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A Reanalysis of *The Bell Curve*: Intelligence, Family Background, and Schooling*

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SINCE ITS PUBLICATION at the beginning of October 1994, *The Bell Curve* by the late Richard Herrnstein and Charles Murray has been discussed in more than one thousand articles in the public and academic press. Initial commentary focused primarily on the book's treatment of race. The majority of these essays were negative, with many denouncing the book as racist. More recent reviews (e.g., Heckman 1995; Hunt 1995; Goldberger and Manski 1995) have focused on the disjunction between the evidence presented and the strong conclusions drawn by the authors.

Herrnstein and Murray argue in *The Bell Curve* that intelligence is the most important determinant of social and economic success in present-day America. They support this conclusion with statistical analyses that suggest that a youth's intelligence (measured at ages fifteen to twenty-three by the Armed Forces Qualifications Test [AFQT]) is considerably more important than his or her parents' social and economic status (SES) in determining social and economic status in adulthood, the well-being of a woman's children, and the avoidance of antisocial behaviors. In their analyses, the effect of AFQT score is more than twice as large as the effect of parents' SES in predicting whether, at ages twenty-five to thirty-two, someone (1) is poor, (2) dropped out of high school, (3) is unemployed, (4) had a child out of wedlock, (5) had been on welfare, (6) had a low-birth-weight baby, or (7) had a child with low IQ scores.[1] In this chapter, we reanalyze Herrnstein and

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[1] See also Goldberger and Manski 1995, pp. 765–766, for a succinct summary of Herrnstein and Murray's conclusions regarding the importance of AFQT score relative to parents' SES.

Murray's data in order to assess whether their principal conclusions are warranted.

Our analyses address three questions. The first two are related to whether Herrnstein and Murray's estimates of the effects of AFQT score and parents' SES are biased by measurement error (especially in parents' SES) or by unmeasured or omitted parental SES or other family background characteristics. The third involves their treatment of schooling.

(1) Is Herrnstein and Murray's index of parents' socioeconomic status adequate for isolating the effects of AFQT score on economic and social success in adulthood? Ideally, in order to isolate the effects of AFQT on adult outcomes, one would like to hold constant—with perfect measures—all aspects of family background that influence both adult outcomes and AFQT scores. Herrnstein and Murray employ a narrowly conceived and poorly measured index of parental SES. As Heckman (1995) notes:

> The statistical methods used by Herrnstein and Murray are vulnerable to measurement error. It would be incredible if 15 to 23 years of environmental influences, including the nurturing of parents, the resources they spent on a child, their cultural environment, their interactions with their children and the influence of the larger community on the children could be summarized by a single measure of education, occupation and family income in one year. If environment is poorly measured but affects the test score—and there is solid evidence of environmental impacts on test scores—the Murray and Herrnstein finding that IQ has a stronger impact on socioeconomic outcomes than measured environment may simply arise from the poor quality of their measure of the environment. Their measure of IQ proxies the mismeasured environmental variable. (p. 21)

In the first part of our analysis we use comparisons of siblings in order to control more completely and broadly for differences in family background characteristics that may influence AFQT scores and adult outcomes. We estimate the effects of AFQT score net of family background by relating differences between siblings in adult outcomes to differences in their AFQT scores (controlling for age and gender). In effect, a youth's sibling(s) acts as his or her "control group." Incredible as it may seem, our sibling analyses suggest that, even though Herrnstein and Murray's parental SES index is poorly measured, it appears to be adequate for producing unbiased estimates of the effects of *AFQT score* on socioeconomic outcomes.

(2) Is Herrnstein and Murray's measure of parents' socioeconomic status adequate for estimating the effects of either parental SES or family socioeconomic background more broadly conceived on social and economic success in adulthood? Here there are two problems. (1) Random measurement error in the parental SES index will bias downward the estimated effects of parental SES. (2) Herrnstein and Murray's index of parents' SES may fail to capture important components of parents' SES and other environmental influences shared by family members (such as neighborhood and school characteristics). Regarding the first point, because Herrnstein and Murray's index of parental SES is highly correlated (0.55) with AFQT score, and because, as we shall see, parental SES is less reliably measured than is AFQT score, Herrnstein and Murray's estimates may substantially understate the effects of parents' SES and overstate the effects of AFQT score on adult outcomes. This is the classical errors-in-variables problem, and the potential for bias is easily demonstrated for a subset of Herrnstein and Murray's adult outcomes that are continuous (as opposed to binary) variables. For these outcomes, we adjust estimates for measurement error using a range of values for the reliability of AFQT score and parents' SES. We find evidence of substantial downward bias in their estimates of the effects of parents' SES.

Next, we investigate more directly the consequences of Herrnstein and Murray's narrow conceptualization of parents' SES. As reviewers have noted, Herrnstein and Murray's index of parental SES covers an important but limited range of socioeconomic attributes of the parental family. For example, Goldberger and Manski (1995, pp. 768–769) remark: "In practice they simply take it for granted that their SES index—a rather ad hoc concoction of information on parental attributes—adequately captures the socioeconomic environment within which a child grows up. This single variable carries the burden of expressing all aspects of the child's upbringing from family structure to sibling relationships to neighborhood characteristics."[2]

We find evidence that Herrnstein and Murray's index of parents' SES produces substantially misleading estimates of the effects of parental family socioeconomic status on social and economic outcomes of youths. Herrnstein and Murray's index of parents' SES fails to capture components of socioeconomic family background that are demonstrably important determinants of adult outcomes. We illustrate this point in two ways that together form upper and lower bounds for the effects of family socioeconomic background.

To obtain lower-bound estimates we first add to Herrnstein and Murray's models a variety of socioeconomic family background controls including indicators of parental family arrangement (e.g., single-parent family, stepparent) at age fourteen, family structure (e.g., number of siblings), urban/rural residence at age fourteen, as well as other aspects of the home environment at age fourteen. We combine the effects of Herrnstein and Murray's parental SES index with the effects of this richer set of socioeconomic background controls to form a single standardized composite effect of family socioeconomic background. The composite effect is dramatically larger than the effect of parental SES alone, and is sometimes larger than the effect of

[2] A similar point is raised by Fischer et al. (1996). They also emphasize the importance of race and gender in the determination of social and economic status in adulthood.

AFQT score. Nonetheless, these composite effects are lower bounds for the effects of family socioeconomic background because they are based on the necessarily limited set of imperfectly measured family background characteristics available in the National Longitudinal Study of Youth.

Our upper-bound estimates of the effects of family socioeconomic background are based on analyses of siblings. These estimates are upper bounds because they are derived under the assumption that anything common to siblings other than AFQT score, age, and gender is attributable to family background. These residual effects of family background are far larger than Herrnstein and Murray's estimated effects of parental SES, and are at times two to four times as large as the effects of AFQT score.

(3) Are Herrnstein and Murray's estimates of the effects of AFQT score sensitive to their treatment of education? Does schooling have an effect on different outcomes, controlling for AFQT score? For a variety of reasons, Herrnstein and Murray were reluctant to include education controls in their models of various outcomes (pp. 124–125). Herrnstein and Murray do estimate their models for educationally homogenous subsamples (i.e., high school graduates; college graduates). Nonetheless, it is difficult to get a sense from their analyses either of the sensitivity of the effects of AFQT to the inclusion of education controls, or, perhaps more important, of the size of the schooling effects, controlling for AFQT score. It may be important to examine more carefully the role of education, however, given the potential for public policy to change educational attainment and thus, possibly, individual outcomes.

In our analyses we find that for many outcomes the effects of AFQT are substantially reduced by the inclusion of education controls. Furthermore, for many outcomes the standardized effect of schooling is larger than the effect of AFQT. This suggests that even if Herrnstein and Murray are correct that AFQT is largely immutable and unaffected by schooling, attempts to raise educational attainment may nonetheless be important, due to its positive partial effect on a variety of social and economic outcomes.

Outline of *The Bell Curve*

The Bell Curve is divided into four sections. In part one Herrnstein and Murray argue that America is becoming increasingly dominated by a cognitive elite. They discuss the increasing selectivity of elite universities and colleges and the rising educational credentials of top managers. In part two they present an extensive set of original analyses aimed at demonstrating that intelligence is the principal determinant of a variety of social and economic outcomes. We are concerned with this portion of the book. The third section examines previous work on racial differences in intelligence and presents new analyses of the importance of AFQT score as a determinant of different outcomes across racial/ethnic groups. The final section of the book discusses a variety of policy issues, most notably affirmative action.

Much of *The Bell Curve* reviews and interprets the analyses and data of others. The exceptions are the chapters in section II, and chapters 14 and 16 of section III, in which Herrnstein and Murray present original analyses of the National Longitudinal Survey of Youth.

The analysis methods used by Herrnstein and Murray are those commonly employed in the social sciences, and their approach to the data is straightforward and clearly explained.[3] As noted, Herrnstein and Murray's principal conclusion is that for all racial and ethnic groups and across a variety of social and economic outcomes, an individual's AFQT score is a more important determinant than is the social and economic status of his parents.

Methods and Data

The original analyses in *The Bell Curve* all use the Department of Labor's National Longitudinal Survey of Youth (NLSY). The NLSY is an ongoing longitudinal study of approximately 12,000 youths aged fourteen to twenty-one as of January 1, 1979 (Center for Human Resource Research 1994).

In section one of their book, Herrnstein and Murray restrict their analyses to whites. In chapter 14 and appendix 6 they repeat these analyses for blacks and Latinos. In our analyses, we estimate models for the entire sample and enter controls for race, ethnicity, and sex. Most of the time we have done so to ensure that we had the largest sample possible. As explained below, sample size becomes an important concern in analyses of sibling differences. We have also repeated the analyses for black, Latino, and white subsamples for continuous outcomes (income, wages, and years of schooling) where sample sizes are sufficient to permit analysis of sibling differences. The results of these analyses, which we present in appendix A, parallel those for the full sample.

Table 7.1 provides a description of the outcome variables and samples from *The Bell Curve* that we have used in our analysis. Our approach to the analysis is to use Herrnstein and Murray's data (supplied to us by Murray) and estimate models analogous to their models. We then report alternative estimates based on different assumptions or modeling strategies. Because we present some models that include controls for years of schooling completed

[3] They use linear and logit regression, and estimate the effects of AFQT score and parental SES on different outcomes when age is controlled. In models for some outcomes they include one additional control variable or restrict the analysis sample as a way to "control" for one important characteristic (e.g., they study a sample of poor mothers in their analyses of welfare use; see pp. 122–125 for a description of their modeling strategy).

TABLE 7.1
Unweighted Sample Means, (SDs), [Analysis Sample Sizes], and Descriptions of Analysis Variables

	Mean (SD) [Obs]	*Descriptions of Variables and Sample*
Family income (1990$) in 1989	34,345 (27,080) 7,977	Total net family income in 1989, 1990 dollars. Excludes persons not working because of school in 1989 or 1990.
In poverty in 1989	0.15 (0.36) 7,977	Total net family income below U.S. Census poverty line. Excludes persons not working because of school in 1989 or 1990.
Annual earnings (1990$) in 1989	24,225 (16,083) 4,974	Year-round workers
Years of schooling completed 1990 (z-score)	−0.1 (1.0) 9,885	
HS dropout	0.18 (0.39) 8,718	Did not get a HS diploma, including those who later earned a GED
BA degree	0.18 (0.38) 9,588	Obtained a bachelor's degree or higher. Excludes persons enrolled as undergraduates in 1990.
High-IQ occupation	0.04 (0.20) 7,944	Excludes persons enrolled in college or graduate school in 1990
Out of LF 1+ mos. in 1989, men	0.15 (0.36) 4,144	
Unemployed 1+ mos. in 1989, men	0.10 (0.30) 3,225	Excludes persons not working because of school in 1989 or 1990
Married by age 30	0.72 (0.45) 4,221	Excludes persons under 30 at 1990 interview (H&M exclude age as a control)
Divorced, first 5 years of marriage	0.20 (0.40) 4,684	
Middle-class values index	0.37 (0.48) 7,692	Men: HS grad + in LF full year + never in jail + married to first wife; Women: HS grad + no out-

(table continues)

TABLE 7.1 *(continued)*

	Mean (SD) [Obs]	*Descriptions of Variables and Sample*
		of-wedlock births + never in jail + married to first husband. Excludes single persons who met other conditions and men who were disabled or enrolled in school.
Ever interviewed in jail, men	0.07 (0.25) 4,809	
CHILD OUTCOMES, FIRSTBORN CHILDREN		
"Illegitimate" (out-of-wedlock) birth	0.36 (0.48) 3,448	
Early AFDC use	0.24 (0.43) 2,683	Mothers poor in year prior to birth
Mother smoked during pregnancy	0.30 (0.46) 3,333	
Low birth weight	0.06 (0.24) 3,325	Below 5.5 pounds. Excludes LBW-premature babies whose weight was appropriate for gestational age.
Ever in foster or relative care?	0.05 (0.23) 3,475	Ever lived in foster care or with nonparental relatives
CHILD OUTCOMES, ALL CHILDREN[a]		
HOME score (percentiles)	46.2 (25.9) 6,711	Home Observation for Measurement of the Environment (short form). Test year and age of child entered as controls.
Motor and social development index (percentiles)	51.1 (26.7) 4,246	Children aged 0–4. Test year and age of child entered as controls.
PPVT (standardized score)	85.9 (20.7) 4,707	Peabody Picture Vocabulary Test. Receptive vocabulary for standard American English. Test year and age of child entered as controls.

(table continues)

TABLE 7.1 *(continued)*

	Mean (SD) [Obs]	*Descriptions of Variables and Sample*
PPVT, 6+ year-olds (standardized score)	87.5 (16.9) 1,784	Sample restricted to children age 6 years and over.
Behavior problems index (standardized score)	107.5 (13.2) 4,645	Children aged 4–12. Maternal reports of behavior problems. Test year and age of child entered as controls. Higher score indicates more problems.

Source: Herrnstein and Murray 1994, p. 646 and elsewhere.

Note: In addition to sample restrictions listed in the table, all samples are restricted to observations with non-missing values for: AFQT score, parents' SES score, age, and 1990 education.

[a] If an assessment (or test score) is available for a given child in more than one year (1986, 1988, or 1990), then the outcome is the average (across years) of the assessments for that child.

as of 1990, we have restricted the samples to respondents who have valid information on Herrnstein and Murray's (standardized) schooling attainment variable. This restriction results in the loss of about 1 percent of the sample.

In 1980 the ASVAB (Armed Services Vocational Aptitude Battery) was administered to nearly the entire sample so that the Department of Defense could renorm the tests based on a national population. The AFQT score Herrnstein and Murray use as their measure of IQ is a weighted average of four of the ten components of the ASVAB. They provide arguments and evidence that their measure is one of the best available for general intelligence. We leave discussion and evaluation of this claim to future work in which we intend to take up issues of endogenous determination of AFQT scores (see also Neal and Johnson 1995; Rogers and Spriggs 1995; Hunt 1995; Winship and Korenman 1997 and forthcoming).

The components of AFQT with their factor loadings are (Herrnstein and Murray 1994, p. 583): Word Knowledge (.87), Paragraph Comprehension (.81), Arithmetic Reasoning (.87), and Mathematical Knowledge (.82). Herrnstein and Murray do not discuss whether, net of their measure, other components of the ASVAB might affect the different adult outcomes. For example, Heckman (1995) notes that the numerical operations component is a strong predictor of labor-market outcomes. Although the construction and interpretation of the AFQT score is an important issue, it is one that we do not explore.

Herrnstein and Murray's measure of parental social and economic status is a combination of the respondent's father's and mother's education, occupation of parents or other adults in the household (the highest revised Duncan

Index score among the two parents or adults), and the natural log of income of the parental family (the average of available years, 1978 and 1979, for youths who report income of the parental household). The components of SES are each standardized to have variance one. A simple average of the available standardized measures is taken in order to create the SES index. The index is standardized to have variance one.

Omitted Variable Bias in the Effects of AFQT Score: Family Fixed-Effect Estimates

Many aspects of the family socioeconomic environment could conceivably be included in Herrnstein and Murray's models because they may influence AFQT score at age fifteen to twenty-three and adult outcomes, and may not be captured adequately by the parental SES index. For example, growing up in a single-parent family has been linked to a variety of social and economic disadvantages (e.g., Murray 1984; Garfinkel and McLanahan 1986). The effects of IQ score estimated by Herrnstein and Murray may be exaggerated (biased upward) by omitted variables. One approach to this problem is to attempt to measure and include in the models additional family background variables. We pursue this strategy below.[4]

Our initial approach is to carry out analyses of siblings. We compare the effect on various outcomes of differences in AFQT scores between siblings. In the case of continuous outcomes (dependent variables), fixed-effect analysis amounts to entering a dummy variable for each family of origin. For dichotomous (binary) outcomes, we estimate fixed-effect logit models for the oldest pair of siblings from each baseline household. The estimation of fixed-effects logit models necessarily involves a substantial reduction in sample sizes because only sibling pairs that have different values for an outcome (e.g., one graduated from high school and the other did not) contribute to the likelihood function (Chamberlain 1980).

The fixed-effect analyses correct for bias due to both measurement error in the parental SES index and omitted family characteristics (i.e., characteristics that are common to siblings). This is a broad notion of family background that includes, for example, characteristics of the neighborhood and the surrounding geographic area (Griliches 1979). The advantage of this

[4] Herrnstein and Murray (1994, p. 123) argue that adding a variety of additional family background variables may be problematic if these variables are "intervening" variables (i.e., endogenous) in the relationship between AFQT score and the outcomes they studied. However, we add variables that describe in more detail the socioeconomic status of the family. A youth's intelligence presumably does not determine the number of siblings he or she has, or the marital status of his or her parents. More important, the effects of AFQT score are not sensitive to the inclusion of additional family background controls in the models, even though the coefficients of the family background variables are often significant.

method is that, to the extent that siblings share identical family backgrounds, the fixed-effect approach provides a way of fully controlling (without measurement error) all aspects of family background. The assumption that siblings have identical family backgrounds is most reasonable when they are close in age.

Table 7.2 presents OLS and logit estimates along with fixed-effects estimates for twenty-six outcomes studied by Herrnstein and Murray. For each outcome, we present models that both include and exclude education controls. In this section of the chapter, we discuss results of models that exclude education controls, and we postpone discussion of models that include education controls to a later section of the chapter.[5]

In the first three columns of the table we present cross-section results for the full sample. These are analogous to (and are very similar to) the models presented by Herrnstein and Murray in *The Bell Curve*. In the fourth through sixth columns we repeat the cross-section analyses for the pooled subsample of siblings in the NLSY. The purpose of these analyses is to gauge the representativeness of the siblings subsample that we use for analyses of sibling differences. In general, cross-section results for the sibling subsample are similar to those for the full sample. As a result, we can be confident that differences we might find between cross-section and fixed-effects estimates are not an artifact of the use of a different sample (the sibling subsample of NLSY respondents).

In the final two columns of the table we present results from family fixed-effect (sibling difference) analyses. With a few exceptions, the fixed-effects estimates for AFQT are remarkably similar to the standard OLS and logit estimates. The exceptions, where the effect of AFQT is reduced, are family

[5] Our treatment of the outcomes for children of NLSY sample women requires additional explanation. Our analyses of outcomes for firstborn children are analogous to Herrnstein and Murray's. However, in our analyses of outcomes for samples that (potentially) include multiple children per woman, we study continuous versions of the binary outcomes studied by Herrnstein and Murray. For example, Herrnstein and Murray study a binary variable that indicates whether or not a child's PPVT score was in the bottom decile for his/her age, whereas we study the (continuous) standardized and age-adjusted PPVT score. The PPVT-R (revised) measures receptive vocabulary for Standard American English for children age three and older. It consists of 175 vocabulary items. Children point to one of four pictures that best describes a word's meaning. The normal percentile score is based on a national norm. The PPVT-R has been found highly correlated with other childhood intelligence tests such as Weschler and Binet, and with subsequent achievement in school (Baker and Mott 1989). Qualitatively, our cross-section results are the same as theirs—higher maternal AFQT score is associated with higher child test score, controlling for parents' SES (i.e., maternal grandparents' SES). The use of continuous outcomes greatly facilitates family fixed-effects analysis and enables us to use all available scores for all children of women included in a given analysis. For tests or assessments that were administered at more than one age for a given child, we average the assessment scores available for each child, and we average the child's ages at assessment. We adjust standard errors for nonindependence among child siblings and among first cousins (i.e., children whose mothers are sisters).

TABLE 7.2
Estimated Effects from Models of Socioeconomic Status and Child Development, All Races Combined

	OLS or Logit Coefficients (SEs)							
	Full Sample[a]			*Siblings XSEC*[a]			*Siblings FE*[b]	
	zAFQT	*zSES*	*zED*	*zAFQT*	*zSES*	*zED*	*zAFQT*	*zED*
Family income (1990$) in 1989	6,975	4,580		7,296	4,487		5,558	
	(354)	(324)		(622)	(577)		(975)	
	4,134	3,627	4,612	4,607	3,717	4,422	3,610	4,305
	(421)	(330)	(379)	(733)	(575)	(699)	(1044)	(963)
Number of obs.		7,977			3,316		3,316	
In poverty in 1989	−0.95	−0.33		−0.99	−0.31		−0.78	
	(.05)	(.04)		(.08)	(.07)		(.17)	
	−0.67	−0.25	−0.50	−0.68	−0.23	−0.59	−0.60	−0.48
	(.06)	(.04)	(.05)	(.09)	(.07)	(.09)	(.18)	(.17)
Number of obs.		7,977			2,926		284	
Annual earnings (1990$), YR workers, in 1989	4,866	1,531		5,548	1,169		5,317	
	(270)	(246)		(603)	(459)		(852)	
	3,040	910	3,092	3,879	803	2,667	4,023	2,341
	(291)	(240)	(300)	(617)	(451)	(592)	(821)	(856)
Number of obs.		4,974			1,579		1,579	
Yrs. schooling completed (z-score)	0.62	0.20		0.59	0.18		0.45	
	(.01)	(.01)		(.02)	(.02)		(.02)	
Number of obs.		9,885			4,758		4,578	
HS dropout	−1.82	−0.48		−1.75	−0.48		−1.63	
	(.06)	(.04)		(.10)	(.07)		(.26)	
Number of obs.		8,739			3,468		263	
BA degree	1.76	0.70		1.76	0.66		1.87	
	(.06)	(.05)		(.09)	(.08)		(.23)	
Number of obs.		9,588			3,884		309	
High-IQ occ.	1.36	0.39		1.39	0.45		1.72	
	(.08)	(.07)		(.14)	(.11)		(.43)	
	0.78	0.14	1.12	0.83	0.23	1.07	1.15	0.92
	(.09)	(.07)	(.08)	(.17)	(.10)	(.15)	(.50)	(.37)
Number of obs.		7,944			2,946		94	
Out of LF 1+ mos. in 1989, men	−0.39	−0.02		−0.34	−0.17		−0.30	
	(.06)	(.05)		(.10)	(.11)		(.19)	
	−0.33	−0.01	−0.10	−0.23	−0.13	−0.19	−0.18	−0.26
	(.06)	(.06)	(.06)	(.12)	(.11)	(.12)	(.22)	(.25)
Number of obs.		4,144			1,096		132	
Unemployed 1+ mos. in 1989, men	−0.44	−0.09		−0.52	−0.02		−0.47	
	(.07)	(.07)		(.14)	(.15)		(.29)	

(*table continues*)

TABLE 7.2 *(continued)*

	OLS or Logit Coefficients (SEs)							
	Full Sample[a]			Siblings XSEC[a]			Siblings FE[b]	
	zAFQT	zSES	zED	zAFQT	zSES	zED	zAFQT	zED
	−0.33	−0.05	−0.19	−0.44	0.01	−0.15	−0.35	−0.23
	(.08)	(.07)	(.09)	(.16)	(.16)	(.19)	(.32)	(.29)
Number of obs.		3,225			720		65	
Married by age 30	−0.04	−0.07		0.13	−0.10		0.20	
	(.05)	(.04)		(.11)	(.10)		(.18)	
	0.24	.01	−0.42	0.27	−0.07	−0.24	0.39	−0.33
	(.06)	(.04)	(.05)	(.14)	(.10)	(.12)	(.24)	(.21)
Number of obs.		4,221			664		136	
Divorced, first 5 years of marriage	−0.22	0.18		−0.26	0.28		−0.53	
	(.05)	(.05)		(.12)	(.10)		(.21)	
	−0.19	0.19	−0.05	−0.22	0.29	−0.08	−0.47	−0.11
	(.06)	(.05)	(.05)	(.13)	(.11)	(.13)	(.24)	(.24)
Number of obs.		4,684			1,046		159	
Middle class values index	0.75	0.23		0.84	0.20		0.67	
	(.04)	(.03)		(.07)	(.06)		(.13)	
	0.27	0.09	0.87	0.28	0.06	1.02	0.31	0.77
	(.04)	(.04)	(.04)	(.08)	(.06)	(.08)	(.14)	(.15)
Number of obs.		7,692			2,652		430	
Ever interviewed in jail, men	−0.91	−0.06		−0.94	0.16		−0.91	
	(.08)	(.07)		(.13)	(.13)		(.26)	
	−0.76	−0.01	−0.29	−0.76	0.21	−0.32	−0.82	−0.16
	(.09)	(.07)	(.07)	(.15)	(.14)	(.14)	(.33)	(.31)
Number of obs.		4,809			1,422		72	
CHILD OUTCOMES, FIRSTBORN CHILDREN								
"Illegitimate" (out-of-wedlock) birth	−0.46	−0.22		−0.65	−0.02		−0.10	
	(.06)	(.05)		(.18)	(.15)		(.36)	
	−0.31	−0.19	−0.22	−0.54	0.01	−0.19	−0.06	−0.19
	(.08)	(.06)	(.06)	(0.20)	(.15)	(.16)	(.40)	(.38)
Number of obs.		3,448			658		91	
Early AFDC use	−0.54	−0.19		−0.77	−0.13		−0.84	
	(.08)	(.06)		(.18)	(.15)		(.33)	
	−0.38	−0.15	−0.28	−0.62	−0.11	−0.30	−0.72	−0.34
	(.09)	(.06)	(.08)	(.19)	(.15)	(.18)	(.35)	(.37)
Number of obs.		2,683			510		75	
Mother smoked during pregnancy	−0.52	−0.01		−0.94	0.29		−0.90	
	(.06)	(.05)		(.16)	(.14)		(.31)	
	−0.17	0.11	−0.64	−0.53	0.44	−0.90	−0.49	−0.86
	(.07)	(.05)	(.06)	(.18)	(.14)	(.20)	(.34)	(.41)
Number of obs.		3,333			624		85	

(table continues)

TABLE 7.2 *(continued)*

	OLS or Logit Coefficients (SEs)							
	Full Sample[a]			Siblings XSEC[a]			Siblings FE[b]	
	zAFQT	zSES	zED	zAFQT	zSES	zED	zAFQT	zED
Low birth weight	−0.35	−0.08		−0.26	−.13		0.46	
	(0.10)	(.09)		(.23)	(.22)		(.53)	
	−0.35	−0.08	−0.00	−0.23	−0.12	−0.06	0.70	−.36
	(.13)	(.09)	(.10)	(.24)	(.22)	(.22)	(.74)	(.71)
Number of obs.		3,325			598		37	
Ever in foster or relative care?	−0.42	−0.22		−0.71	0.15		−0.84	
	(.10)	(.09)		(.26)	(.23)		(.50)	
	−0.27	−0.23	−0.24	−0.69	0.16	−0.04	−0.54	−0.65
	(.13)	(.07)	(.11)	(.28)	(.23)	(.25)	(.56)	(.44)
Number of obs.		3,475			662		39	
CHILD OUTCOMES, ALL CHILDREN[c]								
HOME score (percentiles)	6.9	4.4		9.2	3.9		3.6	
	(0.5)	(0.5)		(1.2)	(1.0)		(1.3)	
	4.2	3.7	4.8	6.1	3.0	6.3	2.7	2.5
	(0.6)	(0.5)	(0.6)	(1.4)	(1.0)	(1.4)	(1.3)	(1.3)
Number of obs.		6,711			1,342		1,342	
Motor & social development index (percentiles)	2.2	1.9		2.8	1.1		−1.1	
	(0.6)	(0.5)		(1.3)	(1.3)		(1.9)	
	1.1	1.6	2.0	1.3	0.7	2.8	−2.0	2.9
	(0.8)	(0.5)	(0.7)	(1.6)	(1.2)	(1.7)	(1.9)	(2.2)
Number of obs.		4,101			819		819	
PPVT (standardized score)	6.8	3.7		5.8	4.0		0.88	
	(0.5)	(0.4)		(1.2)	(1.0)		(1.4)	
	5.2	3.3	3.1	5.2	3.7	1.4	1.4	−2.1
	(0.6)	(0.4)	(0.5)	(1.4)	(1.1)	(1.4)	(1.6)	(1.6)
Number of obs.		4,607			794		794	
PPVT, 6+ year olds (standardized score)	6.8	2.6		9.0	2.3		6.8	
	(0.6)	(0.5)		(1.9)	(1.7)		(2.2)	
	5.1	2.1	3.1	8.4	2.1	0.9	8.3	−3.3
	(0.7)	(0.5)	(0.7)	(2.1)	(1.7)	(1.8)	(2.5)	(2.7)
Number of obs.		1,784			139		139	
Behavior problems index (standardized score; higher = more problems)	−1.6	−0.5		−2.2	0.2		−1.4	
	(0.4)	(0.3)		(0.8)	(0.8)		(1.2)	
	−1.4	−0.5	−0.4	−1.8	0.4	−1.0	−0.9	−1.8
	(0.4)	(0.3)	(0.4)	(0.9)	(0.8)	(1.0)	(1.2)	(1.1)
Number of obs.		4,101			819		819	

Notes: See table 7.1 for a description of dependent variables and samples.
XSEC: cross-section; FE: fixed-effects; YR: year-round; PPVT: Peabody Picture Vocabulary Test; HOME: Home Observation for Measurement of the Environment (short form).

(table continues)

income ($7,296 in column 4, versus $5,558 in column 7), poverty (−.99 versus −.78), years of school completed (.59 versus .45), out-of-wedlock birth (−.65 versus −.10), HOME (Home Observation for Measurement of the Environment) score (9.2 versus 3.6), motor and social development (2.8 versus −1.1), PPVT (Peabody Picture Vocabulary Test) score (5.8 versus 0.8), PPVT for children older than six (9.0 versus 6.8), and the Behavior Problems Index (−2.2 versus −1.4). Much of reduction in the size of the effects of AFQT most likely reflects the exacerbation of attenuation bias (due to measurement error) when data are differenced as compared to when they are entered in levels. For example, adjusting for measurement error bias in fixed-effects estimates raises the estimated effects of AFQT score from 5,558 to 6,558 for family income, and from 5,317 to 6,228 for annual earnings (see appendix C; see also section on measurement error, below). However, it is unlikely that attenuation bias alone could explain the reduction in the AFQT effects in several of the outcomes for children.[6]

The fixed-effect estimator is a powerful method of controlling for family background in that it captures all components that are common to siblings. It

TABLE 7.2 *(continued)*

[a]Models contain controls for age (z-score) and, where appropriate, dummy variables for gender, race/ethnicity (3 dummy variables), year and child's age at the time of assessment. Standard errors are corrected for non-independence of observations among youths from the same baseline household. Thus, unlike Herrnstein and Murray, we combine races and control for race (and gender) of youth, and we do not use sampling weights.

[b]Sibling fixed-effects models for continuous dependent variables (outcomes) are sibling differences estimated by including in the models a dummy variable for each family of origin. For dichotomous outcomes, samples used to conduct sibling cross-section and fixed-effects analyses are restricted to the oldest sibling pair in each household for which necessary data are available. The number of observations that enter fixed-effects logit analyses is relatively small because a sibling pair enters the likelihood function only if outcome values differ (e.g., one graduated from high school and one did not).

[c]Models for "all children" are based on average (across years) of values of outcomes and control variables for children who were assessed in more than one year. In fixed-effects models for children (i.e., first-cousin differences), standard errors are corrected for non-independence of observations among (child) siblings.

[6] Appendix A presents results from analyses of education, wages, and income for subsamples of blacks, Latinos, and whites. The estimates are broadly consistent with those reported in table 8.2 for the full sample. However, figures in the table indicate greater family background heterogeneity bias for blacks than whites (i.e., fixed-effects estimates are smaller relative to cross-section estimates for blacks). However, bias from measurement error (attenuation bias) is greater in fixed-effects analyses than in cross-section analyses, and is probably more severe for blacks in the sample. The reliability of differences in test scores is equal to (R − C)/(1 − C), where R is the reliability of the test score and C is the intrafamily correlation in test scores. The intrafamily correlation in AFQT is higher for whites than blacks in the sample, and therefore, given R, the reliability is lower for blacks. When we corrected the fixed-effects estimates for reliability of AFQT score using a value of 0.95 for R and values of C that vary by race, there was no longer any evidence of greater heterogeneity bias for blacks. We do not present these results because a proper reliability correction would require separate estimates of R for blacks, whites, and Latinos. We are not aware of the existence of such estimates.

is surprising that for many outcomes the fixed-effect estimates for AFQT are similar to the standard estimates. However, Herrnstein and Murray's measure of SES is highly loaded on father's and mother's education. A reasonable conjecture is that parents' education might capture well the component of family background most highly correlated with AFQT and thus serve as an adequate control for family background in estimating the effects of AFQT. If so, the fixed-effect estimates of AFQT would not differ greatly from the standard estimates. The one set of outcomes where the fixed-effect estimates of AFQT are substantially smaller than the cross-section estimates is for outcomes involving children. Here AFQT may be proxying other dimensions of the home environment.

Biases in the Effects of Herrnstein and Murray's Index of Parents' SES: Measurement Error

Above we noted that Herrnstein and Murray's parental SES index and the AFQT score are highly correlated. As a result, separating the effects of these two variables may be difficult and is likely to be sensitive to model specification and other assumptions.

AFQT score is potentially more comprehensive than their SES measure. First, the AFQT score is based on four separate tests, each of which is composed of a large number of questions, whereas SES is based on only the answers to four questions about parental status. Furthermore, Murray (personal communication) reports that the reliability of their four component measure of AFQT is 0.95, indicating that the measure is highly reliable. This figure is consistent with Bock and Moore's comment (1986, p. 196) that "various composites such as the AFQT composite . . . have reliabilities in excess of 0.90." Herrnstein and Murray also report that SES has a reliability of 0.76 (p. 574). This reliability is based on Cronbach's Alpha, however, which is an appropriate measure of reliability under the assumption that one has a set of measures of a single underlying variable. In the case of SES this assumption may not be defensible. Parents' education, the occupation of the head of the household, and parents' income are unlikely to measure a single underlying concept. Rather, we tend to think of these separate variables as combining to determine SES.

The true reliability of Herrnstein and Murray's SES measure is unknown. Ignorance about the reliability of SES does not mean, however, that we should ignore the potential bias induced by measurement error in the estimated effects of SES or AFQT. Because of high correlation between AFQT and SES, measurement error bias in the SES coefficient will be translated to the AFQT coefficient. At present we have discovered no way of obtaining an independent estimate of the reliability of Herrnstein and Murray's SES measurc. Jencks et al. (1979) review a number of studies with different estimated reliabilities for the components of SES. From these estimates, a reliability of .85 for SES would seem to be conservative if we are concerned with measur- ing SES in a single year only. If measured SES changes from year to year during childhood, as it surely does, this reliability estimate is most likely too high if we are after a more permanent concept. In fact, even the .76 re- liability reported by Herrnstein and Murray may be too high.

There is reason to suspect that the three components of Herrnstein and Murray's SES index are measured with considerable error. There is also evidence that errors in these variables can have important consequences for research results. Short-term measures of income, such as that used by Herrn- stein and Murray, can lead to substantial understatements of the correlation between parents' income, on the one hand, and the income of adult children (Solon 1992; Zimmerman 1992), child health (Miller and Korenman 1994), and child development (Korenman, Miller, and Sjaastad 1995), on the other. The reporting and classification of occupations is another source of error (Jencks et al. 1979). And although years of schooling are reliably reported, measurement error in reported schooling can affect estimates of the returns to schooling (Ashenfelter and Krueger 1994).

Measurement error in independent variables leads to potentially severely biased and inconsistent estimates of regression parameters. Simple tech- niques are available to correct for measurement error in linear regression models when the measurement error is purely random. Some popular computer programs such as STATA (Stata Corporation 1993), which we have used for most of our analyses, contain routines for carrying out this correction.

Most of the models estimated by Herrnstein and Murray involve logit analyses. The correction of measurement error in logit analysis is an area of current research. Carroll, Ruppert, and Stefanski (1995) provide a detailed discussion. At present no software is available for the general situation for carrying out these corrections. Therefore, at this time we are able to examine the effects of measurement error only in the three cases where the dependent variable is continuous.

Table 7.3 reports estimates of the effects of AFQT and SES on family income, annual earnings, and education. We have assumed a reliability of .95 for AFQT and reliabilities of .85 or .76 for SES. (We postpone to a later section discussion of the effects of reliability corrections on estimates from models that include education controls.)

As one would expect, given the lower reliabilities for SES than AFQT, correcting for measurement error increases the size of the effect of SES relative to that of AFQT. In the case of income, when a reliability ratio of 0.76 is assumed for SES, SES has a slightly larger effect ($7,036) than AFQT ($6,047). When measurement error is corrected in the earnings equa-

TABLE 7.3
Effects of Reliability Corrections on Coefficient Estimates

	Coefficients (SEs)			Reliability Ratios[a]		
	zAFQT	*zSES*	*zED*	*zAFQT*	*zSES*	*zED*
1. Family income, 1989	6,977	4,578		1.00	1.00	
	(353)	(324)				
	6,825	5,675		0.95	0.85	
	(419)	(436)				
	6,047	7,036		0.95	0.76	
	(457)	(538)				
	4,135	3,623	4,613	1.00	1.00	1.00
	(421)	(330)	(379)			
	3,583	4,458	5,072	0.95	0.85	0.90
	(529)	(453)	(408)			
	3,189	5,634	4,713	0.95	0.76	0.90
	(541)	(571)	(514)			
2. Annual earnings, 1989, YR workers	4,866	1,531		1.00	1.00	
	(262)	(239)				
	5,072	1,762		0.95	0.85	
	(306)	(317)				
	4,855	2,162		0.95	0.76	
	(330)	(389)				
	3,040	910	3,092	1.00	1.00	1.00
	(306)	(243)	(279)			
	2,917	942	3,514	0.95	0.85	0.90
	(379)	(328)	(363)			
	2,842	1,175	3,445	0.95	0.76	0.90
	(386)	(409)	(371)			
3. Annual earnings, 1989, males, YR workers	4,433	2,059		1.00	1.00	
	(379)	(361)				
	4,515	2,469		0.95	0.85	
	(447)	(484)				
	4,199	3,052		0.95	0.76	
	(488)	(598)				
	2,798	1,450	2,790	1.00	1.00	1.00
	(451)	(370)	(426)			
	2,630	1,674	3,111	0.95	0.85	0.90
	(567)	(508)	(569)			
	2,499	2,114	2,966	0.95	0.76	0.90
	(578)	(642)	(584)			
4. Education, 1990 (z-score)	0.62	0.20		1.00	1.00	
	0.64	0.24		0.95	0.85	

(table continues)

TABLE 7.3 (*continued*)

	Coefficients (SEs)			*Reliability Ratios*[a]		
	zAFQT	*zSES*	*zED*	*zAFQT*	*zSES*	*zED*
	(.01)	(.01)				
	0.61	0.29		0.95	0.76	

Notes: Models also include controls for race/ethnicity (3 dummy variables), age, and, where appropriate, gender. Sample sizes are, for outcomes (1) to (4): (1) 7,978 (2) 4,974 (3) 2,776 (4) 9,886.

[a]Reliability ratios are ratios of signal variance to total variance. The values for reliability of zAFQT are from Murray (personal communication) and Bock and Moore (1986). Reliability ratios for zSES are taken from Herrnstein and Murray (1994) and Jencks et al. (1979) (see text for discussion). The reliability ratio for education is the average of two values reported by Ashenfelter and Krueger (1994) based on their analyses of twins.

tions for all year-round workers (males and females, controlling for sex), the effect of SES increases (to $2,162, assuming a reliability ratio of 0.76) although it is still considerably smaller than the effect of AFQT ($4,855). When the analysis is restricted to men (part 3 of table 7.3) and we assume a reliability of 0.76 for SES, its effect ($3,052) begins to approach that of AFQT ($4,199).

When years of schooling is the dependent variable, correcting for measurement error increases the effect of SES (from .20 to .24 and .29), but it is still considerably smaller than that of AFQT (.62, .64, and .61).

Biases in the Effects of Parents' SES: Additional Family Background Characteristics

Herrnstein and Murray's SES index may not capture all relevant aspects of family socioeconomic background. Therefore, we examine the effects of controlling for several additional family characteristics: family arrangement when the respondent was fourteen years old (two-parent, parent and step-parent, single-parent, other); whether, at age fourteen: the respondent lived in an urban area; the respondent's family had a library card, received magazines regularly, and received newspapers regularly; whether an adult female in the household worked outside the home; the number of siblings of the respondent (dummy variables for none, two, three, and four or more); the age of the respondent's mother at the time of the respondent's birth (entered as a quadratic); whether the respondent is the eldest child in the family; and whether the respondent was born outside the United States. Surely, there are other important parental SES and family background components omitted.

Coefficients and standard errors for the full models are presented in appendix B. The results are summarized in table 7.4. In the first two columns

TABLE 7.4
Summary of Effects from Models of Socioeconomic Status and Child Development, with and without Detailed Family Background Controls

	OLS or Logit Coefficients (SEs)					
	Herrnstein and Murray Controls[a]		*Add Detailed FB Controls*[b]		*Composite Effects (Absolute Values)*	
	zAFQT	*zSES*	*zAFQT*	*zSES*	*FB + SES*	*Race + FB + SES*
Family income (1990 $) in 1989	6,975	4,580	6,516	3,615	6,157	6,108
	(354)	(324)	(383)	(410)		
In poverty in 1989	−0.95	−0.33	−0.93	−0.24	0.54	0.57
	(.05)	(.04)	(.05)	(.05)		
Annual earnings (1990 $), YR workers, in 1989	4,866	1,531	4,669	1,285	3,007	3,287
	(270)	(246)	(271)	(279)		
Yrs. schooling completed (z-score)	0.62	0.20	0.58	0.18	0.27	0.29
	(.01)	(.01)	(.01)	(.01)		
HS dropout	−1.82	−0.48	−1.76	−0.40	0.80	0.87
	(.06)	(.04)	(.06)	(.05)		
BA degree	1.76	0.70	1.72	0.67	0.90	0.89
	(.06)	(.05)	(.06)	(.05)		
High-IQ occ.	1.36	0.39	1.34	0.30	0.65	0.68
	(.08)	(.07)	(.08)	(.08)		
Out of LF 1+ mos. in 1989, men	−0.39	−0.02	−0.40	0.00	0.43	0.45
	(.06)	(.05)	(.06)	(.06)		
Unemployed 1+ mos. in 1989, men	−0.44	−0.09	−0.42	−0.04	0.29	0.31
	(.07)	(.07)	(.07)	(.08)		
Married by age 30	−0.04	−0.07	0.01	−0.09	0.30	0.56
	(.05)	(.04)	(.05)	(.05)		
Divorced, first 5 years of marriage	−0.22	0.18	−0.27	0.13	0.25	0.34
	(.05)	(.05)	(.05)	(.05)		
Middle-class values index	0.75	0.23	0.73	0.16	0.47	0.51
	(.04)	(.03)	(.04)	(.04)		
Ever interviewed in jail, men	−0.91	−0.06	−0.88	−0.05	0.60	0.68
	(.08)	(.07)	(0.08)	(0.09)		
CHILD OUTCOMES, FIRSTBORN CHILDREN						
"Illegitimate" (out-of-wedlock) birth	−0.46	−0.22	−0.45	−0.14	0.58	1.14
	(.06)	(.05)	(.07)	(.06)		
Early AFDC use	−0.54	−0.19	−0.54	−0.14	0.55	0.67
	(.08)	(.06)	(.08)	(.07)		

(table continues)

TABLE 7.4 *(continued)*

	OLS or Logit Coefficients (SEs)					
	Herrnstein and Murray Controls[a]		*Add Detailed FB Controls*[b]		*Composite Effects (Absolute Values)*	
	zAFQT	*zSES*	*zAFQT*	*zSES*	*FB + SES*	*Race + FB + SES*
Poor, first 3 years of life	−1.32 (.16)	−0.78 (.13)	−1.35 (.16)	−0.67 (.15)	1.03	1.11
Mother smoked during pregnancy	−0.52 (.06)	−0.01 (.05)	−0.49 (.06)	−0.00 (.06)	0.36	0.73
Low birth weight	−0.35 (.10)	−0.08 (.09)	−0.41 (.11)	−0.10 (.10)	0.32	0.45
Ever in foster or relative care?	−0.42 (.10)	−0.22 (.09)	−0.41 (.13)	−0.34 (.11)	0.58	0.70
CHILD OUTCOMES, ALL CHILDREN[c]						
HOME score (percentiles)	6.9 (0.5)	4.4 (0.5)	6.1 (0.5)	3.0 (0.5)	6.4	9.0
Motor and social development index (percentiles)	2.2 (0.6)	1.9 (0.5)	1.5 (0.7)	1.0 (0.6)	4.1	4.7
PPV (standardized score)	6.8 (0.5)	3.7 (0.4)	6.2 (0.5)	3.3 (0.5)	5.0	8.2
PPVT, 6+ year olds (standardized score)	6.8 (0.6)	2.6 (0.5)	6.5 (0.6)	2.2 (0.5)	3.3	5.6
Behavior problems index (standardized score; (higher = more problems)	−1.6 (0.4)	−0.5 (0.3)	−1.5 (0.4)	−0.3 (0.3)	1.4	1.5

Notes: For complete models, see appendix B. For sample and variable descriptions, see table 7.1.

[a]Controls include AFQT score and SES score, age (z-score), and, where appropriate, dummy variables for gender, race/ethnicity (3 dummy variables), year, and child's age at the time of assessment. Standard errors are corrected for non-independence of observations among youths from the same baseline household.

[b]Detailed family background controls include family arrangement at age 14 (3 dummy variables); dummy variables for the following family characteristics at age 14: urban residence, adult female worked outside the home, family received magazines regularly, received newspapers regularly, had a library card; number of siblings (4 dummy variables); age of mother at birth of respondent (quadratic); whether the respondent was firstborn; and whether the respondent was born outside the United States.

[c]Models for "all children" are based on averages (across years) of outcomes and control variables for children who were assessed in more than one year. In fixed-effects models for children (i.e., first-cousin differences), standard errors are corrected for non-independence of observations among (child) siblings.

we repeat the results presented in table 7.2. In the third and fourth columns we present coefficients and standard errors for the AFQT and SES variables from models that include detailed controls for family socioeconomic background. Finally, in the last two columns of the table we present two "composite" estimates of the effects of family socioeconomic background (both in absolute values). The first is a standardized composite of the SES effect and the effects of the various family background characteristics described in the previous paragraph. The second composite adds to the first the effect of racial/ethnic identification. Since AFQT score is controlled, the effects of race/ethnicity may reflect, at least in part, additional effects of family socioeconomic background (also see Fischer et al. 1996).

The composite effects we have constructed may be unfamiliar to many readers. This procedure allows us to extend Herrnstein and Murray's methodology for comparing effects of AFQT and SES to compare the effects of AFQT to a single, yet more comprehensive measure of family socioeconomic background. The composite effects are derived as follows. We first estimate a model for each outcome using the different controls for family socioeconomic background described above. For example, in a linear regression with dependent variable Y, family background components X, and AFQT we would have:

$$Y = b_0 + X\,b_1 + \text{AFQT}\,b_2 + e \tag{1}$$

where b_1 is a vector of coefficients representing the effects of different family background measures.[7] Using our estimate of b_1 we then calculate the predicted (linear) component of Y, F, due to family background factors:

$$\hat{F} = X\,\hat{b}_1; \tag{2}$$

Using the estimated form of the equation for Y (equation 1) we can rewrite (1) as:

$$Y = \hat{b}_0 + \hat{F} + \text{AFQT}\,\hat{b}_2 + \hat{e} \tag{3}$$

We then standardize $\hat{F}$ to have standard deviation equal to one in the population, producing a new variable $\hat{F}^*$. We can then rewrite (3) as:

$$Y = \hat{b}_0 + \hat{F}^*\,\sigma_f + \text{AFQT}\,\hat{b}_2 + \hat{e} \tag{4}$$

[7] The models also include terms for age and gender controls (not shown). The array X includes Herrnstein and Murray's parental SES index.

Since AFQT is scaled to have standard deviation one in the population, $\hat{\sigma}_f$ and $\hat{b}_2$ can be directly compared. The analogous procedure is used for logit models.[8]

The composite family background measures differ across dependent variables. Our procedure constructs the index for each model so as to maximize the effect of measured family background. This strategy is appropriate if one wishes to isolate the direct effects of measured IQ and measured family background. Our procedure differs from Herrnstein and Murray's because they use a fixed index of IQ (AFQT score) and a fixed index of parents' SES across all models. Given Herrnstein and Murray's position that AFQT measures a single underlying construct of intelligence, their treatment of the AFQT score is appropriate (although an area of future research is to investigate whether different components of AFQT differentially affect different measures of social and economic success).[9] However, we know of no theoretical or evidentiary basis for the use of a single index of parents' SES in all models.

Generally speaking, when family arrangement and the other family socioeconomic background variables are included in the models, the effect of AFQT is virtually unchanged and the effect of SES falls modestly (compare column 1 to column 3 and column 2 to column 4). However, in most cases the effects of many of the other FB (family socioeconomic background) variables are substantial (see appendix B), and the combined effects of the SES index and the FB variables typically far exceed those of SES alone (compare column 2 to column 5 or 6). For example, the effect of FB + SES reported in column 5 is at least 50 percent larger than the effect of SES alone (column 2) for the following outcomes: poverty, annual earnings, high school dropout, high-IQ occupation, out of the labor force, unemployment, married by age 30, middle class values index, and ever in jail, as well as nearly all the child outcomes. Strikingly, there are several outcomes—jail, marriage, out of labor force, and low birth weight—upon which the SES index has no discernible effect, and yet the composite FB effect is substantial.

Comparing the relative size of the AFQT and composite FB effects, it appears that the more closely related the outcome is to schooling attainment, the larger is the effect of AFQT relative to the FB composite. The strength

[8] This procedure is related to the more standard decomposition of the variance of the dependent variable. Specifically:

$$\mathrm{Var}(Y) = \sigma_f^2 + b_2^2 + \sigma_f b_2 \,\mathrm{corr}(F^*, \mathrm{AFQT}) + \mathrm{VAR}(e)$$

The coefficient of the family background effect, σ_f, is just the square root of the component of the variance of Y that is due solely to family background factors, σ_f^2.

[9] Currie and Thomas (1995) examine the effects of different components of mother's AFQT in analyses of child test scores.

of AFQT in predicting education and education-related outcomes further underscores the need to model carefully the joint determination of education, AFQT score, and the various adult outcomes. Other than schooling outcomes, the magnitude of the composite FB effect tends to be in the neighborhood of the AFQT effect, and the point estimate of the composite FB effect is larger than the AFQT effect for seven outcomes (out of the labor force, marriage, illegitimate birth, early AFDC use, foster care, HOME score, and motor and social development score) when race/ethnicity is excluded from the composite effect. The composite FB effect is larger than the AFQT effect for three other outcomes (divorce, low birth weight, and PPVT score for all children) when the effects of race/ethnicity are included in the composite.

Biases in the Effects of Parents' SES: Residual Family Background Effects

The results presented in table 7.4 suggest that the combined family socioeconomic background effect was considerably larger than the effect of the index of parents' SES alone. It is also possible to derive an omnibus estimate of the family background effect implied by the fixed-effect models. This effect captures the effects of all characteristics siblings have in common that are not included in the model (such as AFQT, age, and gender). Thus, for example, it includes not only the effect of having grown up in the same household, but also the effect of having grown up in the same neighborhood or state. This effect potentially includes similarities in such things as personality, motivation, and effort. With continuous dependent variables, we estimate directly the effect of the latent family background variable by conducting a one-way ANOVA (analysis of variance) analysis (by household) of the residual from the fixed-effect model. Here the residual is constructed to include all variance in the dependent variable not due to the observed independent variables. That is, it includes both the individual and family-specific components of the dependent variable, once we have removed the effects of AFQT and other observed variables that may differ among siblings. If we assume that the latent variable has variance one, then its coefficient is equal to the standard deviation of the household effect. These results are shown in table 7.5a.

With discrete outcomes, the same methodology is not available. Instead, we estimate a bivariate probit model. This model is is not as powerful since it is a random effects model, and so we must assume that any unobserved family component is uncorrelated with observed variables such as AFQT. However, we noted in our discussion of the fixed-effect models that SES appeared to be an adequate control for family background for the purpose of

TABLE 7.5A
Standardized Effects of Family Background and AFQT Score from Analyses of Siblings, Continuous Outcomes

	Estimated Effect (SE)			
	OLS		Fixed Effects	
	zAFQT	*zSES*	*zAFQT*	*zFB*[a]
Family income, 1989 (N = 3,316)	7,296 (622)	4,487 (577)	5,558 (890)	12,482 (543)
Annual earnings, 1989, YR Workers (N = 1,579)	5,548 (604)	1,169 (459)	5,317 (765)	6,180 (526)
Yrs. schooling, 1990 (z-score) (N = 4,758)	0.59 (.02)	0.18 (.02)	0.45 (.02)	0.50 (.01)

Notes: Other controls include: zAGE, black, Latino, other race, and, where appropriate, gender.
FB: Family Background.
[a]See text for a discussion of the family background effects.

estimating the effects of AFQT. (The exceptions to this finding were outcomes for the children of NLSY respondents. However, we do not examine child outcomes here.) As in the fixed-effect model, if we assume that the latent variable has variance one, then its effect is the square root of the intersibling correlation. The results of the bivariate probit analyses are reported in table 7.5b.

The first row of table 7.5a shows the imputed effect of family background for family income. The implied effect of family background on income ($12,482) is considerably larger than that of SES ($4,487) or either AFQT effect (OLS: $7,296, and FE: $5,558). The effect of family background on annual earnings ($6,180) is far larger than that of SES alone ($1,169) and is somewhat larger than the effect of AFQT score (OLS: $5,548, or FE: $5,317). Finally the implied effect of family background on education (.50) is far larger than the OLS estimate of SES's effect (.18), and is somewhat larger than the AFQT fixed-effect estimate (.45).

Table 7.5b reports the results from the bivariate probit analyses. Results are similar to those for income in table 7.5a in that in almost all cases the effect of the latent variable and the combined effect of SES and the latent variable are larger than the effect of AFQT, often considerably so. The sole exception is the probability of receiving a BA degree, where the effects are of nearly equal size. The results in table 7.5b suggest there is a very large latent family background component that is orthogonal to the parental SES index, but has substantial effects on many outcomes.

Caution should be used in interpreting the estimates in tables 7.5a and

TABLE 7.5B
Standardized Effects of Family Background and AFQT from Bivariate Probit Analyses of Siblings

	Estimated Effects (SEs)			
			Absolute Value of Effect	
	zAFQT	*zSES*	*Latent FB*[a]	*Total FB*[b]
In poverty in 1989	−0.37 (.04)	−0.18 (.04)	0.65 (.04)	0.68 (.01)
HS dropout	−0.64 (.04)	−0.29 (.04)	0.78 (.03)	0.83 (.01)
BA degree	0.68 (.04)	0.24 (.03)	0.75 (.03)	0.79 (.01)
Out of labor force 1+ mos. in 1989 (men)	−0.21 (.03)	−0.08 (.03)	0.54 (.04)	0.55 (.004)
Unemployed 1+ mos. in 1989 (men)	−0.20 (.03)	−0.11 (.03)	0.74 (.03)	0.75 (.004)
Married by age 30	0.10 (.06)	−0.03 (.07)	0.37 (.13)	0.37 (.01)
Divorced, first 5 years of marriage	−0.19 (.07)	0.17 (.06)	0.21 (.26)	0.27 (.004)
Ever interviewed in jail, men	−0.19 (.03)	−0.13 (.04)	0.96 (.01)	0.96 (.004)
Middle class values index	0.47 (.04)	0.12 (.03)	0.55 (.05)	0.56 (.01)
High-IQ occupation	0.25 (.04)	0.06 (.04)	0.73 (.04)	0.73 (.004)

Notes: Other controls include: zAGE, black, Latino, other race, and, where appropriate, gender. See table 7.1 for variable and sample definitions.
FB: family background
[a]The latent effect is the square root of the cross-equation correlation for siblings.
[b]The total effect is the square root of the sum of the SES effect squared plus the latent effect squared.

7.5b. These estimates attribute to family background all common variance among siblings in the outcome variables that is independent of the effect of AFQT score, gender, and age. For example, the total family background effects include genetic traits that are common to siblings and orthogonal to AFQT score. Similarly, if siblings have grown up in the same places, any effects of location on outcomes will be included in our estimates of the effect of family background. Nonetheless, our estimates do not simply reaffirm Herrnstein and Murray's acknowledgment that the explanatory power of their models is low. *Rather, our sibling models demonstrate that the family one is born into has a very large effect on chances of success in adulthood, independent of measured intelligence.*

The Role of Education

Herrnstein and Murray do not present estimates of the effects of schooling on most of the outcomes they examine. As noted, given the potential for policies to change individual educational attainment, this omission is likely to be important. Also, they examine in only a limited way the effect that controlling for education has on their estimates of the effects of AFQT. In appendixes 6 and 8 as well as in several diagrams in the main body of *The Bell Curve*, Herrnstein and Murray present results from models for two education groups (high school graduates and college graduates). In general, however, it is not obvious from these analyses how sensitive the AFQT effects are to inclusion of controls for education. Furthermore, it is not possible to determine from these analyses the partial effect of education (net of AFQT score). Education may be an important source of omitted variable bias since AFQT and schooling are correlated 0.64.

Herrnstein and Murray argue against including education controls in their models since education may be determined in part by an individual's intelligence (p. 124).[10] Their argument is that if one includes education in the models, the effect of AFQT score would be understated because part of the effect of intelligence is indirect, through education. This objection points to an area of confusion in *The Bell Curve*. Throughout section II, Herrnstein and Murray are unclear about whether, in comparing the effects of AFQT and SES, they intend to contrast the partial (i.e., direct) effects of the variables on an outcome—that is, the effects of AFQT and SES net of the effect of other variables—or the "total" effects of these two variables (their direct effects plus their indirect effects through other variables such as education).

[10] Herrnstein and Murray list three additional objections to including schooling controls: (1) the effects of education may be nonlinear; (2) schooling and AFQT score are likely to be collinear; AFQT score are likely to be collinear; and (3) the relationship between schooling and intelligence is complex: "The effects of education, whatever they may be, depend on the coexistence of suitable cognitive abilities in ways that often require complex and extensive modeling of interaction effects—once again, problems that we hope others will take up but would push us far beyond the purposes of this book" (p. 125).

The first objection is easily addressed by allowing schooling to have nonlinear effects. As for the second objection, the problem of multicollinearity amounts to whether there are enough data to estimate coterminously precise effects of education and AFQT score. In effect, by excluding schooling controls, Herrnstein and Murray overstate the magnitude and precision of their AFQT estimates (e.g., Goldberger 1991, pp. 248–250). As for the final objection, we agree that further work is needed on the complex and possibly interacting relationship between intelligence and schooling. Nonetheless, there is no reason to believe that a model that includes schooling controls in a crude way is inferior to one that omits them altogether.

Furthermore, if one wants to contrast total effects and thus account for the indirect effects of AFQT through education, one should also account for the possible indirect effects of SES through AFQT (and education) on different outcomes.

A critical question is, therefore, whether effects of AFQT are direct or primarily indirect through education. In the latter situation, it is because individuals who have higher AFQT scores tend to get more education, and education directly affects an outcome, that outcomes differ by AFQT score. In this case, the relation between AFQT and an outcome might be changed by policies that alter the relationship between AFQT and schooling. In fact, in *The Bell Curve* Herrnstein and Murray recognize that the relationship between schooling and IQ is malleable when they argue that higher education has become increasingly selective with respect to IQ, and again in chapter 18 when they discuss the "dumbing down" of American education.

Schooling attainment can potentially be manipulated by public policy. If education has a substantial effect on various outcomes, then Herrnstein and Murray's pessimism about society's ability to change individual outcomes may be unwarranted. That is, even if additional education has no effect on IQ, an increase in an individual's education level may enhance his or her chances of success (Hauser and Carter 1995; Jencks et al. 1979).

Table 7.2 reports estimates when education is included as an independent variable. In eleven of twenty-three cases the inclusion of education reduces the effect of AFQT by more than 25 percent. In many cases the standardized effect of education is larger than that of AFQT. In the OLS and standard logit analyses, education has a larger effect than AFQT for family income, annual earnings, high-IQ occupations, the middle-class values index, whether the mother smoked during pregnancy, HOME index, and child's motor and social development index. Parallel changes are found in the fixed-effect models.[11]

The inclusion of education controls also substantially changes the effect of parental SES. This result is hardly surprising, since previous research has repeatedly shown that much of the effect of parental SES on status attainment works indirectly through education. In six of twenty-three cases the effect of SES is reduced by more than 25 percent. It is notable that including education has little impact on the estimates of the effects of SES on the outcomes associated with the children of NLSY respondents.

One might argue that it is appropriate to exclude education controls because Herrnstein and Murray intend to compare the total effects of AFQT

[11] Appendix C presents analyses of family income and annual earnings where we have adjusted fixed-effects estimates for measurement error in AFQT scores and education. In models of family income, the effect of AFQT score falls slightly and the effect of education rises markedly (from 4,305 to 5,627) when we correct for measurement error. Both effects rise slightly in models of annual earnings.

score and parental SES. Even in this case, however, the omission of education is problematic since education may affect AFQT scores. If so, then these analyses understate the effect of parental SES (because parental SES affects education) and overstates the effect of AFQT.[12]

Indeed, Herrnstein and Murray argue that education has a minimal effect on AFQT scores. In appendix 3 of *The Bell Curve* Herrnstein and Murray carry out an analysis of the possible effects of education on AFQT using earlier measures of IQ as a control variable. They find that an increase in education of one year increases a youth's percentile ranking in the AFQT distribution by only 2.2 points, or when they use the standardized AFQT score, by .074 of a standard deviation, about one IQ point per year of education.

In recent work with the NLSY, however, Neal and Johnson (1995) have found, using quarter of birth as an instrument for educational attainment, that each additional year of education increases AFQT score by more than three points (a large effect). Furthermore, our reanalysis of Herrnstein and Murray's data (Winship and Korenman 1997) revealed that seven observations included in Herrnstein and Murray's analyses had years of schooling equal to −5, a missing value code in the NLSY. Furthermore, the results presented on page 591 are from analyses that do not include age at first test, although they state on page 590 that age at first test was included. When missing data are treated appropriately and age at first test included as a control, and with conservative reliability corrections, the effect of education on AFQT more than doubles to about 2.7 IQ points for every year of education (Winship and Korenman 1997).

A considerable modeling effort is needed to sort out the possible mutual effects of education and AFQT score on each other, and to account for the indirect effects of SES on various outcomes through its effect on AFQT. We have begun to develop such models in two related papers (Winship and Korenman 1997, and Winship and Korenman forthcoming). Nonetheless, from the analyses reported here we learn that estimates of the direct effects of AFQT, where we control for education, are often substantially smaller than the effects of AFQT reported in *The Bell Curve*. Furthermore, education has large effects on many outcomes, controlling for AFQT score.

Conclusion

The purpose of section II of *The Bell Curve* and chapter 14 is to demonstrate the importance of AFQT score in determining a variety of outcomes. Herrnstein and Murray summarize their results in the following way: "If a white

[12] We also do not control for quality of education. Presumably doing so would further increase the effects of education and reduce the effects of AFQT score.

child of the next generation could be given a choice between being disadvantaged in socioeconomic status or disadvantaged in intelligence, there is no question about the right choice" (p. 135). Herrnstein and Murray are confident that innate intelligence is the principal determinant of economic and social success.

In their 1979 book, *Who Gets Ahead?* Christopher Jencks et al., using a large number of data sets, analyze the importance of intelligence, education, family background, and noncognitive abilities in determining various economic outcomes. Jencks et al. conclude that all four sets of factors are important, that no single factor dominates the others, and that their relative importance differs across samples and outcomes.

Which conclusion is right? Are Herrnstein and Murray correct in asserting that intelligence is the dominant factor in determining social and economic success? Or, as Jencks et al. assert, is intelligence just one of several important factors including education and family background? Although we mostly confirm with sibling analyses Herrnstein and Murray's finding that the effects of AFQT are substantial and robust,[13] on balance our results are closer to Jencks et al.'s. Although we have not replicated the Jencks et al. analyses, we do find evidence that the partial effects of family background and schooling are as large as, and in many cases larger than, those of AFQT in predicting a variety of outcomes. The large partial effects we find for education (net of AFQT score and family background) are particularly important given Herrnstein and Murray's pessimism about the potential of social policies to change outcomes. In addition, in models that exclude schooling controls, the effects of family background are as large as or larger than the effects of AFQT score.

In reaching these conclusions we have ignored the potentially serious problem of the endogenous determination of AFQT score. For example, if family socioeconomic background and schooling quality are important determinants of AFQT score at ages fifteen to twenty-three, then the estimates of AFQT score and parental SES that we have presented may exaggerate the importance of AFQT score relative to family background in influencing socioeconomic outcomes. The endogeneity of AFQT scores is a subject of ongoing investigation (see, e.g., Neal and Johnson 1995; Rogers and Spriggs 1995).

[13] An exception to our finding of robust effects of AFQT are analyses of the developmental outcomes of young children of NLSY female sample members. Effects of mother's AFQT score are small and not significant when the comparison is made between the children of mothers who are sisters (i.e., first cousins). This finding also stands in contrast to the findings of Currie and Thomas (1995), who report substantial effects of mother's AFQT score after adding controls for mother's education and permanent income. (They do not conduct analyses of sibling differences, however.)

APPENDIX A
Estimated Effects from Models of Socioeconomic Status, by Race

	OLS Coefficients (SEs)							
	Full Sample[a]			Siblings XSEC[a]			Siblings FE[b]	
	zAFQT	zSES	zED	zAFQT	zSES	zED	zAFQT	zED
FAMILY INCOME (1990$), 1989								
Whites	6,627	4,146		7,003	5,208		6,166	
	(500)	(481)		(855)	(877)		(1562)	
	3,765	3,840	4,713	4,084	3,849	5,043	3,910	5,335
	(595)	(500)	(542)	(954)	(916)	(942)	(1578)	(1442)
Number of obs.		4468			1811		1811	
Blacks	6,923	5,352		7,108	3,586		3,685	
	(651)	(574)		(1112)	(1023)		(1384)	
	4,582	4,647	4,201	5,393	3,263	2,849	1,932	3,408
	(756)	(581)	(706)	(1532)	(982)	(1577)	(1807)	(1594)
Number of obs.		1931			861		861	
Latinos	8,425	2,272		8,629	3,038		6,444	
	(863)	(698)		(1365)	(932)		(2000)	
	5,912	1,934	3,839	6,740	2,859	3,354	5,900	1,325
	(1031)	(697)	(876)	(1466)	(916)	(1172)	(2083)	(2232)
Number of obs.		1225			501		501	
ANNUAL EARNINGS, 1989 YEAR-ROUND WORKERS								
Whites	5,056	1,923		6,007	1,410		6,412	
	(389)	(375)		(913)	(804)		(1433)	
	2,906	885	3,663	4,084	591	3,163	4,738	3,061
	(455)	(388)	(415)	(922)	(819)	(903)	(1299)	(1457)
Number of obs.		2823			878		878	
Blacks	5,145	1,362		4,539	1,181		3,046	
	(439)	(393)		(933)	(631)		(881)	
	3,613	859	2,949	3,313	1,047	2,097	2,213	1,458
	(502)	(396)	(490)	(1029)	(622)	(757)	(1017)	(964)
Number of obs.		1161			401		401	
Latinos	3,741	1,283		5,138	926		5,469	
	(583)	(470)		(1154)	(870)		(1570)	
	2,984	1,228	1,158	4,555	963	877	4,838	1,158
	(698)	(470)	(591)	(1212)	(851)	(883)	(1761)	(1002)
Number of obs.		796			248		248	
YEARS OF SCHOOLING COMPLETED, 1990 (Z-SCORE)								
Whites	0.60	0.28		0.55	0.30		0.40	
	(.01)	(.01)		(.02)	(.02)		(.03)	
Number of obs.		5261			2385		2385	

(table continues)

APPENDIX A *(continued)*

	OLS Coefficients (SEs)							
	Full Sample[a]			Siblings XSEC[a]			Siblings FE[b]	
	zAFQT	zSES	zED	zAFQT	zSES	zED	zAFQT	zED
Blacks	0.55	0.17		0.57	0.13		0.50	
	(.02)	(.02)		(.03)	(.03)		(.04)	
Number of obs.		2603			1415		1415	
Latinos	0.71	0.07		0.63	0.02		0.48	
	(.03)	(.02)		(.05)	(.03)		(.05)	
Number of obs.		1603			778		778	

Notes: See table 7.1 for description of dependent variables and samples.

XSEC: cross-section; FE: fixed-effects; YR: year-round

[a]Models contain controls for age (z-score) and gender. Standard errors are corrected for non-independence of observations among youths from the same baseline household.

[b]Sibling fixed-effects models are sibling differences estimated by including in the regression models a dummy variable for each family of origin.

APPENDIX B
Estimated Effects from Models of Socioeconomic Status and Child Development with Detailed Family Background Controls

	OLS or Logit Coefficients (SEs)								
	Ann. Income	*Poor*	*Ann. Earns.*	*Years Schl.*	*HS Drop*	*BA*	*High-IQ Occ*	*Out of LF*	*Unemp*
SES + FB (abs. value)	6,157	0.54	2,767	0.27	0.80	0.90	0.65	0.43	0.29
SES + FB + Race (abs. value)	6,108	0.57	2,251	0.29	0.87	0.89	0.68	0.45	0.31
zAFQT	6,515	−0.93	4,669	0.58	−1.76	1.71	1.34	−0.40	−0.42
	(383)	(.05)	(271)	(.01)	(.06)	(.06)	(.08)	(.06)	(.07)
zSES	3,614	−0.24	1,285	0.18	−0.40	0.67	0.30	0.00	−0.04
	(409)	(.05)	(279)	(.01)	(.05)	(.05)	(.08)	(.06)	(.08)
zAGE	1,806	−0.03	1,580	−0.03	0.11	−0.10	−0.17	−0.08	−0.05
	(296)	(0.04)	(220)	(.01)	(.04)	(.04)	(.07)	(.05)	(.07)
Black	115	0.17	892	0.57	−1.72	1.24	1.00	0.16	0.05
	(749)	(.09)	(548)	(.02)	(0.11)	(.11)	(.18)	(.12)	(.15)
Latino	2,418	−0.07	917	0.25	−0.64	0.28	0.87	0.08	−0.23
	(910)	(.12)	(673)	(.03)	(0.12)	(.14)	(.21)	(.14)	(.21)
Other race	−1,865	0.37	−1,931	−0.03	0.61	0.01	0.17	0.32	0.03
	(1,422)	(.16)	(719)	(.04)	(.17)	(.20)	(.32)	(.22)	(.31)
Female	−1,410	0.79	−7,635	0.09	−0.35	0.28	−0.22	—	—
	(562)	(.07)	(405)	(.01)	(.07)	(.07)	(.13)		
FAMILY ARRANGEMENT, AGE 14									
Mother only	−3,721	0.42	160	−0.01	0.44	−0.05	0.00	0.37	0.35
	(779)	(.09)	(581)	(.02)	(.10)	(.13)	(.21)	(.12)	(.16)
Step	−3,776	0.28	−369	−0.17	0.83	−0.69	0.12	0.40	0.05
	(859)	(.11)	(693)	(.02)	(.11)	(.14)	(.22)	(.14)	(.19)
Other	−5,160	0.40	−236	−0.06	0.66	−0.20	−0.71	0.73	0.50
	(1,191)	(.15)	(1373)	(.04)	(.16)	(.25)	(.61)	(.20)	(.27)
AGE 14									
Urban residence	727	0.26	787	−0.00	0.27	−0.06	0.20	0.39	0.06
	(651)	(.10)	(434)	(.02)	(.09)	(.10)	(.17)	(.13)	(.15)
Adult female worked	−384	−0.10	−399	−0.04	0.15	−0.15	0.24	0.01	−0.04
	(588)	(.08)	(433)	(.02)	(.08)	(.08)	(.13)	(.09)	(.13)
Magazines	920	−0.10	993	0.09	−0.29	0.21	0.39	0.02	−0.10
	(652)	(.08)	(467)	(.02)	(.08)	(.09)	(.17)	(.10)	(.14)
Newspapers	474	−0.13	−69	−0.02	−0.09	−0.18	0.05	−0.07	0.00
	(653)	(.08)	(442)	(.05)	(.09)	(.12)	(.20)	(.11)	(.15)
Library card	1,676	0.03	1,218	−0.03	−0.17	0.15	0.21	0.19	0.12
	(595)	(0.08)	(421)	(.03)	(.08)	(.10)	(.19)	(.10)	(.14)
NUMBER OF SIBS									
None	−1,576	0.02	−1,279	−0.02	−0.44	−0.22	0.24	−0.18	0.05
	(1,860)	(.28)	(1,050)	(.05)	(0.32)	(.21)	(.33)	(.33)	(.41)
Two	−1,046	−0.03	489	−0.03	0.06	−0.16	0.01	0.09	−0.12
	(1179)	(.16)	(789)	(.03)	(.16)	(.11)	(.19)	(.18)	(.24)
Three	−2,725	0.09	−67	−0.09	0.06	−0.35	0.30	−0.04	0.14
	(1,149)	(.15)	(772)	(.03)	(.16)	(.12)	(.20)	(.18)	(.24)
Four or more	−3,297	0.31	−336	−0.14	0.37	−0.51	−0.03	0.20	0.26
	(1,073)	(0.14)	(728)	(.03)	(.15)	(.12)	(.20)	(.16)	(.22)
Age mother at birth	1,157	−0.10	47	0.02	−0.02	0.05	0.09	0.01	−0.04
	(289)	(0.04)	(269)	(.01)	(.04)	(.05)	(.09)	(.05)	(.08)

(*table continues*)

APPENDIX B (*continued*)

	OLS or Logit Coefficients (SEs)								
	Ann. Income	*Poor*	*Ann. Earns.*	*Years Schl.*	*HS Drop*	*BA*	*High-IQ Occ*	*Out of LF*	*Unemp*
(Age mother squared)/100	−1,926	0.16	−74	−0.02	0.01	−0.03	−0.12	−0.02	0.03
	(504)	(.07)	(481)	(.02)	(.07)	(.09)	(.15)	(.09)	(.14)
Firstborn	253	−0.12	−366	0.01	−0.08	−0.10	0.05	−0.08	−0.05
	(801)	(.11)	(631)	(.02)	(.11)	(.10)	(.17)	(.14)	(.18)
Foreign-born	7,215	−0.55	−4,091	0.06	−0.29	0.77	0.69	−0.25	−0.44
	(1,438)	(.18)	(796)	(.04)	(.15)	(.19)	(.27)	(.21)	(.30)
Number of obs	7,977	7,977	5,009	9,885	8,739	9,588	7,944	4,144	3,225

	OLS or Logit Coefficients (SEs)									
	Mar.	*Div.*	*MC Values*	*Ever Jail*	*Illeg. Birth*	*Early AFDC*	*Early Pov.*	*Smoke*	*LBW*	*Foster Care*
Combined FB (abs. value)	0.30	0.25	0.47	0.60	0.58	0.55	1.04	0.36	0.32	0.58
Combined FB & Race (abs. value)	0.56	0.34	0.50	0.68	1.14	0.67	1.11	0.73	0.45	0.70
zAFQT	0.01	−0.27	0.73	−0.88	−0.45	−0.54	−1.35	−0.49	−0.41	−0.41
	(.05)	(.05)	(.04)	(.08)	(.07)	(.08)	(.16)	(.06)	(.11)	(.13)
zSES	−0.09	0.13	0.16	−0.05	−0.14	−0.14	−0.67	−0.00	−0.10	−0.34
	(.05)	(.05)	(.04)	(.09)	(.06)	(.07)	(.15)	(.06)	(.10)	(.11)
zAGE	0.07	−0.03	−0.02	0.02	−0.21	−0.16	−0.34	0.08	0.13	0.20
	(.08)	(.04)	(.03)	(.06)	(.05)	(.06)	(.10)	(.04)	(.08)	(.08)
Black	−1.26	−0.35	−0.22	0.40	1.91	0.55	0.51	−1.15	0.73	0.69
	(.10)	(.12)	(.08)	(.17)	(.11)	(.13)	(.22)	(.12)	(.21)	(.21)
Latino	−0.34	−0.36	0.15	−0.10	0.20	−0.18	−0.41	−1.50	0.43	0.20
	(.12)	(.13)	(.09)	(.22)	(.14)	(.17)	(.31)	(.16)	(.25)	(.27)
Other race	−0.15	0.41	−0.32	0.78	0.03	0.07	0.24	−0.13	0.50	0.07
	(.20)	(.15)	(.14)	(.29)	(.21)	(.25)	(.43)	(.19)	(.36)	(.44)
Female	0.42	0.12	0.34	—	—	—	—	—	—	—
	(.07)	(.08)	(.05)							
FAMILY ARRANGEMENT, AGE 14										
Mother only	−0.19	0.10	−0.51	0.52	0.65	0.38	0.64	0.17	−0.13	−0.11
	(.11)	(.12)	(.08)	(.17)	(.12)	(.13)	(.22)	(.11)	(.19)	(.20)
Step	0.08	0.22	−0.67	0.78	0.44	0.56	0.91	0.41	−0.30	0.41
	(.12)	(.11)	(.09)	(.17)	(.12)	(.14)	(.26)	(.12)	(.24)	(.21)
Other	−0.28	0.19	−0.66	0.74	0.43	0.42	0.72	0.31	−0.08	−0.04
	(.18)	(.19)	(.16)	(.25)	(.19)	(.21)	(.33)	(.19)	(.30)	(.33)
AGE 14										
Urban residence	−0.16	−0.02	−0.18	0.32	0.39	0.32	0.05	0.14	0.01	0.22
	(.10)	(.09)	(.07)	(.18)	(.12)	(.13)	(.22)	(.10)	(.19)	(.20)
Adult female worked	0.21	0.14	−0.05	0.27	−0.11	−0.02	−0.33	0.06	−0.04	−0.09
	(.08)	(.08)	(.06)	(.14)	(.09)	(.10)	(.19)	(.08)	(.15)	(.17)
Magazines	0.06	−0.08	0.23	−0.22	−0.11	−0.28	−0.15	−0.26	0.08	0.11
	(.09)	(.09)	(.06)	(.14)	(.10)	(.11)	(.20)	(.10)	(.17)	(.18)
Newspapers	0.05	−0.14	0.06	0.06	−0.04	0.03	0.07	0.23	0.01	−0.10
	(.10)	(.10)	(.07)	(.15)	(.11)	(.12)	(.20)	(.10)	(.18)	(.18)
Library card	−0.17	0.26	−0.06	0.02	0.13	0.23	0.03	0.02	0.08	−0.17
	(.09)	(.09)	(.07)	(.14)	(.10)	(.12)	(.19)	(.09)	(.18)	(.18)

(*table continues*)

APPENDIX B *(continued)*

	OLS or Logit Coefficients (SEs)									
	Mar.	*Div.*	*MC Values*	*Ever Jail*	*Illeg. Birth*	*Early AFDC*	*Early Pov.*	*Smoke*	*LBW*	*Foster Care*
NUMBER OF SIBS										
None	0.07	0.22	0.07	−1.10	−0.10	0.63	−0.05	−0.40	−0.11	−0.03
	(.23)	(.25)	(.18)	(.77)	(.32)	(.35)	(.60)	(.32)	(.66)	(.74)
Two	0.26	−0.05	0.07	0.35	−0.09	−0.01	−0.45	0.00	−0.11	0.47
	(.13)	(.14)	(.10)	(.29)	(.18)	(.22)	(.41)	(.16)	(.34)	(.38)
Three	0.19	−0.19	0.12	0.11	0.10	0.01	0.01	−0.02	0.38	0.52
	(.13)	(.14)	(.10)	(.30)	(.18)	(.21)	(.38)	(.15)	(.32)	(.37)
Four or more	0.38	−0.07	−0.01	0.46	0.24	0.34	0.35	−0.04	0.14	0.28
	(.12)	(.13)	(.09)	(.27)	(.16)	(.19)	(.34)	(.15)	(.30)	(.35)
Age mother at birth	−0.03	−0.09	0.04	0.03	−0.11	−0.07	−0.05	−0.12	0.06	−0.17
	(.05)	(.04)	(.03)	(.08)	(.05)	(.06)	(.10)	(.05)	(.09)	(.08)
(Age mother squared)/100	0.01	0.15	−0.07	−0.09	0.20	0.00	0.07	0.19	−0.09	0.00
	(.08)	(.08)	(.06)	(.15)	(.09)	(.00)	(.18)	(.09)	(.15)	(.00)
Firstborn	0.03	0.08	−0.06	−0.08	−0.07	−0.10	0.00	−0.41	0.08	−0.04
	(.10)	(.11)	(.08)	(.19)	(.13)	(.15)	(.28)	(.12)	(.23)	(.23)
Foreign-born	0.17	−0.18	0.15	−0.35	−0.80	−0.91	−1.20	−0.74	−1.02	−1.42
	(.16)	(.18)	(.12)	(.29)	(.21)	(.26)	(.47)	(.23)	(.45)	(0.54)
Number of obs	4,221	4,684	7,692	4,809	3,448	2,683	1,369	3,333	3,325	3,475

	OLS or Logit Coefficients (SEs)				
	HOME	*MOSO*	*PPVT*	*PPVT6*	*BPI*
SES + FB (abs. value)	6.4	4.1	5.0	3.3	1.4
SES + FB + Race (abs. value)	9.0	4.7	8.2	5.6	1.5
zAFQT	6.1	1.5	6.2	6.5	−1.5
	(0.5)	(0.7)	(0.5)	(0.6)	(0.4)
zSES	3.0	1.0	3.3	2.2	−0.3
	(0.5)	(0.6)	(0.4)	(0.5)	(0.3)
zAGE	1.7	−0.6	−0.4	−0.6	0.0
	(0.4)	(0.5)	(0.4)	(0.5)	(0.3)
Year 1	−1.9	0.4	2.4	1.7	5.5
	(2.0)	(1.3)	(0.9)	(1.3)	(1.0)
Year 2	−0.0	3.9	−0.2	−0.9	3.8
	(1.5)	(1.4)	(0.9)	(1.3)	(0.8)
Child's age (months) or age group = #1[a]	−5.1	−0.19	0.07	0.00	0.02
	(1.1)	(0.05)	(.01)	(.02)	(.01)
Child's age group = #2	−3.2	—	—	—	—
	(1.1)				
Black	−11.2	1.8	−11.3	−8.7	−1.4
	(1.0)	(1.3)	(0.8)	(1.0)	(0.6)
Latino	−1.6	−3.9	−6.1	−3.7	−2.3
	(1.2)	(1.4)	(1.1)	(1.3)	(0.8)
Other race	−3.8	3.3	−1.4	−1.0	−0.5
	(1.8)	(2.3)	(1.1)	(1.5)	(1.1)

(table continues)

APPENDIX B *(continued)*

	OLS or Logit Coefficients (SEs)				
	HOME	*MOSO*	*PPVT*	*PPVT6*	*BPI*
FAMILY ARRANGEMENT AGE 14					
Mother only	−0.7	−0.6	1.2	0.0	1.4
	(1.1)	(1.3)	(0.9)	(1.0)	(0.7)
Step	−2.3	−3.2	0.8	0.8	2.3
	(1.2)	(1.4)	(0.8)	(1.1)	(0.7)
Other	−2.3	−2.3	0.5	0.1	2.0
	(1.7)	(2.3)	(1.4)	(1.8)	(1.0)
AGE 14					
Urban residence	1.5	−0.9	−1.1	−0.6	−0.2
	(0.9)	(1.2)	(0.7)	(1.0)	(0.6)
Adult female worked	−0.3	−0.4	−1.0	−0.0	0.9
	(0.8)	(0.9)	(0.6)	(0.8)	(0.5)
Magazines	2.0	2.2	0.7	0.3	−0.8
	(0.9)	(1.1)	(0.7)	(0.9)	(0.5)
Newspapers	2.2	0.8	0.8	0.7	0.1
	(0.9)	(1.2)	(0.7)	(1.0)	(0.6)
Library card	5.1	4.9	2.3	0.8	−0.2
	(0.9)	(1.1)	(0.7)	(0.9)	(0.6)
NUMBER OF SIBS					
None	3.3	−3.1	0.9	3.2	1.0
	(2.3)	(3.7)	(2.0)	(2.4)	(1.6)
Two	0.5	−3.0	0.7	−0.6	0.9
	(1.5)	(1.7)	(1.1)	(1.7)	(0.9)
Three	0.4	−0.6	−0.4	−2.7	1.2
	(1.4)	(1.8)	(1.1)	(1.6)	(0.9)
Four or more	−1.4	−2.7	−2.5	−1.5	0.9
	(1.3)	(1.7)	(1.0)	(1.5)	(0.8)
Age mother at birth	0.5	−0.1	0.3	0.5	−0.5
	(0.4)	(0.6)	(0.4)	(0.4)	(0.3)
(Age mother squared)/100	−0.8	0.4	−0.3	−0.0	1.0
	(0.8)	(1.1)	(0.6)	(0.1)	(0.5)
First born	−1.4	−2.5	−1.1	−1.1	0.1
	(1.1)	(1.4)	(0.9)	(1.1)	(0.7)
Foreign born	1.8	0.7	−6.1	−4.1	−0.0
	(1.7)	(1.9)	(1.7)	(1.8)	(1.0)
Number of obs	6,711	4,101	4,707	1,784	4,645

Note: See table 7.1 for a description of dependent variables and samples.
[a]Child's age group for HOME score; age at assessment in months for other outcomes.

APPENDIX C

Effects of Reliability Corrections on Fixed-Effect Coefficient Estimates

	Fixed-Effects Coefficients (SEs)		Reliability Ratios[a]	
	zAFQT	*zED*	*zAFQT*	*zED*
1. Family income, 1989	5,558 (975)		1.00	
	3,610 (1,044)	4,305 (963)	1.00	1.00
	6,558 (1,049)		0.85	
	3,554 (1,297)	5,627 (1,298)	0.85	0.77
2. Earnings, 1989 (year-round workers)	5,317 (852)		1.00	
	4,023 (821)	2,341 (856)	1.00	1.00
	6,228 (659)		0.86	
	4,493 (873)	2,677 (800)	0.86	0.80

Note: Models also include controls for age and sex.

[a]Reliability ratios are ratios of signal variance to total variance. The values for reliability of AFQT score are based on Murray (personal communication) and Bock and Moore (1986); the reliability ratio of education is based on Ashenfelter and Krueger (1994). These values are adjusted for use in fixed-effect estimation using the intrafamily correlation of test scores and education. See also chapter footnotes.

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