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Achievement Tests in the Panel Study of Income Dynamics Child Development Supplement

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Abstract

To objectively assess the academic skills in reading and mathematics of children in the PSID Child Development Supplement (CDS), subtests from the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R) were administered in all three waves of the survey. This document provides an introduction to and an overview of these assessments. In addition, this document describes cognitive tests available for the CDS children's primary caregivers and for respondents to the 1972 PSID that provide a measure of a grandparent's cognitive skills for many CDS children.

1. Introduction

The Panel Study of Income Dynamics (PSID) is a nationally-representative, longitudinal study of U.S. families that began in 1968. Interviews were conducted annually through 1997, and biennially since 1997 (see McGonagle et al., 2012). The PSID Child Development Supplement (CDS) was launched in 1997 to examine a broad array of child developmental outcomes within the context of family, neighborhood, and school environments for an original sample of nearly 3,600 children aged 0–12 years in PSID families (McGonagle and Sastry, 2014). Two additional waves of CDS were fielded in 2002/03 and 2007/08 when eligible children in CDS were, respectively, 5–17 and 10–17 years of age. Further details about CDS are available in the user guide available for each wave (Hofferth et al., 1997; PSID, 2010; PSID 2012).[1]

In order to objectively assess the academic achievement of the CDS children at each wave—and to measure growth in academic skills over time as children progressed through school—reading and mathematics assessments were administered to children in each of the three waves of the CDS. Children aged three years and older were administered subtests of the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; McGrew, Werder, and Woodcock, 1989; Woodcock and Mather, 1989), a well-established set of measures that provides researchers with information on several dimensions of intellectual skills, including current developmental status, degree of mastery in reading and mathematics, and age- and grade-group standing.

For all three waves of the CDS, three subtests were selected to measure reading and math achievement: the Letter-Word Identification test, the Passage Comprehension test (administered to children age six years and older), and the Applied Problems test; the Calculation test was also administered in CDS-I. The Letter-Word Identification test assesses symbolic learning and reading identification skills. The Passage Comprehension test assesses reading comprehension and vocabulary, and the ability to use these two skills together in a sentence completion task. The Applied Problems test assesses mathematics reasoning, achievement, and knowledge. The Calculation test assesses knowledge of mathematic operations and ability to perform computations. Scores from each of these tests can be used individually; in addition, the Letter-Word Identification test and the Passage Comprehension test can be combined to provide a score for Broad Reading and the Applied Problems test and the Calculation test can be combined to provide a score for Broad Math (the latter is only available for CDS-I).

For each of the individual tests and the two test composites, the PSID Online Data Center (www.psidonline.org) provides raw scores, standard scores, W scores, and percentile ranks (explained below); also available through the PSID Online Data Center are the individual question-item results, which indicate, for each respondent, whether a specific question on each test was correct or incorrect. (The PSID Online Data Center also provides access to all publicly released data from the Core PSID and the CDS.)

The CDS children's primary caregivers (PCG; most commonly the mother) were also administered the WJ-R Passage Comprehension test in CDS-I, in order to assess their reading skills. Entirely separately from the CDS assessments, but potentially of interest to users of the CDS assessment data, is the fact that in 1972 the respondents to the Core PSID interview were

[1] The CDS User Guides are available online at http://psidonline.isr.umich.edu/Guide/documents.aspx.

administered a sentence completion test that provides an assessment of verbal skills—specifically, the Lorge-Thorndike Sentence Completion Test. The test from 1972 may be of interest because for many of the CDS children, it provides a measure of a grandparent's verbal ability. Taken together, the WJ-R assessments from CDS for children and their primary caregivers and the 1972 sentence completion test for a grandparent can be used to provide an intergenerational perspective on children's acquisition of cognitive skills. The sample design of the CDS combined with structure of the PSID also provides an intragenerational perspective on children's achievement by allowing comparisons in test scores among siblings and among first cousins.

This PSID Technical Document provides guidance and advice on the use and interpretation of the CDS and PSID cognitive assessments, including scoring details and interpretation, as well as data quality and integration issues. The remainder of this document is organized as follows: Section 2 describes the WJ-R test, including how to interpret and use the various scores. Section 3 provides details on children's WJ-R scores and their interpretation and Section 4 details issues surrounding the administration of the PCG WJ-R test. Section 5 describes the 1972 Sentence Completion test and related validation studies. Section 6 provides guidance surrounding the use of assessments for intergenerational analyses, and Section 7 concludes.

2. WJ-R Test Administration and Score Interpretation

The WJ-R comprises a total of nine subtests that measure a range of academic achievement dimensions. Of those subtests, four were selected and administered to CDS children in CDS-I to measure reading and math skills: Letter Word Identification, Passage Comprehension, Applied Problems, and Calculations. Based on WJ-R guidelines regarding the age-appropriateness of the subtests, younger children (ages 3-5 years) were only administered the Letter Word Identification and Applied Problems subtests, while older children (aged 6 years and older) were administered all four subtests (although the Calculation subtest was dropped from CDS-II and CDS-III). The tests are summarized in Table 1.

Table 1. Summary of Woodcock-Johnson (Revised) subtests used in CDS

WJ-R Subtest	Description	Age group	Notes
Letter-Word Identification	Assesses symbolic learning and reading identification skills	3–17 years	-
Passage Comprehension	Assesses reading comprehension and vocabulary	6–17 years	Also available for PCGs in CDS-I
Broad Reading	Combines results from the Letter-Word Identification and Passage Comprehension subtests	6–17 years	-
Applied Problems	Assesses mathematics reasoning, achievement, and knowledge	6–17 years	-
Calculations	Assesses knowledge of mathematic operations and ability to perform computations	6–17 years	Only administered in CDS-I
Broad Math	Combines results from the Applied Problems and Calculations subtests	6–17 years	Only available for CDS-I

The WJ-R tests have standardized administrative protocols. Specifically, the WJ-R Test is an 'easel' test—that is, a test with a question book that sits in front of the respondent. Each WJ-R

test requires that interviewers administer it exactly as described in training and their interviewer manual. Any deviation from these procedures invalidates the results.

WJ-R administration involves identifying each subject's basal (starting) level and ceiling (ending) level, both of which depend upon a subject's age and ability. Having a basal and ceiling limits the test length, while ensuring that the test begins with a set of questions that the subject has a near-certainty of answering correctly and ends with a set of questions that the subject has a near-certainty of not answering correctly (Woodcock and Mather, 1989). Test questions are ordered in increasing difficulty, and starting questions are suggested for each age/grade level. If a subject answers six consecutive questions correctly, the basal level is established. If not, the test administrator moves backward through the assessment, by page, until the subject answers six consecutive questions correctly. The test is complete either when the subject answers six consecutive questions incorrectly (the ceiling), or the last test question is administered. Testing is administered by entire page on the easel, with each page typically including multiple question items. If the ceiling condition is met mid-page, the administrator is instructed to complete the page before terminating the test. Therefore, data users may see cases with more than six consecutive incorrect answers.

Interviewers also evaluated conditions that might have violated the guidelines for administering the test and interfered with obtaining a reliable test score. The presence of such conditions is coded and available in the PSID Online Data Center. Specifically, administrators noted whether others were present during testing, and, if so, whether their presence distracted the subject. In addition, a variable indicates whether testing was completed and, if not, the reason. Potential reasons include:

- Caregiver terminated the test,
- Child would not respond,
- Major interruption,
- Child did not understand the WJ-R,
- A language problem,
- An emotional condition,
- A physical condition,
- Child was tired, or
- Other reason.

Four scores are available for each WJ-R subtest: the raw score, the standard score, the percentile score, and the W score. The four scores and their uses are summarized in Table 2. A new data release in January 2014 included 1997 and 2002 W scores in the PSID Online Data Center for the first time. Users should take care to choose the most appropriate score for their particular purpose.

Raw scores are simply a count of correct answers. Standard scores and percentile scores use each subject's raw score and age, and the scores of members of the subject's age group from the WJ-R norming samples, to create standardized scores and percentiles. The percentile rank indicates the percent of the age-matched norming sample that had scores below those of the subject, and hence reveals a subject's standing within their age group. Standardized scores have a mean of 100 for

each age group and a standard deviation of 15, which facilitates comparisons across subjects of different ages and comparisons with different achievement assessments (which are also typically standardized to a similar scale). Both standardized scores and percentile scores are useful for cross-sectional comparisons—particularly comparisons that pool subjects across a range of ages. However, these scores are not well-suited for examining changes in a subject's performance on a WJ-R subtest over time because each test result is standardized independently; therefore, a change in a child's standard score or percentile rank can reflect both a change in the child's subtest score and the overall change in the relevant reference group.

Table 2. Summary of Scores Available for Woodcock-Johnson (Revised) Subtests in CDS

Score	**Description**
Raw score	Count of correct answers on test
Standard score	Age-standardized score with mean of 100 and standard deviation of 15 for comparing achievement across children
Percentile score	Age-standardized percentile for comparing achievement across children
W score	Score for analyzing gains in achievement over time

The W score is an equal-interval scale that measures both the subject's achievement and the item difficulty on the same scale. All test items are assigned a W value, based on each item's difficulty, using a Rasch measurement model. These item scores are used to generate a W score for any possible raw score. The W score is scaled such that a score of 500 represents the average performance of a typical 10 year old subject. Because W scores are on an equal-interval scale, and are not dependent upon peer performance, they are useful for measuring a subject's growth in a subject area over time. Any 10-point increase in the W score reflects the subject's ability to perform, with 75% success, tasks that he or she was previously able to perform with 50% success (Jaffe, 2009).

WJ-R tests were scored using standard scoring procedures. In CDS-I and CDS-II, scoring was performed using WJ-R scoring look-up tables, while in CDS-III, scoring was performed using a scoring program developed by the Woodcock-Munoz Foundation that automated the process. CDS-I and CDS-II were also rescored using the same scoring program that was used for CDS-III, in order to validate the earlier scoring results.

3. Completion Rates for the Child WJ-R Subtests in CDS

In CDS-I, of the 2,803 children who were eligible to take any of the WJ-R subtests, 2,223 attempted the assessments and 2,190 completed all appropriate WJ-R subtests. In subsequent waves, the number of children eligible for testing changed for several reasons. First, younger children become age-eligible to participate in testing. Second, older children reached 18 years of age and left the CDS sample—at which time they became eligible for the PSID Transition into Adulthood (TA) study which did not administer the WJ-R. Finally, some children were lost to follow-up due their family's attrition from the Core PSID or from the CDS. Table 3 shows the number of eligible children for the WJ-R subtests and the number of begun and completed WJ-R subtests across the three waves.

Table 3. Counts, by Wave, of Children Eligible for WJ-R Subtests and of Begun and Completed Subtests

WJ-R subtest	CDS-I (3,563 Children)			CDS-II (2,907 Children)			CDS-III (1,608 Children)		
	Eligible	Began subtest	Completed subtest	Eligible	Began subtest	Completed subtest	Eligible	Began subtest	Completed subtest
Letter-Word Identification (ages 3+ years)	2,803	2,223	2,218	2,907	2,644	2,633	1,608	1,491	1,490
Passage Comprehension (ages 6+ years)	1,877†	1,532	1,522	2,856	2,595	2,541	1,608	1,491	1,491
Applied Problems (ages 3+ years)	2,803	2,223	2,209	2,907	2,644	2,625	1,608	1,491	1,485
Calculation (ages 6+ years)	1,877†	1,532	1,517	N/A	N/A	N/A	N/A	N/A	N/A

†Approximate number of eligible children for Passage Comprehension and Calculation subtests based on age at 1997 Core PSID interview.

In order to examine the characteristics of children that were eligible for, but did not attempt the WJ-R assessment, we conducted a logistic regression analysis of whether an eligible child attempted the CDS-I WJ-R as a function of child and household characteristics. We found that Hispanic children,[2] and children from households headed by individuals with lower educational attainment were less likely to attempt the WJ-R. See Appendix 1 for complete model results. Users should keep in mind these results when analyzing the CDS WJ-R assessment data because the CDS sample weights only account for the participation of children in the overall study, not for participation in study components such as the WJ-R assessments.

Table 4. Reasons for Incomplete Child WJ-R Tests

Reason for incomplete test	CDS-I		CDS-II		CDS-III	
	Variable name	Number of mentions	Variable name	Number of mentions	Variable name	Number of mentions
Caregiver terminated test	Q3E2A	0	Q24D2A	0	Q34D2A	0
Did not respond to WJ-R	Q3E2B	9	Q24D2B	2	Q34D2B	2
Major interruption	Q3E2C	1	Q24D2C	0	Q34D2C	0
Did not understand WJ-R	Q3E2D	5	Q24D2D	5	Q34D2D	0
Language problem	Q3E2E	0	Q24D2E	0	Q34D2E	0
Emotional condition	Q3E2F	4	Q24D2F	3	Q34D2F	1
Physical condition	Q3E2G	9	Q24D2G	0	Q34D2G	0
Tired	Q3E2H	2	Q24DH	2	Q34DH	0
Other	Q3E2I	17	Q24D2I	6	Q34D2I	4
Number of children who did not complete all appropriate WJ assessments		33		23		7

[2] Technically, children from non-white and non-black racial groups, but predominantly Hispanic.

For children who attempted the WJ-R, but did not complete it, the PSID Online Data Center provides users with variables that explain why WJ-R subtests were not completed. Table 4 details the possible reasons for not completing the WJ-R, as well as the frequency with which each reason is mentioned. Test administrators were permitted to select more than one possible reason when appropriate, and reasons were not always provided for incomplete tests.

It is typically the younger children that failed to complete the WJ-R. In CDS-I, children aged three years and six years (the youngest children that could take the Letter-Word Identification/Applied Problems tests and Calculation/Passage Comprehension tests, respectively) comprised over half of the children not completing the WJ-R.

Even after excluding tests that were flagged as incomplete, there remain a small number of WJ-R scores that are questionable because their values mark them as outliers. We describe a procedure for identifying such cases, but leave it to users to decide whether to exclude these cases from their analyses. Table 5 shows the percentage of children that completed the WJ-R assessments and had scores more than three standard deviations away from the mean. Because the standard scores are normally distributed, only 0.3% of cases should have scores in this category. Some standard scores are quite extreme, including standard scores of 0. Because the CDS is a longitudinal study, users can evaluate whether to exclude outlier scores by looking at both the likelihood of a given score, and the relationship to other scores for the same child.

Table 5. WJ-R Subtest Standard Scores More than Three Standard Deviations Above or Below the Mean

WJ-R subtest	**Cases more than three standard deviations above or below the mean**		
	CDS-I	**CDS-II**	**CDS-III**
Letter-Word Identification	1.9%	3.3%	2.1%
Passage Comprehension	0.6%	1.3%	0.8%
Applied Problems	1.9%	1.3%	0.7%
Calculations	0.8%	-	-

CDS sampled up to two children per household. Therefore, we have assessment data for sibling pairs in the CDS, which enables users to identify the effects of common family factors on children's achievement. There is both entrance into and attrition from the sample of siblings who completed the WJ-R assessments. First, siblings under the age of three years in CDS-I did not complete a WJ-R test, but these children could have completed the tests in CDS-II and -III. Second, a sibling could turn age 18 years and leave the CDS sample, or siblings could become non-respondents. Table 6 provides counts of sibling pairs that completed all appropriate WJ-R subtests by CDS wave.

Table 6. Sibling Pairs with WJ-R Assessments

	In same wave			
Sibling pairs	**CDS-I**	**CDS-II**	**CDS-III**	**In any wave**
Number of sibling pairs with completed WJ-R assessments	558	699	318	951
Total number of sibling pairs	1,109	857	342	1,109

The PSID Online Data Center provides access to each child's Raw Score, Standard Score, Percentile Rank, and W Score. Table 7 provides the means for each of these scores for CDS children who completed WJ-R assessments in every wave. As the table illustrates, average raw scores and W scores increased over time, reflecting a child's learning. Percentile ranks and standard scores exhibit no clear trends, because these scores are dependent upon both the child's change in achievement as well as the peer group's average change in achievement over time.

Table 7. Average WJ-R Scores for Children with Scores in Every CDS Wave

	Raw Scores			**Standard Scores**			**Percentile Ranks**			**W Scores**		
WJ-R subtest	CDS-I	CDS-II	CDS-III	CDS-I	CDS-II	CDS-III	CDS-I	CDS-II	CDS-III	CDS-I	CDS-II	CDS-III
Letter-Word Identification	27	45	48	102	102	100	55	52	49	449	515	524
Passage Comprehension	20	27	29	104	102	97	57	53	44	483	509	514
Applied Problems	24	38	41	104	102	101	58	53	52	470	514	525

4. Primary Caregiver Assessments

The main respondent for the CDS is the child's primary caregiver (PCG). The PCG was usually the child's mother, but could also have been the father or other adult who knew the most about the child. In CDS-I, approximately 95% of PCGs were the child's mother, step-mother, or adoptive mother.

In CDS-I, every PCG was asked to complete the WJ-R Passage Comprehension subtest. The test was only administered to PCGs in CDS-I, and was intended to provide an objective measure of the PCG's reading skills. Because there is a high degree of intergenerational correlation in test scores, the PCG scores have significant analytic value. Researchers can use the PCG Passage Comprehension scores to control for unobserved family factors, which might otherwise lead to omitted variable bias in estimating relationships, especially when examining the effects of family factors on children's WJ-R test scores.

Among the 3,563 children in CDS-I, WJ-R Passage Comprehension scores of the PCG were obtained for 2,740 children (77%). Because of the somewhat high proportion of missing scores, we analyzed the probability that a PCG completed the WJ-R test as a function of socioeconomic and demographic characteristics. The results, shown in Table 8, reveal that PCGs who were black, young adults (30 years of age or less), and non-working, and those living in household in which the head was at least a high school graduate, were more likely to complete the WJ-R.

Because of the relatively high degree of missingness in PCG WJ-R scores, users might consider imputing missing PCG scores when using the scores for analytic purposes. Many methods exist for missing value imputation, and, for illustrative purposes, we used multiple imputation to impute missing PCG test scores as a function of PCG age, race, language, sex, education, income, and employment status. The resulting mean absolute percentage error on a 20% holdout sample was approximately 11%.

Table 8. Logistic Regression Model Estimates of Whether PCG Completed WJ-R Assessment

Variable	**Estimate (Std. Err.)**
Intercept	1.1645***
	(0.2040)
Sample (vs. SRC sample)	
SEO sample	-0.2904
	(0.2059)
Immigrant sample	-0.5091*
	(0.2658)
PCG married (vs. PCG unmarried)	0.1579
	(0.1157)
PCG age (vs. PCG age 30-45)	
PCG age ≤30	0.4518***
	(0.1529)
PCG age >45	0.1267
	(0.1091)
Race/ethnicity (vs. white)	
Black	0.4564**
	(0.2120)
Other	-0.0276
	(0.2444)
Male PCG (vs. female PCG)	-0.3701
	(0.2618)
Head education (vs. college graduate)	
Less than high school	-0.4994***
	(0.1911)
High school graduate	-0.1104
	(0.1597)
Some college	-0.0560
	(0.1662)
PCG employed (vs. PCG not employed)	-0.2391*
	(0.1251)
Family income quartile (vs. fourth quartile)	
First quartile	0.1078
	(0.1766)
Second quartile	-0.0109
	(0.1601)
Third quartile	-0.0211
	(0.1490)
PCG number of children	0.0187
	(0.0472)
Likelihood ratio join test of all parameters (χ^2)	62.63***

Note: *p<.10, **p<.05, ***p<.01. N=2,411; 1,861 PCGs completed WJ tests.

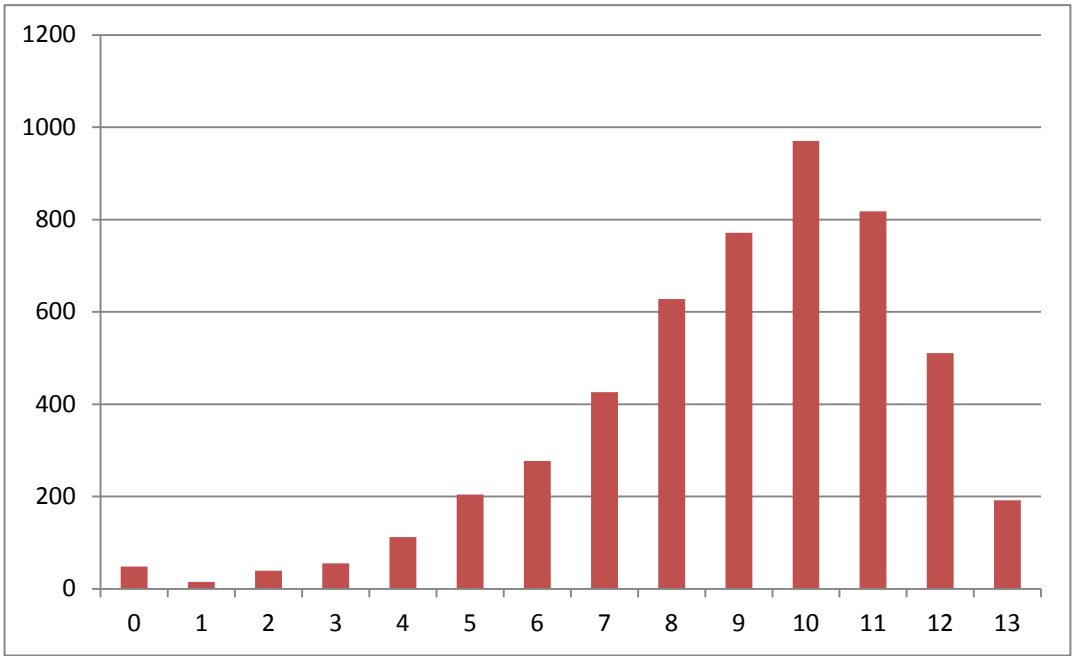
Users should note that the language of test was not recorded for PCGs. This is problematic because different versions of the test were used for English and Spanish languages. The versions have a different number of questions, and therefore have a different correspondence between values of the raw score and processed scores (W Score, Standard Score, and Percentile Rank). As

a result, only raw scores were previously released through the PSID Online Data Center. We have now provided processed scores for PCGs, after using variables in the 1997 Core PSID to impute test language. Specifically, we used Head/Wife race (ER12020) and whether a language other than English is spoken at home (ER11938) to impute the language most likely used to by the PCG when completing the test. If the Wife (when PCG is a Wife) or Head speaks a language other than English at home, and if the race of the Head/Wife is coded as "Mentions Hispanic," then we assigned the score based on the Spanish test. Otherwise, we used the English score. Using this approach, approximately 5% of the children had PCGs who completed the Spanish test.

5. 1972 Lorge-Thorndike Sentence Completion Test (SCT)

In the 1972 wave of PSID, respondents were administered a sentence completion test as a measure of language skill. The test was taken from the verbal part of the Lorge-Thorndike Intelligence Test (1950), and comprised thirteen items. Each item is a sentence in which a word is missing, and respondents were given five words from which to choose the best, most sensible answer. Scores ranged from 0–13, with a mean score of 9.0. The distribution of SCT scores is provided in Figure 1. (See Appendix 2 for the test items that were administered to respondents.)

Figure 1. Sentence Completion Test Score Distribution



Although it is a seemingly simple assessment, the SCT was tested and validated as part of the 1971 Detroit Survey, a survey of 365 Detroit residents (Veroff, et al., 1971). Ultimately, the SCT was selected because it was quick and simple to administer and score, and a Detroit Survey analysis suggested that it provided a robust measure of achievement across respondents by race, sex, and socioeconomic status, as well as across various other dimensions of cognitive skills and achievement (Veroff, et al, 1971). Specifically, the survey tested seven potential assessments. The selected tests covered the domains of verbal and perceptual skills. The SCT was found to be

highly correlated with the other six tests, highly correlated with education, and the results were robust across respondent race, interviewer race, sex, and socioeconomic status (see Appendices 3 and 4). In 1972, every respondent, typically the head of household, was asked to complete a SCT. Scores were similar between Head and Wife respondents (Table 9), and modestly lower for other respondents.

Table 9. Mean Sentence Completion Test (SCT) Score by Relationship to Head

Relationship to Head	Mean SCT score	Count
Head	9.0	4687
Wife	8.9	368
Child	8.7	14
Other relative (incl. in-laws)	8.0	2
Parent	8.0	2
Sibling	0.0	1

Table 10 shows the relationship between SCT scores and the respondent's education, sex, age, and race/ethnicity. SCT scores increased significantly with years of completed schooling. In addition, the SCT scores also exhibit statistically significant differences by respondent sex, age group, and race/ethnicity (of household head).

Table 10. Mean Sentence Completion Test (SCT) Score by Respondent Education, Sex, Age and Head Race

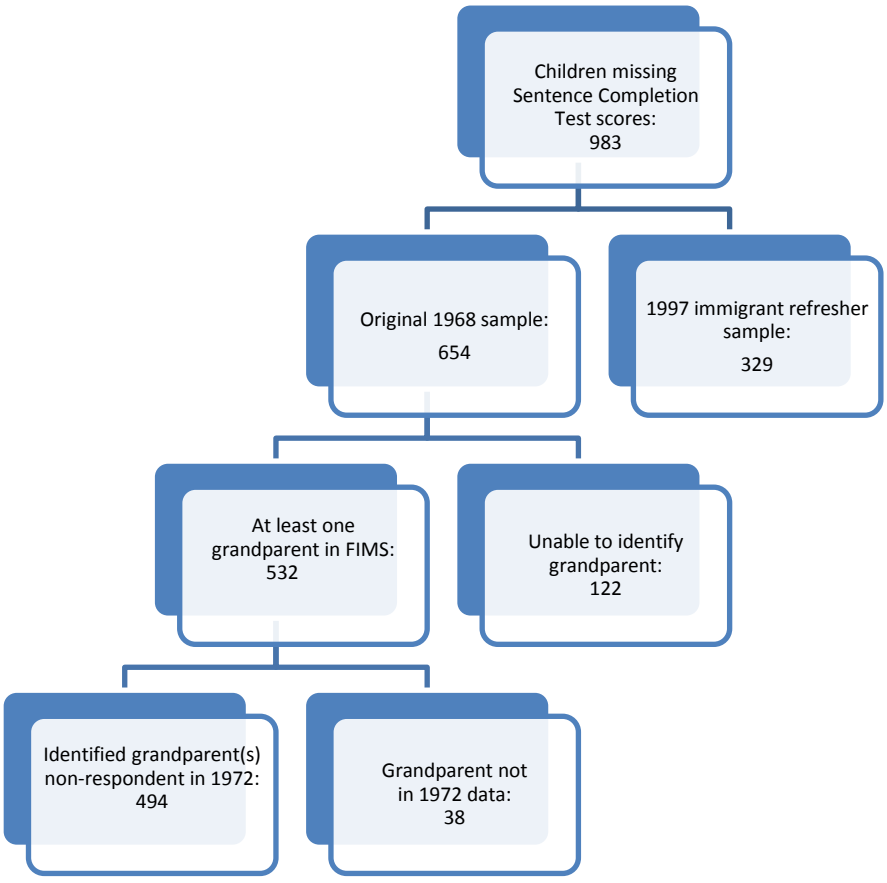
Variable	Mean SCT score	Count
Education* **		
Less than 9 years schooling	7.5	1,229
9-12 years schooling	9.1	2,101
>12 years schooling	10.7	705
Sex* **		
Male	9.2	3,250
Female	8.6	1,816
Age* **		
≤ 25 years	9.3	985
26– 45 years	9.3	2,023
46+ years	8.6	2,058
Race/ethnicity of head* **		
White	9.7	3,151
Black	7.8	1,754
Hispanic	8.0	124
Other	8.3	37

Note: *p<.10, **p<.05, ***p<.01, for F-test of the joint effect of categorical variables on SCT scores.

6. Intergenerational Analysis

Taken together, the child, PCG, and 1972 Household Head assessments provide users with an intergenerational view of achievement. Using the PSID's Family Information Mapping System (FIMS),[3] we can identify the parents and grandparents of CDS children. Most CDS children have at least one grandparent who completed the 1972 sentence completion test. Of the 3,563 children in the CDS, grandparent test scores are available for 2,580 children (983 children do not have a matched grandparent SCT score from 1972 PSID). The primary reasons that a grandparent test score is not available are: (a) the child was from the 1997 immigrant refresher sample and hence did not have a family member participate in the 1972 PSID; (b) we are not able to identify the child's grandparents; or (c) the grandparent was not in the 1972 wave of the PSID. A summary of the reasons for missing scores is shown in Figure 2.

Figure 2: Children Missing Grandparent Sentence Completion Scores



[3] To make it easier to create data extracts that include information on parents, grandparents, and siblings of the focal person, the PSID created the Family Identification Mapping System - FIMS. See http://simba.isr.umich.edu/FIMS/ for a tutorial and documentation.

Grandparent sentence completion test scores are available for 72% of CDS children. It is nearly always the case that the FIMS-identified grandparent without a test score was either the wife or a child of the Household Head in 1972 (and, therefore, was not the 1972 respondent). Although we do not have test scores for these grandparents, we do have socioeconomic status and demographic characteristics that can be used to impute test scores. If users impute sentence completion scores for the 494 children with a grandparent who is identified in FIMS, the percent of CDS children with grandparent test scores increases to 86%.

The relationship between CDS children and their grandparent with the 1972 sentence completion test score is detailed in Table 11. Note that in a handful of cases, the sentence completion test score was for the CDS child's parent. In most cases, the 1972 respondent was the household head, and therefore male. Approximately 58% of the 1972 test scores are available for a relative (grandparent or parent) on the CDS child's maternal side, while 42% are for a paternal relative. Although we might have naively assumed an even split between test scores from relatives on the mother's and father's side, the higher prevalence of maternal relatives likely reflects prevailing rates of single parenthood and estrangement between fathers and children.

Table 11. Summary of Relationship Between the 1972 PSID Respondents and CDS Sampled Children

1972 respondent relationship to CDS child	Count	Percent
Mother's father	1,050	38.2%
Father's father	765	27.8%
Mother's mother	504	18.3%
Father's mother	310	11.3%
Mother's adoptive father	31	1.1%
Adoptive father's father	16	0.6%
Adoptive mother's father	11	0.4%
Father's adoptive father	10	0.4%
Adoptive father's mother	7	0.3%
Adoptive mother's mother	4	0.1%
Adoptive mother's adoptive mother	1	0.0%
Mother's adoptive mother	1	0.0%
Father	29	1.1%
Adoptive father	4	0.1%
Mother	3	0.1%
Adoptive mother	2	0.1%
Total	**2,748**	**100.0%**

We can assess parents' academic achievement using the PCG WJ-R scores, because the child's PCG is typically the child's mother or adoptive mother. In fact, the PCG is the child's mother or father (birth, adoptive, or step-parent) for over 98% of the CDS children. The PCG to CDS child relationship is detailed in Table 12.

Without resorting to imputed test scores, data users can conduct three-generation analyses using assessments for over half of the CDS children. Figure 3 identifies the children for whom assessments are available for the child, his or her PCG, and a grandparent. Note that the Sentence Completion Test respondent is not always the PCG's parent. Of the 2,411 PCGs in CDS-I, the

PSID has Sentence Completion Test score for a parent of 1,000 of the PCGs. Table 13 describes the relationship between the PCG and the 1972 SCT respondent.

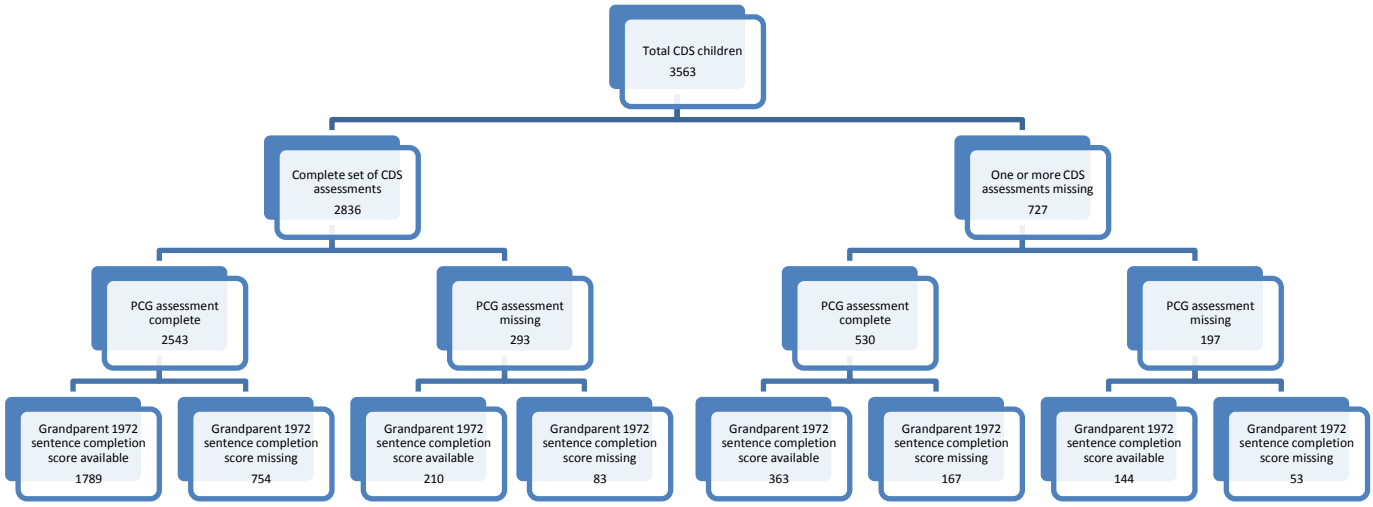
Table 12. Summary of Relationship Type between the PCG and CDS Sampled Children

PCG relationship to CDS child	Count	Percent
Mother/stepmother/adoptive mother	3,407	95.6%
Father/stepfather/adoptive father	97	2.7%
Legal guardian	44	1.2%
Other adult in household	15	0.4%
Total	3,563	100.0%

Table 13. Summary of PCG's Relationship with Sentence Completion Test Respondent

Child's PCG relationship with SCT respondent	Count	Percent
Father/adoptive father	1020	28.6%
Mother/adoptive mother	455	12.8%
Both	45	1.3%
Child's PCG not related to SCT respondent	986	27.7%
No grandparent SCT score	1057	29.7%
Total	3563	100.0%

Figure 3. Availability of Test Scores across Multiple Generations



7. Summary

The CDS was designed to supplement the Core PSID by collecting detailed prospective data on children's cognitive, behavioral, and health status to understand the process of development and accumulation of human capital. The WJ-R assessments, administered in every wave of the CDS, provide an objective measurement of cognitive achievement over time. In addition to child cognitive achievement, the PSID provides objective measures of parent and grandparent cognitive skills through the PCG WJ-R scores and the 1972 Sentence Completion Test. Table 14 shows that there exists a strong, statistically significant correlation among these achievement test scores. As a result, the intergenerational assessments are valuable as both explanatory and descriptive variables, as well as measures to correct for unobserved family characteristics.

Table 14. Correlations among Intergenerational Assessments

	CDS-III Passage Comprehension Standard Score	**PCG Passage Comprehension Standard Score**	**Grandparent Sentence Completion Test Score**
CDS-III Passage Comprehension Standard Score	1	0.39***	0.32***
PCG Passage Comprehension Standard Score	0.39	1	0.38***
Grandparent Sentence Completion Test Score	0.32***	0.38***	1

Note: *** $p<.01$ for correlation coefficient = 0.

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Appendix 1. Logistic Regression Model Estimates of Whether an Eligible Child Attempted the 1997 WJ-R Assessments

Variable	**Estimate (Std. Err.)**
Intercept	1.078***
	(0.3593)
Sample (vs. SRC sample)	
SEO sample	0.0220
	(0.2372)
Immigrant refresher sample	-0.0882
	(0.1938)
Child age (years)	0.0223
	(0.0168)
Race/ethnicity (vs. white)	
Black	0.1261
	(0.2080)
Other	-0.6406
	(0.2071)
Male household head (vs. female)	0.0642
	(0.1304)
Head education (vs. college graduate)	
Less than high school	-0.5833***
	(0.1688)
High school graduate	-0.2564*
	(0.1542)
Some college	-0.1859
	(0.1611)
Head employed (vs. not employed)	-0.1144
	(0.1428)
Family income quartile (vs. fourth quartile)	
First quartile	0.1696
	(0.1852)
Second quartile	0.0548
	(0.1401)
Third quartile	-0.0754
	(0.1401)
Region (vs. South)	
Northeast	-0.2494
	(0.1536)
North Central	-0.01724
	(0.1256)
West	0.0995
	(X.XXX)
Household in SMSA (vs. not in SMSA)	0.0041
	(0.1037)
Likelihood ratio join test of all parameters (χ^2)	53.78***

Note: *p<.10, **p<.05, ***p<.01. Model estimated on 2,803 eligible CDS child observations, among who X,XXX attempted the WJ-R assessments.

Appendix 2. 1972 Lorge-Thorndike Sentence Completion Test

We see only _____ at night.
1) Children 2) Plants 3) Stars 4) Houses 5) Trees

Not every cloud gives _____.
1) Weather 2) Shade 3) Sky 4) Climate 5) Rain

In the spring the buds form on the branches of the _____.
1) Trees 2) Rivers 3) Bugs 4) Leaves 5) Animals

There is an old _____ "An apple a day keeps the doctor away."
1) Talk 2) Saying 3) Reader 4) Book 5) Man

The ragged _____ may prove a good horse.
1) Puppy 2) Child 3) Calf 4) Lamb 5) Colt

The important thing is not so much that every child should be taught as that every child should be given the wish to _____.
1) Learn 2) Play 3) Hope 4) Reject 5) Teach

The person who _____ another must make good the damages.
1) Reforms 2) Improves 3) Instructs 4) Injures 5) Delights

False facts are highly _____ to the progress of science.
1) Injurious 2) Necessary 3) Devoted 4) Useful 5) Instrumental

It is better that ten guilty persons _____, than that one innocent suffer.
1) Suffer 2) Escape 3) Capture 4) Starve 5) Repent

The winds and the waves are always on the side of the ablest _____.
1) Soldiers 2) Statesmen 3) Navigators 4) Students 5) Weathers

The vanquished never yet spoke _____ of the conqueror.
1) Ill 2) Well 3) Little 4) Nastily 5) Often

Think long when you may _____ only once.
1) Abstain 2) Live 3) Die 4) Decide 5) Eat

The coward threatens only when he is _____.
1) Afraid 2) Surrounded 3) Safe 4) Conquered 5) Happy

Appendix 3. Original Documentation for 1972 Sentence Completion Test

Source: PSID. 1972. *A Panel Study of Income Dynamics: Study Design, Procedures, Available Data*. 1968–1972 Interviewing Years (Waves I–V), Volume I. Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI, Pages 367–371.

Sense of Personal Efficacy and Planning Horizon (1972,V2939) is intended to identify the respondent's satisfaction with himself and his confidence about his future. Points are given for expressing sureness that his life will work out the way he wanted it to, planning his life ahead, thinking his plans work out, usually finishing things he starts, preferring to save money for the future, having no limitation on getting ahead, and thinking about things that might happen in the future. The question asking whether or not one has limitations on getting ahead was dropped in 1972; and the index this year consists of only six components. The factor analysis indicates that three items of this index--planning ahead, preferring to save, and thinking about what might happen.in the future--form a separate index. The correlation of the 1971 index was .204.

Indexes of Background and Current Problems of the Head

Three indexes were created for the head of the family from the 1968 questionnaire; one measuring background problems, another employment problems and a third current handicaps. They have not been recreated for new heads of families, but since new heads of families are asked all background questions, the user can create these indexes for such families if he wishes.

Sentence Completion Test Score (1972, V2949)

Heads of 1972 families were administered a thirteen-item sentence completion test, from the verbal part of the Lorge-Thorndike Intelligence Test. Each item

in the test is a sentence in which a word is missing. The respondent is given five words from which he selects the one that makes the best, truest, most sensible sentence. Ability to handle such a task is assumed to be a trait that is unchanged from year to year, and hence has not been measured every year. The variable numbers along with the correct replies are as follows: V2730, stars; V2731, rain; V2732, trees; V2733, saying; V2734, colt; V2735, learn; V2736, injures; V2737, injurious; V2738, escape; V2739, navigators; V2740, well; V2741, decide; V2742, safe. For each correct reply one point is give and the index score is the sum of the correct replies (zero to thirteen).

The sentence completion test was chosen only after methodological investigation showed it to be the most valid, least affected by race or sex of interviewer or respondent and most procedurally feasible measure of "general intelligence" available for use in a household survey.

A short series of questions purporting to measure "intelligence" were included in the 1968 questionnaire but asked only of less than a quarter of the sample. That test was a truncated version of the Quick Test, developed by Ammons and Ammons.[7] Because our use of this test was considered improper by the authors, none of the norms and protocols developed for this instrument can be used when analyzing scores on this test. (We did not administer increasingly difficult questions when the respondent failed four times in a row. This would have required having the interviewers know the correct

[7] Ammons, R..B. and Ammons, C.H. "The Quick Test (QT): Provisional Manual," Psychological Reports, 1962, 11 (Monograph Supplement 7-VII).

answers, and putting respondents under severe pressure.) In addition it should be noted that the group of families administered this test was a highly clustered subset of the Census sample, and is not representative of any easily-definable population subgroup. Because of the heterogeneity of the household sample and the potential biases that could exist from respondent-interviewer interaction, it was thought further developmental work was necessary before such a sequence could be asked of the entire sample.

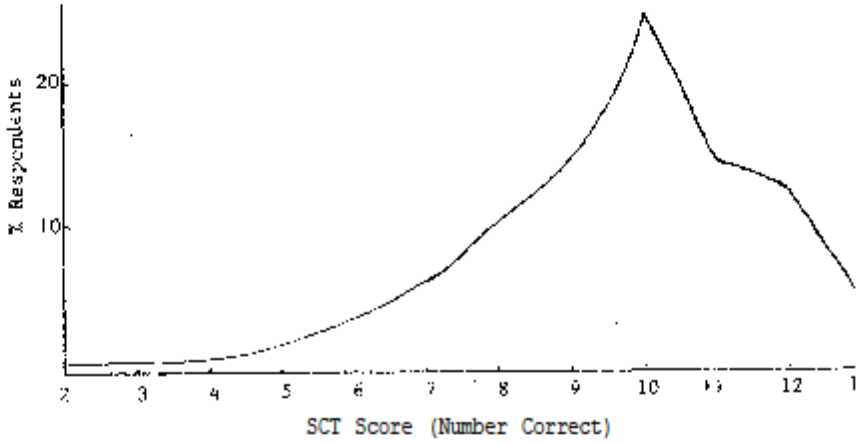
To this end, with the help of several social psychologists at the Institute, several existing intelligence tests were selected for analysis, and they were pretested on several household interview samples before the selection of the Sentence Completion Test.[8]

Respondents were administered several intelligence measures and scores on each of these measures were intercorrelated in hopes of finding two clusters of intelligence -- a verbal and a perceptual performance facility. The intelligence tests considered included the Sentence Completion, Ammons Quick Test, Information, Digit Span, Raven Progressive Matrices, Digit Symbol Substitution, Picture Order Central, and Picture Order Incidental. The first three were hypothesized to represent verbal facility and the second five perceptual performance. Correlational analysis indicated that the two hypothesized clusters of intelligence did not exist. Consequently, education attained by the respondent was used to assess the validity of the measures that were used, but making

[8] For a fuller description of the research, see J. Veroff, et. al., Measuring Intelligence and Achievement Motivation, Ann Arbor: Institute for Social Research, 1972, especially pp. 26-47.

sure that there was still some variance remaining even after various demographic factors, especially education, were controlled.

All eight measures of intelligence seemed equally correlated, suggesting that a very general factor of intellectual competence was being tapped, though the set of correlations generated by the Sentence Completion test was higher than those generated by any other test. This correlational analysis was repeated separately for various socio-economic groups. Duncan's prestige coding of the respondent's father's occupation was used to divide the sample into three groups as nearly equal in size as possible; a fourth group consisting of respondents whose fathers were absent from the home when growing up was also included. Again, the Sentence Completion Test proved superior to all other tests for people from different backgrounds, and it was concluded that thirteen items of a Sentence Completion test from the verbal part of the Lorge-Thorndike Intelligence was the best single measure of general intelligence for all population subgroups. The test was found to discriminate best at the lower end of the distribution:



Distribution of the Scores Obtained on the Sentence Completion Test

The correlation data were then examined to be sure that none of the measures showed any interviewer bias. Of most concern was the possibility of an interaction effect -- that black respondents would be more anxious and do less well in response to a white interviewer than in response to a black interviewer and vice versa. Though black interviewers' respondents were slightly more educated than white interviewers' respondents, the effect of race of interviewer on intelligence still remained after controlling for education, though the intercorrelation matrix on all eight measures of intelligence was very similar for the two racial groups. Investigation of the data for possible black-white interaction effects was of especial importance to this study, since black respondents are often interviewed by white interviewers. We plan to examine our own data to see if this black-white interaction exists. It should be noted that since one of the study's objectives is to examine the effect of intelligence on well being, it was considered infeasible to use new criteria for intelligence such as job performance, income, or occupational mobility.

Motivation Score (1972,V2950)

From the same methodological research that recommended the use of the Sentence Completion Test to measure "general intelligence" were derived sixteen questions measuring achievement motivation. Each component is assumed to be equally weighted and one or zero is added to the total score depending on the reply. The variable numbers and replies that add a point to the total motiva-

Appendix 4. Further Description of 1972 Sentence Completion Test

Source: Morgan, James N., Katherine Dickinson, Jonathan Dickinson, Jacob Benus, and Greg Duncan. 1974. *Five Thousand American Families: Patterns of Economic Progress, Volume I, An Analysis of the First Five Years of the Panel Study of Income Dynamics*. Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI.

Appendix F

MEASURES OF ACHIEVEMENT MOTIVATION AND COGNITIVE ABILITY

The original model underlying this Panel Study called for a measure of mental ability. In the first wave of interviews a simplified version of the Armon's Quick Test was administered experimentally to a small subsample of the panel. It was decided, however, that it was necessary to develop a measure more appropriate for use in voluntary interviews with an adult population. In the belief that psychological factors are essential variables in explaining economic behavior, we asked psychologists Joseph Veroff, Lou McClelland, and Kent Marquis of the Institute for Social Research to explore the feasibility of developing measure of motivation and cognitive ability which could be used in household interviews.

The measures would have to meet fairly stringent criteria:

1. Be feasible in a cross-section sample of the United State population.
2. Be reliable and valid for major groups within the population.
3. Not provoke hostility or anxiety, and have a reasonable and honest explanation to the respondents.
4. Be extremely brief -- no more than five minutes even for respondents who are difficult to interview.

Of these criteria, this was the most severe restriction. From past research it was clear that a single measure of achievement motivation by itself would not have much predictive value. Multiple measures would be essential. To avoid cultural bias in measuring intelligence, it was originally thought that here also at least two different assessment procedures would be necessary.

Pilot studies investigating the usefulness of existing intelligence and motivation measures were undertaken. After two preliminary surveys in Jackson, Michigan, seven measures of intelligence were selected for further testing in a final survey in Detroit. For testing verbal mediational facility the Tange-

[1] See, Measuring Intelligence and Achievement Motivation in Surveys, by J. Veroff, L. McClelland, and K. Marquis, Survey Research Center, Institute for Social Research, Ann Arbor, Michigan, 1971.

Thorndike Sentence Completion Test, Ammon's Quick Test, and Wechsler's Information Test were tried. To test perceptual performance Wechsler's Digit Span, Raven's Progressive Matrices, and Picture Order Control and Incidental Tests were tried.

Although the study's directors had expected to recommend at least two types of measures, each reflecting a different kind of intelligence, they found that one test, the Sentence Completion Test, was significantly correlated with every other measure, even when respondent's education, age, race, and sex were statistically controlled for. Thus it alone was included in the fifth wave.

The test asks the respondent to supply from a set of alternatives a missing word in a sentence. Although it is a measure of verbal comprehension and learning, the Sentence Completion Test also requires hypothesis testing and skill in patterning sentences similar to skills involved in the perceptual performance measures which were used. It was, therefore, able to stand by itself as a valid measure of intelligence.

The Detroit interview also included many varied achievement measures. Among these were several new methods plus revisions of some traditional ones. The measure finally selected was composed of a series of 14 questions. For most groups, except for black females, this measure correlates moderately well with both a projective measure of achievement and a behavioral assessment of moderate risk taking.

We have found that both the "I.Q." test and achievement motivation scores correlate well with other variables (see Table F.1), but not so well that they have no potential explanatory power of their own.

Administering these tests to the respondents caused no particular problem. Although some interviewers predicted trouble, there were, in fact, very few refusals.

To the word test the interviewers read the sentences and choice of words to the respondent and the respondent was given a booklet containing the same sentences and words to follow along. Most respondents accepted the test calmly — even enthusiastically. The test did cause difficulties in telephone interviews as the respondent had no booklet. It was almost impossible to administer to people who could not read or had trouble with English and a very few respondents were not able to cope with it at all.

Some of the respondents were confused and irritated by a few of the motivation questions of the "which would you rather" variety, complaining that no clear alternatives were offered -- that sometimes both choices were desirable and could probably be true at the same time. However, in 1972 our response rate was over

higher than in 1971, hence few respondents can have been seriously antagonized by these tests.

There is, of course, the problem that these two measures were taken on the fifth interview, and one can never be sure they do not in part reflect the results of the past five years, rather than permanent personality or ability characteristics which caused that experience. People in white collar jobs, for instance, might use words more often and learn how to handle them more effectively. And recent success might affect people's achievement imagery. So while both measures intend to measure a stable concept, the final proof of their explanatory power will only come if this panel is followed for enough future years so that the outcome can be measured *after* the measurement of these factors. And even then a complex dynamic model would have to be invoked.

Regardless of the causal mechanism, however, if people are given intelligence tests as part of the qualification requirements for jobs, then their ability to handle such tests is an important matter.

The Ammon's Quick Test was administered as an experiment to a small subsample of this panel in 1968, the first wave of interviews. It involved sets of four pictures and a list of words to be read off. Each word was related to one of the four pictures, and the respondent was asked to select which one. This involved not only vocabulary, but also some analogous reasoning. The original design of the test called for careful administration with more and more difficult words until the subject missed four in a row. We could not do this with interviewers and voluntary respondents, so we selected a relatively easy set, attempting to distinguish only the middle range, not the geniuses.

At any rate, for a few respondents, we have scores for this test in 1968 and for the sentence completion test in 1972.[1] The inter-person correlation between the two is relatively high, as can be seen in Table F.2.

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[1] For details of the early test, see Volume II of the documentation, p. 46, and Martha J. Mednick, "The Relationships of the Ammon's Quick Test of Intelligence to Other Ability Measures," Psychological Reports, 22 (1968), pp 49-59.

TABLE 8.2

Picture-Word Test in 1968

Sentence Completion Test in 1972	0-5	6-9	10-11	12	13	14 (All Right)
0	0	1	0	0	0	3
1-3	9	10	2	0	0	0
4-6	62	39	20	14	7	3
7	22	13	34	16	2	3
8	0	13	33	10	3	5
9	10	13	8	20	20	10
10	7	9	19	32	29	24
11	0	0	1	1	11	21
12	0	2	0	7	7	17
13	0	0	0	0	1	13
	100%	100%	100%	100%	100%	99%
Number of Cases	11	58	51	56	67	82

Rank Correlation (Kendall's Tau3) = .47

NOTE: A very few cases where head was not the respondent in one year or the other may reduce the correlation, but most such cases were omitted.

TABLE F.1

Correlations of Test Score ("IQ") and
Achievement Motivation (N/Ach) with Other Variables

		Test Score		Achievement Motivation	
Number	Variable	Tau-B*	Cramer's V	Tau-B	Cramer's V
2628	Race	-.23	.19	-.06	.07
2915	Geographic mobility	.01	.06	.04	.06
2907	Hourly earnings	.25	.13	.18	.10
2818	Number of states lived in	.06	.06	.10	.08
2543	Sex (femaleness)	-.10	.13	-.17	.21
2822	Father's education	.17	.11	.13	.08
2823	Head's education	.37	.19	.25	.13
2813	Religion	**	.08	**	.06
3825	Head a veteran	.12	.10	.11	.09
2911	Region	**	.07	**	.07
2975	Number of inter-county moves	.08	.08	.11	.09
2974	Number of changes of residence	.02	.06	.09	.08
2973	Changes in jobs	.14	.10	.10	.08
2972	Changes in family composition	-.01	.06	.04	.06
2934	Age	-.12	.09	-.14	.09
2950	Achievement motivation	.27	.12	--	--
2939	Efficacy-Planning index	.18	.12	.20	.13
2940	Trust-hostility index	.20	.19	.09	.08
2942	Aspiration-ambition index	-.02	.06	.12	.09
2943	Real earnings activity index	.03	.07	.07	.07
2944	Economizing index	-.11	.08	-.11	.08
2945	Risk avoidance index	.21	.12	.11	.07
2946	Planning acts index	.17	.11	.13	.09
2947	Connectedness index	.05	.08	.01	.05
2948	Money earning acts index	.14	.10	.14	.09
2804	Number of siblings of head	-.17	.09	-.08	.06

*For explanation of these two measures of association, see Appendix C.

**Inappropriate - no natural ranking.