Short and Long Term Effects of Headstart

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Abstract

Introduction

Head Start is a nationwide preschool program targeted at children who come from socioeconomically disadvantaged backgrounds. The program, started in 1965 as part of the 'War on Poverty', is funded federally. Head Start has helped over 30 million children and their families in all 50 states, the District of Columbia, Puerto Rico and the U.S. territories. It provides comprehensive early childhood education, health, nutrition, and parent involvement services to these children and their families. It helps create healthy development in children ages three to five from low-income families.

The children are eligible based on the net family's income. Although each local program includes other eligibility criteria, such as disabilities and services needed by other family members. Families must earn less than the federal poverty level. Families sometimes may qualify under a categorical eligibility category. Kids from higher income families or families experiencing emergency situations can be enrolled up to 10% of any funded program. While the Obama administration consistently increased the funding for the Head Start program, the Trump administration has cut down the budget allocated for education and training outlays by about 45.7% - which severely impacted Head Start programs. This brought us to our research question: Is Head Start effective? Does it have any short-term and/or long-term benefit on its participants? Does this effect vary for different races? Many studies have been conducted during Head Start's multi-decade history to measure its effectiveness. Based on our literature review of the subject, there seems to be no academic or political consensus about the program's effectiveness

CCR Analytics published their results in 2014, studying 49,467 children assessed in the 2012-2013 school year from 81 Head Start programs throughout California. The study was open to all California Head Start programs participants who used the DRDP-PS 2010 assessment tool. It found that providing two years of Head Start to a child increases the probability by at least 13% that the child will be ready for school. In 2009, David Deming evaluated the program, using the National Longitudinal Survey of Youth (NLSY 79 data). He compared siblings and found that those who attended Head Start showed stronger academic performance, more likely to graduate from high school and attend college, and less likely to suffer from poor health as an adult. We are using Deming's dataset as our primary dataset to explore the causality effects and see if we can get similar results or have something new waiting for us.

According to Lee, who collected data across sixty Head Start classrooms in 2007 and 2008, Head Start is associated with significant gains in test scores and significantly reduces the probability that a child will repeat a grade. In 2005, Barnett and Hustedt reviewed the literature and stated that although the reviews found were mixed, they were generally positive. According to the Administrative History of the Office of Economic Opportunity, children who finish the program and are sent to disadvantaged schools perform worse than their peers by as early as second grade. Only by isolating such children and sending them to better schools could gains be sustained. Time magazine's columnist Joe Klein, in 2011, called for the elimination of Head Start, citing an internal undisclosed report that the program is costly and makes a negligible impact on children well-being. W. Steven Barnett, director of the National Institute for Early Education Research at Rutgers University, rebutted Klein stating that the weighing all of the evidence and not just that cited by partisans on one side or the other leads to the most accurate conclusion that Head Start produces modest benefits including some long-term gains for children.

Methodology

Given that the National Longitudinal Survey of Youth consisted of survey participants from 1979 to 2004, there was a number of significant data processing steps needed prior to any analysis. With 12,686 participants spanning nearly two decades, the principal population we would be targeting their early childhood to young adulthood time frames. Individuals were interviewed annually until 1994, and then biennially afterwards. The age of the cohort within the survey consisted of individuals born between 1957 and 1964. The gender ratio was split approximately 50:50 between men and women (6,403) males and (6,283) females. Our goal on understanding on the short and long term effects of the Head Start program, focused on the subset of children born to the female NLSY79 respondents.

Using a subset of data created by Deming in his paper *"Early Childhood Intervention and Life-Cycle Skill Development: Evidence from Head Start,"* we utilized a subset of 11,470 children from the NLSY79 survey to conduct our paper. The first step was the identify which independent and dependent variables that we would examine. With variables ranging from whether or not a child had a disability to asthma, income levels at 3 years hold, to test scores on the Peabody Individual Achievement Test (PIAT) for both Math (PIATMT) and Reading Comprehension (PIAT), the goal was to read though the 882 variable list and find the features that we think would be useful to define both our research question, and provide the underlying dataset to demonstrate our findings. A summary of children who participated within the survey and are included in our research data set are included in the results section. With this in mind, we focused on the following variables to help us answer our question:

- **Composite Scores from ages 6 to 11**
- **Composite Scores from ages 12 to 14**
- **Composite Scores from ages 15 to 18**
- **Peabody Picture Vocabulary Test (PPVT) at 3 years old**
- **High School Graduation**
- **College Enrollment**
- **Grade Repetition**
- **Self Reported Health**

The **Composite Scores** were generated by selecting the number of children throughout the survey time frame who were at a given age at any given time. The composite score was generated from multiplying the percentile scores of each child from the Peabody Picture Vocabulary Test, Peabody Individual Achievement Math Test, Peabody Individual Achievement Reading Comprehension Test. The goal behind this design was such that all participating children within the study can be ranked and compared within each year's cohorts, as well as across time between cohorts.

The **Peabody Picture Vocabulary Test** itself was the direct raw score from when the child was tested at 3 years old from the years 1986, 1988, and 1990.

The **High School Graduation** was a indicator variable generated from whether or not a child every graduated from high school. Given that we have different cohorts of children each reaching and completing high school at different years, this indicator variable would be 0 for children who have not reached and completed a high school education, i.e. a child born in 1998, was aged 6 in the year 2004, and therefore, has a High School Graduation variable as zero.

College Enrollment was an indicator variable structured much like High School Graduation. If a child ever reached 13 years of educations, namely, a university/college institution, this variable would become 1 and 0 otherwise. Children who were too young, would still have an result of 0.

Grade Repetition was an indicator variable based on whether or not a child ever repeated one or more grades from primary (elementary), secondary (middle and high), and tertiary school (university) levels.

Self Reported Health was an indicator variable based on whether or not an individual ever reported a less than 3 on a scale of 5 during the survey.

Results and Analysis

Summary Table

We first begin with a summary table of the total number of children broken down by age, education level, and primary variables of interest.

Table 1: Children Summary

Age	Grade	School Type	Total	PIAT Participants	Non-HeadStart	HeadStart
6 Years Old	Kindergarden	Elementary School	4727	3425	3939	788
7 Years Old	1st Grade	Elementary School	5095	3510	4281	814
8 Years Old	2nd Grade	Elementary School	4955	3363	4127	828
9 Years Old	3rd Grade	Elementary School	5187	3370	4348	839
10 Years Old	4th Grade	Elementary School	4969	3238	4109	860
11 Years Old	5th Grade	Elementary School	5110	3155	4268	842
12 Years Old	6th Grade	Middle School	4754	2882	3917	837
13 Years Old	7th Grade	Middle School	4806	2719	4019	787
14 Years Old	8th Grade	Middle School	4366	2439	3581	785
15 Years Old	9th Grade	High School	4385	276	3656	729
16 Years Old	10th Grade	High School	3876	164	3164	712
17 Years Old	11th Grade	High School	3759	98	3129	630
18 Years Old	12th Grade	High School	3295	39	2684	611

As we have children born to females from the NLSY79 survey, there is a spread of children who become eligible for the Head Start Program at different years. We resolve this issue by tabulating the data to reflect specific criteria based on a child's age, rather than the current calendar year. Reading the table from the first row, we see that there are a total of 4,727 children in the survey who were aged 6 at some point in the survey time frame: 3,425 took a PIAT test at age 6, 3,939 did not participate in a Head Start program, and 788 participated in a Head Start program. Note, that the subset of 6 year old contain children who were born in 1979 up to 1998. This would give reason as to why for the last row of the table, there are only 3,295 children who were aged 18 - these are the children who were born from 1979 to 1986, and then through the course of the survey, continued to participate.

Linear Modeling of Composite Scores

Our first approach was to define an measure the impact of Head Start programs to the Peabody Picture Vocabulary Test, Peabody Individual Achievement Math Test, and Peabody Individual Achievement Reading Comprehension Test for each child. As the survey was administered annually up to 1994 and then biennially to 2004, we have target data of most children for each year, specifically whether or not they took the PIAT tests. But as the level of participation dropped as the survey moved forward, the data we have for effects when children are older are much smaller. The reasoning for this phenomena is currently unknown. Given this, a decision was made to categorize and analyze children based on age ranges rather than specific ages. This would allow an additional level of functional analysis on the school type level, namely, the effects of Head Start on Elementary, Middle, and High School children.

In the dependent variables, we have broadly categorized individuals aged 6 to 11 as Elementary School children, 12 to 14 as Middle School, and 15 to 18 as High School; with **compscore6to11**, **compscore12to14**, and **compscore15to18**, reflecting each category respectively. While in the independent variables, we have a similar list of variables from Elementary School to Middle School. The reason why **Father_HH_0to3** and **PPVTat3** were excluded from the High School Linear Model was because at this point in time, there were no values reported in either variable for each children who participated in the PIAT testing - all values for these two variables were Not-Available. Because of the time frame of the survey, not all children consistently participated in the PIAT tests used to run our regression models.

Table 2: Composite Score based on Age

	Dependent variable:		
	compscore6to11	compscore12to14	compscore15to18
	(1)	(2)	(3)
Hispanic	-4.579^{**} (1.907)	-1.863 (2.526)	-11.757^{***} (3.780)
Black	-2.737 (2.000)	-8.914^{***} (2.604)	-15.190^{***} (3.090)
Male	2.240^{*} (1.242)	2.986^{*} (1.638)	2.087 (2.167)
FirstBorn	4.606^{***} (1.337)	5.938^{***} (1.751)	4.353 (2.705)
LogInc_0to3	2.379^{**} (0.938)	1.657 (1.217)	2.866^{*} (1.474)
MothED	1.291^{***} (0.307)	1.362^{***} (0.399)	1.454^{***} (0.476)
Father_HH_0to3	0.852 (1.780)	2.481 (2.286)	
PPVTat3	0.499^{***} (0.053)	0.377^{***} (0.070)	
logBW	7.880^{**} (3.274)	4.757 (4.424)	15.247^{***} (4.945)
Repeat	-10.868^{***} (1.571)	-11.847^{***} (2.080)	-17.849^{***} (2.249)
PoorHealth	-3.102 (2.141)	-1.535 (2.775)	-3.916 (3.289)
Age_Moth_Birth	0.344 (0.268)	0.695^{*} (0.358)	-0.135 (0.796)
headstart	-6.784^{**} (3.016)	-0.296 (4.087)	-3.972 (6.371)
mentaldisability	-32.962^{***} (11.989)	-35.748^{*} (20.838)	-29.677^{***} (11.322)
learndisability	-11.593^{***} (3.898)	-10.951^{**} (5.326)	-19.547^{***} (4.612)
Hispanic:headstart	4.190 (4.453)	-7.938 (5.917)	4.716 (8.204)
Black:headstart	5.806 (3.700)	1.122 (4.943)	-1.403 (7.000)
Constant	-45.298^{**} (17.927)	-30.703 (24.159)	-60.337^{**} (29.132)
Observations	683	629	347
Log Likelihood	$-2,848.009$	$-2,767.487$	$-1,507.726$
Akaike Inf. Crit.	5,732.018	5,570.974	3,047.451
Note:			*p<0.1; **p<0.05; ***p<0.01

In terms of magnitude (the absolute value of the coefficient) and significance (p-value), the independent variables that we see that are the biggest factors in a child's testing performance were:

- Race:
  - **Hispanic**: whether the child was Hispanic, 0 or 1.
  - **Black**: whether the child was Black, 0 or 1.
- Socioeconomic factors:
  - **FirstBorn**: whether or not the child was the eldest among siblings, 0 or 1.
  - **LogInc_0to3**: the log scale income of the child from ages 0 to 3.
  - **Mother ED**: the mother's age in years/
  - **logBW**: a log scale of the child's weight at birth.
  - **Repeat**: whether or not the child ever repeated a grade, 0 or 1.
- Individual Factors
  - **mentaldisability**: whether or not this child was diagnosed with a mental disability, 0 or 1.
  - **learndisability**: whether or not this child was diagnosed with a learning disability, 0 or 1.

Overall, we find that the role of Head Start on a child's short term (Elementary School), to long term (High School), effects to be insignificant at best and negative in magnitude at worst. Whether or not this was attributed to the significant (almost 1/2 decrease) drop in participating children in the survey or because the effects of Head Start (in terms of what it teaches a child and its relevance to subsequent testing parameters) were not related to what was being assessed in the PIAT tests. What we can definitively was that throughout a child's formative years, mental health and learning disability, followed by whether a child has needed to repeat a grade level, and race, play a significant role in their success. When we interact race with participation with Head Start, we find that there are no significant effects found.

Effects of Head Start on PPVT at Age 3

We decided to use a mixture of linear models and logit models to analyze the effect of Head Start on the outcome variables of **PPVTat3**, **somecollege**, **hsgrad**. The table showing effects of Head Start on **PPVTat3** is a linear model. The tables showing Head Start on **somecollege** and **hsgrad** are logit models, and the coefficients for both were exponentiated for ease of interpretation.

Table 3: Headstart effect on PPVT Scores at Age 3

	Dependent variable:			
	PPVTat3			
	(1)	(2)	(3)	(4)
headstart	-6.741^{***} (1.054)	-6.739^{***} (1.055)	-2.992^{***} (1.010)	-3.440^{**} (1.677)
Hispanic			-8.504^{***} (1.073)	-8.274^{***} (1.173)
Black			-12.205^{***} (0.946)	-13.120^{***} (1.066)
Male		0.030 (0.852)	0.193 (0.783)	0.702 (0.777)
hsgrad				3.046^{***} (0.785)
FirstBorn				3.721^{***} (0.784)
headstart:Black				3.125 (2.245)
headstart:Hispanic				-1.380 (2.717)
Constant	25.028^{***} (0.477)	25.013^{***} (0.645)	29.140^{***} (0.671)	25.691^{***} (0.875)
Observations	984	984	984	984
R^2	0.040	0.040	0.191	0.228
Adjusted R^2	0.039	0.038	0.188	0.222
Residual Std. Error	13.348 (df = 982)	13.355 (df = 981)	12.270 (df = 979)	12.014 (df = 975)
Note:				*p<0.1; **p<0.05; ***p<0.01

We begin in column 1 by regressing the data for **PPVTat3** only on **headstart** using a linear model. The effect of the Head Start program in this model shows a very statistically significant, yet negative effect of -6.741. The linear model in column 4 includes **Hispanic**, **Black**, **Male**, **hsgrad**, **FirstBorn**, and interaction terms for **headstart** with race. The very (p-value <0.01) significant variables from this regression are **headstart**, **Hispanic**, **Black**, **Male**, **hsgrad**, and **FirstBorn**. The **Black** variable has a very large average effect (-13.120) on the outcome of **PPVTat3** scores and is the largest in magnitude. The **headstart** variable still has a significant (p-value <0.05) but is smaller in magnitude and less significant than that of previous regressions with less variables. This means that participation in Head Start has a consistently negative effect on **PPVTat3** with the data provided in our dataset after controlling for other very significant variables. Given that the children who participate in Head Start are likely to come from disadvantaged socioeconomic backgrounds, this plays an important factor in the following models there are negative effects for Head Start. However, this does not mean that Head Start causes lower test scores, this just means that there is a selection bias for children who participate in Head Start. The model in column 4 includes variables that were shown to explain a significant amount of variation in the original dataset and were therefore chosen to be included in order to convey the decreasing marginal effect of Head Start on **PPVTat3** scores at age 3.

Effects of Head Start on College Enrollment

Table 4: Headstart effect on College Enrollment

	Dependent variable:			
	somecollege			
	(1)	(2)	(3)	(4)
headstart	1.625*** (0.055)	1.637*** (0.056)	1.308*** (0.058)	0.841*** (0.130)
Male		0.740*** (0.045)	0.737*** (0.045)	0.679*** (0.050)
Black			1.997*** (0.053)	1.982*** (0.069)
Hispanic			1.619*** (0.059)	1.649*** (0.073)
LogInc_0to3				1.145*** (0.032)
headstart:Black				1.491*** (0.158)
headstart:Hispanic				1.249*** (0.186)
Constant	0.275*** (0.025)	0.318*** (0.032)	0.243*** (0.040)	0.112 (0.344)
Observations	11,470	11,470	11,470	7,485
Log Likelihood	−6,162.935	−6,140.100	−6,049.910	−4,664.154
Akaike Inf. Crit.	12,329.870	12,286.200	12,109.820	9,344.308
Note:				*p<0.1; **p<0.05; ***p<0.01

The effect of Head Start on college enrollment is measured by the indicator variable **somecollege**. We used a logit model to measure the effects of going to college. Note, the coefficients in the table have been exponentiated for ease of interpretation. Simply running a regression of **headstart** on **somecollege** shows that **headstart** has a very significant effect on the outcome of having college enrollment. The odds of attending college are increased by a factor of 1.625. However, this effect is shown to decrease the odds of attending college when controlling for other significant variables such as **Male**, **Black**, **Hispanic**, **LogInc_0to3**, and interaction **headstart** race variables. In column 4, which all variables, the odds of enrolling in college are 0.841 if you participated in the **headstart** program and is very significant. This tells us that after controlling for other highly significant variables, that attending the Head Start program actually hurt your odds of enrolling in college. Once again, this can be explained by the type of individuals who participate in Head Start coming from disadvantaged background compared to more affluent peers.

Effects of Head Start on Highschool Graduation

In order to measure the effect of Head Start on whether a child graduates High School we decided to use a logit model in order to tell us the odds ratio. To start in column 1, we regressed **headstart** on

Table 5: Headstart effects on High School Graduation

	Dependent variable:			
	hsgrad			
	(1)	(2)	(3)	(4)
headstart	1.625*** (0.055)	1.637*** (0.056)	1.308*** (0.058)	0.854*** (0.130)
Male		0.740*** (0.045)	0.737*** (0.045)	0.677*** (0.050)
Black			1.997*** (0.053)	1.933*** (0.069)
Hispanic			1.619*** (0.059)	1.695*** (0.074)
LogInc_0to3				1.088*** (0.035)
MothED				1.044*** (0.011)
headstart:Black				1.473*** (0.158)
headstart:Hispanic				1.229*** (0.186)
Constant	0.275*** (0.025)	0.318*** (0.032)	0.243*** (0.040)	0.112 (0.342)
Observations	11,470	11,470	11,470	7,479
Log Likelihood	−6,162.935	−6,140.100	−6,049.910	−4,650.817
Akaike Inf. Crit.	12,329.870	12,286.200	12,109.820	9,319.634
Note:				*p<0.1; **p<0.05; ***p<0.01

hsgrad and then exponentiated the coefficients for the all the regressions included in the table. When regressing **headstart** only on **hsgrad** we see that being enrolled in the program increases the odds of graduating High School by a factor 1.625 and is very significant. Column 4 includes the variables **Male**, **Black**,**Hispanic**,**LogInc_0to3**,**MothED**, and **headstart** interaction terms. Once again, the effect of **headstart** improves the odds of graduating High School by a factor of 0.854 and is statistically significant. Once we add for other important and highly significant variables, the **headstart** variable decreases the odds of graduating high school. We believe that this is caused by selection bias within our dataset as the effects in Deming's original research paper also showed this result on High School graduation.

Effect of Head Start on Grade Repetition

We try to see if children who attend Head Start have a higher or lower probability of repeating their grade. We compare Head Start participants to children who would otherwise be eligible but did not participate.First, we take into consideration children whose family income is below the federal poverty level (<$22,000), we exclude observations with *"NA"* values as we don't want missing values to affect our analysis. Hence, we choose observations that have non missing values for **LogInc0to3**, **Father_HH_0to3**, **MothEd**, **FirstBorn**, **Age_Moth_Birth**. We run a logit model to see the effect of participation in Head Start on grade repetition. We run multiple regressions, controlling for various dependent variables and get the following results. It is important to note that the values in the table below are the odds ratio and not just the coefficients of the variables.

The odds of a Head Start participant ever repeating a grade as compared to a non Head Start participant is 0.924 and significant (p-value <0.05), while controlling for other variables. This odds ratio is even lower for Hispanics who attend Head Start program, however, Black children who attend Head Start have an odds ratio of 1.265 as compared to their non Head Start counterparts. This shows that Head Start participants in general have lower probabilities of repeating a grade as compared to non Head Start participants.

Effect of Head Start participation on Poor Health

NLSY79 collects data from various participants where they are asked to self-report their health condition on a 5 point scale. If they report it as either Poor (1) or Fair (2), as opposed to Good (3), Very Good (4) or Excellent (5), we categorize them as self-reported Poor Health. We ran multiple logit regression models on

Table 6: Odds ratio of Head Start participants repeating a grade compared to non Head Start participants

	Dependent variable:		
	repeatgrade		
	(1)	(2)	(3)
headstart	0.997*** (0.182)	1.006*** (0.186)	0.924** (0.425)
Hispanic		0.992*** (0.270)	1.036*** (0.318)
Black		1.229*** (0.232)	1.096*** (0.293)
Male			1.627*** (0.184)
MothED		0.869*** (0.040)	0.873*** (0.040)
learndisability		1.278*** (0.451)	1.196*** (0.456)
headstart:Hispanic			0.748 (0.600)
headstart:Black			1.265*** (0.491)
Constant	0.115 (0.114)	0.510 (0.502)	0.386 (0.527)
Observations	1,367	1,367	1,367
Log Likelihood	−453.762	−447.080	−442.902
Akaike Inf. Crit.	911.524	906.159	903.804
Note:			*p<0.1; **p<0.05; ***p<0.01

Head Start participation and self-reported Poor Health compared to non Head Start participants. The table below summarizes our odds ratios.

Table 7: Odds ratio of Head Start participants reporting poor health compared to non Head Start participants

	Dependent variable:		
	PoorHealth		
	(1)	(2)	(3)
headstart	0.750*** (0.194)	0.762*** (0.197)	1.116*** (0.396)
Hispanic		1.003*** (0.262)	1.214*** (0.309)
Black		0.889*** (0.231)	1.016*** (0.285)
Male		0.551*** (0.189)	0.543*** (0.189)
logBW		0.483 (0.355)	0.482 (0.355)
headstart:Hispanic			0.500 (0.597)
headstart:Black			0.653 (0.478)
Constant	0.137 (0.112)	5.711*** (1.686)	5.202*** (1.688)
Observations	1,219	1,219	1,219
Log Likelihood	−421.094	−413.803	−413.088
Akaike Inf. Crit.	846.189	839.607	842.175
Note:			*p<0.1; **p<0.05; ***p<0.01

The Head Start participants are less likely in general to report Poor Health conditions as compared to non Head Start participants. However, when controlling for Head Start interactions with race, we get on average, a white Head Start participant is 1.12 times more likely to report Poor Health conditions as compared to a white non Head start participant. Black and Hispanic children however, are still less likely to report Poor Health conditions if they attend Head Start, although these results aren't statistically significant.

Effect of Head Start Participation on Post-High School Idleness

We now look at students who graduated from High School but neither enrolled in college nor went into the labor force. We measure *idleness* using an indicator variable, **Idle** which is 1 if the student neither enrolls in college nor enters the labor market and 0 if otherwise. By running logit regression models of Head Start participation on **Idle**, we get the following results.

Table 8: Odds ratio of Head Start participants being both out of school and labor force compared to non Head Start participants

	Dependent variable:		
	Idle		
	(1)	(2)	(3)
headstart	0.886*** (0.153)	0.845*** (0.161)	1.095*** (0.369)
Hispanic		1.995*** (0.228)	2.049*** (0.270)
Black		1.464*** (0.211)	1.523*** (0.256)
Male		0.660*** (0.154)	0.618*** (0.153)
logBW		1.036*** (0.333)	
hsgrad			0.701*** (0.162)
headstart:Hispanic			0.644 (0.484)
headstart:Black			0.822* (0.423)
Constant	0.214** (0.094)	0.156 (1.586)	0.202 (0.233)
Observations	1,285	1,219	1,285
Log Likelihood	−584.788	−551.419	−574.564
Akaike Inf. Crit.	1,173.575	1,114.837	1,165.129
Note:			*p<0.1; **p<0.05; ***p<0.01

The odds ratio of Head Start participants who are *Idle* are compared to non Head Start participants. The odds ratio of Head Start participants seem to follow a similar pattern as the self-reported Poor Health. Head Start participants in general are less likely than non Head Start particpants to be idle. However, when controlled for Head Start interactions with race, Hispanic and Black Head Start participants are less likely to be idle compared to their non Head Start counterparts. However, White Headstart participants are just as likely to be idle compared to their non Head Start counterparts.

Conclusion

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