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Intellectually Talented Children: How Can We Best Meet Their Needs?

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The Study of Mathematically Precocious Youth (SMPY) was founded by Julian C. Stanley in September 1971 at Johns Hopkins University. Its work has spanned more than two decades and is now located at two sites—Johns Hopkins University and Iowa State University. Regional centers, based on SMPY's philosophy and procedures, have been established at four universities as well. They are the Center for Talented Youth (CTY) at Johns Hopkins, the Talent Identification program at Duke University, the Center for Talent Development at Northwestern University, and the Rocky Mountain Talent Search at the University of Denver. Within CTY is the Study of Exceptional Talent (SET), providing counseling and services in the SMPY tradition to our nation's most intellectually talented adolescents (top 1 percent and beyond). In addition, there are numerous other local programs across the nation and world based on SMPY's work. Together, these programs serve approximately 150,000 students on an annual basis, making them a dominant feature of our educational landscape.

SMPY always has been concerned with the optimal development of intellectually precocious youth, particularly mathematically talented youth. Its empirical investigations are predicated on conducting research *through service* to intellectually gifted adolescents. By developing and providing innovative educational programs and educational counseling, SMPY attempts to discover those mechanisms that promote both intellectual and social well-being (they are not unrelated) among the gifted.

By simultaneously conducting research on and providing services to gifted youth, SMPY developed a dual focus. First, it created a set of programs and services constituting what has become known as the *SMPY model* for serving intellectually talented sudents (Benbow, 1986; Stanley, 1977; Stanley & Benbow, 1982, 1986). The SMPY model was field-tested extensively (e.g., Benbow & Stanley, 1983a) and then widely disseminated. Second, SMPY launched a longitudinal study to investigate the development of intellectually talented students and to assess the impact of educational interventions on their educational and career development (Lubinski & Benbow, 1994). About five thousand talented individuals currently are being tracked throughout their adult lives. The SMPY longitudinal study, which we are conducting at Iowa State University, is similar to the classic Terman (1925–1959) study. SMPY's study, however, contains over three times as many subjects, and these participants are identified using a specific aptitude test, not a general intelligence test. They were comprehensively assessed at age 13 in terms of both their intellectual and nonintellectual personal attributes.

Both the programmatic and research strands of SMPY will be described in this chapter. First, however, the theoretical model guiding SMPY's educational programming and its empirical research on the dispositional determinants of scientific educational/career paths of the gifted is provided. It serves as the foundation for our work.

The Theoretical Model Guiding SMPY's Work

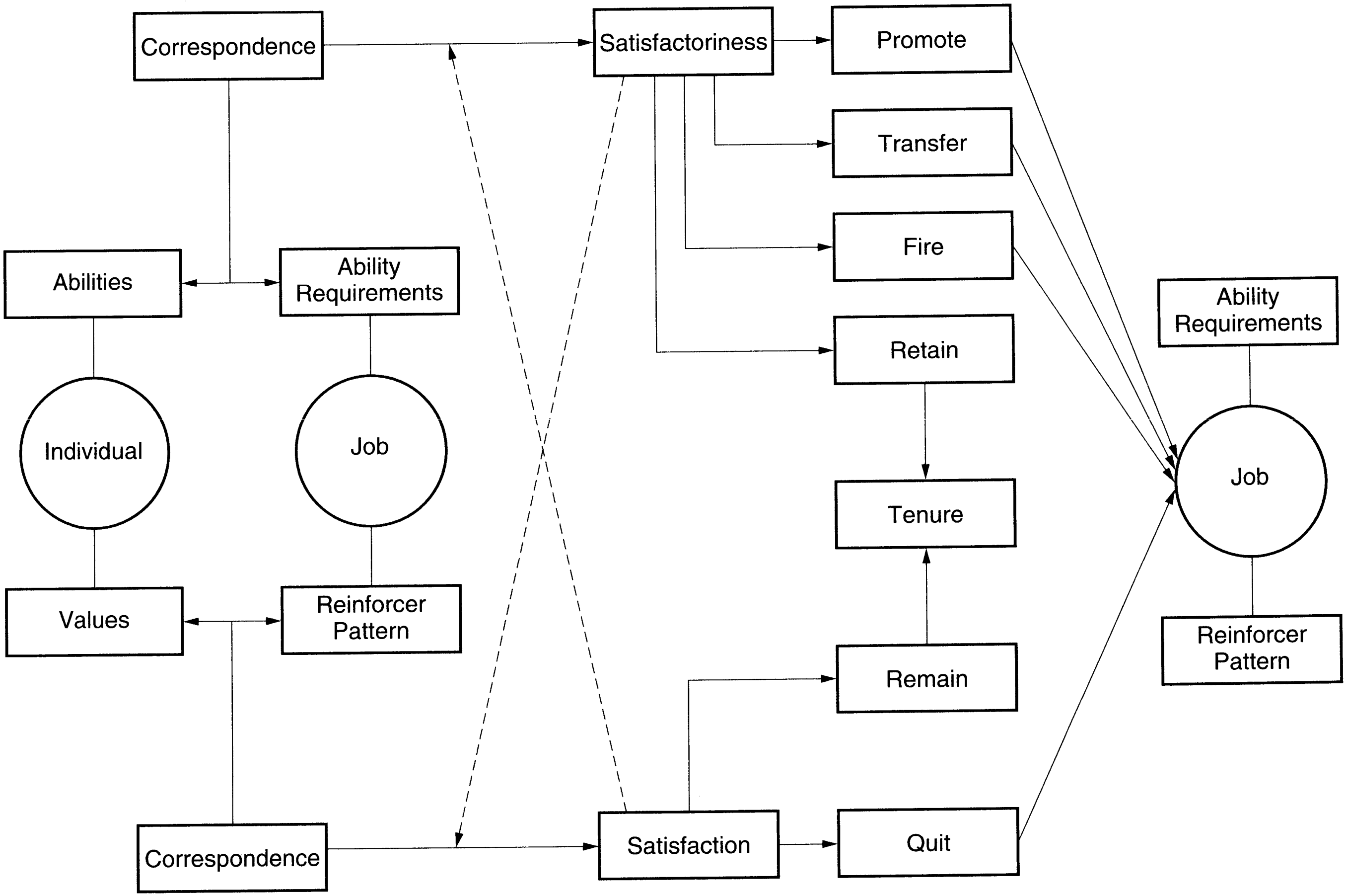
The conceptual framework guiding SMPY's scholarly work and its educational programs/interventions draws on three theoretical perspectives (Dawis & Lofquist, 1984;

Tannenbaum, 1983; Zuckerman, 1977), while incorporating information about the development of talent and personal preferences for contrasting educational/vocational paths (Benbow & Lubinski, 1994; Lubinski & Benbow, 1994). Since its beginning, SMPY's work has been consistent with a well-established model of vocational adjustment (see Figure 12.1), the Theory of Work Adjustment (TWA), a model developed over the past thirty years by René V. Dawis and Lloyd H. Lofquist at the University of Minnesota (Lofquist & Dawis, 1969, 1991). Although formulated to allow a better understanding of adjustment in the world of work, an especially attractive feature of this model is that it can be readily extended to critical *antecedents* to vocational adjustment, such as choice of educational program. Currently SMPY is, in fact, explicitly extending the model to explain just that—educational adjustment.

According to the TWA, to ascertain the optimal learning and work environment for an individual, one must first parse the individual's work (or academic) personality *and* environment into two broad yet complementary subdomains. An individual's work personality primarily comprises his or her (1) repertoire of specific skills or abilities and (2) personal preferences for content found in contrasting educational/vocational environments. In contrast, different environmental contexts (educational curricula and occupations) are classified in terms of (1) their ability requirements and (2) their capability to reinforce personal preferences. Optimal educational and work environments for an individual are those for which two levels of correspondence can be established, *satisfactoriness* and *satisfaction*. Satisfactoriness refers to the correspondence between an individual's abilities and the ability requirements of a particular environment (e.g., occupation or educational curriculum), whereas satisfaction denotes correspondence between an individual's preferences and the types of reinforcers provided by the environment. Good educational and career choices maximize satisfactoriness and satisfaction and, consequently, the degree of commitment to one's choice.

An important implication of this model is that *both* abilities and preferences must be assessed, concurrently, to ascertain the readiness of a given individual for a particular educational or career track (see, e.g., Lubinski & Thompson, 1986). Similarly, components of the educational/vocational environment (response requirements *and* reward systems) need to be evaluated simultaneously to estimate whether both dimensions of correspondence are likely to be achieved. It is important to keep in mind that correspondence, and thus personal fulfillment for any one individual, whether gifted or not, is not likely to be found but in a few educational or career tracks. Multipotentiality is not prevalent among the gifted (Achter, Lubinski, & Benbow, 1996).

To provide a practical illustration of TWA and its implications, we will focus on the physical sciences, given their special place in SMPY's research. For these disciplines, we know that the ability requirements involve especially high mathematical reasoning ability (e.g., Benbow & Arjmand, 1990; Green, 1989; Walberg, Strykowski, Rovai, & Hung, 1984). Yet high spatial/mechanical reasoning abilities are also important, probably the second most critical personal attribute for satisfactoriness all along the math/science pipeline (Humphreys, Lubinski, & Yao, 1993). Verbal ability is *relatively* less critical, but still valuable. In terms of preferences, investigative interests (scientific) and theoretical values (intellectual, philosophical) are among the most salient personal preferences for gravitating toward scientific environments, finding their content reinforcing for developing one's intellectual talent, and maintaining a commitment toward these kinds of disciplines (e.g., Dawis, 1991; Holland, 1985; Lubinski & Benbow, 1992, 1994; Roe, 1953). The physical sciences also require intense abilities and preferences for manipulating and working with sophisticated things and gadgets. Individuals with pronounced or relatively higher social values (or stronger need for people contact), in contrast, are not as readily reinforced in such environments. These are the abilities and preferences that are important for adjustment in scientific environments and, thus, must be assessed and in place for an individual considering entrance into them (Lubinski, Benbow, & Sanders, 1993). Moreover, these personal attributes, coupled with an intense commitment



Source: Adapted from Dawis & Lofquist (1984).
Note: The dotted lines serve to illustrate how satisfaction and satisfactoriness function jointly to determine educational/vocational tenure. When an individual is not satisfactory, the environment is motivated to transfer or fire the individual, whereas if the person is not satisfied, the person is motivated to leave. When satisfaction and satisfactoriness co-occur, both the person and the environment are motivated to cultivate and maintain interactions with one another.

Figure 12.1 A depiction of the theory of work adjustment.

to mastery of one's chosen discipline and substantial energy for work (to be discussed), are the sine qua non for high scientific achievement.

It should be noted, however, that possession of this constellation of personal attributes (though rare) is still not sufficient for the manifestation of exceptional scientific achievement. That is even rarer. Those who have the personal potentialities also require special encounters with the appropriate environment to facilitate the emergence of world-class scientific achievement. This is the second aspect of SMPY's theoretical model, to which we now turn.

Bloom (1985) noted from his interviews of talented performers in a variety of disciplines that special experiences, sometimes interventions, are important in their development.[1] Moreover, Zuckerman (1977), in her analysis of Nobel Laureates' careers, saw that their development or emergence fit well with the model of "the accumulation of advantage." That is, individuals who produce exceptional scientific advances almost universally show promise extremely early in their lives, and this evidenced precocity not only responds to but also creates greater opportunities for intellectual development.[2] For example, most Laureates receive an advantage in graduate work by attending the most distinguished universities (10 universities produced 55% of the Laureates) and by studying with the best minds of the day—thereby begetting a pattern of eminence creating eminence.

Tannenbaum (1983), furthermore, postulated that great performances or productivity results from a rare blend of superior general intellect, distinctive special aptitudes, the right combination of nonintellective traits, a challenging environment, *and* the smile of good fortune at crucial periods of life (see Chapter 3 in this volume). The first three components seem to parallel the abilities and preferences discussed in the Theory of Work Adjustment, and the latter two the work of Zuckerman. According to Tannenbaum, success depends on this *complete* configuration of personal propensities and experiential facilitators, whereas failure results from even a single deficit. By virtue of its synergetic significance, then, every one of Tannenbaum's five qualifiers is a necessary requisite for high achievement, and none alone is sufficient to overcome inadequacies in the others. We have adopted that view as well. Thus, for the optimal development or actualization of talent to occur, not only must the individual possess the necessary personal attributes critical for success and satisfaction in his or her chosen vocational track, but he or she also must be given (or create, or seek out) the opportunity to develop in an appropriate educational-learning environment. All components are vital.

The practical implications for SMPY were that we must first identify the appropriate educational and vocational environments for the individual under consideration, and then attempt to arrange educational interventions congruent with the individual's abilities and needs. Until recently SMPY focused most of its efforts on optimizing satisfactoriness by using acceleration to provide a better fit between the individual's abilities and the learning environment. We now turn to how this was accomplished by describing the SMPY educational model.

The SMPY Model

SMPY's educational intervention activities over the past two decades can be captured succinctly by a pseudochemical formula devised by Stanley: $MT{:}D_4P_3$. This stands for Mathematical Talent: Discovery, Description, Development, and Dissemination of its Principles, Practices, and Procedures (Stanley, Keating, & Fox, 1974). SMPY's focus is on the individual student, and its first step is to understand that student, who initially was the mathematically talented student. This is accomplished through the identification (i.e., participation in a talent search, to be described) and characterization phases of its model (i.e., the first

[1] See Chapter 17 by Sosniak.

[2] Sandra Scarr (1992; Scarr & McCartney, 1983) has written insightfully on how people actually seek out and create environments for themselves that correspond to their personal attributes.

two D's), where students become aware of their distinct profile of abilities and preferences. Once the students' ability and preference profiles are known, students are encouraged to adapt their educational program to create an appropriate learning environment, one that is commensurate with and responsive to their abilities (the third D, Development). This is accomplished through use of acceleration or following the principle of placement according to competence. Students are prompted, through personal correspondence, newsletters, and the like, to look at the entire curriculum available to them, including postsecondary curriculum as well, in order to locate where in each subject they might be appropriately placed according to their demonstrated competence (not age). Then they are encouraged and supported in their attempts to gain access to appropriate curricula or educational experiences that may or may not be within their home schools (e.g., MathCounts). In essence, SMPY promotes primarily competence rather than age as the criterion to be used in determining who obtains access to what curricula and experiences, and at what time. The goal is to develop a combination of accelerative options, enrichment, and out-of-school opportunities (already available resources) that reflect the best possible alternative for educating a specific child and, thereby, enhancing satisfactoriness. This approach has been labeled *curricular flexibility*.

Much of SMPY's programmatic research has been aimed at refining this model for identifying and serving mathematically and verbally gifted youth. We now explore its components in greater depth.

Talent Search

To identify large numbers of mathematically talented students, SMPY developed the concept of an annual *talent search* and conducted six separate searches in March 1972, January 1973, January 1974, December 1976, January 1978, and January 1979. During those years, 9,927 intellectually gifted junior high school students in the Mid-Atlantic region between 12 and 14 years of age were tested. Students were eligible to participate in a SMPY talent search if they had scored in the upper 5 percent (1972), 2 percent (1973 and 1974), or 3 percent (1976, 1978, and 1979) in mathematical ability on the national norms of a standardized achievement test battery administered as part of their schools' regular testing program (e.g., the Iowa Test of Basic Skills).

All of these students then took the College Board Scholastic Aptitude Test (SAT), both the mathematics (SAT-M) and verbal (SAT-V) sections. (In 1972 and 1974 the SAT-V was not administered.) Their resulting SAT score distributions consistently were indistinguishable from those typically observed for above-average high school students, the students for whom the test was designed (Benbow, 1988). This form of assessment, using tests designed for older students with younger gifted students, is known as *out-of-level testing* and is especially powerful in measuring analytical reasoning ability when the test is the SAT (Benbow & Wolins, in press; Minor & Benbow, in press).

For the adolescents participating in talent searches, the SAT is ideal for revealing systematic sources of intellectual differences among the gifted that are hidden by the ceiling effects observed with conventional instruments. These individual differences are psychologically meaningful and important to assess for purposes of structuring accelerative educational opportunities. The differences in academic accomplishments among individuals in the top 1 percent are remarkable. Benbow (1992) showed that over a ten-year time frame, between ages 13 and 23, the academic achievements of those individuals in the *top quarter of the top 1 percent* in mathematical ability were much more impressive than the achievements of those in the *bottom quarter of the top 1 percent,* who were, nonetheless, themselves high achievers. Hence differential expectations for individuals in this range, which spans the range of IQ scores from approximately 135 to over 200, are justified and should be established.

Through out-of-level testing in talent searches, which began by serving and studying mathematically talented students only but then spread to students high in verbal and/or overall general intellectual ability, students are able to learn about their relative strengths and weaknesses with respect to the two most critical intellectual attributes for academic excellence, mathematical and verbal reasoning. Overlooked by this process, however, is the assessment of spatial ability, the remaining major marker of general intelligence (Lubinski & Dawis, 1992). Because of SMPY's interest in the sciences and the importance of spatial ability for success in that domain (Humphreys et al., 1993), this ability (along with preferences) is assessed in the supplemental testing sessions offered to those who score highly on the SAT (Cohn, 1977; Lubinski & Benbow, 1992, 1994). Through talent searches and supplemental testing sessions, the first two D's, Discovery and Description, of the SMPY model are handled.

SMPY's Smorgasbord

The primary purpose of identification, in SMPY's view, is to help assess what educational interventions and services are not only appropriate but necessary for the student's optimal intellectual development. In 1971, when SMPY began, it was not clear what was appropriate for facilitating the education of intellectually precocious youth. It did appear, however, that acceleration, though rarely utilized, was the method with the most empirical support. Thus, SMPY began experimenting with various educational innovations based on the principle of acceleration to determine some of the optimal means of providing academic challenges to gifted students.

Some of the educational alternatives that SMPY began experimenting with and then included in its smorgasbord of accelerative options (Southern, Jones, & Stanley, 1993) are: early admittance to school, grade skipping, entering college early with or without the high school diploma (most high schools will award a high school diploma after completion of one year of college) (Brody & Stanley, 1991; Eisenberg & George, 1979; Stanley & Benbow, 1983), entering a college early-entrance program such as Simon's Rock or the Texas Academy for Math and Science (Stanley, 1991), International Baccalaureate (see description in Cox, Daniel, & Boston, 1985), taking a course (e.g., Algebra 1) one or two years earlier than typical, taking college courses on a part-time basis while in secondary school (Solano & George, 1976), taking special fast-paced classes during the summer or academic year (Durden, 1980; Stanley & Stanley, 1986; Swiatek & Benbow, 1991b, VanTassel-Baska, 1983), completing two years of a subject in one year, compressing curricula, taking Advanced Placement (AP) courses and examinations (AP courses are college-level courses taught in high school, which may garner college credit for the student if final AP exam scores are sufficiently high) (Zak, Benbow, & Stanley, 1983), individual tutoring in advanced subject matter (Stanley, 1979), earning a master's degree simultaneously with the bachelor's degree, and joint B.A./M.D. or B.A./Ph.D. programs. Essentially, SMPY uses already available resources, curricula, or programs designed for older students, but with younger gifted students (Benbow & Stanley, 1983a). This is consistent with basic research findings revealing that gifted students are simply precocious or developmentally advanced (Dark & Benbow, 1990, 1991; Elkind, 1988). It also makes recommended interventions highly cost-effective (Benbow, 1991).

In conjunction with the aforementioned work involving experimentation with various forms of acceleration, SMPY developed fast-paced classes where, for example, students master one full year of high school subject matter in just three intensive weeks during the summer. This effort began in 1972 with a mathematics class of some 30 students (Fox, 1974). Today, about 10,000 students are served annually through such classes, which are offered during the summer and academic year in verbal, mathematical, and scientific areas.

The fast-paced mathematics classes, an innovation for which SMPY is especially noted, cover precalculus mathematics. In three intensive summer weeks or on alternate Saturdays throughout the academic year, the typical student completes one to two high school mathematics courses. Some students are prepared by the end of the program to take calculus as eighth graders (Bartkovich &

Mezynski, 1981). We summarize next how they achieve this remarkable feat.[3]

Diagnostic Testing—Prescriptive Instruction

SMPY's initial experiences in working with mathematically talented students, through its Wolfson I and II precalculus mathematics classes, involved covering the entire precalculus sequence in 14 months of classes conducted on Saturdays or else in the summer. All units were taught to all students, but at a rate dictated by the ablest members of the class. Much success was experienced (Benbow, Perkins, & Stanley, 1983; Swiatek & Benbow, 1992). These classes revealed not only that these students could learn mathematics extremely rapidly but also that many of them already knew mathematical concepts not yet explicitly taught to them (Bartkovich & George, 1980; Bartkovich & Mezynski, 1981; Stanley, Keating, & Fox, 1974). Moreover, the rate at which unknown mathematical concepts and principles were acquired also varied. These findings illuminated a need for developing a teaching approach that could accommodate both the individual's idiosyncrasies in knowledge of mathematics and his or her rate of learning. The results of experimenting led to the diagnostic testing followed by prescriptive instruction (DT-PI) model (Stanley, 1978, 1979), which was first piloted in the summer of 1978 with remarkable success (Bartkovich & Mezynnski, 1981).

This individualized instructional approach, which can be used in both individual and group settings, is a strategy for teaching gifted students at a rate dictated by their abilities, and only those concepts or units in a subject they have not mastered. It is a sequential method of (1) determining the student's current level of knowledge using appropriate tests, (2) pinpointing areas of weakness by analyzing items missed on a given test, (3) devising an instructional program that targets those areas of weakness and allows the student to achieve mastery on a second form of the test, and (4) proceeding to the next higher level and repeating steps 1 to 3.

The DT-PI model has been used successfully with students as young as 6 years of age and has been used to help students master arithmetic or basic mathematics, precalculus, calculus, the sciences, and other courses such as the mechanics of standard written English. Not only teachers but also paraprofessionals, mentors, and qualified volunteers from the community can use this approach. It is an extremely flexible instructional model.

The SMPY Longitudinal Study

We now turn our attention to the other facet of SMPY—its longitudinal study, planned to extend fifty years. Through this study we are working toward developing a comprehensive and refined understanding of the processes whereby precocious forms of intellectual talent develop into noteworthy forms of adult achievement and creative accomplishment. How various educational interventions or opportunities, such as acceleration, facilitate the development of potential into actual achievement and creativity is a question of special importance to SMPY's research program.

Design

A description of the longitudinal study is provided in Table 12.1. There are five cohorts in all (extensive detailing is provided in Lubinski & Benbow, 1994): Four were assembled through talent searches, while a fifth cohort is composed of 750 graduate students in top U.S. mathematics and physical science departments. Each of the first four cohorts is separated in age by a few years, while cohort 5 overlaps with cohort 4. Combined, the cohorts span more than twenty years; therefore, findings from each cohort can serve in part as replications for similar analyses conducted in other time frames. In addition, because the students in the first four cohorts were identified over a twenty-year period using the same criteria and are studied at the same junctures, the study allows for a reasonable assessment

[3] A more detailed description can be found in Benbow (1986).

Table 12.1
The Five Cohorts of SMPY's Longitudinal Study

Cohort	*N*	*When Identified*	*Age at Identification*	*SAT Criteria*	*Ability Level*
1	2,188	1972–1974	12–13	Verb. $\geqq$ 370 or Math $\geqq$ 390	1%
2	778	1976–1979	12	Top 1/3 of Talent Search Participants	0.5%
3	423	1980–1983		Math $\geqq$ 700 or Verb. $\geqq$ 630	0.01%
Comparison Groups	150	1983	12	SAT-M + SAT-V $\leqq$540	5%
		1982	12	500–590 Math 600–690 Math	0.5%
4>	1,000	1987–	12	Math $\geqq$ 500 or Verb. $\geqq$ 430	0.5%
5>	750	1992	23	Graduate students in top-ranked engineering, math, and science departments in the United States	

of historical effects and also for some degree of quasi-control of historical influences.

Another unique aspect of this study is the ability to modify and add new assessment materials. Cohort 4 grows by approximately 400 participants each year, allowing us to ask questions not possible in the early 1970s. Finally, a retrospective but also longitudinal study of graduate students in this nation's top engineering, mathematics, and physical science departments was initiated (Cohort 5) to ascertain whether such students differ in experiential or psychological ways from students identified via conventional talent searches. Data from Cohort 5 will help determine how well SMPY's findings, based on students identified by the SAT at age 13, generalize to other groups of gifted individuals.

The Cohorts

The first four SMPY cohorts were formed using different ability cutoffs on the SAT. The first three cohorts are successively more able; the fourth, consisting of primarily Midwestern residents who are being identified through the Office of Precollegiate Programs for Talented and Gifted (OPPTAG) at Iowa State University, represents the same ability level as Cohort 2. A detailing of each cohort is outlined in Table 12.1.

Cohort 1 comes from SMPY's March 1972, January 1973, and January 1974 Talent Searches. As seventh- or eighth-graders, they scored SAT-M ≥ 390 or SAT-V ≥ 370 (Benbow, 1983, 1992; Benbow & Arjmand, 1990). Those cutoff scores were selected because they represented the average performance of a random sample of high school females on the SAT at that time. The 2,118 students were drawn primarily from the state of Maryland, with a heavy concentration from the greater Baltimore area. Cohort 2 comprises at least the top one-third of seventh-grade students from SMPY's December 1976, January 1978, and January 1979 Talent Searches, using cutoff scores at or above the top 0.5 percent in general intellectual ability. These 778 students were drawn from the Mid-Atlantic states. These first two cohorts are separated by at least three years. About 60 percent of the participants are male.

Cohort 3 comprises three groups and is national in its representation. It consists of nearly 300 students who scored at least 700 on SAT-M before age 13 between November 1980 and November 1983, plus more than 150 students scoring at or above 630 on SAT-V before age 13. These scores represent the top 1 in

10,000 for mathematical and verbal reasoning abilities, respectively. Finally, for comparison purposes, Cohort 3 includes two additional groups. The first group consists of 150 seventh-grade students scoring slightly above chance on the SAT (i.e., SAT-M + SAT-V ≤ 540) in the 1983 Talent Search conducted by the Center for Talented Youth (CTY) at Johns Hopkins University. Because chance performance tends to imply low ability, it is important to keep in mind that this last group's ability level is still in the top 3 to 5 percent on national norms (only students in the top 3 to 5 percent in ability can enter a Talent Search); thus, by most definitions they too would be considered at least modestly gifted. The second comparison group consists of 50 seventh graders, in the early 1980s, whose SAT-M scores were either in the 500–590 range or in the 600–690 range.

Cohort 4 currently consists of 1,000 students, primarily Midwesterners, scoring before age 13 at least 500 on SAT-M, 430 on SAT-V, *or* 930 or more on SAT-M + SAT-V. Like Cohort 2, they represent the top 0.5 percent in ability. Students in Cohort 4 had enrolled in Iowa State's summer program for intellectually talented youth,[4] a program based purely on the SMPY model. Several comparison groups also are being formed from the Iowa Talent Search, which screens students with abilities in the top 3 percent in the nation, as well as from students in the normative ability range.

Finally, Cohort 5 contains over 750 individuals from various engineering, mathematics, and physical science disciplines who were enrolled in this nation's top graduate programs in 1992. Approximately 50 percent of the sample consists of females. This sample was surveyed in the spring of 1992, with a response rate of 93 percent.[5]

Collectively, the five cohorts of SMPY comprise approximately 5,000 highly able students. This number will soon increase to about 6,000, the target number for the study. All of the students in the five cohorts are being surveyed at critical junctures throughout their youth and adult lives. Each cohort, moreover, will be surveyed at the same ages to ensure comparability of findings across cohorts.

To date, we have surveyed Cohort 1 at age 13, 18, 23, and 33 (in progress). Cohort 2 also has been surveyed at ages 13, 18, and 23, with the last survey just being completed. Cohort 3 has been surveyed at ages 13, 18, and 23 (in progress). Cohort 4 has been surveyed at age 13 and 18 (in progress). Cohort 5 has been surveyed at age 23 only, but that survey included much retrospective information. Response rates to our several follow-up surveys range from 75 percent to well over 90 percent. Respondents do not differ significantly from nonrespondents on key variables, including ability, family background, and college attendance (Benbow & Arjmand, 1990).

Preliminary Findings

What are some of the major findings that have emerged so far from the longitudinal study? Perhaps the most important one is that we can identify at age 13 most of those students who have the potential to become our nation's great scientific achievers (Benbow, 1992; Lubinski & Benbow, 1992, 1994; Lubinski, Benbow, Eftekhari-Sanjani, & Jensen, in preparation). Students labeled as mathematically talented on the basis of high SAT-M scores at age 13 do disproportionally enter careers in the math/science pipeline. Indeed, graduate students in Cohort 5 who happened to take the SAT-M at age 13 earned scores comparable to those of participants in Cohort 2. More specifically, we know that among the gifted, those choosing to enter the math/science areas as adults have especially strong mathematical reasoning and spatial abilities and investigative/realistic or theoretical preferences (Lubinski, Benbow, & Sanders, 1993). This holds for both genders and is consistent with the Theory of Work Adjustment.

We also have learned from longitudinal analyses that most mathematically talented students seem to be successful in translating their potential into academic achievement. At

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[4] See Lubinski and Benbow (1992, 1994) for a profile of their abilities, interests, and values.

[5] Some of the findings from this survey are reported in Lubinski, Benbow, Eftekhari-Sanjani, and Jensen (in preparation).

the end of high school and college, these students were high academic achievers (Benbow, 1983, 1992; Benbow & Arjmand, 1990). For example, by age 23 at least 85 percent of Cohort 1 had graduated from college with excellent academic records; almost half of them were pursuing graduate training. The achievements of Cohorts 2 and 3, however, are even more impressive, as expected given their initially greater ability level (Lubinski & Benbow, 1994). Moreover, there appears to be no threshold effect for ability in its relationship to subsequent academic achievement; those with the most ability tend to show the strongest record of academic achievement (Benbow, 1992).

Results of studies evaluating SMPY's programmatic innovations have been uniformly positive (e.g., Benbow, Lubinski, & Suchy, in press; Benbow & Stanley, 1983a; Brody & Benbow, 1987; Kolitch & Brody, 1992; Richardson & Benbow, 1990; Stanley & Benbow, 1983; Swiatek & Benbow, 1991a, 1991b, 1992). Even though intellectually gifted students as a group do achieve academically at a high level (Benbow, 1992; Benbow & Arjmand, 1990), it does appear that they do not achieve as highly if deprived of an education that corresponds to their level of competence. Moreover, students themselves view SMPY's services and programs as satisfying and personally beneficial several years later (Benbow, Lubinski, & Suchy, in press). Especially valued, beyond the sheer intellectual stimulation, was the acknowledgment of their abilities and the contact with intellec-tual peers. This was especially true for females.

Although multiple studies have been conducted on the variety of acceleration options that SMPY has promoted with its participants (see Benbow, 1992, for a review), we can summarize the results quite succinctly: When differences are found, they favor the accelerates over the nonaccelerates irrespective of the mode of acceleration (e.g., Swiatek & Benbow, 1991a, 1991b). In addition, students are satisfied with their acceleration in both the short and the long term (Richardson & Benbow, 1990; Swiatek & Benbow, 1992).

To date SMPY has been concerned primarily with enhancing *satisfactoriness* as defined by TWA through the provision of educational interventions that are accelerative in nature.[6] Although preferences were assessed and considered throughout SMPY's history, work directly experimenting with ways to optimize *satisfaction,* the other dimension of correspondence within TWA, has not been systematic. We now know that we are able to forecast salient features of gifted students' adult vocational interest profile by assessing their interests at age 13 with instruments designed for adults (Lubinski, Benbow, & Ryan, 1995). Therefore, interventions directly aimed at also enhancing satisfaction now seem timely and appropriate for SMPY to develop. Optimizing satisfaction as well as satisfactoriness should lead to even greater educational and vocational adjustment and well-being among the gifted.

Gender differences have been striking among the participants in SMPY's longitudinal study and very much publicized by the popular media (e.g., Pool, 1994). What are the facts? There are more males than females who are markedly talented in mathematics at age 13 (Benbow, 1988; Benbow & Stanley, 1980, 1983b). Moreover, highly able males and females, when considered as a group, have differing ability and preference profiles (Lubinski & Benbow, 1992, 1994; Lubinski, Benbow, & Ryan, 1995; Lubinski & Humphreys, 1990a, 1990b; Lubinski, Schmidt, & Benbow, in press). When evaluating these differences in the light of the Theory of Work Adjustment, the data inevitably lead to the prediction that highly able males and females will find personal fulfillment in differing educational and career tracks. That is, the psychological profiles of mathematically talented males are often more congruent with studying in the physical sciences than are those of mathematically gifted females, and these predictions have been borne out by the longitudinal data collected by SMPY (Lubinski & Benbow, 1992;

[6] It should be noted, however, that this work appears to enhance satisfaction indirectly (Lubinski et al., 1993, footnote 3). Providing an appropriate educational environment tends also to provide an appropriate social environment.

Lubinski, Benbow, & Sanders, 1993). As adults, mathematically talented males are more heavily represented in the physical sciences and at the highest educational levels than their female counterparts.

In the social and emotional arena, we find that intellectually gifted students have positive self-concepts, especially in academics, and self-esteem (Swiatek, 1993). They possess an internal locus of control; and, on average, their psychological health does not differ much from that of normative or socioeconomically privileged samples (Jensen, 1994). There are indications, however, that modestly gifted students appear to be somewhat better adjusted than the highly gifted and that verbally gifted females are at a somewhat greater risk for emotional distress. As for moral reasoning, the highly gifted score at a level comparable to college students four to five years their senior. Yet moral reasoning, as currently measured, seems to be just another measure of verbal ability (Sanders, Lubinski, & Benbow, 1995). Hence, the underlying meaning of "advanced moral reasoning ability" among the gifted is equivocal.

Finally, what are some of SMPY's basic findings from research on the biological nature of giftedness. Extremely talented youth show a higher proportion of left-handers, suffer more frequently from allergies, and tend to be myopic (Benbow, 1986); overall, however, mathematically gifted individuals possess better physical health than both their average-ability and socioeconomically privileged peers (Lubinski & Humphreys, 1992). Intellectually gifted males, in particular, evince enhanced right-hemisphere functioning. This has been determined using standard tasks, such as dichotic listening, and the EEG (O'Boyle, Alexander, & Benbow, 1991; O'Boyle & Benbow, 1990). Moreover, studies from both cognitive and psychometric approaches to intelligence converge on the notion that intellectually gifted students are simply precocious. They do not solve problems in qualitatively the same manner as average-ability individuals of their age, but in a manner similar to individuals four to five years older. Mathematically gifted students are especially strong at manipulating information in working memory and in handling numeric/spatial stimuli within working memory. The verbally gifted, in contrast, are better at representing word stimuli in working memory.

Summary and Conclusion

SMPY's work has focused on the optimal development of intellectual talent since its founding in 1971 by Julian C. Stanley. This has been accomplished through both intervention research and a planned fifty-year longitudinal study. Through this programmatic research agenda, it systematically developed an identification procedure based on out-of-level testing (i.e., the Talent Search; see Chapter 13 by Assouline and Lupkowski-Shoplik), which has diagnostic value for gifted individuals and has demonstrated predictive validity over 10-year intervals (Benbow, 1992). We learned, through SMPY's longitudinal research, that the future pool of truly exceptional scientists and engineers will consist mostly of talent-search-identifiable individuals (Benbow, 1992; Benbow & Arjmand, 1990). Within this group of gifted individuals we now have identified, by utilizing the Theory of Work Adjustment as a guide, the psychological profiles at age 13 of those who eventually do enter the math/science pipeline (Lubinski, Benbow, & Sanders, 1993).

Moreover, through its programmatic work SMPY experimented with ways to best provide an education that is commensurate with a gifted student's advanced abilities. Acceleration in its many variants seemed to be the procedure of choice; and indeed it was. Those who accelerate perform better academically than those who do not accelerate their education, irrespective of mode of acceleration (e.g., Swiatek & Benbow, 1991a, 1991b). Put simply, our results point to the generalization that gifted individuals will not achieve as highly if not provided with a challenging education that is structured at a pace commensurate with their ability level. Acceleration appears to be the best method for achieving this goal.

Current reform efforts seem bent on making no provisions for the gifted. This can only result in loss of a precious resource within our society. On the basis of the current empirical evidence, not allowing gifted children to accelerate is simply educational malpractice (Benbow & Stanley, in press).

Finally, sound empirical investigations have shown that SMPY's procedures are educationally efficacious. No other model for educating gifted children has gathered so much empirical support for its practices and procedures. It is no wonder, then, that the SMPY model has had such a significant effect on education, particularly gifted education, as documented by VanTassel-Baska (in press).

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