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ABSTRACT

A sizable representative subsample of the standardization group for the Metropolitan Achievement Tests participated in both the Fall and Spring standardization programs. Fall and Spring test records were matched for all such pupils and Fall-Spring "growth expectancies" were derived. Additionally, the sample was split into three subgroups based on pretest national stanine and "growth expectancies" developed separately for below-average, average, and above-average achievers. Comparison of the "growth rates" of these three groups and of the total Fall-Spring sample with the national norms were made. The resulting data seem most appropriate for test users assessing the short-term growth of non-average groups. (Author)

DEVELOPMENT OF EMPIRICAL "GROWTH EXPECTANCIES" FOR THE METROPOLITAN ACHIEVEMENT TESTS

by

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Presented at:

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Washington, D.C.
March 31, 1975

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Development of Empirical "Growth" Expectancies for the Metropolitan Achievement Tests

The relevance of "national norms" for assessing the "growth" of pupils in academic skills -- especially those pupils who are functioning at a below-average level -- is questioned by survey achievement test users with increasing frequency. This paper deals primarily with two distinct issues relating to the relating to the longitudinal use of national normative data:

a.) How closely do interpolated achievement test norms approximate empirically-derived norms? That is, can a fall-to-spring "growth" be assessed accurately using only one set of empirical norms and another set of interpolated norms?

b.) Given the inappropriateness of "national averages" for assessing the "growth" of non-average pupils (e.g. the foolish expectation of "a month of growth for a month of instruction"), what growth expectancies can be developed for groups of pupils who are achieving at levels significantly above or below the level at which their "average" grade-mates are functioning? These data would seem most appropriate for measuring the growth of special groups such as Title I pupils, pupils in communities where ability levels are far above (or below) average, etc.

Until recent years, test publishers provided only one set of empirical norms per grade for their achievement series; other data were derived through interpolation. Even when a test has been standardized twice or more per grade, not all of the score modes (percentiles, grade equivalents, or standard scores) may be based on

and for the nation as a whole according to 1960 census data.

TABLE 1

SUMMARY OF KEY VARIABLES
USED TO DESCRIBE THE
METROPOLITAN NORMATIVE AND FALL-SPRING SAMPLES

Variable	Total Normative Sampling	Fall-Spring Sample	National Population
Median Years of Schooling	10.7	10.4	10,6
Median Family Income (in $100's)	55	53	56
Percent of Black Residents	9.9	11.0	10.5
Median Deviation 1 Qs	99.5-100.5	99.6-101.1	100

The Fall-Spring study was conducted by matching -- by computer and by hand -- the Fall and Spring score records of individual pupils. Thus, only pupils who took both tests were included in the subsequent analyses. A total of almost 15,000 cases ranging in number by Grade from 1468 in Grade 8 to 2860 in Grade 2 were included in the final sample.

After matching Fall and Spring pupil records, distributions of "difference" or "gain" scores in terms of standard scores, were run separately by grade and subtest for the total sample. Similar distributions were developed for three subgroups of the total sample defined in terms of their pretest (Fall) scores. Pupils whose Fall scores fell in stanines 1-3 composed the first group; stanines 4-6 defined the average groups; and stanines 7-9 defined the third group. "Gain" scores by subtest and grade were distributed and summarized for each of these three groups. Note

the multiple normings. Additionally, normative samples drawn for multiple normings, though matched quite closely in relevant characteristics, are based on different pupils. It seems important to assess whether these various factors affect the results obtained pre- and posttesting identical pupils within the same academic year and interpreting the results in terms of national norms. This study was designed in part to investigate this question.

A second purpose of this study was to yield data descriptive of the "growth" within an academic year of three groups of pupils classified according to their pretest scores: low achievers (those who scored in national stanines 1-3 on their pretest), average achievers (pretest stanines 4-6), and high achievers (pretest stanines 7-9). These data would provide meaningful estimates of the amount of growth expected of pupils who fall into one of these groups. National normative data are most appropriate for describing the growth of pupils functioning at or near "average."

METHOD

Twenty of the school systems in the standardization of the 1970 Metropolitan Achievement Tests were involved in both the Fall (October) and Spring (April) norming programs. These twenty systems were selected to be representative of the entire standardization group (and thus, of the nations's school population) in terms of relevant population characteristics. Average Otis-Lennon Mental Ability Test deviation IQs for this sample ranged from a low of 99.6 (Grade 8) to a high of 101.1 (Grade 5). Key variables used in selecting and describing the Metropolitan sample included the median years of schooling of adults over age 25 in the community, median family income, and the percent of blacks in the population. Table 1 presents figures for these variables for the "Fall-Spring" sample, for the total Metropolitan standardization group,

that a given pupil's scores might have placed him in different groups on the various subtests. For example, if the pupil had Fall stanine scores of 3 in Spelling and 4 in Reading, he was placed in the below-average Spelling group and the average Reading group.

RESULTS

The four score distributions per test (total group and the three subgroups) derived as above yield empirical standard score "growth expectancies" over a six-month period in the skills measured by the Metropolitan. Summary growth data and Fall-Spring correlations by grade for Metropolitan Total Reading and Total Mathematics are presented in Tables 2 and 3 for the total sample; tables 4-6 contain data for the three Mathematics Tests separately. Additionally, these tables present comparable data derived from the total Metropolitan normative sample.

Tables 7-13 present growth data for seven Metropolitan tests for the three subgroups (below-average, average, and above-average) of the sample. As would be anticipated, the growth of average subgroup is quite comparable to that of the total sample (compare Tables 2 and 3 with the Average group in Tables 9 and 10.)

In Tables 7-13 no allowances were made for the effects of regression toward the mean. This was intentional since most school personnel seldom have either the inclination or statistical background for making such adjustments. The data as presented are considered generally more appropriate for the typical school user.

Figures 1 and 2 summarize Tables 2 and 3 in a graphical format. Fall and Spring means are plotted and connected by grade on these figures. The solid line indicates the Metropolitan normative standard score "growth curve." Aside from Fall-Spring vs. normative sample comparison, these figures reveal interesting information regarding the "summer growth/forgetting" question.

TABLE 2

Fall, Spring, and "Gains" Summary Statistics in Standard Scores for Pupils Tested in October and April Compared with MAT "Normative Gains" for the Same Period --

TOTAL READING

Grade	Fall-Spring Correlation	Fall - Spring Study Sample								MAT Norms	
			Fall Scores		Spring Scores		Gain			Gain	
		N	$\bar{X}$	S.D.	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$
2	.76	2851	45.9	11.4	54.8	10.8	8.3	8.9	7.7	7.5	9
3	.77	1635	57.6	13.3	62.8	13.0	4.6	5.2	9.0	4	4
4	.77	2180	66.0	14.9	71.7	14.1	4.6	5.7	9.9	5	5
5	.73	2361	74.1	16.4	79.6	13.1	4.2	5.4	11.2	3.5	4
6	.76	2404	81.7	17.6	85.5	14.2	2.8	3.8	11.4	3	3
7	.85	1771	86.4	16.6	89.4	16.3	2.6	3.0	9.1	1	2
8	.89	1461	92.8	16.6	95.2	17.4	2.3	2.5	8.1	1	2

TABLE 3

Fall, Spring, and "Gains" Summary Statistics in Standard Scores for Pupils Tested in October and April Compared with MAT "Normative Gains" for the Same Period --

TOTAL MATHEMATICS

Grade	Fall-Spring Correlation	Fall - Spring Study Sample								MAT Norms	
			Fall Scores		Spring Scores		Gain			Gain	
		N	$\bar{X}$	S.D	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$
2	.75	2831	48.6	12.3	59.6	11.2	10.7	11.0	8.3	9	11
3	.74	1611	62.0	13.4	71.4	12.2	9.0	9.3	9.3	9.5	8
4	.69	2150	72.8	14.2	81.9	12.5	8.2	9.1	10.7	8	7
5	.66	2351	82.3	14.7	88.5	11.2	4.7	6.2	11.2	4	4
6	.71	2378	90.8	15.5	96.0	13.2	3.8	5.2	11.1	3	3
7	.78	1760	96.4	15.8	100.0	13.4	2.7	3.6	10.0	1.5	2
8	.79	1461	102.2	16.2	105.6	14.1	2.6	3.4	10.0	1	1

The data presented here have important advantages over "growth" charts or tables offered in the past. First, the data are empirical -- no interpolation or extrapolations are involved. Second, and perhaps more importantly, the same pupils were used for computing the Fall-Spring score changes. The regular Metropolitan percentile rank/stanine tables provide the first advantage above. However, the regular "Beginning" and "End" of year norms are not based on identical sets of pupils, although great care was taken to match the two samples as closely as possible. An additional advantage of these data is that the sample is closely representative of both the entire Metropolitan normative sample and the nation's school population, thus making interpretation of obtained results more meaningful.

TABLES 4 - 6

Fall, Spring, and "Gains" Summary Statistics in Standard Scores for Pupils Tested in October and April Compared with MAT "normative Gains" for the Same Period --

Mathematics Computation

Grade	Fall-Spring Correlation	Fall - Spring Study Sample								MAT Norms	
		N	Fall $\bar{X}$	Fall S.D	Spring $\bar{X}$	Spring S.D.	Gain Median	Gain $\bar{X}$	Gain S.D.	Gain Median	Gain $\bar{X}$
3	.68	1632	58.1	11.0	66.6	10.9	8.2	8.5	8.7	8.5	9
4	.68	2174	68.2	10.9	78.7	12.4	10.2	10.5	9.3	10	10
5	.68	2361	79.0	11.1	86.1	11.0	6.2	7.0	8.8	5.5	6
6	.72	2393	88.0	12.5	94.0	12.4	5.4	6.0	9.2	7	6
7	.77	1776	94.1	12.7	96.8	13.2	2.5	2.8	8.8	3	2
8	.80	1466	99.7	12.9	103.0	14.0	2.7	3.3	8.5	1	1

Mathematics Concepts

Grade	Fall-Spring Correlation	Fall - Spring Study Sample								MAT Norms	
		N	Fall $\bar{X}$	Fall S.D.	Spring $\bar{X}$	Spring S.D.	Gain Median	Gain $\bar{X}$	Gain S.D.	Gain Median	Gain $\bar{X}$
3	.75	1622	59.6	12.2	67.5	12.4	8.1	7.8	8.6	8	7
4	.74	2154	69.2	12.4	76.0	12.3	6.4	6.8	8.9	6	5
5	.72	2359	78.2	12.5	83.4	13.0	4.7	5.3	9.6	5	5
6	.75	2396	85.2	13.2	90.4	14.8	4.7	5.2	10.0	4.5	4
7	.77	1781	87.7	12.7	90.4	12.7	2.4	2.7	8.6	0	1
8	.79	1468	93.4	13.7	96.2	14.1	2.3	2.8	9.0	0	1

Mathematics Problem Solving

Grade	Fall-Spring Correlation	Fall - Spring Study Sample								MAT Norms	
		N	Fall $\bar{X}$	Fall S.D.	Spring $\bar{X}$	Spring S.D.	Gain Median	Gain $\bar{X}$	Gain S.D.	Gain Median	Gain $\bar{X}$
3	.71	1624	61.3	13.1	69.0	13.6	7.7	7.8	10.2	7	7
4	.72	2167	71.4	13.6	78.3	13.6	6.2	6.9	10.3	6	6
5	.70	2357	79.6	14.3	83.8	12.8	3.7	4.2	10.6	3.5	3
6	.75	2395	87.6	15.6	90.4	13.8	2.2	2.8	10.5	3	2
7	.81	1777	93.3	15.7	97.2	15.1	3.7	3.9	9.5	3	2
8	.79	1466	98.4	16.1	101.2	15.1	2.3	2.8	10.2	2.5	1

TABLES 7 AND 8

Median, Mean and S.D. of MAT Standard Score "Gains" Over a Six-Month Period by Grade for Three Subgroups and Total Group (N=1461-2861 per grade)

WORD KNOWLEDGE

Grade	HIGH PRETEST			AVERAGE PRETEST			LOW PRETEST			TOTAL GROUP		
	Median	Mean	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	Mean	S.D.
2	2.3	3.8	8.8	9.0	9.4	5.6	13.0	13.8	8.5	8.7	8.9	7.9
3	2.0	2.0	8.9	5.3	5.6	5.4	5.4	6.5	11.6	4.8	4.9	8.3
4	0.4	2.1	10.6	4.5	5.2	5.9	5.1	7.9	13.9	4.3	5.1	9.3
5	3.7	4.2	6.9	4.0	4.1	6.0	6.0	9.0	15.5	4.3	5.2	9.3
6	1.9	2.7	8.0	3.3	3.6	6.0	4.6	7.4	16.0	3.1	4.1	9.6
7	2.5	2.6	5.8	2.3	1.9	6.4	4.4	5.2	13.5	2.7	2.8	8.4
8	1.8	1.5	7.3	2.3	2.1	7.1	2.7	3.3	11.8	2.2	2.2	8.4

READING

Grade	HIGH PRETEST			AVERAGE PRETEST			LOW PRETEST			TOTAL GROUP		
	Median	Mean	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	Mean	S.D.
2	2.8	3.4	9.8	8.0	7.8	6.8	11.3	11.3	9.9	7.6	7.5	8.6
3	5.1	5.2	10.1	4.9	5.0	7.4	5.3	7.1	14.0	5.0	5.0	9.8
4	2.3	2.1	8.3	4.5	4.5	7.9	6.3	8.5	15.5	4.4	4.8	10.4
5	.3	.4	7.1	3.6	3.0	7.0	12.7	14.6	16.9	3.6	4.6	11.0
6	-3.8	-3.4	8.1	2.6	2.4	6.2	8.3	11.2	17.5	2.0	2.4	10.9
7	1.8	2.2	8.9	1.6	1.2	8.2	5.3	6.3	13.4	2.2	2.5	9.9
8	.4	.7	9.0	2.3	2.3	8.6	2.1	2.9	11.8	2.0	2.0	9.5

Median, Mean and S.D. of MAT Standard Score "Gains" Over a Six-Month Period by Grade for Three Subgroups and Total Group (N=1461-2861 per grade)

TOTAL READING

Grade	HIGH PRETEST			AVERAGE PRETEST			LOW PRETEST			TOTAL GROUP		
	Median	Mean	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	Mean	S.D.
2	5.9	6.7	8.9	8.2	8.5	4.7	11.0	12.6	11.1	8.3	8.9	7.7
3	3.8	4.2	8.8	4.8	5.1	4.9	4.3	6.6	14.8	4.6	5.2	9.0
4	3.9	4.0	7.8	4.8	5.3	5.6	4.4	8.7	18.0	4.6	5.7	9.9
5	2.9	2.8	5.8	4.0	3.9	5.1	7.8	13.0	21.2	4.2	5.4	11.2
6	.8	.9	7.0	3.0	2.8	4.6	5.2	10.6	21.8	2.8	3.8	11.4
7	3.7	3.9	6.2	1.7	1.6	5.8	3.5	5.2	15.4	2.6	3.0	9.1
8	2.6	2.4	6.4	2.4	2.5	6.4	1.2	2.4	12.5	2.3	2.5	8.1

TOTAL MATHEMATICS

Grade	HIGH PRETEST			AVERAGE PRETEST			LOW PRETEST			TOTAL GROUP		
	Median	Mean	S.D.	Median	$\bar{X}$	S.D.	Median	$\bar{X}$	S.D.	Median	Mean	S.D.
2	6.2	7.1	8.8	10.5	10.8	6.2	16.1	16.0	9.9	10.7	11.0	8.3
3	7.7	7.0	6.3	9.4	9.2	6.2	9.7	12.7	15.8	9.0	9.3	9.3
4	6.5	6.8	5.5	9.0	8.8	5.4	7.3	12.4	20.2	8.2	9.1	10.7
5	4.4	4.8	5.2	4.4	4.3	4.8	7.2	13.9	22.2	4.7	6.2	11.2
6	4.2	4.3	6.1	3.5	3.8	5.1	4.6	10.4	22.3	3.8	5.2	11.1
7	2.8	2.8	5.1	2.3	2.2	4.9	3.8	7.5	18.2	2.7	3.6	10.0
8	3.3	3.1	4.6	2.0	2.1	5.4	2.9	6.8	18.6	2.6	3.4	10.0

TABLES 11-13

Median, Mean and S.D. of MAT Standard Score "Gains" Over a Six-Month Period by Grade for Three Subgroups and Total Group. (N=1461-2861 per grade)

MATHEMATICS COMPUTATION

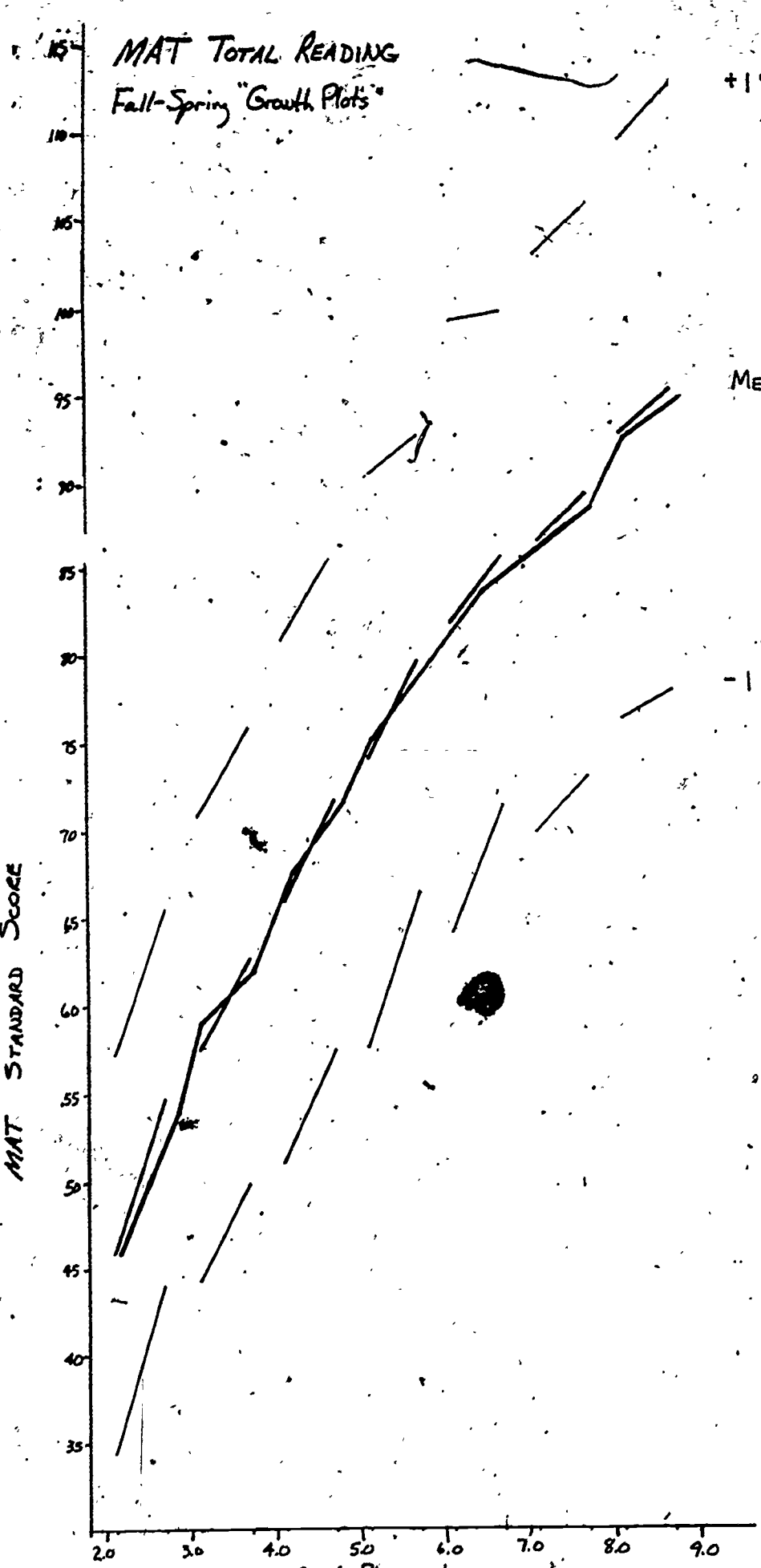
Grade	High			Average			Low			Total		
	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD
3	4.4	4.4	8.0	8.8	9.0	7.2	11.4	12.6	10.9	8.2	8.5	8.7
4	8.2	8.1	8.2	11.0	10.8	8.2	10.2	12.3	12.5	10.2	10.5	9.3
5	5.4	5.2	6.3	5.9	6.2	7.0	9.5	11.8	13.4	6.2	7.0	8.8
6	3.1	3.3	7.2	6.4	6.3	7.3	5.8	8.7	14.1	5.4	6.0	9.2
7	1.7	2.5	7.2	2.7	1.6	7.3	4.7	6.4	12.6	2.5	2.8	8.8
8	1.1	2.7	8.9	2.8	3.1	6.6	5.0	4.8	11.4	2.7	3.3	8.5

MATHEMATICS CONCEPTS

Grade	High			Average			Low			Total		
	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD
3	5.6	5.0	8.0	8.3	8.1	7.7	9.9	10.6	10.4	8.1	7.8	8.6
4	3.0	2.9	6.7	7.3	7.2	6.9	8.2	9.7	13.8	6.4	6.8	8.9
5	4.2	4.7	7.5	4.2	4.0	7.7	7.7	10.1	14.9	4.7	5.3	9.6
6	6.4	6.2	7.8	4.0	3.9	7.6	4.8	7.7	16.6	4.7	5.2	10.0
7	1.0	1.1	8.0	1.6	2.0	7.1	5.2	6.0	11.2	2.4	2.7	8.6
8	1.4	1.6	8.0	2.2	2.5	7.7	3.6	5.0	11.9	2.3	2.8	9.0

MATHEMATICS PROBLEM SOLVING

Grade	High			Average			Low			Total		
	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD	Median	$\bar{X}$	SD
3	4.8	4.7	9.2	7.9	7.5	8.6	10.5	11.7	13.2	7.7	7.8	10.2
4	3.9	4.1	7.9	6.4	6.8	7.7	7.4	10.0	15.4	6.2	6.9	10.3
5	1.8	1.2	7.3	3.6	2.8	8.0	10.3	12.4	16.0	3.7	4.2	10.6
6	-1.6	-1.0	7.8	2.5	2.3	7.2	6.0	8.7	16.6	2.2	2.8	10.5
7	2.2	2.5	7.9	2.9	2.8	7.8	7.8	8.2	13.0	3.7	3.9	9.5
8	-.3	.6	7.6	2.3	2.0	8.0	6.0	7.5	15.1	2.3	2.8	10.2


MAT TOTAL READING
Fall-Spring "Growth Plots"
+1 S.D.
MEAN
-1 S.D.
MAT STANDARD SCORE
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
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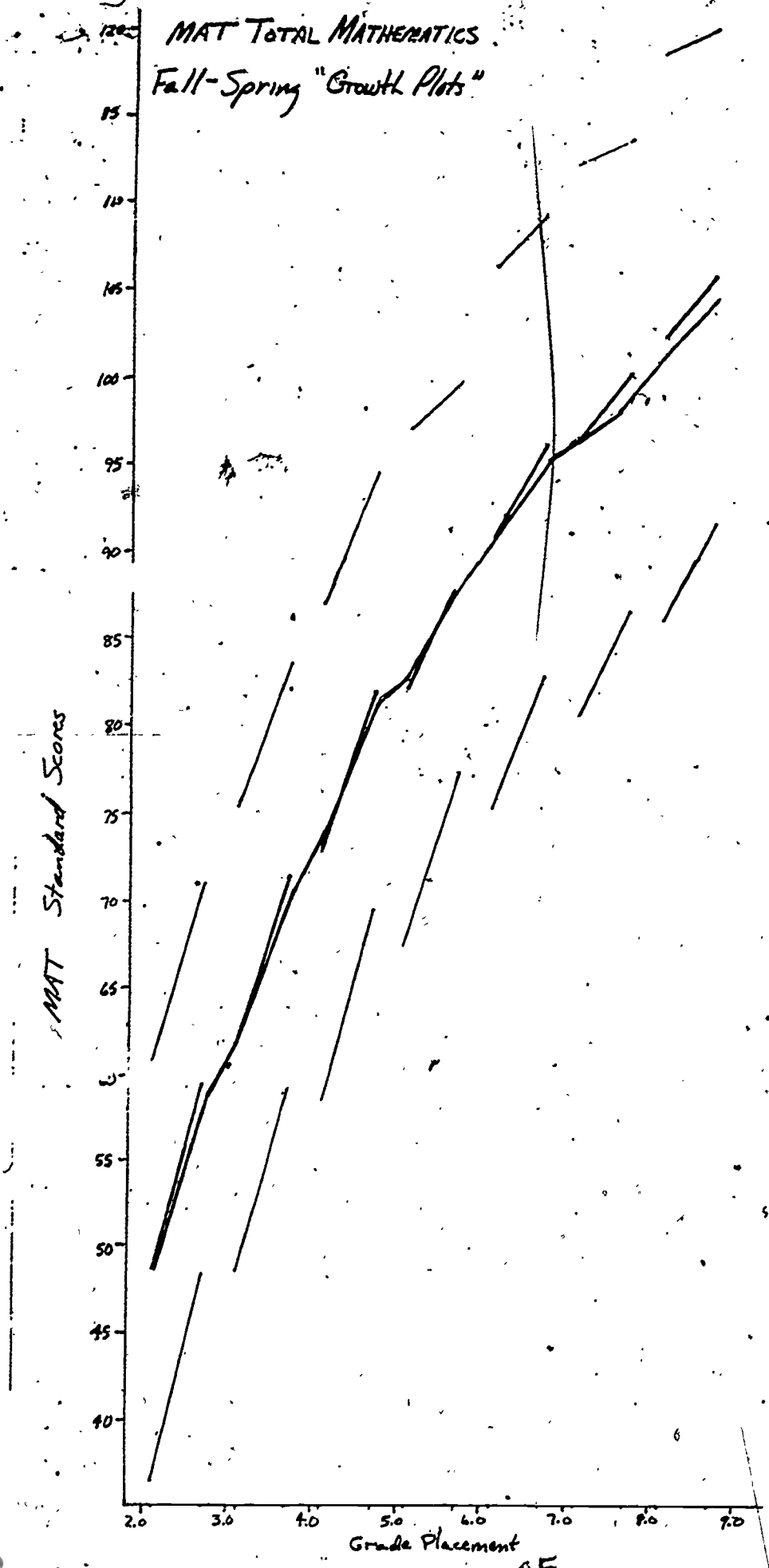
8.0
9.0
Grade Placement

Figure 1.


MAT TOTAL MATHEMATICS
Fall-Spring "Growth Plots"
+1 S.D.
MEAN
-1 S.D.
MAT Standard Scores
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115
110
105
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95
90
85
80
75
70
65
60
55
50
45
40
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Grade Placement

Figure 2.