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COGNITIVE CHARACTERISTICS OF THE TOP-SCORING THIRD OF THE 1976 TALENT SEARCH CONTESTANTS

Sanford J. Cohn

Initial results from the 1976 Talent Search provided evidence for considerable precocity in mathematical and verbal reasoning ability among the mathematically apt seventh-grade-age boys and girls who participated in the first screening of that competition (George & Cohn, 1977). This initial screening procedure consisted of both the mathematics section (SAT-M) and the verbal section (SAT-V) of the Scholastic Aptitude Test.

A second screening procedure was employed to distinguish from among the 873 contestants those youths who might best profit from immediate intervention by SMPY to facilitate accelerative opportunities in their education. In order to avoid eliminating high scorers on SAT-M alone and very high scorers on SAT-V alone, selection for further testing required a composite SAT score of at least 1330 determined by weighing mathematical reasoning ability twice that of verbal reasoning ability. In short, the following condition had to be met for a student to be invited back for further testing:

$$2(\text{SAT-M}) + 1(\text{SAT-V}) \geq 1330.$$

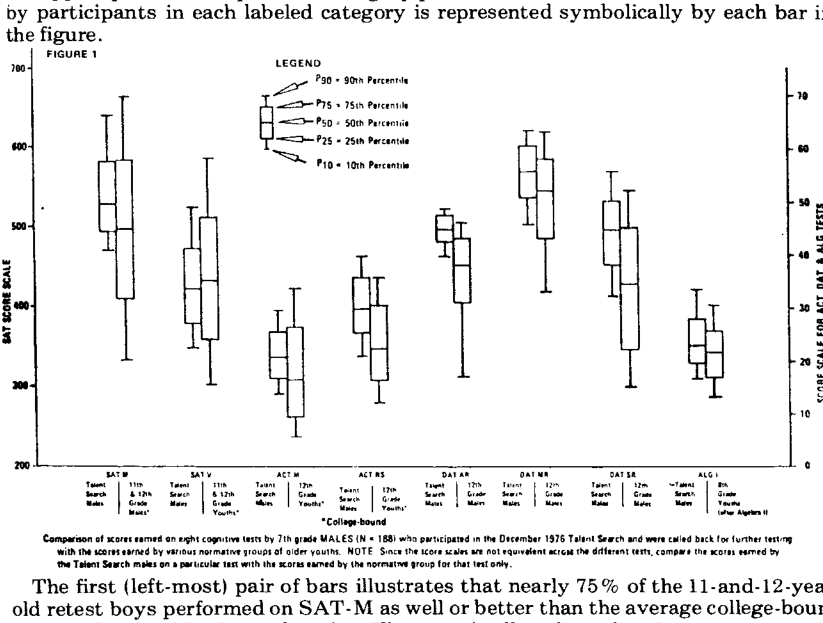
For example, a student who scored 500 on SAT-M would have to have achieved at least a score of 330 on SAT-V to be included.

The inclusion of the verbal subtest in the selection criterion for those to be invited back for further testing and possibly later for educational facilitation is supported by SMPY's past experience with fast-paced instruction in mathematics. Even extraordinarily mathematically talented youths need a reasonably high learning rate to take advantage of many of the accelerative educational alternatives recommended by SMPY. Verbal ability, as measured by SAT-V, seems to be a good approximation of learning rate.

Nearly 33% of the original 873 contestants were selected into what became known as the "retest group," thereby representing the top 1% of same age youths in the nation with respect to mathematical aptitude. Ninety-seven percent, that is all but six boys and two girls, of the 286 students invited to return to The Johns Hopkins University campus for an entire day of further high-level testing decided to take advantage of this opportunity to explore more fully descriptive evaluation of their cognitive abilities, attitudes, and interests. The ratio of boys to girls increased from approximately 1.39:1 in the original pool of contestants to 2.09:1 in retest group. Clearly, the fact that 5.5% of the boys scored higher on SAT-M (620-780) than did the two highest scoring girls (610), combined with the double weighting of scores on SAT-M for selection into the retest group, accounts for the increase in the number of boys relative to the number of girls comprising that select group.

Six additional tests of specific cognitive abilities were administered to the 188 boys and 90 girls who ultimately comprised the retest group, bringing the total number of cognitive measures to eight (including the original screening with SAT-M and SAT-V). Each pair of bars in Figure 1 compares the performance of the boys as a group with a normative sample of older youths. The norms vary for each test used, as does the grading scale, so comparisons across different tests must be avoided. Instructions for interpreting each bar are shown in the "legend." The center-most line represents the 50th percentile of each group. (A percentile is the score below which a specified percentage of a normative group scored on a particular test. For example, the 50th percentile of college-bound 11th and 12th grade males on SAT-M is shown as slightly less than a score of 500 in Figure 1). The spread encompassed by the rectangle includes the middle 50% of the scores earned by the 278 examinees, from the 25th to the 75th percentile, with the lower spur denoting the 10th percentile and the upper spur the 90th percentile. Eighty percent of the distribution of scores earned by participants in each labeled category is represented symbolically by each bar in the figure.

FIGURE 1



Comparison of scores earned on eight cognitive tests by 7th grade MALES (N = 188) who participated in the December 1976 Talent Search and were called back for further testing with the scores earned by various normative groups of older youths. NOTE: Since the score scales are not equivalent across the different tests, compare the scores earned by the Talent Search males on a particular test with the scores earned by the normative group for that test only.

The first (left-most) pair of bars illustrates that nearly 75% of the 11-and-12-year-old retest boys performed on SAT-M as well or better than the average college-bound male high school junior and senior. The use of college-bound male norms as a comparison group for SAT-M performance represents the most stringent comparison available for this test. On SAT-V 40% of these young boys did at least as well as the average college bound 11th and 12th grader does. If we again consider the fact that boys tended to score very high on SAT-M in conjunction with the quasi-ipsative selection criterion (2(SAT-M) + 1(SAT-V) $\geq$ 1330), the lower percentage of the retest boys who outperformed college-bound juniors and seniors on SAT-V relative to that for SAT-M is expectable. Moreover, pre-screening was based only on performance on a standardized mathematics test. No pre-contest verbal performance criterion was used. Neither must one have extensive background to have demonstrably high ability in mathematics reasoning, as is usually the case for extraordinarily high verbal reasoning aptitude. "Living, loving, and losing" seems more characteristic of literary ability. That close to half to these boys compared favorably with the most able youths four and five years their senior places their performance on SAT-V in perspective as remarkable evidence of verbal precocity. The rather high correlation between the boys' scores on SAT-M and SAT-V ($r = .205, p \leq .01$) indicated that the boys among the retest group who scored high on SAT-M also tended to score high on SAT-V.

The adequacy of SAT-M as a measure of mathematical aptitude was confirmed by the observation that more than 75% of these gifted seventh-grade-age boys scored as well as or better than the average college-bound senior male does on the Mathematical Usage subtest of the American College Test battery (ACT-M). A nearly identical percentage of these boys scored high on ACT-M and SAT-M, even though ACT-M contains questions based on the content of precalculus mathematics courses whereas SAT-M does not. Apparently, even on a speeded test these youngsters can figure out the algorithms underlying content-dependent problems without prior instruction. The extraordinarily high correlation between the retest boys' scores on SAT-M and ACT-M ($r = .74$, $p < .001$) indicates that high scorers on one test also tend to be high scorers on the other.

Science careers have been the goal of many of the participants in previous talent searches (Stanley, 1977). The Natural Sciences Readings subtest of the American College Test battery (ACT-NS) was given to assist later career counseling efforts on behalf of the current high-scoring contestants. Approximately 65% of the boys tested at least as well as the average college-bound male does on this test.

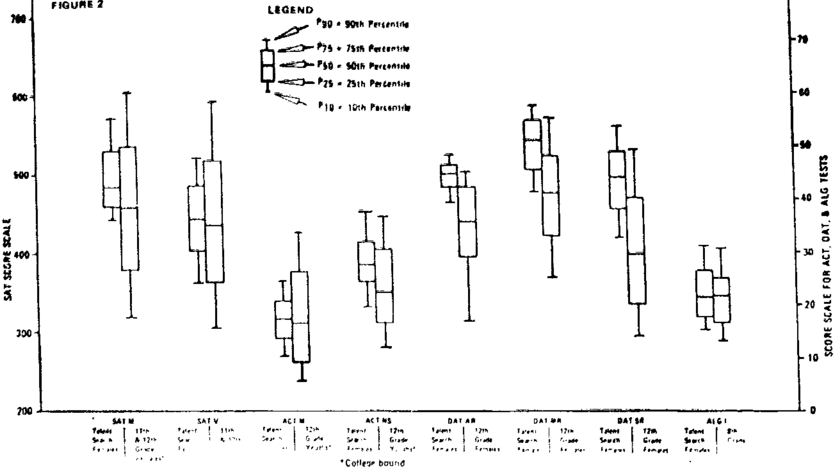
The abstract reasoning subtest of the Differential Aptitude Test battery (DAT-AR) was administered as a "culture-fair" measure of intelligence, since (except for the instructions) it is independent of verbal content. The fifth pair of bars in Figure 1 demonstrates that this test did not have enough "ceiling" for these youngsters, as practically all of them outperformed the average 12th-grade male. It is important to note here, for all subtests of the DAT battery to be discussed that, although reported separately by sex, the normative groups are for high school seniors, with no distinction drawn between a college-bound group and high-school boys or girls in general as had been the case for SAT-M, SAT-V, ACT-M, and ACT-NS.

Assessment of mechanical reasoning ability, especially important in the physical sciences, was accomplished by administering the Mechanical Reasoning subtest of the DAT (DAT-MR). Nearly 70% of the younger boys bettered the performance of the typical male 12th grader. This augurs well for excellent performance by these boys in physics courses and on APP physics exams.

The ability to perceive the relationships between two-dimensional patterns and their kindred shapes in three dimensions plays an important role in many mathematics courses, most obviously projective geometry, and in mechanical drawing. The DAT subtest of Spatial Relationships (DAT-SR) was used to assess this specific ability among the top-scoring third of the talent search contestants. Well over 80% of the boys exceeded the score earned by the average male 12th grader on this measure.

For many of the youngsters who chose to compete in the talent searches, 180 45-minute class periods of Algebra I taken in the eighth or ninth grade would constitute an exercise in boredom (Stanley, 1976). The Educational Testing Service's Cooperative Mathematics Algebra I Achievement Test (ALG-I) was administered to these youngsters, most of whom had not yet taken a course in this subject. The performance of the retest boys, as shown in the eighth set of bars in Figure 1, is compared with that of a rigorous normative group for this test, eighth graders who have completes one school year of algebra. Almost 60% of the seventh grade boys, most of them without prior training, outscored the average eighth grader. Most of the talent-search group had not yet taken a formal course in algebra.

FIGURE 2



Comparison of scores earned [illegible] by 7th grade FEMALES (N = 90) who participated in the December 1976 Talent Search and were called in [illegible] testing with the [illegible] native groups of older youths. NOTE: Since the score scales are not equivalent across the different tests, compare the scores earned by the Talent Search females on a particular test with the scores earned by the normative group for that test only.

As Figure 2 shows, the 90 retest girls also exhibited high levels of achievement on the eight cognitive measures, comparable with bright females as much as five years their senior. The eight sets of bars depict the comparisons of scores earned by these girls with those earned by girls comprising the strictest female norms available for each of the tests. In all but two instances (SAT-V and ALG-I) they were matched against selective samples of older girls. Combined sex norms were used as the bases of comparison for the two exceptions, as they had been with the boys.

The first pair of bars indicates that on SAT-M 75% of the select girls outperformed the average college-bound female 17 and 18 year-olds. For SAT-V, nearly 55% of the female youths exceeded the median score of the normative sample. Approximately 55% of the girls scored on ACT-M at least as well as the Typical college-bound female does. The fourth set of bars in Figure 2 reveals that 88% of the girls topped the performance of the typical college-bound 12th grade female in natural science reasoning ability (ACT-NS).

On each of the DAT subtests measuring abstract reasoning (DAT-AR), mechanical reasoning (DAT-MR), and the capacity to apprehend spatial relationships (DAT-SR), practically all of the girls surpassed the average scores earned by their 12th grade counterparts. (Reminder: Unlike those for the SAT and the ACT, norms for the DAT battery, although separate for each sex, are not differentiated into college-bound versus non-college bound categories. They are based on a general sample of 12th graders by sex.)

Scores earned on the Algebra I achievement test (ALG-I) by these 11 and 12 year-old girls, most of whom never had exposure to this subject, compared favorably with those attained by eighth graders who had already completed an algebra course.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

On difficult tests of specific cognitive abilities, tests developed originally for use with older youngsters, seventh-grade-age contestants who scored in the upper third in the 1976 Talent Search demonstrated considerable precocity. In fact, many of them showed substantial or even high levels of competence in Algebra I even before having taken a course in it.

The profiles of intellectual abilities along with other measures of interests and attitudes provide SMPY with a strong foundation of information for tailoring a highly individualized educational process for each of the high-scoring contestants. Much of the intervention offered to these youngsters is based on the smorgasbord of accelerative techniques developed by SMPY and described in two books published by The Johns Hopkins University Press: *Mathematical Talent: Discovery, Description and Development* and *Intellectual Talent: Research and Development* (mentioned further elsewhere in this issue).

SMPY's active participation in each student's educational development is consistent with one of its expressed purposes, "to provide effective service for the intellectually gifted, now." The controversy among educators specializing in teaching the gifted youngster presently rages over the relative merits of enrichment versus acceleration. At a time when funding for the minimum educational needs of our society is suffering severe cutbacks, cumbersome programs designed to "broaden" the educational experience of intellectually talented youths are being scrutinized. In the meantime, while often the effectiveness of these costly "enrichment" programs is questionable and the criteria for including students in them ill-conceived, the model of identification and facilitation of acceleration is a viable substitute.

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Counselor's Information Service, 1640 R. I. Ave. NW, Washington, DC, 20036 is a quarterly often containing information useful for the gifted. A sample:

STUDENTS FREQUENTLY NEED ASSISTANCE WITH REGARD TO COLLEGE ADMISSIONS. ARE YOU FAMILIAR WITH THE FOLLOWING RESOURCES?

American College Admissions Advisory Center, 2401 Pennsylvania Ave., Philadelphia, PA 19130.

American College Testing Service Scholarship Program, P.O. Box 168, Iowa City, IA 52240.

College Admissions Center, 1 Rockefeller Plaza, New York, NY 10020.

College Counseling for Transfers (1976). Chronicle Guidance Publications, Inc., Moravia, NY 13118.

College Planning/Search Book (1977-78). American College Testing Program, P.O. Box 808, Iowa City, IA 52240.

Comparative Guide to American Colleges for Students, Parents, and Counselors (1977). James Cass and Max Birnbaum. Harper and Row Publishers, Inc., 10 E. 53rd St., New York, NY 10022.

Comparative Guide to Two Year Colleges and Career Programs (1976). James Cass and Max Birnbaum. Harper and Row

Publishers, Inc., 10 E 53rd St., New York, NY 10022.
Directory of Accredited Institutions (1976-77). Association of Independent Colleges and Schools, 1730 M St., N.W., Washington, D.C. 20036.
Guide to the Advanced Placement Program (1977-78). The College Board, Box 2815, Princeton, NJ 08540.
Lovejoy's College Guide (1976). Clarence E. Lovejoy. Simon and Schuster, 630 Fifth Ave., New York, NY 10020.
Western Interstate Commission for Higher Education, Boulder CO 80302.
College Handbook, The (Sixteenth Edition, 1977). Susan F. Watts (Ed.). The College Board, P.O. Box 2815, Princeton, NJ 08540.
College Handbook, The: Index of Majors (1977). The College Board, P.O. Box 2815, Princeton, NJ 08540.
Directory of Accredited Home Study Schools 1977-78. National Home Study Council, 1601 18th St., N.W., Washington, D.C. 20009.
Directory of Accredited Private Trade and Technical Schools (1977-78). National Association of Trade and Technical Schools, 2021 L St., N.W., Washington, D.C. 20036.
Free University Directory: Spring 1977. Free University Network, 615 Fairchild Terr., Manhattan, KS 66502.
Guide to Independent Study through Correspondence Instruction (1977-79). National University Extension Association, One Dupont Circle, Washington, D.C. 20036.
Handbook on International Study for U.S. Nationals (1976). Institute of International Education, 809 UN Plaza, New York, NY 10017.
Lovejoy's Career and Vocational School Guide (Fifth Edition, 1978). Clarence E. Lovejoy. Simon and Schuster, Inc., 630 Fifth Ave., New York, NY 10020.
1978 Community and Junior College Directory. American Association of Community and Junior Colleges, One Dupont Circle, Washington, D.C. 20036.
On-Campus, Off-Campus Degree Programs for Part-time Students (1976). National University Extension Association, One Dupont Circle, Washington, D. C. 20036.
Patterson's American Education (Annual). Educational Directories, P.O. Box 199, Mount Prospect, IL 60056.
Peterson's Travel Guide to Colleges: Northeast (1977). Also available is companion volume on colleges in Middle Atlantic States. Peterson's Guides, P.O. Box 2123, Princeton, NJ 08540.

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