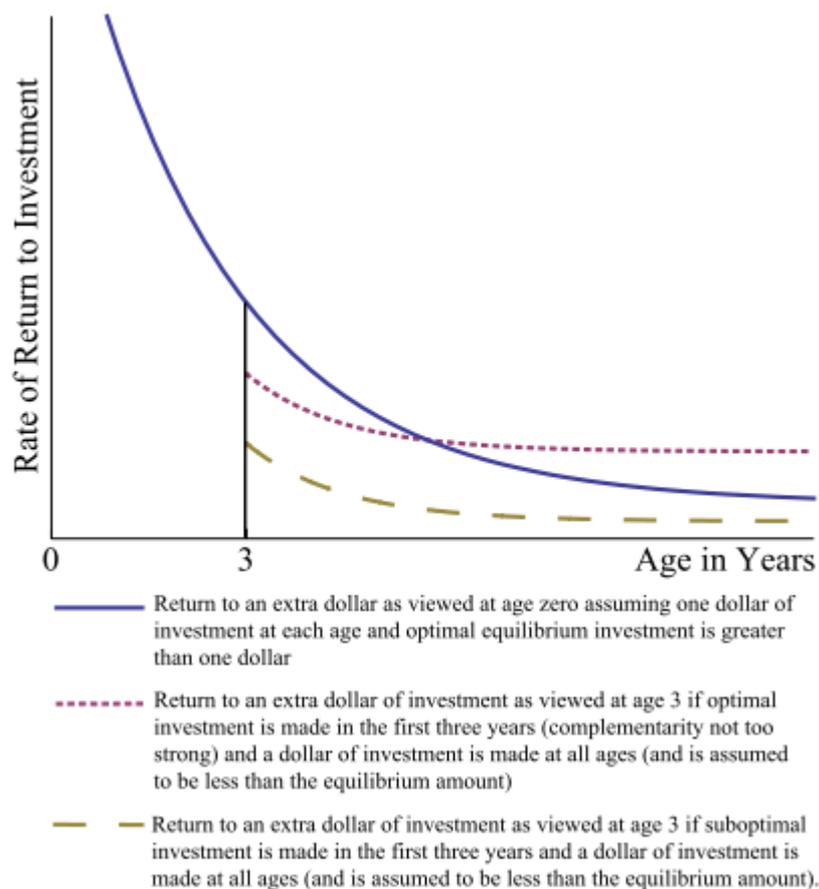
Source: Naudeau, Kataoka, Valerio, Neuman and Elder (2011)

Table 10: Returns to a Unit Dollar Invested

(a) Return to a Unit Dollar Invested at Different Ages from the Perspective of the Beginning of Life, Assuming One Dollar Initially Invested at Each Age



(b) Returns to One More Dollar of Investment as Perceived at Different Ages, Initially and at Age 3



Source: Heckman (2008)