

The Malleability of IQ and the Impact of Early Childhood Intervention

In their book The Bell Curve, as well as the summary article reviewed here, Charles Murray and Richard Herrnstein examine the gap between the IQ scores of blacks and whites in America (Murray and Herrnstein 1994). They assert that the mean IQ score of the black population is consistently around 85, while that of the white population is 100, indicating an IQ gap of approximately 15 points or 1 standard deviation. Given the substantial size of this gap, the authors set out to review arguments for the possible causes of such a difference. They examine the merits of various arguments that suggest that the gap is an artifact of the test used, but conclude that this is not a principal cause of the IQ gap. They then conclude that the 15-point gap must be due to an actual difference in ability, which may be attributable to environmental differences, genetic differences or both. The authors compare the hypothesis that the IQ gap is entirely environmentally-determined with the claim that it is somewhat environmentally-determined and somewhat genetically-based. To make this comparison, they analyze claims that IQ is malleable; from this, they conclude that it is not sufficiently malleable for the IQ gap to be entirely caused by environmental factors and that genetic differences are playing a role in the degree of malleability. This conclusion is based, in part, on the claim that even when the environment is changed for blacks (e.g. through adoption into a white family), IQ rises more for blacks that have some white ancestry (e.g. one white parent) than for blacks that are solely of African descent. The authors also base this

conclusion on the claim that few intervention programs yield lasting increases in black IQ scores indicating that IQ cannot be long-term affected by changes in environment.

The goal of this paper is to investigate these last few claims, namely that IQ is not sufficiently malleable to account for the black/white gap, that environmental changes benefit blacks with some white ancestry more than those with only African ancestry, and that intervention programs do not provide long-term effects. A number of studies in these areas will be reviewed to counter these claims about the malleability of IQ. From this analysis, I hope to show that Murray and Herrnstein were unjustified in their conclusion that the IQ gap must be somewhat genetically-determined, and I hope to provide some policy recommendations for combating the IQ gap in the future.

Murray and Herrnstein's first major claim is that IQ is not sufficiently impacted by environment for that to be the sole source of the 15-point black/white IQ gap. The existence of the Flynn effect, however, provides a prime example of the dramatic impact that environmental factors on IQ. The Flynn effect refers to the significant increases in average IQ scores that have occurred each decade around the world since WWI, the first implementation of such a test. It is generally accepted that IQ scores have risen at a rate of 3 points per decade (Neisser 1997), but there are some instances, such as in the Netherlands, of increases of 7 points per decade on particular forms of IQ tests (e.g. the Raven test). It seems reasonable to assume that the genetics of the world's population have not significantly improved over the last 100 years, and thus, that these improvements are due to environmental factors alone. Neisser has highlighted a number of possible environmental factors that may have caused these improvements; these factors will be discussed here and will be examined for their possible role in causing the black/white IQ gap, as well.

First, Neisser suggests that the Flynn effect may be due to improvements in the nutrition of the general population. Nutrition has clearly played a role in causing the significant increases in height that have occurred over this period, as well as significant increases in head size and possibly increases in average brain size. These increases may have then resulted in improvements in general cognitive ability. If this were a major cause of the Flynn effect, it would be reasonable to conclude that nutrition is playing a role in the black/white IQ gap as well. Given that black mothers are at greater risk for nutritional deficiencies during pregnancy than white mothers (Scarr and Weinberg 1976), it is clear that if improvements in nutrition are related to the Flynn effect then the nutritional deficiencies of many black mothers may be contributing to the IQ gap. There are some researchers, such as Richard Lynn of the University of Northern Ireland, that believe that advances in nutrition are the sole cause of the Flynn effect, but Neisser argues that this is only one of many possible contributing factors. Thus, it seems somewhat unreasonable to attribute the IQ gap to nutritional differences alone.

The next factor that Neisser cites as a possible cause of the Flynn effect is increases in the duration of schooling. Neisser notes that a number of studies have shown that individuals who do not attend schools, for whatever reason, score significantly lower on IQ tests than their peers who have attended school. Furthermore, a study by Cahan and Cohen has shown that one additional year of schooling seems to have a greater impact on IQ score than does one additional year of chronological age. If length of schooling were a major cause of the Flynn effect, it would then seem reasonable to attribute part of the IQ gap to this environmental factor given that black students often start school slightly later, are held back more often, and attend college less frequently than white students. Neisser does not believe this factor actually plays a major role in the Flynn effect, however, given that the increases in IQ scores are seen even in elementary school children, and

elementary school was already universally mandatory in the 1930s. Thus, schooling does not seem to play a major role in the Flynn effect, but it is still possible that it might be influencing the black/white IQ gap.

Finally, Neisser considers the expanding visual and technical environment that has developed over the century; he believes that this may be playing the largest role in generating the Flynn effect. Neisser suggests that increased exposure to pictures hanging on walls, movies in theaters, TV shows, video games and other complex visual stimuli such as picture puzzles and montages may have resulted in significant increases in visuo-spatial skills. Given that the increases in IQ scores occur primarily in this area and that the largest increases are seen on the Raven test which deals solely with analysis of visual patterns, it seems reasonable that this environmental change may be the primary cause of the Flynn effect. If this is true, it may be important to consider whether black and white environments differ with respect to the amount of visual and technical media they provide. It is unclear at this point whether such a difference exists, but it is important to take away from this analysis that environmental factors do exist that can result in IQ score differences of even more than 15 points.

A study by Scarr and Weinberg further speaks to the level of environmental influence on IQ and the malleability of this measure of intelligence (Scarr and Weinberg 1976). This study also addresses Murray and Herrnstein's claim that blacks with some white ancestry have higher IQ scores than do blacks of African descent alone, when environmental changes occur. In their article, Scarr and Weinberg investigate the influence of adoption into a white upper-middle class home on the IQ test performance of black children with either one or two black parents. The authors studied 101 white upper-middle class families in Minnesota that had adopted either white, black, interracial, or Asian/Indian children into their homes. Various characteristics of the children's adoptive

experiences (e.g. age at placement, time in home, number of placements, quality of placements) were collected, as well as characteristics of the adoptive home (e.g. mother's and father's educations and IQ, father's occupation, family income) and characteristics of the natural parents (e.g. mother's and father's races and education levels). With knowledge of each of these facets of the children's background and experiences, the authors were able to accurately analyze the IQ scores of the different groups of children and determine the role that environment played in generating these scores. The researchers found that the black and interracial adopted children had a mean IQ score of 106.3, which is significantly above the mean IQ score of the black population in Minnesota at the time, as well as significantly above the white national mean IQ score of 100. This score was significantly lower than the mean IQ of the white adoptees (111.5), but this difference was confounded by differences in age of placement, number of placements, and quality of placements, particularly for the black adoptees. If we compare the mean IQ of white adoptees to that of interracial adoptees alone (109.0), groups that differ much less in their placement histories, the mean IQ scores do not significantly differ. This comparison seems more reasonable because the black adoptee group also significantly differs from the other two in quality of the adoptive home, in part because adoption agencies try to place children in homes that are more similar to the natural families. Even when the data for the black adoptees is considered alone, though, the mean IQ score of this group (96.8) is significantly higher than that of the Minnesota black population. Furthermore, despite the differences in mean IQ of the interracial and black adopted children, it is inappropriate to conclude that the environmental changes benefited black children with some white ancestry more than it benefited those with only African ancestry, as Murray and Hernstein claim from these results. Such a comparison is not appropriate and, in fact, not possible from this study, given the confounding of ancestry with placement history. It is appropriate to conclude, however,

that when the environment is lastingly changed, IQ scores can significantly improve, illustrating the malleability of these scores.

Despite the improvement in and malleability of IQ scores that this study demonstrates, it clearly would be inappropriate to advocate adoption into a white family as the method for closing the IQ gap between the black and white populations. The study does demonstrate, though, that IQ scores can be impacted by changes in environment, and thus, it becomes important to investigate more practical ways of implementing these changes. Thus, we turn our discussion to the impact of intervention programs that attempt to generate similar changes in environment, while keeping the child in his/her natural home.

Murray and Hernstein have claimed that intervention programs do not have a lasting impact on IQ scores and that, given this, IQ must not be particularly environmentally malleable. It is necessary to investigate this claim from two perspectives: first, is it in fact true that intervention programs do not have a long-term impact on IQ and second, if programs do not have a long-term impact, does this actually indicate that environment cannot be solely responsible for the IQ gap, and thus that IQ is not malleable.

To examine the first part of Murray and Hernstein's claim, it is important to examine some intervention programs that have investigated their program's long-term results. It is, in fact, true that very few interventions have resulted in increases in IQ scores that last more than five years after the intervention has ended. Although the majority of intervention programs have not had such long-term impacts, there are a few interventions that have produced long-term gains, and thus it is important to examine these particular programs and determine in what key respects they differ from various other programs whose impacts have been shorter-lived. One particularly successful program is the Abecedarian Project that was implemented in North Carolina in 1972 (Campbell et.

al. 2001). For this project, 111 infants, 98% of whom were black, were recruited; these infants were healthy newborns noted as high risk based on factors such as family income and maternal education level. 57 of these infants were randomly assigned to a treatment group and 54 were assigned to a control group. The treatment group attended a child-care center 5 days a week, 50 weeks a year, from an average age of 4.4 months until kindergarten. The center provided a low teacher-child ratio (1:3 for infants, 1:6 for children age 5), significant in-service training for teachers and minimal teacher turnover. The care revolved around a curriculum that was designed to promote cognitive, language, perceptual-motor, and social development for infants, followed by language development and preliteracy skill training during the later preschool years. The children also received most of their meals at the center, and thus, to control for potential differences in nutrition, the control group was provided with an iron-fortified formula for the first 15 months. The control group was also provided with diapers as an incentive to participate.

At various intervals from when the children were age 3 to 21, age-appropriate IQ tests were administered in order to gauge the impact of the intervention on the intelligence of these high risk, primarily black, children. From these scores, growth curves were then fit to model the changes in IQ over time of each participant, using a cubic polynomial equation. Mean curves for the treatment and control groups were then derived. These curves are presented in Figure 1, taken from (Campbell et. al. 2001). As can be seen in the figure, there was a significant main effect of treatment across all ages during both the treatment and the follow-up periods. There was also a main effect of time, indicating that, in both groups, there was a significant decline in IQ score over time. Furthermore, there was an interaction between treatment and time of assessment, illustrating that the gap between the treatment and control IQ scores was significantly larger during the

treatment period than at any of the follow-up stages, although the gap was still significant during each of the follow-up intervals, as well.

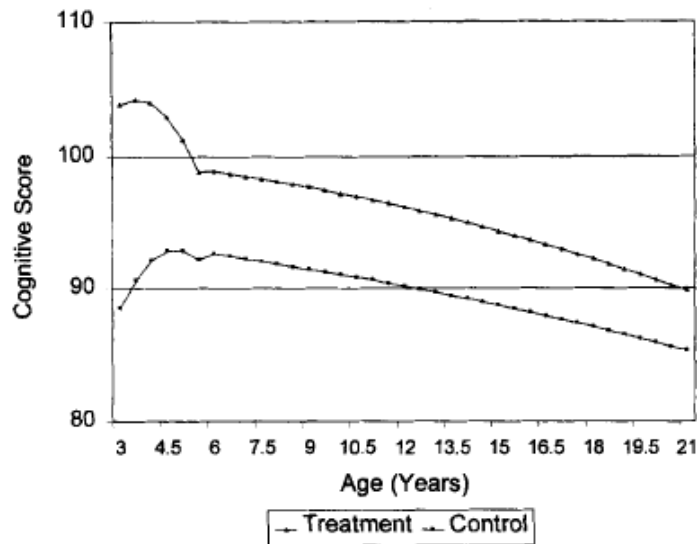


Figure 1: Mean growth curves of participants' IQ scores as a function of treatment condition

Treatment effect sizes were also calculated for the preschool and follow-up periods to confirm the significant impact of treatment. To represent these two time periods, the researchers chose the IQ means at ages 4 and 15. Effect sizes were then calculated using the standard deviation of the sample as well the more conservative standard deviation of the Weschler IQ test. The effect sizes from these two calculations are listed in Table 1. Given that educators consider effect sizes of 0.25 or greater to indicate a significant practical impact (Campbell et. al. 2001), it is clear that, even with the conservative estimates of using the test's normal standard deviation, the Abecedarian Project produced a significant influence in both the preschool and follow-up stages.

Effect Size

	Sample Standard Deviation	Test Standard Deviation
Preschool	1.75	0.74
Follow-Up	0.87	0.37

Table 1: Effect sizes of treatment during the preschool and follow-up periods calculated from either the sample or the test standard deviation

Given the results achieved by this program in the form of both improvements in IQ scores as well as academic achievement, it is important to examine what made this program so effective. The Abecedarian Project differs from many other intervention programs because it began treatment for high risk children around 6 months of age. Most interventions do not begin until the preschool period, and then provide services with less frequency and less intensity to children who have already fallen behind in their cognitive development. It seems likely that the early intervention before these children have suffered any cognitive setbacks was what set this program apart and allowed it to generate a lasting impact on IQ scores all the way through age 21. Furthermore, given that the program was 8 hours a day, 5 days a week, 50 weeks a year for four years, it clearly exceeds the intensity of most other intervention programs that have been developed and implemented thus far. The child care of this program was also of particularly high quality given the developmentally appropriate curricula implemented by highly trained staff attending to the children with a 1:3 teacher-infant ratio and 1:6 teacher-child ratio. Given the lasting impact of the program, it is important to tease out which of these attributes made the project so effective and to determine what attributes of the child or family environment were changed in order to mediate this lasting impact on IQ score.

A study by Burchinal et. al. (1997) attempts to answer these questions by investigating the effectiveness of five different forms of early intervention. This analysis examined the interventions provided in the Abecedarian Project and Project CARE, both taking place in North Carolina with children born between 1972 and 1980. In this study, the authors examined four different groups of children from the Abecedarian Project (only two of these groups were discussed in the study described above), as well as three groups from Project CARE. The breakdown of different treatment programs may be seen in Figure 2 below, taken from (Burchinal et. al. 1997).

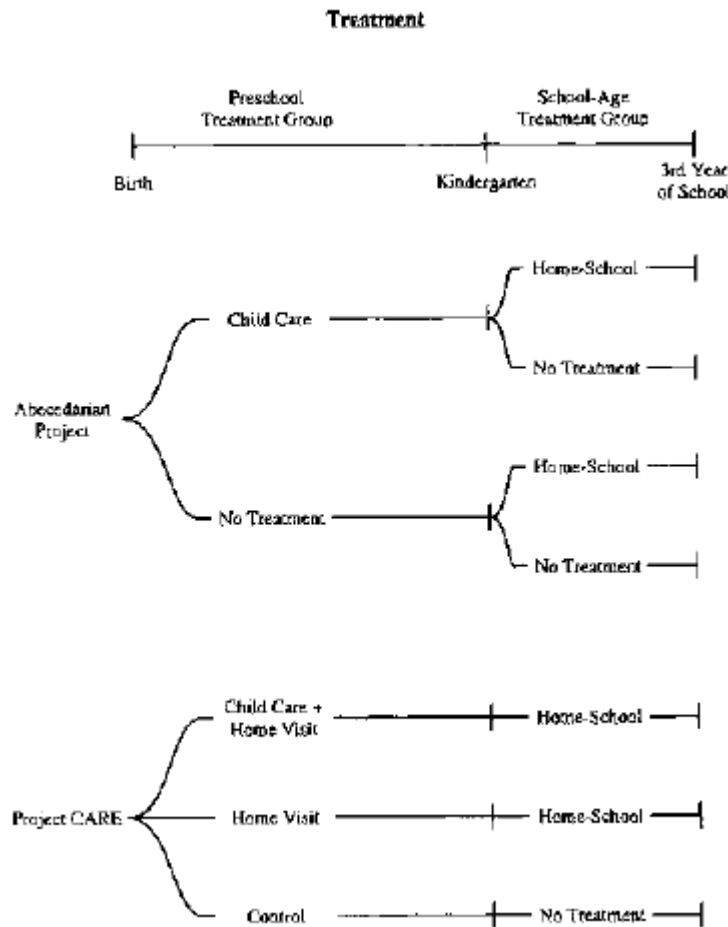


Figure 2: Breakdown of treatment groups for Abecedarian Project and Project CARE

As can be seen in the figure, the Abecedarian program consisted, initially, of a control group and a treatment group who received the center care described earlier. Once the children entered school, each group was then randomly split such that half the children received no further treatment and half received three years of support (known as home-school treatment) from a resource teacher who delivered activities to the home that were meant to address the child's current needs as identified by his/her homeroom teacher. This treatment was geared towards reinforcing the skills the children learned in school, as well as increasing parent involvement in the child's education. Project CARE consisted of three other groups of children broken down by the treatment they received. Each of the two treatment groups received weekly home visits during which the visitor "encouraged and modeled positive parent-child interactions, provided the family with support, served as an advocate for the family, and promoted effective coping skills" (Burchinal et. al. 2001). The *Learninggames* curriculum was also used by the visitors in order to promote various problem-solving skills. For one treatment group, these visits were accompanied by the same childcare treatment as in the Abecedarian Project, while the other treatment group received these visits alone. Finally, both treatment groups in Project CARE also received the support of a resource teacher for three more years, once the children entered kindergarten. The control group received no treatment at any point, other than nutritional supplements, but was not prevented from sending their children to various community daycares prior to enrollment in kindergarten.

For each of the seven groups in both projects, IQ tests were administered to the participating children at various intervals, using age-appropriate tests, through age 8. The Infant Behavior Record (IBR) was also completed for each infant at ages 6, 12, and 18 months. Demographic characteristics of the family, such as marital status, maternal and paternal age, employment status and maternal income, were collected at entry, as well as when the children were 5 and 8 years old.

Mothers' authoritarian caregiving attitudes were also investigated using the Parent Attitude Research Instrument (PARI) when the children were 3 and 8 years old. Finally, the responsiveness and educational quality of the home environment was also measured each year from when the children were 6 to 54 months as well as at age 7 using the Home Observation for Measurement of the Environment (HOME). The researchers desired to test how each of these factors might mediate the effects of treatment on the children's IQ scores over time and thus developed four possible models to fit to the data to gauge the impact of each possible factor. The first model correlated IQ with treatment, age of the child, mother's marital status and the child's gender. The second model added maternal IQ to these possible predictors. The third model added mother's authoritarian attitudes and responsiveness of the family environment to Model 2, predicting that these factors might mediate the effects of treatment over time. Lastly, the fourth model added the measure of infant responsiveness to the third model to test this as another possible mediating factor. Each of these models were applied to growth curves of each child's IQ over time; note that these curves were not aggregated by treatment as in the previous study and in Figure 1 because the investigators were interested in individual differences within the treatments, as well as across them.

The data from Model 1 of the authors' analysis indicate that there were significant differences in the children's IQ across time as a result of their treatment group. These results are summarized in Figure 3 taken from (Burchinal et. al. 2001). Note that there was no significant difference between the childcare plus home-school treatment of the Abecedarian project and the childcare plus home visits plus home-school treatment of Project CARE and thus, these two groups are collapsed together for the rest of the analysis.

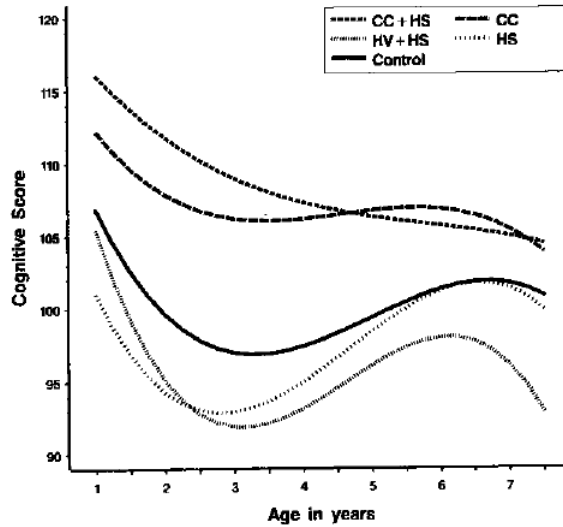


Figure 3: Mean growth curves of IQ over time broken down by treatment condition

Children in the childcare plus home-school support and the children in childcare-only treatments tended to have significantly higher IQ scores than children in the other conditions across time as well as less change in these scores over time. There were no significant differences, however, between the IQ growth curves of the home visit plus home-school, the home-school alone, or the control conditions.

Applying Model 2 to the growth curve data indicated that maternal IQ was still a significant predictor of the child’s IQ score and its patterns of change over time, across treatment conditions. Children with higher maternal IQ showed significantly higher IQ scores across time as well as patterns of increasing IQ score from 6 months to 8 years of age. Model 3 indicated that responsiveness of the family environment, as measured by HOME, was also directly correlated with IQ scores over time. Mothers’ authoritarian attitudes, however, were not significantly correlated with IQ scores. Even with these added predictors, treatment still had a significant impact on IQ score in Model 3. Furthermore, these two added factors did not mediate the impact of treatment on the children in the study. Finally, Model 4 indicated infant responsiveness and task orientation were

significantly correlated with greater cognitive performance for the children in this study, although the strength of this correlation decreased for later assessments of IQ. The strength of Models 3 and 4 were then compared to determine if infant responsiveness was mediating any of the relationships found in this earlier model. This analysis showed that infant responsiveness may have mediated the impact on cognitive performance of treatment and maternal IQ, but not that of family and home responsiveness. Furthermore, a repeated-measures analysis revealed that children in the two childcare conditions had patterns of increasing task orientation scores during infancy when compared to the other conditions. These analyses reveal that the impact of the childcare treatment programs was in part mediated by infant responsiveness, indicating that the treatment cultivated this attribute of the child, which then contributed to the lasting effects of treatment on IQ scores.

From this study, it is clear that intensive early childcare can provide a lasting impact on cognitive development, and that one aspect of how this intervention helps is by increasing the responsiveness of the infant. The existence of this mediating factor may explain, in part, why programs that begin in the preschool years have not generated the same lasting impact as the Abecedarian Project and Project CARE.

The next question that arises, given the benefits of the childcare treatment specifically, is whether any childcare program that spans the same age range as these projects could have this same impact on IQ scores. This issue is explored in another study by Burchinal et. al. (1989) that compares the cognitive development of children in the Abecedarian university-based childcare center with that of children in community-based childcare centers and with children who did not consistently attend childcare during this critical period of development (age 1 year to kindergarten). These latter two groups were created from a random sample of children in the area based on the amount and consistency of childcare that the children had received. While these groups were not

randomly divided, given that childcare experience determined what condition they fell into, they did not significantly differ on any of the major descriptors of their lives, such as maternal education, IQ, and age, or their race, sex, or quality of home environment at four measurements from 6 to 42 months. Thus, it seemed reasonable to consider the cognitive development of the two groups relative to that of children in the university-based childcare. IQ data was then collected semiannually for the children between ages 6 and 54 months. Three pair-wise comparisons were then performed between the Intervention, Community, and Minimal childcare conditions, using repeated-measures analysis. The mean IQ scores of the three groups over time are presented in Figure 4 taken from (Burchinal et. al. 1989).

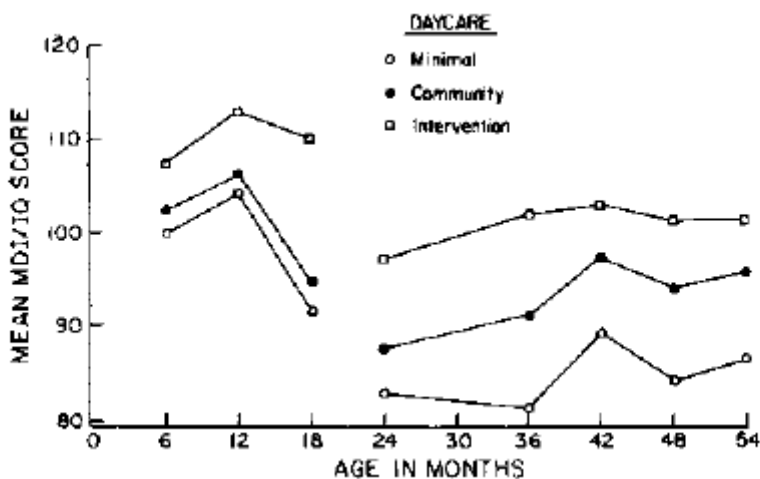


Figure 4: Mean IQ scores of children from 6 to 54 months, broken down by condition

The data analysis illustrated that the mean IQ scores of the infants (age 6 to 18 months) in the intervention childcare were significantly higher than those of infants in community day care as well as those with minimal daycare experience. Furthermore, the infants in the intervention program showed a pattern of cognitive development that significantly differed from that of infants in the other two conditions. During this period, there were no differences in either the pattern or level of cognitive development between the community and minimal daycare groups. A different

pattern of results emerged for the preschool period, however. Again, the intervention children scored higher than the children in both the other two conditions, but the pattern of development did not differ for this group as it had during infancy. Also, during this period, the IQ scores of the community group were significantly higher than those of the minimal daycare group, although no difference in pattern of development was apparent. This second finding indicates that while the intervention program produced the largest impact on IQ, community daycare also positively impacted IQ during the preschool years, and thus such programs may serve as an appropriate intervention, given that they are less expensive and more easily implemented. The long-term impact of these community daycares has not been investigated, though, so it is unclear whether they would provide the lasting improvements in cognitive development that the intervention program provided. It is important to note that a contributing factor to the effects of the community daycares is that they were selected to be of particularly high quality, with age-appropriate teacher-child ratios and class sizes. Another study by Burchinal et. al. (1996) has indicated that low-quality childcare centers that do not implement these low teacher-child ratios and class sizes have not provided significant positive influences on the cognitive development of the children who attend them. Thus, these structural measures of the quality of the childcare as well as the duration of daycare attendance are of particular importance to improving the IQ scores of children. It seems probable that these structural characteristics are what allow for the individual attention that increases infant responsiveness and may mediate the influence on cognitive development.

Despite the long-term impacts of the intervention programs reviewed here, it is important to again note that few programs show these significant long-term gains in IQ scores. Given the rarity of long-term gains, despite the frequency of IQ increases that last up to five years post-intervention, it is important to address the second question posed earlier namely, do short-term gains in the

absence of long-term impact indicate that IQ is not very environmentally malleable. Nisbett argues that this is not the conclusion we should draw from these findings (1995). In his article refuting The Bell Curve, he makes the important point that short-term gains in and of themselves illustrate the impact of environment on IQ, and that one should not expect that, when the environment reverts back to its impoverished state post-intervention, IQ scores will not be negatively affected and gains will diminish over time. This idea is illustrated in the phenomenon of summer-learning loss. A number of studies, in particular (Entwisle et. al. 2001), have demonstrated that while lower-class (primarily black) children show the same gains on achievement tests during the school year as middle-class (primarily white) children, the lower-class children lose an average of over 2 months' worth of reading skill during the summer months, while middle-class children gain approximately 1 month's worth of reading skill. These studies illustrate that there is some lack of cognitive stimulation of the home environment of the lower-class children that is actually depressing the cognitive skills of these children during the summer months. This environmental factor is also illustrated in the cognitive growth curves of the children from the Abecedarian Project, where both the treatment and control groups show a significant decline in IQ scores over time, presumably due to the same factors as what cause summer-learning loss in these groups. Given the presence of such an environmental influence, it is not surprising that few intervention programs provide increases in IQ that can be sustained for more than five years post-intervention. Furthermore, this lack of long-term results may actually further support the idea of environmental impact on IQ, illustrating the magnitude of the impact of quality of environment on cognitive development.

Each of the studies investigated thus far has demonstrated the influence of environment on cognitive abilities. Furthermore, the Flynn effect and the adoption study by Scarr and Weinberg both illustrate that extreme changes in environment can result in increases in IQ score that are

greater than the 15 point black/white IQ gap. These findings, in and of themselves, seem to refute Murray and Herrnstein's claim that the IQ gap must be in part due to genetic differences. When these results are coupled with the outcomes of the intervention studies reviewed here, the case against Murray and Herrnstein becomes even stronger. In particular, Murray and Herrnstein's conclusion does not seem warranted after attacking their claim that IQ is malleable only if intervention programs maintain their impact more than five years post-intervention. Thus, it seems clear from the evidence reviewed here that the IQ gap may be entirely explained by environmental factors. Given this, it becomes necessary to examine the implications of this conclusion for how the IQ gap should be managed in the future. Intervention programs are clearly an important component of combating the IQ gap, in particular programs that are in line with the findings of the studies related to the Abecedarian Project. This research seems to indicate that intensive childcare programs with developmentally appropriate teacher-child ratios and class sizes are the most effective intervention found thus far. Furthermore, the findings indicate that these programs provide lasting effects when they are implemented for infants specifically, because it is at this age that childcare can mold the responsiveness of the child, shaping how he interacts with his environment and his future willingness and ability to acquire various cognitive skills. Thus, it seems important to advocate programs of this form as the primary means to combat the black/white IQ gap and to squash any future claims that the gap is due to genetic differences between the two races.

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