Does Mother's Involvement Matter for The Cognitive Development of Interracial Children? Testing the Race of the Mother Hypothesis.

Abstract

Extensive research has been conducted on the effect of mothers' socialization on their children's cognitive test scores. But less is known about the relation between mothers' race/ethnicity and the performance of children from interracial families. It has been proposed by Willerman et al. (1974) that cognitive scores of interracial children will be more similar to those of the mother's race/ethnic group. This is because the mother is the main agent of socialization in youth and adolescence and, as such, the mother provides most of the environmental stimulation. Using the Collaborative Perinatal Project (CPP) and the High School Longitudinal Study of 2009 (HSLS: 2009) data, the current study re-analyzes Willerman et al.'s (1974) observation that mother's race is a strong determinant of the child's cognitive ability. In both datasets, we did not find consistent support for the mother's involvement hypothesis. Furthermore, in the CPP, which was analyzed prior by Willerman et al. (1974), it was found that the earlier superior IQ scores of interracial children of White mothers at age 4 eventually fade out at age 7. Alternative theories are considered.

Keywords : Cognitive ability, race, maternal involvement

1. Introduction

Over the past decades, there were many opportunities at raising children's intelligence over time. These measures include education and training programs, and adoption into wealthy families. A large body of evidence shows that educational induced gains often do not have a lasting effect on intelligence test scores (Brody, 1992, pp. 174-185; Besharov et al., 2011; te Nijenhuis et al., 2015; Protzko, 2015; Ritchie et al., 2015). This conclusion is relevant to the discussion of the impact of cognitively stimulating environments on intelligence. Especially among minority groups, as often these education programs involved minority children. The mother's socialization effect was proposed by Protzko et al. (2013) as an explanation for this fade-out effect. They suggested that mothers must encourage their children to seek more cognitively demanding environments in order to sustain their improved cognitive gains.

This mother's socialization effect was mentioned prior by Willerman et al. (1974) who proposed what we call the "race of the mother hypothesis". They argued that if racial differences in intelligence test performance are determined by additive genetic factors, then test scores for children of interracial matings should be independent of the maternal race. But if, on the contrary, test differences between races have an environmental basis, then the children of interracial matings should more closely resemble the mother since she is the primary agent of socialization during the early years. Willerman et al. (1974) reported that the interracial infants tested at 8 month of age did not show any deficits related to having a Black mother but that the interracial children of Black mother tested at age 4 show a deficit of 9 IQ points. They interpreted this outcome as supporting the hypothesis that White mothers provide superior postnatal environments compared to Black mothers. In this case, mother's race is used as a proxy for mother's involvement. A large body of research (Seginer, 1986; McBride et al., 2009: Boonk et al., 2018) indicates indeed that parent

involvement in the children's education, especially mother involvement, is associated with improved children's academic achievement. With respect to interracial groups, Arcidiacono et al. (2015) tested the mother's race effect among Black and Hispanic minorities in the Add Health data and found support for Willerman's hypothesis. As these findings are scarce, it is of interest to investigate further the mother's socialization effect on cognitive development among interracial families.

The competing hypothesis is what Jensen (1998) termed as the Spearman's hypothesis, which states that between-group differences are a function of the cognitive test's *g*-loading, which is tied to complexity. The *g* factor, specifically, is known for having impactful social outcomes (Gottfredson, 1997). According to this theory, one should expect environmentally induced cognitive gains for either group being inversely correlated with the *g* factor due to such cognitive gains fading away as the children are transitioning to adulthood as complexity increases at a time when the true level of *g* reasserts itself (Spitz, 1991). One interpretation of this pattern is that *g* has a strong genetic basis when it comes to group differences (Lasker et al., 2019; Fuerst et al., 2021).

The present study provides a follow-up analysis of Willerman on the CPP public dataset, using IQ test scores at age 7, and by extending the analysis to Asian and Hispanic (Puerto Rican) groups. Furthermore, the HSLS public dataset is also analyzed in a similar fashion, by comparing the cognitive scores of minority children (Blacks, Asians, Hispanics) from interracial families. Our expectation is that Black and Hispanic mothers provide less stimulating cognitive environments to their children compared to White mothers, whereas Asian mothers provide more stimulating cognitive environments (Kim et al., 2013), hence providing a cultural explanation for their score differences, as they are used as a proxy for mother's involvement. Our analyses take into account SES as a control variable since, according to Willerman, the mother's effect should be significant above and independent of SES.

2. Method

2.1. Collaborative Perinatal Project

2.1.1. Data

The Collaborative Perinatal Project (CPP) is a national multi-site prospective cohort study that recruited 48,197 pregnant women at 12 university-affiliated medical centers between 1959 and 1966. The CPP is a longitudinal data which followed women and their offspring through pregnancy, delivery, and the first 7 years of the children's life (Broman, 1984) and was carefully conducted with a follow-up rate of 79% at age 7 (Niswander & Gordon, 1972). The study aimed at understanding how biomedical, environmental (socioeconomic factors), and genetic factors interact to influence pregnancy outcomes and child health.

Out of the 41,911 children who were followed and underwent neurological examination at age 7, those who had no or inadequate intelligence test results were excluded as well as children whose mothers did not report socioeconomic data. The study sample (N=174 at age 4, N=149 at age 7) included offspring with complete data on the variables of interest.

2.1.2. Cognitive Test and Demographic Variables

The 4-year assessment was based on the Stanford–Binet IQ scale. Full scale Intelligence Quotient (FSIQ) was assessed using the Wechsler Intelligence Scale for Children (Wechsler, 1949), which contained 7 subtests that evaluate different areas of cognition including verbal (VIQ) (information, comprehension, digit span, vocabulary) and performance intelligence (PIQ) (picture arrangement, block design, coding). The Information, Comprehension, and Vocabulary subtests of Verbal IQ tap verbal comprehension, and the Digit Span subtest taps working memory. The Picture Arrangement and Block Design subtests of Performance IQ assesses perceptual reasoning/organization, whereas the Coding subtest assesses processing speed. The Wechsler full-scale IQ includes a combination of both the verbal and performance IQ measures.

Demographic variables used in the analysis include sex, race, marital status, parents' years of education, and socio economic index. The socioeconomic index variable is based on an average of a set of rankings of paternal (or other head of household) education, occupation, and family income. With respect to the marital status variable, we treated this one as a dichotomy variable in which the categories "married" and "common law" are coded as 1 and any other category such as "single", "widowed", "divorced", "separated" and "unknown" as 0.

2.2. High School Longitudinal Study 2009

2.2.1 Data

The National Center for Education Statistics (NCES)' High School Longitudinal Study 2009 (HSLS:09; Duprey et al., 2018) is based upon a nationally representative sample of entering 9th-graders in the fall of 2009 who were selected from a nationally representative sample of high schools with 9th and 11th grades. The original sample was recruited based on a two-stage stratified random sample design with schools randomly selected in the first stage and then students randomly selected from the sampled schools in the second stage (Ingels et al., 2011). In 2009, 21,444 9th-grade students from 944 schools, their parents (or guardians), math and science teachers, along with their school administrators and counselors completed the base-year surveys. NCES conducted the first follow-up in 2012, followed by the 2013 update which included the collection of students' high school transcripts (collected after students were scheduled to graduate), and finally the second follow-up in 2016. The current study includes students' and parents' responses to the base-year and first follow-up questionnaires to obtain students' demographic data as they contain relevant data under investigation in this paper.

2.2.2. Cognitive Test and Demographic Variables

Mathematics assessments were available and used as an approximation to cognitive tests, which provide a measure of achievement in algebraic reasoning. In both the base year and the first follow-up, the assessment was administered by computer using a two-stage design. In the first stage, each student took a common Stage 1 router test. On the basis of Stage 1 performance, each student was routed to a low, moderate, or high level of difficulty Stage 2 test.

Demographic variables used as a control in this study are: race, gender, parents' highest level of education and their mutual interactions.

Because the study sample comprised respondents from the base-year survey and new respondents in the first follow-up survey, we averaged the corresponding variables of these two waves (e.g., Math scores and parent education).

We used the sampling weights provided by NCES (Duprey et al., 2018) for the base year and the first follow-up. The use of sampling weights is often recommended for adjusting for sampling methods (e.g., oversampling bias and nonresponse) and producing representative estimates (Duprey et al., 2018; Ingels et al., 2011). Since the present analysis includes base-year as well as the first follow-up student data, the follow-up longitudinal weight (W2W1STU) is the recommended variable of choice.

The study sample only includes respondents with complete data on the variables of interest We gathered a subsample of 567 respondents (N=71 for White-Black interracials; N=373 for White-Hispanic interracials; N=123 for White-Asian interracials). The subsample of the Black minority is small mainly because we considered respondents living with both parents. One possible explanation is that the number of households without a father in the U.S. is relatively high among Blacks, and this was evidenced in the data. Of a total black sample of 2,450, there were 1,001 respondents who lived with both of their biological parents, there were 114 who lived with only the father as biological parent, and there were 977 who lived with only the mother as biological parent.

3. Results

3.1. CPP

We first disclose data on parent education by parent's race and look for patterns. In Table 1, we notice that the two parents in the White mother and Black father couple average almost one more year of education than the parents in the Black mother and White father couple. The same pattern holds for the parents in the White mother and Asian Father couple who are both more educated than the Asian mother with White father. A surprising result comes from the White-Hispanic couples, as both parents in the Hispanic mother and White father couple have one more year of education than the White mother with Hispanic father. In general, the gap in education is greater among fathers.

Table 1. Parent Education by Mother and Father's Race in the CPP

Race of Mother	Race of Father	Mother's Education			Father's Education		
		Mean	N	SD	Mean	N	SD
White	Black	11.207	116	2.172	11.647	99	2.869
Black	White	10.775	40	2.094	10.629	35	2.798
White	Asian	13.438	16	3.483	14.688	16	3.807

Asian	White	13.000	17	2.784	13.882	17	3.998
White	Hispanic	9.128	78	2.349	9.515	66	3.119
Hispanic	White	10.060	67	2.461	10.627	59	2.870

Table 2. IQ Scores For 4- and 7-years-old Children Among Interracial Families (Controlled for SES and gender)

		Age 4			Age 7		
Interracial Mating	Race of Mother	Mean*	N	SD	Mean*	N	SD
White-Black	White	0.406	69	0.966	0.347	71	0.879
	Black	-0.054	22	0.802	0.099	22	0.556
White-Asian	White	-0.020	9	1.075	0.522	11	0.539
	Asian	0.496	11	1.001	0.635	12	0.771
White-Hispanic	White	-0.247	37	0.908	-0.019	28	0.813
	Hispanic	0.207	26	0.727	0.367	5	0.532
Control Group							
All White		0.268	16714	1.028	0.268	18201	0.983
All Black		-0.198	18732	0.924	-0.232	19649	0.952
All Asian		0.264	75	1.018	0.674	84	1.000
All Hispanic		-0.378	2022	0.889	-0.302	1318	0.955

*Mean values are expressed in z-scores.

Table 3. IQ Scores For 4- and 7-years-old Children Among Interracial Families (Controlled for gender only)

		Age 4			Age 7		
Interracial Mating	Race of Mother	Mean*	N	SD	Mean*	N	SD
White-Black	White	0.349	72	0.943	0.305	74	0.783
	Black	-0.064	22	0.704	0.097	22	0.578
White-Asian	White	0.387	9	0.876	0.930	11	0.636
	Asian	0.890	11	0.955	1.123	12	0.683

White-Hispanic	White	-0.280	38	0.889	-0.134	29	0.776
	Hispanic	0.180	27	0.690	0.164	6	0.411
Control Group							
All White		0.449	17126	1.000	0.455	18690	0.953
All Black		-0.349	19225	0.843	-0.397	20209	0.857
All Asian		0.672	76	1.020	1.099	84	0.991
All Hispanic		-0.481	2052	0.797	-0.432	1356	0.873

*Mean values are expressed in z-scores.

Before computing IQ mean scores controlling for SEI, we start a preliminary analysis involving a regression of IQ at age 7, controlled for gender, race, marital status, SEI variable, as well as all of the possible interactions among gender, race, and marital status variables, for all groups separately. In the full model, SEI had a large effect for all groups while race had a large effect only among Black and Hispanic groups.

For the comparison of IQ mean scores between groups, the computation included SEI and gender variables as controls. Table 2 displays the results controlled for SEI and gender at age 4 and 7 respectively. We confirm the mother's socialization effect among Black and Asian families, but not among Hispanic mothers since they had children with higher cognitive scores, at age 4. A closer inspection reveals that children of White mothers and Asian fathers have almost the same score as children of Black mothers and White fathers. The depressed score of children with White mothers and Asian fathers was likely an outlier at age 4, which then disappeared at age 7. In general, at age 7, this mother's effect decreases significantly among interracial Black families, with an advantage of 0.46 standard deviation for White mother at age 4 to an advantage of only 0.25 standard deviation for White mother at age 7, and interracial Asian families, with an advantage of 0.52 standard deviation for Asian mother at age 4 to an advantage of only 0.11 standard deviation for Asian mother at age 7, but only by a very small amount among interracial Hispanic families with an advantage of 0.45 standard deviation for Hispanic mother at age 4 to an advantage of 0.39 standard deviation for Hispanic mother at age 7. The finding that the Hispanic mother, rather than White mother, is associated with higher IQ score does not confirm the mother's involvement hypothesis.

Upon closer inspection however, when data are disaggregated by marital status, we observe that among interracial Black families, the decline in the IQ gap at age 7 only occurred among the married mothers, not the unmarried mothers, for which the gap is still very large at age 7 (Results available in the Supplemental Material).

We then replicate the analysis without controlling for the SEI variable in order to account for possible moderators. Table 3 displays the results after controlling for gender only. The same pattern holds at both ages for all groups. We still notice a decline of about the same magnitude in the mother's effect at age 7.

As a robustness check, we compare the interracial groups' scores to the mean score of the control groups. At both ages, we observe that the scores of interracial children on average fall in between the majority group and their own respective minority group, as one would normally expect. A curious pattern we observe is the fact that children of White mothers and Black fathers consistently score above the White group after controlling for SEI but not before. It seems SEI moderates the advantage of the interracial children of White mothers with Black fathers.

To further investigate the relationship between parents' contribution to respondents' score, a multiple regression using the Full Scale IQ at age 7 as the dependent variable is performed within each interracial group. This is done by restricting the samples to intermarried couples (e.g., White mother and Black father couples as well as White father and Black mother couples being grouped into a single White-Black group variable), so as to produce accurate estimates. Holding constant the effect of sex and socio economic status, the effect of mother's race is evaluated. The mother's race variable was coded as 0 for the White majority group and 1 for the minority group.

Among the White-Black families, the Black mother variable shows a negative value (β=-0.154, *p*=0.122). Among the White-Hispanic families, the Hispanic mother variable shows a modest positive value (β=0.175, *p*=0.313). Among the White-Asian families, the Asian mother variable shows a small positive value (β=0.106, *p*=0.612). None of these correlations reach significance due to the small sample sizes.

While the children were still young and the genotypic aspect of IQ not yet fully expressed, the result seems to suggest that the environmental advantage would decrease over time.

3.2. HSLS

We first display the data on parent education and look for patterns. In Table 4, we observe a pattern that is different from the CPP. Both parents in the Black mother and White father couple have higher education than the White mother with Black father. But similar to the CPP, the Hispanic mother with White father both average a slightly higher education than the White mother with Hispanic father. On the other hand, the difference is much greater among White-Asian families favoring both parents in the White mother and Asian father couple.

Table 4. Parent Education by Mother and Father's Race in the HSLS

Race of Mother	Race of Father	Mother's Education			Father's Education		
		Mean	N	SD	Mean	N	SD
White	Black	2.7973	61	1.1187	2.7947	59	1.1884
Black	White	2.9798	17	1.3141	3.0629	17	1.9483
White	Asian	3.7261	35	1.8209	4.2883	35	1.9268
Asian	White	3.2877	96	1.3126	3.7040	95	1.6559

White	Hispanic	2.9141	192	1.0556	2.8557	189	1.3353
Hispanic	White	3.0332	212	1.3465	3.1089	212	1.4719

Before computing Math scores controlling for parent education, a preliminary test requires checking for potential confounders. We thus included sex, race, parent education and its interaction with sex, with race and then both. We ran the following nested regression models with Math assessment as dependent variable : 1) sex, race, parent education, 2) parent education and its interaction with sex, 3) parent education and its interaction with race, 4) parent education and its interaction with both race and sex. In all models, parent education has a substantial effect while race has a rather small effect, and the other variables did not contribute much to the variation of the dependent variable.

We then obtain the Math scores controlling for the effect of parent education and gender. Table 5 displays the Math scores by respondents' race and parent's race. We observe that the mother's effect is absent among White-Asian and White-Hispanic couples, whereas the mother's effect shows a negative impact on the children's score among White-Black couples, as the Black mother variable is associated with a much higher children's score, an advantage of 0.59 standard deviation. To find out if SES acts as a moderator, the results are replicated without controlling for SES and are displayed in Table 6. We observe the same pattern generally holds even before controlling for SES.

As a robustness check, we compare the interracial groups' scores to the mean score of the control groups. First, the interracial children of Black mothers shows a score advantage of 0.26 standard deviation compared to the mean of the White group when SES is accounted for but shows an advantage of only 0.10 standard deviation when SES is not controlled, which suggests that SES moderates their advantage. Furthermore, the interracial children of White-Asian couples shows a mean score which falls in between the White and Asian groups after accounting for SES but a score very close to the mean score of the Asian group before controlling for SES. Finally, the interracial children of White-Hispanic couples shows a score very close to the mean score of the Hispanic group after accounting for SES but a score which falls in between the White and Hispanic groups before accounting for SES. This latter pattern does not seem to support the mother's race hypothesis, as children of White-Hispanic families should have scored at least above the Hispanic mean after accounting for SES due to having a White mother.

Table 5. Mathematics Assessment Scores For Children Among Interracial Families (Controlled for SES and gender)

Interracial Mating	Race of Mother	Mean	N	SD
White-Black	White	-0.1303	56	0.7503
	Black	0.4601	15	0.8557
White-Asian	White	0.6681	33	0.6401

	Asian	0.5834	90	0.8295
White-Hispanic	White	0.0622	173	1.0924
	Hispanic	0.0983	200	1.1783
Control Group**				
All White		0.1999	5696	0.9419
All Black		-0.3603	500	0.9314
All Asian		0.8833	854	0.9890
All Hispanic		0.0489	988	0.9185

* The small sample for the Black children living with both biological parents is due to the fact that in the U.S., many Blacks live with the mother alone, and this pattern is also reflected in the present data.
** Groups are composed of both parents reporting being all White, or all Black, or all Hispanic, or all Asian.

Table 6. Mathematics Assessment Scores For Children Among Interracial Families (Controlled for gender only)

Interracial Mating	Race of Mother	Mean	N	SD
White-Black	White	0.0495	58	0.7089
	Black	0.5310	16	0.9936
White-Asian	White	1.1280	34	0.8202
	Asian	0.9201	93	0.8748
White-Hispanic	White	0.2398	179	1.0434
	Hispanic	0.2869	212	0.9570
Control Group**				
All White		0.4289	5966	0.9635
All Black		-0.1752	528	0.9117
All Asian		1.1135	911	0.9943
All Hispanic		-0.1538	1054	0.8941

* The small sample for the Black children living with both biological parents is due to the fact that in the U.S., many Blacks live with the mother alone, and this pattern is also reflected in the present data.
** Groups are composed of both parents reporting being all White, or all Black, or all Hispanic, or all Asian.

To further investigate the relationship between parents' contribution to respondents' score, a multiple regression is also performed within each interracial group. Holding constant the

effect of sex and parent education, the effect of mother's race is evaluated. The mother's race variable was once again coded as 0 for the White majority group and 1 for the minority group.

Among the White-Black families, the Black mother variable shows a strong positive value (β=0.298, *p*=0.000). Among the White-Hispanic families, the Hispanic mother variable shows a very small positive value (β=0.041, *p*=0.000). Among the White-Asian families, the Asian mother variable shows a very small negative value (β=-0.044, *p*=0.000).

Generally, these results indicate that the father's race seems to determine respondents' Math scores more than the mother's race does.

4. Discussion

Our findings do not exhibit a substantial mother effect among interracial families. In the CPP, the significant decrease in the mother's effect between age 4 and age 7 among Black-White families is consistent with the pattern observed in education programs and adoption studies (te Nijenhuis et al., 2014, 2015). In the HSLS data, the father's race determines the children's score more significantly than the mother's race. Generally, these results contradict the mother's involvement effect. Considering the assumption that Black/Hispanic mothers and Asian mothers provide, respectively, inferior and superior home environments in a way which explain their score differences, this wasn't evidenced in this data.

Nonetheless, the finding that the Black mother is still associated with depressed scores of interracial children at age 7 among unmarried couples is worth interpreting. It could be that the worst environment associated with having a single parent in the household prevented these children from catching up. But this doesn't explain why Hispanic mothers have children with higher scores compared to White mothers or why Asian mothers do not have children with significantly higher scores. Perhaps more importantly, it was found in both data that the children's cognitive score seems to closely resemble the education level of their parents. In the CPP, interracial families with White mothers show higher education levels and children with higher cognitive score whereas, in the HSLS, interracial families with Black mothers show higher education levels and children with higher cognitive score. It is possible that the children's score is more determined by the parents' characteristics related to their higher education level which cannot be accounted for solely by controlling for education or SES.

The result of the present study generally failed to replicate the findings of Willerman et al. (1974) and Arcidiacono et al. (2015). The latter study found that having a Black (or a Hispanic) mother is associated with lower verbal IQ in the Add Health. However, upon closer inspection, their regressions analyses evaluated the mother's race effect in the combined sample of the majority and minority groups. In other words, they didn't restrict the sample to interracial families in the same way as was done in the present study. This may have caused biased estimates of the mother's race effect.

On the other hand, the finding that father's race more strongly determines the children's math score in the HSLS data is rather unexpected considering that most studies found a positive relationship between the mother's involvement and the children's achievement (McBride et al., 2009) even though these analyses did not look into interracial families.

However, with respect to the HSLS data, Sheng (2021) also confirmed a stronger positive effect of the father's involvement. Not only did fathers show a higher level of involvement in school-based activities compared to mothers but it was found that the positive relationship between parent involvement and adolescents' GPA was stronger for the fathers.

While the positive effect of mother's involvement is a well documented finding, Beaver et al. (2014) noted that often these studies fail to account for genetic confounding. Indeed, not only it is known that family and home environments are substantially heritable (Kendler & Baker, 2007) but GCTA studies showed there is a strong evidence that genes which account for variances in intelligence and achievement are the same genes which account for variances in family SES (Trzaskowski et al., 2014; Marioni et al., 2014; Krapohl & Plomin, 2016). Using adoption-based design to isolate any possible genetic overlap between family variables and intelligence scores, Beaver et al. (2014) reported in the Add Health data that while both the father and mother's involvement positively affected children's verbal IQ at early age, such a positive effect disappeared when these children were examined seven years later. This result is consistent with the conclusion of the present study.

In general, data on racially mixed individuals are restricted to children tested at a very young age, well before the genotypic aspect of IQ fully manifests. Since cognitive differences exhibit lower heritability at a younger age (Briley and Tucker-Drob, 2013), an examination of the longitudinal trajectory of their IQ would better help understanding cognitive development across different levels of cognitive environments. Indeed, a direct test of the environmental hypothesis is to measure the *g*-loadedness of educational gains in a longitudinal perspective over a long period of time. A longitudinal study conducted by Ritchie et al. (2015), using SEM method, was able to address this issue. Going from a bifactor model, their best fit data, they compared three model pathways, all controlling for prior IQ measured at age 11: The first model considers education affecting subtest scores only through *g*, the second model considers education affecting subtest scores through *g* but also independently of *g*, and finally the third model considers education affecting subtest scores only independent of *g*. Their best fit was the third model. Although this is a first step to understanding the nature of educational gains, extending this line of research to minority groups would help clarify this issue.

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