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Youths Who Reason Exceptionally Well Mathematically and/or Verbally

Using the MVT:D^4 Model to Develop Their Talents

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The Study of Mathematically Precocious Youth (SMPY) was established at Johns Hopkins University in 1971 by Professor Julian Stanley to help youths who reason extremely well mathematically find the educational resources they need to achieve their full potential (Benbow & Stanley, 1983; Keating, 1976; Stanley, 1977; Stanley, Keating, & Fox, 1974). After administering above-grade-level tests to identify students with advanced mathematical reasoning abilities, SMPY provided counseling and created programs to meet their academic needs. Eventually, university-based talent centers were established around the country to continue the practices SMPY pioneered. Because SMPY's methods for developing talent evolved over time in a very pragmatic way, that is, in response to the needs of individual students, the psychological and conceptual bases for this approach have not been especially emphasized in the literature.

In the first edition of this book, for example, Stanley and Benbow (1986) suggested that SMPY was "not concerned much with conceptualizing giftedness" and had "not spent much time contemplating the psychological underpinnings of giftedness" (p. 361). However, Duke University psychologist Michael Wallach, in a review of one of SMPY's early books (Stanley, George, & Solano, 1977), observed that:

> What is particularly striking here is how little that is distinctly psychological seems involved in SMPY, and yet how very fruitful SMPY appears to be. It is as if trying to be psychological throws us off the course and into a mire of abstract dispositions that help little in facilitating students' demonstrable talents. What seems most successful for helping students is what stays closest to the competencies one directly cares about: in the case of SMPY, for example, finding students who are very good at math and arranging the environment to help them learn it as well as possible. One would expect analogous prescriptions to be of benefit for fostering talent at writing, music, art, and any other competencies that can be specified in product or performance terms. But all this in fact is not unpsychological; it is simply different psychology (Wallach, 1978, p. 617).

There was always a strong rationale behind the choices and decisions that were made by SMPY (Stanley, 1977). Three principles from developmental psychology, in particular, have contributed to the programmatic recommendations that were adopted. These principles are that learning is sequential and developmental (Hilgard & Bower, 1974), that children learn at different rates (Bayley, 1955, 1970; George, Cohn, & Stanley, 1979; Keating, 1976; Keating & Stanley, 1972; Robinson & Robinson, 1982), and that effective teaching involves a "match" between the child's readiness to learn and the level of content presented (Hunt, 1961; Robinson & Robinson, 1982). The implication of these principles, as delineated by Robinson (1983), Robinson & Robinson (1982), (Stanley, 1997), and Stanley and Benbow (1986), is that the level and pace of educational programs must be adapted to the capacities and knowledge of individual children. The pioneering work of Hollingworth (1942), who used above-grade-level tests to measure students' precocity (see Stanley, 1990), and of Terman (1925), who was among the first to systematically identify and study gifted students, also profoundly influenced the direction of SMPY.

All of SMPY's work was very much research-based, as the principal investigators sought validation of their hypotheses and evaluated the effectiveness of various intervention strategies. Today, longitudinal studies of early SMPY participants are still being conducted by David Lubinski and Camilla Benbow at Vanderbilt University (e.g., Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000; Lubinski, Benbow, Shea, Eftekhari-Sanjani, & Halvorson, 2001; Lubinski, Webb, Morelock, & Benbow, 2001), and the university-based talent search programs that have adopted SMPY's principles and practices also engage in ongoing research related to the students they serve. Consequently, there exists a large body of published empirical evidence in support of this approach to talent identification and development, something many theories lack.

In this chapter, the conceptual and operational components of this model are summarized. It is meant to help youths who reason extremely well mathematically and/or verbally develop their talents. We begin with the history of SMPY.

BACKGROUND AND HISTORY OF SMPY

It was in the summer of 1968 that Julian Stanley was told about Joe, a 12-year-old who was doing some amazing work in a computer science course for middle school students at Johns Hopkins University. Eager to know more about the extent of Joe's abilities, Stanley arranged that fall to have this eighth-grader (unfortunately, without practicing beforehand) take the College Board Scholastic Aptitude Test (SAT), a test designed for college-bound high school seniors. Joe scored 669 on SAT-Mathematical Reasoning (SAT-M), higher than the average student entering Johns

Hopkins as a freshman. He also scored 590 on SAT-Verbal Reasoning (SAT-V), 772 on SAT-II (achievement test) Math, and 752 on SAT-II Physics, all exceptional scores for college-bound students and especially for a 13-year-old student who had not yet entered high school.

When local high schools, both public and private, proved unwilling to adjust their programs to accommodate his advanced educational needs, this 13-year-old entered Johns Hopkins University as a regular, full-time freshman. He did well, earning good grades and obtaining both his undergraduate and master's degrees in computer science by age 17. Then, a year after Joe was tested, another 13-year-old eighth-grader emerged, who also scored exceptionally well on SAT aptitude and high school achievement tests and who, with Stanley's help, also entered Johns Hopkins in lieu of going to high school. Finally, within a short time, a third accelerant enrolled at Hopkins after the 10th grade under Stanley's guidance. (For more information about these early radical accelerants, see Stanley, 1974.)

SMPY's experience with these exceptional youths suggested that the SAT-M, administered above grade level, was an effective means of identifying students who reasoned extremely well mathematically at a young age and who were capable of learning advanced subject matter in mathematics and science. The SAT offered many advantages over other assessment measures. Most importantly, it provided adequate ceiling to discriminate among students, all of whom might score well on in-grade-level tests. It also offered national above-grade-level norms for comparison purposes, and the test was secure, in that students could not get access to the questions in advance.

Because few seventh- and eighth-graders have formally studied the mathematical content that high school students have, the SAT appeared to be more of a reasoning test for seventh- and eighth-graders than for high school juniors and seniors. Presumably, students who score well on this difficult test without exposure to its content do so by using extraordinary reasoning abilities at the "analysis" level of Bloom's (1956) taxonomy. The predictive validity of the SAT for later high achievement among talent search participants has been documented (Benbow, 1992; Benbow & Stanley, 1983). SMPY also found that further assessment of a student's verbal reasoning and achievement levels, as well as other attributes, was valuable and important for guiding educational decisions.

SMPY began to launch systematic talent searches in an effort to find other students who exhibited advanced mathematical reasoning abilities similar to Joe and the other accelerants. It was expected that only a few such students would be found and that accommodations to meet their needs could be made on an individual basis. The first SMPY talent search took place in March 1972 on the Johns Hopkins campus for 450 seventh-, eighth-, and accelerated ninth-graders. They took advanced tests in math and/or science. Many more of the participants scored at higher levels than the researchers expected; for example, of the 396 who took the SAT-M, 13 percent scored 600 or more. Achievement levels were also surprisingly high among these students, who had had little formal exposure to the subject matter tested. The number of students found with exceptional abilities documented the need to search for such students on a regular basis and to find ways to meet their academic needs (Stanley et al., 1974).

Other talent searches and extensive experimentation with accelerated courses for the high scorers followed in 1973, 1974, 1976, 1978, and 1979 (Benbow & Stanley, 1983; Keating, 1976; Stanley, 1996). Finally, in late 1979, the entity that is now the Center for Talented Youth (CTY) at Johns Hopkins was established to expand the talent searches greatly, including emphasis on SAT-V scores, and to provide residential academic programs, while SMPY continued under Stanley's direction to focus on research and counseling extremely mathematically precocious students.

People often ask why SMPY itself chose to focus exclusively on mathematical reasoning ability. With a small staff and little funding to pursue the initial work, limited resources are part of the answer as to why not all talent areas were pursued. However, scientific knowledge was also a focus in the first (1972) talent search, and for a short time the project was called the Study of Mathematically and Scientifically Precocious Youth. Because quite a few of the high scorers on the college-level test of scientific knowledge did not score exceptionally well on SAT-M, it was decided early to drop the science test from the talent search and, instead, administer it later only to those examinees scoring well on SAT-M.

Because the purpose was to help gifted youths supplement their school-based education, it seemed sensible to focus on an ability closely related to several major subjects in the academic curricula of schools in the United States. Moreover, to capitalize on the precocious development of this ability by greatly accelerating students' progress in the subject matter concerned, it was necessary to choose school subjects more highly dependent on manifest intellectual talent for their mastery than on chronological age and associated life experiences. The published literature supported the choice of mathematics in that such writers as Cox (1926), Bell (1937), Gustin (1985a, 1985b), Roe (1951), Lehman (1953), Kramer (1974), Weiner (1953), and Zuckerman (1977) have documented the existence of great precocity in mathematics and the physical sciences. Concern about meeting the needs of verbally talented students in the talent searches did lead quickly to the establishment of a separate Study of Verbally Gifted Youth (SVGY) (McGinn, 1976). Coexisting with SMPY at Johns Hopkins from 1972–1977, it was the predecessor of CTY's dual emphasis on mathematical and verbal reasoning. Its writing instructor is still a member of the CTY staff.

From the beginning, SMPY's goal was not just to identify precocious students but also to help them develop their exceptional abilities. The researchers assumed not only that many students with advanced mathematical reasoning abilities can learn precalculus mathematics and related subjects far more quickly than schools ordinarily permit, but also that motivation to learn may suffer appreciably when the pace of instruction is too slow and unchallenging (Stanley & Benbow, 1986). With few alternative programs available in those days, SMPY emphasized acceleration but, never intending that radical early entrance to college should be the only or the main option even for the most gifted students, the researchers identified and developed numerous forms of acceleration and curricular flexibility. In an effort to match the level and pace of instruction to the abilities and needs of the students, Stanley and colleagues experimented with a variety of strategies to speed up the learning of math, biology, chemistry, and physics (Benbow & Stanley, 1983; Fox, 1974; George et al., 1979; George & Denham, 1976; Stanley, 1976, 1993; Stanley & Benbow, 1986; Stanley & Stanley, 1986).

Evaluation of these strategies was ongoing, and research results supported the value of accelerated instruction for mathematically precocious students (see Benbow & Stanley, 1983). In addition to ability, motivation and interest were found to be crucial components to successful learning in accelerated environments. Thus, the researchers preferred to work directly with the youths themselves, rather than their parents, to ensure that they were eager to embark on any accelerative path they chose (Stanley & Benbow, 1986). Consideration of a broad "smorgasbord of educationally accelerative options" (Stanley, 1979, p. 174) came to be recommended when counseling gifted students about their educational needs, from which students could pick those that best served them as individuals.

EXPANDING THE SEARCH

The decision in 1979 to create CTY at Johns Hopkins to run the talent search was intended to allow for its expansion. Until then, all of the testing and scoring and many of the programs (all commuting, none residential) had been held on the Hopkins campus. The success of SMPY's efforts was creating a huge demand from parents to have their children participate. Many were driving long distances for testing and programmatic opportunities. The time had come to expand the search geographically, establish residential summer programs so that students would not have to commute such a long way, and address the needs of students with high verbal scores because SVGY was no longer in existence. Once CTY was established, SAT testing was offered to seventh-graders (and later expanded to serve other age groups) through regular Educational Testing Service testing nationwide. The first residential program was held in southern Maryland in the summer of 1980, featuring courses in the humanities as well as math and science. Since then, some courses in the social sciences have also been added.

CTY's talent search and programmatic offerings have grown rapidly from 1980 to the present. Today, approximately 85,000 second- through eighth-grade students from any of 19 states, the District of Columbia, and countries throughout the world participate in the annual talent search (Barnett & Juhasz, 2001). In recognition of the increasing importance of spatial reasoning in today's world, CTY developed a Spatial Test Battery to supplement assessment of mathematical and verbal reasoning (Stumpf & Mills, 1997). The summer program has also expanded, with approximately 10,000 students currently taking courses each year at 23 sites throughout the United States, and distance education courses help meet students' academic needs throughout the year (Brody, 2001). In addition, CTY's international efforts have led to the establishment of programs in Ireland, England, Spain, and elsewhere (e.g., see Gilheany, 2001; Touron, 2001). A strong research department, diagnostic and counseling center, and family academic conferences supplement CTY's many programmatic offerings. CTY's Study of Exceptional Talent (SET) continues SMPY's emphasis on serving the highest scorers by providing them with individualized counseling and other resources.

Soon after CTY was created, regional talent searches based on the Johns Hopkins model were established at Duke University, Northwestern University, and the University of Denver. Programs utilizing SMPY's talent search approach were also established at California State University-Sacramento, Arizona State University, Iowa State University, the University of Iowa, Carnegie Mellon University, and elsewhere. Collectively, these programs identify and serve several hundred thousand students each year who score well on above-grade-level mathematical or verbal aptitude tests (Lupkowski-Shoplik, Benbow, Assouline, & Brody, 2003; Olszewski-Kubilius, 2004; Stanley & Brody, 2001).

Numerous other initiatives across the country have also been influenced by research disseminated by SMPY, especially with regard to utilizing accelerative strategies and providing special supplemental opportunities to serve students with advanced cognitive abilities. For example, when SMPY began in 1971, very few academic summer programs for precollege students existed, whereas today many colleges and universities offer accelerative or enriching courses for gifted middle and high school students. Early college entrance programs have also been established at selected colleges and universities, many with Stanley's help, to allow young college entrants to enroll as a cohort and receive more academic and emotional support than is typically provided to regular-age college students (Brody, Muratori, & Stanley, 2004; Muratori, Colangelo, & Assouline, 2003; Sethna, Wickstrom, Boothe, & Stanley, 2001; Stanley, 1991).

The MVT:D⁴ Model

The first book-length report of SMPY's initial work was titled *Mathematical Talent: Discovery, Description, and Development* (Stanley et al., 1974). The three "D" words indicate the steps utilized by SMPY to find and serve talented youths. As a way to emphasize these steps, as well as the mathematical reasoning ability that the early talent searches involved, the book's title and this model of talent development was sometimes abbreviated to MT:D^3. Later, a fourth D was added in acknowledgment of an increasingly important dimension: *Dissemination* of its principles, practices, and procedures (Benbow, Lubinski, & Suchy, 1996; Stanley, 1980).

These four steps continue today as the model utilized by the talent searches and other programs that have adopted these principles. Because programs have also been established for students who exhibit exceptional verbal abilities, it is appropriate to add a "V," for verbal talent, to the acronym. The MVT:D^4 Model, therefore, stands for building on Mathematical and/or Verbal Talent through Discovery, Description, Development, and Dissemination.

The first step, *discovery*, refers to the systematic identification of talent. Through annual talent searches, large numbers of students are found whose exceptional mathematical and/or verbal reasoning abilities may have been largely unnoticed prior to this testing. Even among students who may have been labeled "gifted and talented" by their schools, parents and educators are often surprised to discover the level of their precocity after they take above-level tests through the talent searches. Other examinees who score very high wonder why they are not in their school's gifted-child program. Multiple criteria, some of them not related to ability, may have excluded them. Thus, relying on parents, teachers, or in-grade assessments to recognize giftedness is inadequate. Systematic talent identification programs utilizing above-grade-level assessments are sorely needed. The talent searches provide this.

Description refers to the assessment of students' characteristics in addition to the primary talent area, as well as to the research that helps evaluate various programmatic interventions. Individual differences in students' cognitive strengths and weaknesses, personality characteristics, motivation, learning styles, and content knowledge need to be considered when determining the strategies that will help maximize talent development. In addition, both short-term and longitudinal research studies are important to program evaluation. Through many years of research, SMPY and the talent searches have made consistent and important contributions to what is known about the characteristics and needs of gifted students and have validated numerous intervention strategies.

Development refers to providing gifted students with the challenging educational programs they need to develop their talents as fully as possible.

Through a variety of accelerative strategies, the pace and level of content can be adjusted to meet their needs. Special programs designed for advanced students serve to augment the typical school curriculum in important ways. SMPY and the talent searches have developed numerous programs that they offer directly to academically advanced students, often via summer courses or distance learning via computer, in addition to working to enhance the level of challenge available to academically talented students in their schools.

Finally, *dissemination* refers to sharing these principles, practices, and research results with educators, policy-makers, parents, and other researchers. Books, articles, and other publications; presentations at conferences; consultations with schools; and e-mail correspondence are all intended to further this goal. Over the last three decades, Stanley and colleagues have worked hard to disseminate their ideas.

Conceptualizing Giftedness

This volume depicts a variety of conceptions of giftedness, each distinguishable in some way. Although other theorists are likely to identify with the four steps of discovery, description, development, and dissemination previously described as they seek to identify and serve gifted students, the focus on precocity within specific areas of aptitude and the accompanying need to serve these students through accelerating the learning of subject matter make the SMPY and talent search model nearly unique within the field of gifted education (e.g., see Renzulli & Reis, 2004, for a somewhat different approach).

What Is Giftedness? The strategies embraced by SMPY and the talent searches are very much grounded in a belief in the psychology of individual differences. Although this view strongly endorses the importance of quality education for all, it is not assumed that everyone in society will achieve equally in all areas, even if they are given equal opportunities. Some individuals do have special talents, and recognizing and nurturing these talents is crucial not only for the individual but also for the future of society, as these individuals have the potential to be our future problem solvers. This view does not require students to be advanced in all areas to be considered "gifted." Rather, individuals vary considerably in their cognitive profiles, in their specific strengths and weaknesses. A given individual can be strong in one area but not in another (e.g., strong in math reasoning but weak in verbal, such as the student who, at age 12, recently scored 800 on the SAT-M but 340 on the SAT-V).

In defining giftedness, we are concerned therefore with those who exhibit exceptional reasoning ability in a specific area of aptitude, primarily math or verbal reasoning, but also spatial, mechanical, and other specific abilities (e.g., see Shea, Lubinski, & Benbow, 2001; Stanley, 1994). An important component of this view is the concept of precocity (e.g., gifted students are those who, because they learn at a faster rate and can comprehend more advanced ideas at younger ages, can reason much like older students). This equates giftedness with advanced mental age in specific areas, not just with being a good learner among age peers.

Talent development is important to achieving one's full potential, however. Although the talent searches identify advanced reasoning abilities that are already evident rather than potential that might be hidden at that point, the assumption is that ongoing educational support will be crucial to developing that gift. Thus, the talent search programs stress the development of challenging programmatic options to foster the development of talent.

How Does this Conception Compare with Other Conceptions of Giftedness? Although the emphasis that Terman (1925), Hollingworth (1942), and others placed on general IQ has diminished somewhat over time, there are still many educators who equate giftedness with high general ability. Sometimes this means it can be difficult to comprehend that a highly gifted student with exceptional mathematical reasoning ability can also be average in some content areas or even have a learning disability (Brody & Mills, 1997). Although the SMPY view does not deny the existence of a general intelligence factor (*g*) as some do, the measurement of specific aptitude has been found to be much more useful educationally than general IQ for identifying precocity. We have found boys and girls with *extremely* high IQs, even 212, who were asymmetrical with respect to V versus M, that is, far better on M than V, or on V than M.

Because the focus described here is on specific areas of aptitude, some may conclude that this view overlaps with those who propose multiple intelligences as a conception of giftedness, and to some extent it does. However, we would hesitate to use the word "intelligence" to describe mathematical or verbal reasoning ability and would also hesitate to apply equal weight to some of the areas that have been labeled intelligences. In addition, some schools that have adopted the multiple intelligence model fail to address students' primary talent areas to the extent we would recommend (Kornhaber, 2004; Stanley, 1997).

Some theorists include such affective traits as motivation and self-concept in their definitions of giftedness. SMPY's research on values, interests, and aspirations clearly shows the importance of these characteristics in predicting achievement (e.g., see Achter, Lubinski, Benbow, & Eftekhari-Sanjani, 1999). However, many affective characteristics can be altered by interventions; therefore, it seems unwise to include them as defining characteristics of giftedness.

Other gifted-child specialists stress creativity either as a separate area of giftedness or as a key component to identifying gifted individuals. SMPY's philosophy is that creativity needs to be embedded in content areas. True creative production can come only once a significant amount of content has been mastered (an argument for acceleration of subject-matter acquisition and allowing gifted individuals to enter into a creative phase at a younger age).

Finally, some theorists suggest that giftedness can be recognized only in adult achievement. This seems valid, which may be one reason the early writings of SMPY avoided using the word "gifted" in favor of descriptors like "precocious" and "exceptional." High-scoring young students have the potential to excel, but the true test of excellence must come after content has been mastered and original work or activities can be pursued. Early identification of this potential, however, is important so that students receive the educational opportunities that will allow this potential to be fulfilled.

How Should Gifted Individuals Be Identified? Identification strategies should match the program. Thus, one might use general IQ for a general enrichment program, but exceptional mathematical reasoning ability is crucial for an accelerated mathematics program in which the outcome knowledge is evaluated carefully. Because our concern has been with students who are unchallenged by age-in-grade instructional programs, finding those whose abilities are far above grade level is important. The SAT administered above grade level has proven valid and useful for the purpose of identifying students with exceptional mathematical or verbal reasoning abilities.

Whichever test is used for identifying talented students should have adequate ceiling to determine the full extent of the student's abilities. In CTY's talent search, for example, participants, all of whom have scored at or above the 97th percentile on the mathematics, verbal, or total score of an in-grade achievement test, can (and some do) score anywhere between 200 and 800 on the above-their-level SAT. This distinguishes the students who are bright and learn well but are not ready for more advanced work from those who are truly exceptional and need a differentiated educational program.

We also recommend using aptitude tests in specific academic areas to identify students in need of advancement in those areas. Although tests of general IQ can be useful for many purposes, IQ is a global composite of different cognitive abilities. As previously noted, we have not found IQ to be very useful for identifying students who are brilliant in a specific academic area (e.g., mathematics or science).

SMPY followed up their testing on the SAT with assessment of numerous other traits, for example, achievement in math and science, spatial and mechanical aptitude, values, and career interests (Stanley et al., 1974; Stanley, 1979; Keating, 1976). A full assessment of a variety of factors can be important in determining appropriate intervention strategies to meet a student's needs.

How Should Gifted Individuals Be Instructed in School and Elsewhere? The typical school program is designed for students with average abilities. Students whose abilities are advanced in particular areas need advanced work in those fields, and the more talented the student, the greater the need for a differentiated curriculum. Typically, this means accessing content designed for older students, or acceleration. Unfortunately, many people think of acceleration only in terms of skipping grades. In fact, there is an educational "smorgasbord" of at least 20 ways to accelerate a student in subject matter or grade placement (Southern, Jones, & Stanley, 1993).

When designing a program for a gifted student, the goal is to achieve an "optimal match" (Robinson & Robinson, 1982; see also Durden & Tangherlini, 1993; Lubinski & Benbow, 2000) between a student's cognitive and other characteristics and his or her educational program. An individualized program utilizing curricular flexibility is needed (Brody, 2004). This requires willingness, when appropriate, to adjust the level and pace of instruction, to place advanced students in classes with older students, and/or to allow them to do independent work (Benbow & Stanley, 1996). Effective articulation at the next stage to assure continuation of the advanced curriculum is also a key component of interventions recommended by SMPY (Stanley, 2000).

A "bridging" strategy developed by SMPY is the Diagnostic Testing – Prescriptive Instruction model (Stanley, 2000). Basically, this refers to pretesting, diagnosing specific content that has not been mastered, and structuring an academic program to teach only the new content. Long used in special education for students with academic deficits, this approach is too rarely used with students with advanced academic skills and knowledge. SMPY's application of it was to mathematics, but it can be adjusted for other subjects, such as English grammar.

Supplemental educational programs are also important and valuable. Although schools can attempt to address the needs of advanced students through curricular flexibility, the fact that they may have few truly exceptional students in the school population limits programmatic options. Today, there is an abundance of academic summer programs, dual enrollment programs in cooperation with universities, and distance education that can provide access to a broad array of subjects not offered in school. Extracurricular activities can also enhance learning and develop leadership in a field. Academic competitions such as the Intel (formerly Westinghouse) Science Talent Search and the International Mathematical Olympiad can be particularly challenging for even the most advanced high school students.

SMPY's counseling efforts encouraged students to develop challenging individualized programs. This approach is now used in CTY's SET program, which helps students who score at least 700 on SAT-I M or SAT-I V before age 13 find opportunities to accelerate and/or supplement their school programs (Brody, 2004; Brody & Blackburn, 1996). SET encourages students to consider a variety of options to supplement and/or accelerate school programs. Academic summer programs, distance education, and challenging extracurricular options are considered important components of most students' programs. Attention is also given to helping students find ways to interact with intellectual peers. Whether through school-based classes, out-of-school programs, or participation in activities or competitions, the opportunity for advanced students to interact with peers who share their abilities and interests can be critical to social and emotional development, areas of growth often overlooked by educators in favor of only academic development.

How Should the Achievement of Gifted Individuals Be Assessed? Assessing students' content knowledge is critical to meeting their educational needs. In particular, students with advanced cognitive abilities tend to pick up much information from their environment, so pretesting before offering instruction will help define what they already know so they can be taught only what they don't yet know (Stanley, 2000). Additional assessment after instruction is completed will also affirm mastery of content at that level and help students gain credit (or, at least, appropriate placement) for accelerated work.

Both criterion-referenced measures and standardized tests with norms are important in assessing gifted students' performance. Because in-grade standardized tests often do not measure the advanced content that is appropriate for students with exceptionally high cognitive abilities, content-specific criterion-referenced measures are needed. At the same time, the normative comparisons provided by standardized tests can be useful when evaluating learning compared with age-mates. When learning is accelerated, above-grade-level achievement tests should be used in lieu of in-grade tests, which usually lack adequate ceiling.

In some areas, a portfolio of products and accomplishments, such as written reports, artwork, science projects, and performance in academic competitions, can be valuable measures of student achievement. Certainly, winning a top prize ($100,000 for the top contestant) in the Intel Science Talent Search or qualifying to represent the United States in an international competition is a clear testimony to a student's learning and stellar achievement.

CONCLUSION

Many persons seem hostile toward intellectually talented youths, though perhaps a little less so toward those splendid in mathematics than toward the verbally precocious. This attitude contrasts sharply with the American public's generally favorable feelings about prodigies in music and athletics. Friedenberg (1966) and Stanley (1974), among others, have discussed how deep-seated this prejudice is. Expressions such as the following abound in literature back to Shakespeare's time: "Early ripe, early rot," "So wise so young, they say, do never live long," "For precocity some great price is always demanded sooner or later in life," and "Their productions . . . bear the marks of precocity and premature delay" (Stanley, 1974, pp. 1–2).

There is also a prevailing assumption that intellectually talented students do not need any special help, that they will make it on their own. In fact, some seemingly do well, earning top grades in grade-level courses and entering selective colleges, but their goals and aspirations may be less than they might have been with greater challenge. Of more concern are the ones who become underachievers. Never having had to study to learn something, they fail to develop the study habits necessary even to achieve well compared with their age-mates. These students are at great risk of being "turned off" to anything academic and to developing social and emotional difficulties as well.

Another misconception is that gifted students, to be truly exceptional, must be achieving at the level of the great thinkers of the world, such as Gauss, Euler, Fermat, Bertrand Russell, Mozart, Galois, Pascal, Newton, Sweitzer, or (especially) Einstein. Terman encountered a great deal of this, with critics noting that among the 1,528 boys and girls to whom he administered an individual intelligence test in California in the early 1920s, he did not discover anyone who became a worthy successor to the greatest musicians, artists, and writers of all time. It was not enough that, for example, he found a youth who became a great, highly cited psychometrician and president of at least three very important national professional societies. Some insight into problems of defining and predicting genius may be obtained from Albert (1975), Bell (1937), and Simonton (1994).

In describing the work of SMPY, Stanley has often paraphrased Browning's "A man's reach should exceed his grasp, or what's a heaven for?" as "A mathematically precocious youth's reach should exceed his or her grasp, or what's an educational system for?" The goal is to extend the reach and the grasp of students with exceptional gifts, so that they dream bigger dreams, aspire to greater accomplishments, learn more at younger ages, and ultimately achieve higher levels. We do not guarantee identifying future Nobel laureates, Pulitzer Prize winners, U.S. poet laureates, or Fields Medalists through our talent searches, much less Einsteins!

But we are finding youths with exceptional reasoning abilities and helping them achieve far beyond what they would probably have done without intervention. And, as they become future scientists and mathematicians, physicians and entrepreneurs, politicians and teachers, and humanists, our society will benefit from their enhanced abilities to solve problems and contribute to progress.

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