



## **UCD GEARY INSTITUTE DISCUSSION PAPER SERIES**

### **Early Childhood Intervention: Rationale, Timing and Efficacy\***

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## **Abstract**

This paper provides a brief review of the economic rationale for investing in early childhood. It discusses the optimal timing of intervention, with reference to recent work in developmental neuroscience, and asks how early is early? It motivates the need for early intervention by providing an overview of the impact of adverse factors during the antenatal and early childhood period on outcomes later in life. Early childhood interventions, even poorly designed ones, are costly to implement, therefore it is vital that interventions are well-designed if they are to yield high economic and social returns. The paper therefore presents a set of guiding principles for the effectiveness of early intervention. It concludes by presenting a case for a new study of the optimal timing of interventions.

**Keywords:** Early childhood intervention, brain development, optimal timing

**Word count:** 2127

## **Introduction**

Traditionally, public provision of education was a means of reducing inequality among different socio-economic groups in society. Yet despite two centuries of this public intervention there is still a high degree of inequality in human capital acquisition. Research shows that these differences across socio-economic groups in terms of both cognitive and non-cognitive outcomes appear early in the child's life and persist throughout their academic career.<sup>1</sup> Evidence based on UK data finds that for children born in 1970, there is a 13 percentile gap in an index of cognitive development at 22 months between children from high and low socio-economic status (SES) families.<sup>2</sup> Therefore, the skills needed to accumulate human capital are shaped early in life. This is consistent with recent work in developmental neuroscience which has shown greater plasticity of the brain in the early periods.<sup>3</sup>

Attention has therefore shifted to ameliorating these inequalities in the early years when the potential for changing outcomes is greatest through investing in targeted early interventions programmes. Several of these programmes, including the Perry Preschool Program<sup>4</sup>; Head Start<sup>5</sup>; High/Scope Pre-School Curriculum Study; Chicago Child-Parent Center<sup>6</sup>, which were evaluated using rigorous experimental methods, have demonstrated positive impacts in adulthood across a variety of domains including educational attainment, risky behaviour, earnings, parenting skills, although the impacts differ across programmes and outcomes. Yet there is still much debate in the literature concerning the optimal timing and quantity of interventions.

This paper provides a brief review of the economic rationale for investing in early childhood. It then questions exactly how early is early and discusses the optimal timing of intervention. Early childhood interventions, even poorly designed ones, are costly to implement, therefore it is vital for interventions to be well-designed if they are to yield a high economic and social return. The final section of this paper provides insights on this presenting a set of guiding principles for the effectiveness of early intervention. The paper concludes by presenting a case for a new study of the optimal timing of interventions.

## **The Economics of Early Childhood Intervention**

While equity considerations are central for the early intervention argument, another, perhaps more significant argument for policy makers, is the economic efficiency. Early investment in preventive programmes aimed at disadvantaged children is often more cost effective than later remediation which can be prohibitively costly. Early intervention programmes have been shown to improve attendance and performance in school, raise the quality and productivity of the workforce, reduce crime, teenage pregnancy and welfare dependency.<sup>7</sup> A key finding in this area is that efficiency in public spending would be enhanced if human capital investment were re-orientated from the old (remedial programmes) to the young (preventative programmes). The curve shown in Figure 1a plots the rate of return to human capital investment at different stages of the life cycle. It demonstrates that there is a higher rate of return at younger ages for a constant level of investment.<sup>8</sup> By investing early, the benefits are enjoyed for longer, which in turn increases the return to investment.<sup>9</sup> Finally, as the technology of skill formation posits that skill begets skill and early skill facilitates later skill acquisition<sup>10</sup>, early investment raises the productivity of later investment. The economic argument for early investment does not therefore preclude later investment; rather it argues that there are dynamic complementarities to be gained from investing at different stages of the life cycle, starting as early as possible.

## **The Optimal Timing of Interventions - How early is early?**

The argument for investing early is convincing, yet how early is early? There is much debate about the optimal timing of interventions, with many of the most successful interventions starting before the age of 3.<sup>11</sup> Research in developmental neuroscience has had important implications for the early childhood literature. By demonstrating that the child's brain is far from being mature at birth and is substantially changed by experiences it has highlighted the potential importance of intervening early and that the timing of these experiences can be important<sup>12</sup>. In particular, sensitive periods within the early years have been identified where there are windows of opportunity for certain developments to take place.<sup>13</sup> Others have argued that as the zero to three age period is vital for the production and subsequent retention of synapses (the growth of connections

between neurons), this period needs maximum stimulation for development to take place. For example, several studies support the notion that the sensitive period of phonology is from the sixth month of fetal life through the first year of life.<sup>14</sup> It has also been found that with increasing ages of exposure to language, there is a decline in the average proficiency, and this decline begins as early as 4 to 6 years of age, until proficiency plateaus in adulthood. More recent work has shown that the early environment directly affects the expression of the genes which control the development of the brain and whole nervous system<sup>15</sup>. This evidence provides support for the notion of a sensitive period in the development of particular systems but clearly further research in this area is needed.<sup>16,17</sup>

### *Early childhood period*

Intervening early is important as a number of factors during early childhood, such as health, family structure and environment can have an effect on the children's development, which will subsequently affect their human capital acquisition and later life outcomes. Health in the early years can significantly influence child development. The quality of nutrition, especially breast feeding, has been shown to have a long term impact on physical health and cognitive development<sup>18,19</sup>. Poor nutrition in the early years can have a long-lasting impact on children's physical, behavioural and intellectual development.<sup>20</sup>

The family environment in children's early years can also play a vital role in their early child development future success. Typically children from poorer families have lower scores on standardised tests of verbal ability and cognitive skills including reading readiness, number skills, problem solving, creativity and memory.<sup>21</sup> Poverty in childhood also leads to more emotional and behavioural problems.<sup>22</sup> The home environment also has a significant influence on a child's social, emotional, and cognitive development. Research indicates that children who are wanted and are raised by both biological parents in a low-conflict family have better outcomes in the early years of school.<sup>23</sup> The quality of the parent-child relationship also has a lasting impact on the child's social and behavioural development. The physical environment at home, such as the availability of

learning materials, also impacts on the child's cognitive and social development.<sup>24</sup> Maternal depression is linked with increased developmental difficulties for children and a negative impact on the child's behaviour and mental health.<sup>25</sup>

### *Antenatal period*

Evidence also shows that the antenatal period is vital for outcomes later in life. For example, a wealth of medical evidence suggests that substance misuse during pregnancy can have an adverse effect on child development. Alcohol use during pregnancy can lead to birth defects and developmental delays,<sup>26</sup> and even low levels of alcohol use can be associated with low birth weight. Tobacco use can also lead to intrauterine growth restrictions and/or premature labour resulting in low birth weight<sup>27</sup>, a higher incidence of behavioural problems<sup>28</sup> such as increased attention deficit, hyperactivity<sup>29</sup>, and chronic aggression<sup>30</sup>. Drug use is also associated with poorer child outcomes, although the exact influences of certain drugs is difficult to determine due to confounding factors such as nutrition, alcohol and tobacco use. Evidence shows that cocaine use during pregnancy is associated with low birth weight, intrauterine growth restrictions and abnormal brain growth.<sup>31</sup> Low birth weight can subsequently affect a child's cognitive abilities leading to poorer performance on tests of cognitive ability<sup>32</sup>, lower academic performance in the future<sup>33</sup>, increased likelihood of need for special education or grade retention<sup>34</sup>, and poorer language and social skills<sup>35</sup>. The literature has also identified a causal relationship between poor nutrition and cognitive and behavioural outcomes.<sup>36</sup> Poor maternal nutritional intake during the prenatal period can have an adverse effect on the child's neurodevelopment and health in later life.<sup>37</sup> The antenatal period is also important for brain development, particularly in the first trimester when infectious diseases, neurotoxins and nutrient deficiencies may have a detrimental effect on future development.<sup>38</sup>

Although there is less research on the effectiveness of intervening in the pre-birth period, the Nurse-Family Partnership (NFP) programme, in which nurses deliver home visits to families which begin during pregnancy and continue until age two, provides evidence that very early intervention is effective.<sup>39</sup> Research conducted by randomised control

trials indicates that the NFP is effective in improving child's cognitive development. A follow-up study finds that at age 6, children visited by nurses had higher intellectual functioning and receptive vocabulary scores and fewer clinical behavioural problems.<sup>40</sup> An adolescent follow up indicates there were increasingly large differences in the rates of child abuse and neglect between the treatment and control groups, with nurse visited mothers having significantly fewer arrests and convictions and their children reporting fewer sexual partners and arrests.<sup>41</sup> The effects were strongest for children of young, primiparous, unmarried, low SES mothers.

Therefore, there is some evidence to suggest that intervening very early i.e. in the antenatal period, may lead to an amendment to the earlier discussion. For example, in Figure 1b, we incorporate the antenatal period from conception to birth. It seems likely that the return to investing in the antenatal period is highest, and moreover that investing in this period may raise the productivity and alters the rate of return on investment at every period particularly if the early investment is followed through by additional supports. In other words the economic returns are pushed outwards at every age<sup>1</sup>. The fact that the NFP programme had a greater impact on young women who are having their first child also gives an added meaning to the word "early". It is important to give the greatest support at the very beginning of a women's reproductive life. The benefits of the intervention with the first birth should carry over the following, and in some cases, prevent a second high risk birth.

### **Principles of Effective Intervention**

The high economic and social return to investing in early childhood can only be realised if high quality interventions are initiated. The five principles of effective intervention, based on results from a variety of rigorously evaluated early childhood health and education interventions, are summarized below<sup>42</sup>:

- i. *Dosage*: Programmes that provide greater amounts of intervention produce greater benefits.

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<sup>1</sup> This idea first arose in discussions with UCD colleagues at the Coombe Womens Hospital, Dublin.

- ii. *Timing*: When interventions begin earlier and continue longer, they produce larger and longer-lasting benefits.
- iii. *Direct Receipt of Services*: Interventions that directly alter children's daily behaviour (health and education for example) produce larger positive and longer lasting results than interventions that rely on indirect routes (i.e. parenting programmes).
- iv. *Differential Benefits*: Some children show greater benefits from participation in early interventions than others, with the differences related to aspects of the initial risk conditions and the degree to which the programme is tailored to address that risk.
- v. *Continuity of Support*: Initial positive effects of early interventions will diminish if there are inadequate later supports to maintain the positive outcomes of the intervention.

Interventions are costly to implement, therefore in order to derive the greatest benefits for children, while simultaneously having a high rate of return for investors, they need to be well-designed and largely align with these five principles of effective intervention.

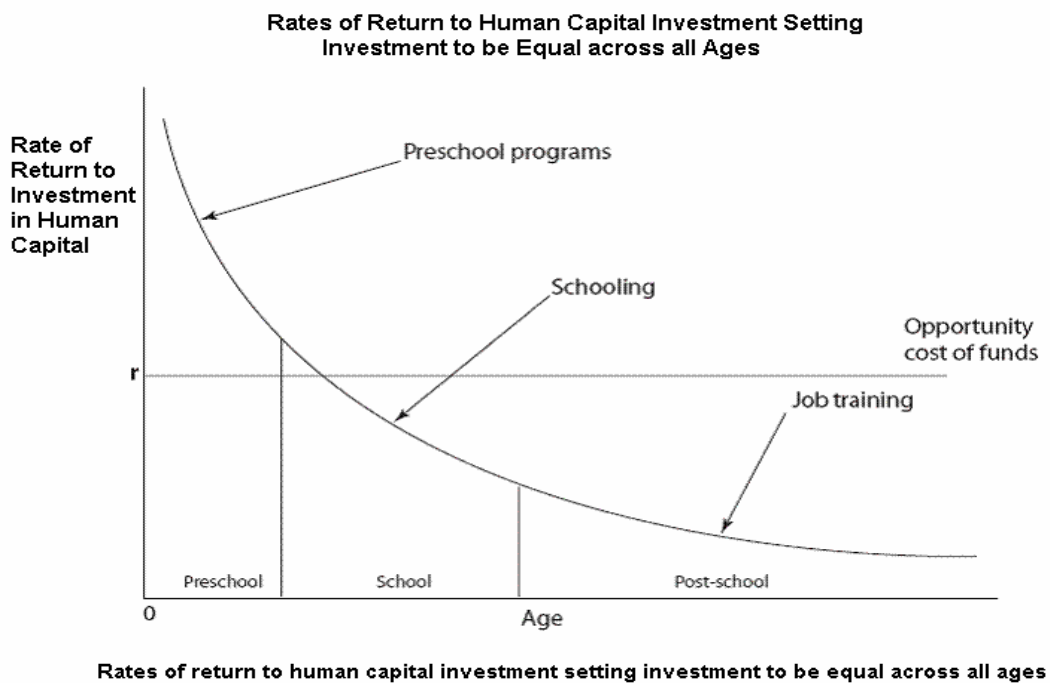
### **Conclusion and Policy Implications**

This review discusses how the economic return to investing in early childhood is high, and that early investment is generally more effective in improving life outcomes than investments later in life. These conclusions dovetail with national policy in Ireland which has begun recognising the importance of the early years, specifically with the introduction of a universal package aimed at childcare in 2006. The government are also co-funding, with Atlantic Philanthropies, a new initiative which includes a series of early childhood intervention programmes, evaluated by randomised control trial. This major investment in childhood interventions offers an unprecedented opportunity to conduct high impact, innovative scientific research which will distil world knowledge on the most effective childhood interventions and the optimal way to implement and measure such interventions. The economic and social returns to these interventions, if guided by the principles of effective intervention, are likely to be high.



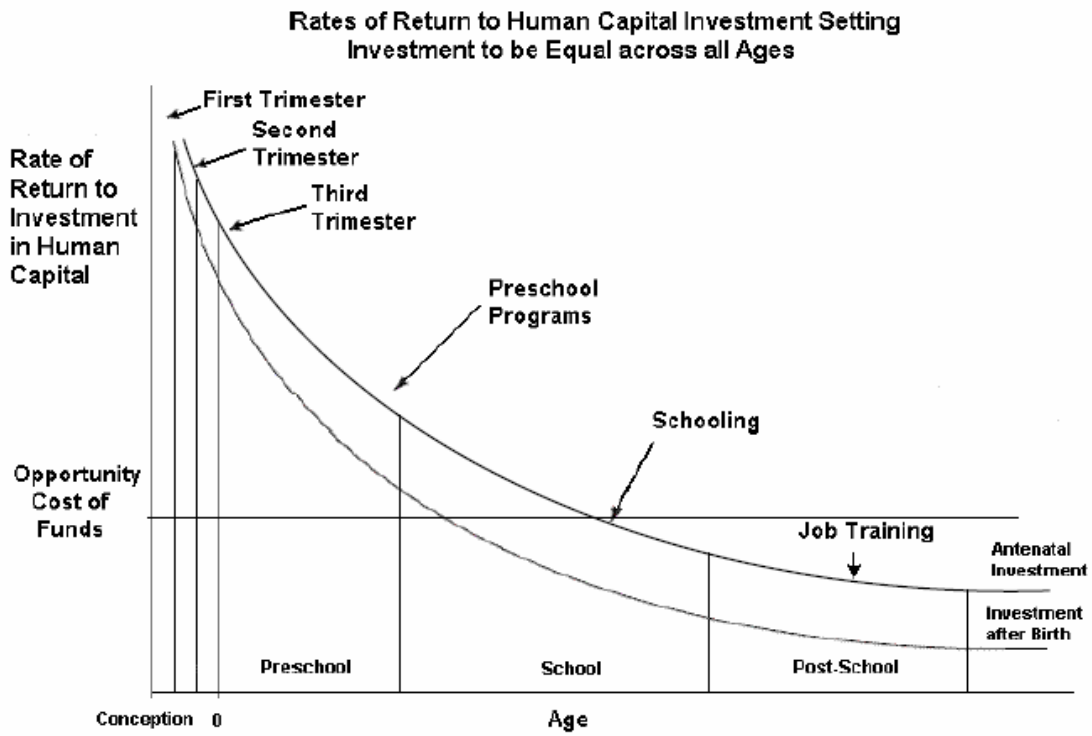
This paper also considers the optimal timing of intervention. In general the literature argues that the earlier the better, although concrete evidence about the optimal timing of intervention is lacking. We propose an explicit study which models the impact of intervening at different stages in the child's life. An optimal study design would incorporate a series of randomised interventions, with some groups starting the intervention in the antenatal period and other starting at later stages. A follow-up study of these groups would then reveal the impact of the timing.

**Figure 1a**



Source: Carneiro and Heckman, 2003.

Figure 1b



Rates of return to human capital investment setting investment to be equal across all ages

## Endnotes

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