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Top 1 in 10,000: A 10-year follow-up of the profoundly gifted

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ABSTRACT

Adolescents identified before the age of 13 (N = 320) as having exceptional mathematical or verbal reasoning abilities (top 1 in 10,000) were tracked over 10 years. They pursued doctoral degrees at rates over 50 times base-rate expectations, with several participants having created noteworthy literary, scientific, or technical products by their early 20s. Early observed distinctions in intellectual strength (viz., quantitative reasoning ability over verbal reasoning ability, and vice versa) predicted sharp differences in their developmental trajectories and occupational pursuits. This special population strongly preferred educational opportunities tailored to their precocious rate of learning (i.e., appropriate developmental placement), with 95% using some form of acceleration to individualize their education.

We studied 320 profoundly gifted individuals (who averaged over 180 in estimated IQs) from their early adolescence to their early adult years. Never before has a sample this large from this rare ability level been assembled for systematic study, let alone for longitudinal study. Thus, scientists lack much data on this intriguing population, whom many consider to possess great potential for contributing to society.

However, literature regarding the gifted and talented does contain a number of intriguing case history reports of children and adolescents with profound intellectual gifts such as those by Feldman (1986), and Hollingworth (1927, 1942) studied 12 profoundly gifted students longitudinally. Although Terman's (1925–1959) classic longitudinal study selected participants with cutoffs around the top 1% of general intellectual ability (a cut just below IQ of 140), relatively few participants were in the profoundly gifted range, and they were not systematically studied. Although qualitative studies suggest that such individuals possess vast potential, the studies also suggest that these individuals seem to be at a higher risk for social and emotional difficulties, which could interfere with their full use of the special skills they possess (Silverman, 1998). Do profoundly gifted individuals possess inordinate potential, or is there an ability threshold as some investigators have suggested (Gardner, 1993; MacKinnon, 1962; Renzulli, 1986)? Can such exceptional youths capitalize on their unique strengths? Can interventions smooth things out or even facilitate the talent-development utilization process? These are the questions we attempted to address in this study.

This study is distinctive because previous longitudinal research with gifted individuals secured participants using global measures of general intelligence (i.e., IQ), whereas we based our conceptualization of general intelligence on the mainstream scientific view outlined by Gottfredson (1997a) and explicated by Carroll (1993), namely, a hierarchical organization of cognitive abilities. In this framework, the general factor of general intelligence (g), is supported by a number of lower-order group factors. Although general intelligence is certainly considered to be important (Jensen, 1998; F. L. Schmidt & Hunter, 1998), specific abilities of the intellectually talented are now much more appreciated. Thus, the modern approaches that are being used for identifying gifted individuals are now considering specific abilities to identify talent (Benbow & Stanley, 1996). We used these modern methods to identify our sample, and therefore this study provides the first opportunity (to our knowledge) (a) to systematically compare different types of profoundly gifted individuals on the basis of contrasting intellectual strengths and (b) to study exceptional talent that previously might have been missed.

We drew our sample from the 10-year follow-up of the Study of Mathematically Precocious Youth's (SMPY's) 1 most able cohort (Lubinski & Benbow, 1994). Before the age of 13, these individuals had taken the College Board Scholastic Aptitude Test (SAT), 2 and because of their high Math and Verbal SAT scores, they met the selection criterion of being in at least the top 1 in 10,000 in either mathematical reasoning ability or verbal reasoning ability. We then compared the developmental paths chosen by these individuals by following three different types of profoundly gifted young adults (identified during early adolescence): those with highly advanced verbal reasoning abilities, relative to their mathematical ability (high-verbal); those with exceptional mathematical reasoning, relative to their verbal ability (high-math); and those who were more intellectually uniform (high-flat).

Gaining systematic knowledge of this population and its subgroups is particularly timely because of current societal changes. A number of observers have suggested that modern society has moved out of the industrial revolution and into the information age. If Hunt's (1995) analysis is correct, what is especially needed to maintain and advance modern society, and what employers are increasingly looking for, are symbol analyzers. The expertise that society has the greatest need for, and appears most committed to investing in, is the kind that readily develops from the distinguishing intellectual dimensions of this special population: managing and reasoning with linguistic and numerical symbols (our modern-day cultural artifacts). Because of the changes in society, previous longitudinal studies of the gifted are less useful, even if findings can be extrapolated somewhat, because they describe development from a time when securing educational and vocational opportunities commensurate with abilities was more difficult, especially for women, and society was less technologically and knowledge based. These studies also did not involve individuals at the level of functioning that this study used.

An aim of this research is not to simply describe this special population, but to uncover ways to facilitate their development. Thus, we were interested in ascertaining whether talent development procedures might be enhanced by using the ability configurations we examined in this study. For example, if the ability configurations we used index differential proclivities toward educational opportunities, contrasting occupations, and mediums for creative self-expression, then these ability configurations might also provide clues as to what opportunities would best serve different types of profoundly gifted students. Consequently, we gave special attention to criteria such as lifestyle preferences, educational outcomes, and vocational choice, as well as to respondents' subjective impressions of their education experiences and opportunities in life.

In addition to analyzing normative categorical and continuous criteria, we compiled some idiographic data (aggregated into meaningful classes) for a richer appreciation of the developmentally sequenced activities and the accomplishments of this special population over the decade studied. Data from Cattell's (1965) three sources were included: Q-data (subjective questionnaires), L-data (biographical, life record), and T-data (objective tests). Although statistical tests were computed throughout, more impressive than finding statistical significance (when examining longitudinal data across multiple-time points) is uncovering consistent function forms or patterns (Meehl, 1978, 1990), especially when consistencies are established across widely diverse and temporally remote phenomena (Humm, 1946). Therefore, we devoted particular attention to the divergent outcomes between the most distinctive groups (viz., high-math and high-verbal) and hypothesized that our intermediate group (high-flat) would manifest a criterion patterning that was less divergent from the other two groups than they would be from each other.

Finally, beyond the applied implications of the behaviors and outcomes reported here, this sample was drawn from the same population currently being studied by a multi-disciplinary team. This project involves an ongoing analysis of the human genome (Chorney et al., 1998; Plomin, 1999), utilizing the three ability configurations used here, and is designed to uncover DNA markers of general and specific intellectual abilities. Because this study constitutes the first report of the behavioral tendencies of this special population, it may be considered the phenotypic counterpart to modern genotypic analyses on the fundamental nature of intellectual precocity.

METHOD

Participants

All 320 participants (78% Caucasian, 20% Asian, 2% other) in this 10-year follow-up study secured scores that were either ≥700 in the math portion of the SAT (SAT-M) or ≥630 in the verbal portion of the SAT (SAT-V) before age 13 (1980–1983). For members of this age group, these cutting scores constitute a selection intensity of about 1 in 10,000 in mathematical and verbal reasoning ability, respectively. The IQs of the participants were estimated from sample statistics that were collected on hundreds of thousands of talent search participants compiled over the past two decades (raw data, J. C. Stanley, personal communication, June 1998). Talent search participants who took the SAT consisted of a sample of approximately the top 3% in general ability for ages below 13 years. Means (and standard deviations) for these adolescents' SAT-M and SAT-V scores were approximately 430 (*SD* = 85) and 370 (*SD* = 75), respectively. We assumed that adding these two mean values (430 + 370 = 800) approximated the cutting score for the top 1% (*z*-score = 2.32) on the general factor. Given that the correlation between SAT-M and SAT-V for talent search participants is around $r = .55$, we estimated their standard deviation on general intelligence on the basis of their SAT-M + SAT-V composite to be as follows: $[(85)^2 + (75)^2 + 2(.55)(85)(75)]^{1/2} = 140.93$. At this point, each student's general ability level was estimated by subtracting 800 from their SAT composite, and dividing this difference by the standard deviation (140.93) to reflect the number of standard deviation (*z*-score) units that needed to be added to 2.32 to estimate their normative standing on general intelligence in *z*-score units. Finally, this value was multiplied by a conventional IQ standard deviation (viz., 16) and added to 100 to estimate IQ on the familiar metric. Once we performed these computations on our participants' scores, we found the mean and standard deviation to be 186 and 11, respectively (with 99% of these estimates ≥160).

We obtained further evidence of intellectual precocity from Raven's Advanced Progressive Matrices (APM; Raven, Court, & Raven, 1985) assessments for a subset of participants, 88 male and 20 female whose mean ages (and standard deviations) were 12.9 (0.5) and 13.2 (0.5) years, respectively. For these assessments, male and female mean APM scores (and standard deviations) were: male participants = 29.0 (3.9) and female participants = 29.0 (3.9), respectively. These means are substantially higher than the mean of 21.7 (5.9) from Jensen, Saccuzzo, & Larson's (1988) sample of 261 undergraduates.

During the early 1990s, the participants (age 23) were mailed follow-up questionnaires consisting primarily of educational and occupational information. Eighty percent of men and 93% of women responded.

Procedure

The sample was divided into three groups on the basis of their preadolescent SAT profiles. Two groups had tilted SAT profiles, meaning that their SAT scores differed from each other by more than a standard deviation: *High-verbal* participants (31 male, 42 female) had SAT-V scores that fell more than one standard deviation beyond their SAT-M scores. *High-math* participants (169 male, 16 female) had SAT-M scores that fell more than one standard deviation beyond their SAT-V scores. Finally, the third group (53 male, 9 female) consisted of participants whose SAT-M and SAT-V scores fell within one standard deviation of each other. These profiles were labeled *high-flat.* This partitioning resulted in two tilted groups with opposite intellectual strengths and relative intellectual "weaknesses" (quantitative vs. verbal) and one flat group that was more intellectually uniform. SAT means (and standard deviations) for each group were as follows: high-math, SAT-M = 729 (26) and SAT-V = 473 (73); high-verbal, SAT-M = 556 (72) and SAT-V = 660 (30); and high-flat, SAT-M = 719 (32) and SAT-V = 632 (44).

We further divided these three groups by gender and compared their educational and vocational attainments across both normative and idiographic data. For variables that did not covary with ability profiles, results are reported only by gender. For variables that did not covary with ability profiles or gender, results are reported for the entire sample.

RESULTS

Acceleration

Before characterizing various outcomes, a distinctive finding on the educational experiences of these participants (and how they felt about them) should be noted. An overwhelming majority of participants (95%) took advantage of various forms of academic acceleration in high school or earlier to tailor their education to create a better match with their needs (Figure 1). The majority of these participants used advanced subject matter placement (82%), took AP or other exams for college credit and advanced study (82%), or took college courses while still in high school (57%). Some participants also indicated that they had used grade-skipping (49%), taken special courses (44%), used tutors or mentors (25%), or entered college early (19%). Most participants (71%) were satisfied with the level of acceleration they experienced. Of those participants who did not indicate satisfaction with their accelerative experiences, the majority indicated that they would have preferred to have been accelerated even more, not less.

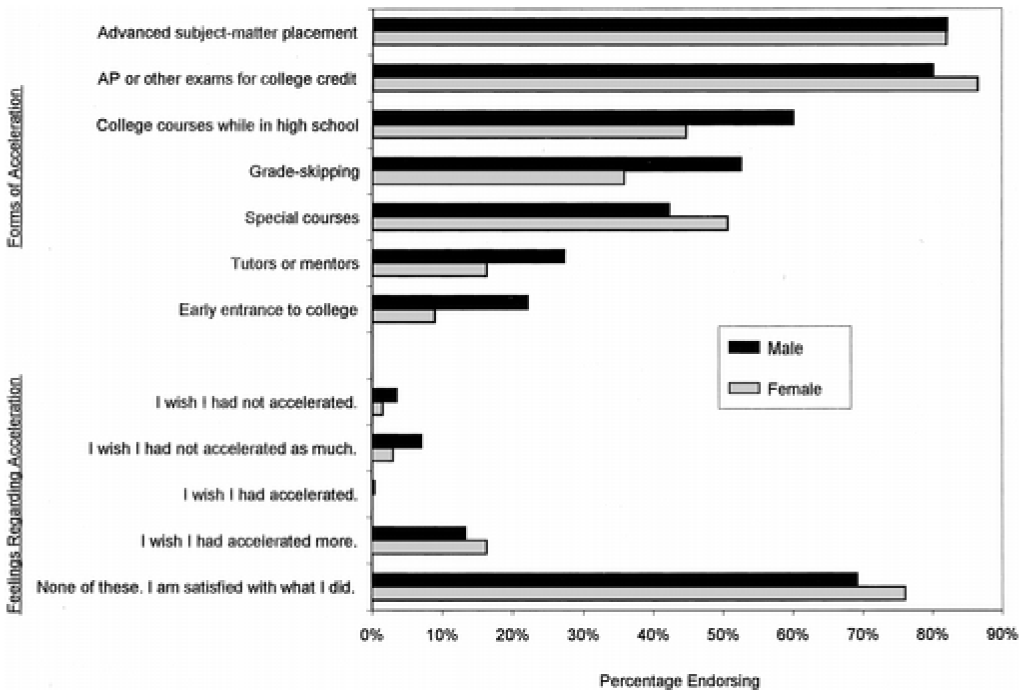

Figure 1. Percentages of male and female participants who used various forms of educational acceleration are shown on the top section, and participants' feelings regarding their accelerative experiences are shown on the bottom section. AP = advanced placement

Respondents reported favorable views of acceleration, both educationally and personally (Figure 2). The most favorable opinions involved participants' educational growth, including their general academic progress and interest in learning in a variety of areas. The respondents also rated acceleration quite favorably in regard to their social and emotional development: self-acceptance, acceptance of their abilities, personal growth, and an increased ability to get along with their intellectual peers and with adults. The respondents rated their perceptions of acceleration in regard to their grades, their interest in the humanities and social sciences, and their general emotional stability positively but less favorably. On average, participants indicated that their acceleration made no detectable difference in their social life or in their ability to get along with their age peers. These neutral reports are informative because they forestall concerns about future regrets.

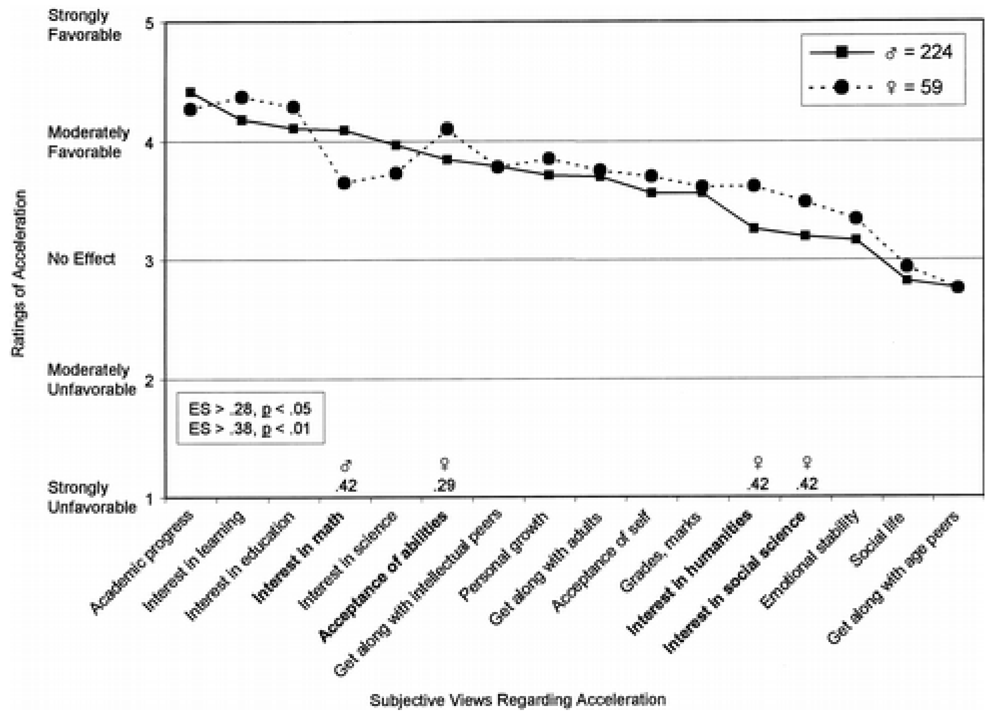

Figure 2. Participants' subjective views regarding acceleration. ES = effect size

Some significant sex differences appear in Figure 2, as indicated by the effect sizes (ESs) along the *x*-axis. Males tended to view acceleration more favorably in relation to their interest in math (ES = .42), whereas females perceived acceleration more favorably in relation to their interest in the humanities (ES = .42), social sciences (ES = .42), and acceptance of their abilities (ES = .29). Additionally, participants' ability profiles contributed to their views of acceleration in regard to their interest in subject areas congruent with their relative strengths. High-math participants reported an increased interest in math (ES = .36), $F(2, 285) = 14.92$, $p < .0001$, and high-verbal participants reported an increased interest in the humanities and social sciences (ES = .25), $F(2, 281) = 7.83$, $p < .0005$; and (ES = .21), $F(2, 282) = 5.67$, $p < .004$, respectively.

Academic Interests and Educational Outcomes

Evidence of differential interests among the groups was also apparent in participants' choice of favorite courses in high school and college. There were significant differences among the groups, as indicated by the chi-square values included in Figure 3, in their preferences for math/science courses or for humanities courses in both high school and college. As Figure 3 illustrates, high-math participants preferred math/science courses, whereas high-verbal participants were more likely to prefer humanities courses. High-flat participants were intermediate. This pattern of ability–preference congruence was quite consistent from high school to college. Below we find that these differences portend distinct educational outcomes.

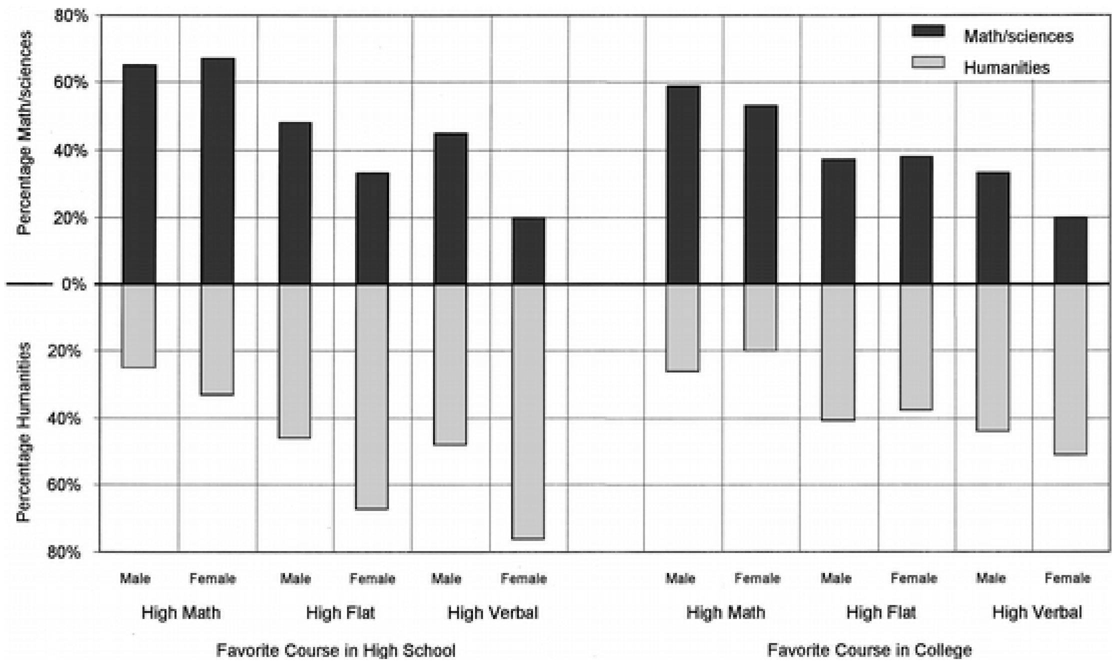

Figure 3. Participants' favorite course in high school and in college. Percentages in a given column do not necessarily sum to 100% because only participants indicating either math/sciences or humanities courses are displayed. Significance tests for differences among groups for favorite course were as follows: high school math/sciences, $\chi^2(2, N = 320) = 20.7$, $p < .0001$; college math/sciences, $\chi^2(2, N = 320) = 18.2$, $p < .0001$; high school humanities, $\chi^2(2, N = 320) = 36.6$, $p < .0001$; and college humanities, $\chi^2(2, N = 320) = 30.2$, $p < .0001$

Table 1 reports participants' secured or intended educational credentials: Over 96% sought a bachelor's degree, with 93% having already secured one by the time of the 10-year follow-up. Forty-nine percent of participants aspired to obtain a master's degree, with 31% having already secured one by age 23. Fifty-six percent of participants intended to obtain a doctoral degree, with 12% having already secured one. The doctoral degrees already earned at the time of the 10-year follow-up included 23 doctors of philosophy, 9 doctors of law, and 7 doctors of medicine.

Table 1

Major Areas of Educational Credentials, Percent by Degree

	High-math						High-flat						High-verbal					
	Male			Female			Male			Female			Male			Female		
Major area	B	M	D	B	M	D	B	M	D	B	M	D	B	M	D	B	M	D
Math/inorganic science[a]	71.6	27.2	24.3	43.8	25.0	12.5	60.4	20.8	30.2	44.4	0.0	0.0	45.2	16.1	9.7	16.7	4.8	2.4
Medicine/organic science	6.5	0.0	10.1	31.3	6.3	31.3	7.5	1.9	7.5	11.1	11.1	22.2	12.9	3.2	12.9	16.7	9.5	21.4
Social sciences	11.2	3.6	3.0	6.3	0.0	0.0	13.2	1.9	3.8	0.0	11.1	0.0	12.9	3.2	6.5	21.4	2.4	4.8
Humanities/arts	7.7	1.8	0.6	12.5	0.0	0.0	18.9	5.7	7.5	44.4	22.2	22.2	32.3	6.5	6.5	50.0	19.0	21.4
Law			5.3			0.0			11.3			33.3			19.4		2.4	4.8
Other/unknown	5.3	16.6	7.7	6.3	18.8	0.0	3.8	11.3	1.9	0.0	33.3	11.1	0.0	16.1	9.7	11.9	14.3	7.1
Total	94.7	49.1	50.9	100.0	50.0	43.8	98.1	41.5	62.3	100.0	77.8	66.7	96.8	45.2	64.5	100.0	52.4	61.9
Already secured	91.7	34.3	10.1	93.8	25.0	25.0	96.2	24.5	18.9	100.0	44.4	22.2	90.3	29.0	12.9	97.6	23.8	4.8

Note. Values represent the percentage of respondents who have secured or intended to secure the given degree. Columns do not necessarily sum to the total because some participants are seeking multiple degrees. B = bachelor's degree; M = master's degree; D = doctoral degree.

[a] Math/inorganic science includes engineering and computer science.

Major Areas of Educational Credentials, Percent by Degree

With respect to undergraduate majors, the specific disciplines that participants chose appear to have been a function of both gender and ability profile. Sixty-nine percent of the high-math group pursued undergraduate math/inorganic science degrees, as compared with 58% of the high-flat group and 29% of the high-verbal group. Forty-two percent of the high-verbal group pursued humanities or arts undergraduate degrees, as compared with 23% of the high-flat group and 8% of the high-math group.

A similar trend was found for graduate study. Among the high-math group, 34% aspired to graduate degrees in math/inorganic sciences, as compared with 32% of the high-flat group and 8% of the high-verbal group. Of the high-verbal group, 15% pursued graduate degrees in the humanities/arts, as compared with 8% of the high-flat group and 2% of the high-math group. Fifteen percent of the high-flat group pursued law degrees, versus 11% of the high-verbal group and 5% of the high-math group.

Results pertaining to gender-related preferences mirrored findings from previous research with less able participants (Achter, Lubinski, Benbow, & Eftekhari-Sanjani, 1999; Benbow, 1992; Lubinski & Benbow, 1992): Male students gravitated toward math/inorganic sciences more often than female students of comparable ability. Focusing on undergraduate degrees, high-math male students were overwhelmingly found in math/inorganic sciences, whereas female students with similar abilities were split among math/inorganic sciences and medicine/organic sciences. The majority of high-flat male students were found in math/inorganic sciences, whereas high-flat female students were evenly split among math/inorganic sciences and humanities/arts. Of interest, high-verbal male students were more uniformly split among math/inorganic sciences and humanities/arts, whereas high-verbal female students were found mostly within the humanities/arts.

The exceptional talent of these participants is further highlighted by the institutions they chose for doctoral training (Table 2). Of participants pursuing doctorates in this study, 42% were doing so at universities ranked within the top 10 U.S. universities by the National Research Council (NRC, 1995), as compiled by Webster and Skinner (1996; see Table 2 note). Although all ranking systems for graduate training programs are fallible (if not contentious), a simple scan of the list of universities attended makes clear that by any standard, these participants are in some of the most elite programs in the world. For example, 19 doctoral degrees were being sought at Harvard University; 17 were at University of California, Berkeley; and 17 more were at Stanford University.

Table 2
Doctoral Degrees and Institutions Attended

Institution	PhD	MD	JD	Total
Harvard University†	11	4	4	19
Stanford University†	14	2	1	17
University of California, Berkeley†	14		3	17
Massachusetts Institute of Technology†	9			9
Brown University	4	1		5
University of Chicago†	5			5
University of Michigan	3		2	5
University of Virginia	2	2	1	5
Yale University†	3		2	5
Columbia University	2		2	4
University of California, Los Angeles	2	2		4
University of Pennsylvania	2	2		4
California Institute of Technology†	3			3
Rutgers, The State University of New Jersey	2		1	3
University of Texas at Austin	3			3
Washington University	3			3
Boston University	1		1	2
Carnegie Mellon University	2			2
Georgetown University			2	2
Johns Hopkins University		2		2
Princeton University†	2			2
Rensselaer Polytechnic Institute	2			2
Thomas Jefferson University	1	1		2
University of California, San Diego†	1	1		2
University of Illinois at Urbana-Champaign	2			2
University of North Carolina at Chapel Hill	2			2
University of Pittsburgh	1	1		2
University of Toronto	1		1	2
University of Washington	2			2
University of Wisconsin—Madison	2			2
Baylor University		1		1
Case Western Reserve University			1	1
College of William and Mary			1	1
Cornell University†	1			1
Duke University	1			1
George Washington University			1	1
Northwestern University	1			1
Oregon Health Sciences University		1		1
Pennsylvania State University University Park Campus	1			1
Purdue University	1			1
School of Visual Arts	1			1
State University of New York Health Science Center at Brooklyn		1		1
University of Arizona	1			1
University of California, Davis	1			1
University of California, Irvine	1			1
University of Connecticut		1		1
University of Illinois		1		1
University of New South Wales—Sydney, Australia			1	1
University of Rochester		1		1

Note. Numbers refer to the number of participants seeking each doctoral degree at each institution. Numbers do not sum to the total number of degree-seekers because 28 participants did not indicate an institution and 5 are seeking multiple doctoral degrees: 4 MD/PhD and 1 PhD/JD. PhD = doctor of philosophy; MD = doctor of medicine; JD = doctor of jurisprudence.
† These are the top 10 universities as indicated by Webster and Skinner's (1996) compilation of the National Research Council's (NRC's; 1995) ratings of the nation's doctoral programs. The NRC rated doctoral programs in 41 disciplines from 274 institutions. Webster and Skinner provided a means to compare universities offering doctorates in at least 15 disciplines according to the mean for all programs for the Scholarly Quality of Program Faculty reported by the NRC.

Doctoral Degrees and Institutions Attended

Scores on the Graduate Record Examination (GRE) were interesting. Eighty-six of 125 participants (68.8%) that reported scores for the GRE-Quantitative earned the maximum 800, 26 of 123 (21.1%) did so on the GRE-Verbal, and 82 of 124 (66.1%) did so on the GRE-Analytic subtest. These compare to base-rate expectations for perfect scores, which are 1.67% for the GRE-Quantitative, 0.23% for the GRE-Verbal, and 1.23% for the GRE-Analytic. Of the 122 participants reporting scores for all three subtests, 14 earned the highest possible composite score of 2400. The base-rate for perfect scores on all three tests is approximately 0.02% (L. J. Stricker, personal communication, September 20, 1999); hence, our finding of 14 of 122 (11.5%) perfect scores across all three GRE tests was over 500 times base-rate expectations!

Vocational Intentions

An analysis of vocational goals revealed that post-secondary teaching aspirations were quite common among all groups, although more so for the high-flat (39%) and high-verbal (34%) groups than for the high-math (18%) group. Administrative goals were more prevalent among high-math (23%) and high-flat (23%) groups than among the high-verbal (8%) group. Groups were less divergent in their aspirations for research careers (high-flat: 11%, high-math: 9%, high-verbal: 5%), but both tilted groups indicated interests in technical and clinical areas more frequently than did their high-flat counterparts (technical: high-math = 12%, high-verbal = 10%, high-flat = 5%; clinical: high-verbal = 11%, high-math = 9%, high-flat = 2%).

We used Stevens and Hoisington's (1987) measure of occupational prestige with general population norms for men (M = 39.5, SD = 14.1) and women (M = 39.5, SD = 13.1) and found that both the mean and median prestige scores of the intended occupations of each group were at least two standard deviations above the norm. Sharp negative skews characterized all of these distributions, as evidenced by the quartiles of the entire sample (Q_1 = 59.3, Mdn = 75.1, and Q_3 = 78.3).

Clearly, participants' career aspirations clustered at the high end of occupational prestige, but taking an idiographic look at specific accomplishments paints a more colorful picture of their intellectual expression. Table 3 forestalls the common misperception that the highly able tend to be limited to a circumscribed realm of worldly pursuits. For example, at a point in young adulthood when less than a quarter of their age-peers were completing their undergraduate studies (U.S. Department of Education, 1997), study participants had already published in a range of scientific journals, including *Pediatric Cardiology* and the *American Journal of Human Genetics.* In the realm of creative writing, another participant had a story accepted by *Harvard Literary Magazine.* Several participants had also already acquired awards of distinction within the humanities, including two Fulbright scholarships, the Presidential Scholar for creative writing, a Mellon Fellow in the Humanities, and the Hopwood writing award. Still another had adapted Pink Floyd's *The Wall* into a multimedia rock opera. Several developed commercially viable software, such as *Football* (one of the most popular video games in the United States), a fantasy role-playing system, and a prototype of an advanced spelling correction system for speech recognition software. Another participant designed and implemented a software library as part of a $10 million sale for her corporation. (We could have added a number of specific details to Table 3, but some of our participants wished to maintain their anonymity.)

Table 3
Awards and Special Accomplishments

Sciences and technology	Humanities and arts
Scientific publications (11)	Creative writing (7)
Software development (8)	Creation of art or music (6)
Inventions (4)	Fulbright award (2)
National Science Foundation fellowship (2)	Wrote proposal for a novel voting system for new South African Constitution
Designed image correlation system for navigation for Mars Landing Program	Solo violin debut (age 13) Cincinnati Symphony Orchestra
American Physical Society's Apker Award	Mellon Fellow in the Humanities
Graduated from Massachusetts Institute of Technology in 3 years at age 19 (entered at 16) with perfect (5.0) grade point average and graduated from Harvard Medical School with MD at age 23	Presidential Scholar for Creative Writing
Teaching award for "Order of Magnitude Physics"	Hopwood writing award
	Creative Anachronisms Award of Arms
	First place in midreal–medieval poetry
	Foreign language study fellowship
	International predissertation award

Other	Group	Sciences & technology	Humanities & arts
Phi Beta Kappa (71)	High-math	16	5
Tau Beta Pi (30)	High-flat	6	6
Phi Kappa Phi (14)	High-verbal	7	13
Entrepreneurial enterprises (2)			
Omicron Delta Kappa			
Olympiad silver medal			
Finished bachelor's and master's degrees in 4 years			
Received private pilot's license in 1 month at age 17			

Note. Numbers in parentheses represent the number of participants indicating each accomplishment. All other entries represent a single individual.

Awards and Special Accomplishments

These idiographic achievements may be aggregated in ways congruent with the ability profiles examined here for cogent scientific generalization: For example, although participants reported a myriad of accomplishments, many were readily classifiable as within the scientific and technical domains versus within the humanities and arts. For high-math participants, 76% of the classifiable accomplishments fit comfortably within scientific–technical areas, whereas 65% of the classifiable accomplishments of the high-verbal participants were within the humanities and arts (see Table 3). The accomplishments of high-flat participants were evenly split between the two domains.

Lifestyle Preferences

Finally, participants were asked to indicate the importance of a heterogeneous collection of lifestyle preferences (Figure 4). Participants, on average, indicated that having strong friendships, finding the right person to marry, being successful at work, and having time for avocational interests were important to extremely important. Participants also indicated that having a full-time career, having children, providing their children with better opportunities than they had, and having lots of money were somewhat important, and that being a community leader and living near parents and relatives were slightly less important. Participants indicated that having a part-time career for some part or all of their lives was least important. Both sexes were quite similar in their overall importance ratings; however, a few differences emerged. Items involving a part-time career generated the largest gender differences (ESs = .50 and .46), with women generally placing more importance on part-time career alternatives than did men. The importance of having a lot of money generated significant gender and ability profile differences, with men placing more importance on this than did women (ES = .40), and high-math participants placing more importance on monetary gain than high-flat or high-verbal participants (ES = .24), $F(2, 304) = 8.42$, $p < .0003$.

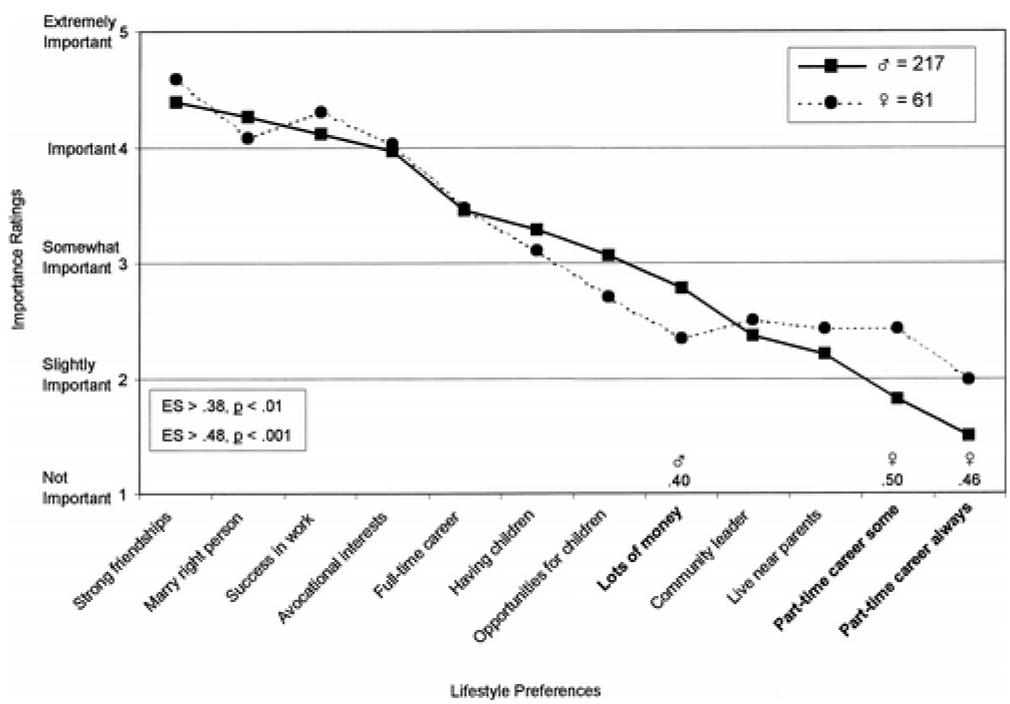

Figure 4. Importance ratings for lifestyle preferences. ES = effect size

DISCUSSION

Identifying profoundly gifted individuals (top 1 in 10,000) during early adolescence does indeed isolate a rich source of human capital for literary, scientific, and technical achievements. Only time will reveal the full impact that these individuals may have on society. Yet, they are off to an exciting start—surpassing any group studied to date. In their early 20s, they are beginning to accumulate achievements that are marked for individuals at this stage of development. The nature of the achievements of the individuals in this study was foretold by their ability level (top 1 in 10,000) and pattern (high-verbal vs. high-math) before age 13. This speaks to the predictive and differential validity and the usefulness of above-level SAT assessments for this special population. This is particularly noteworthy, given that all of our participants were well beyond the cutting score for the top 1% in general intellectual ability.

How can researchers assess distinctive achievements at an age when most individuals are still in the training or the apprenticeship stage? One marker is having earned an advanced degree. In this regard, that 75% of male participants and 81% of female participants were aspiring to degrees beyond a bachelor's is impressive. Even more impressive is that the majority of these top 1 in 10,000 respondents (56%) were pursuing doctoral degrees. This is over twice the proportion of a less able, but nevertheless intellectually gifted (top 1%), contemporary sample, 25% of whom were found to secure doctorates (Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000). Note that the base-rate expectation for the general population is only 1% for doctoral degrees (U.S. Department of Education, 1997). We believe that the capability of identifying a population by the age of 12 at promise for securing doctorates at over 25 times base-rate expectations is truly impressive (Benbow et al., 2000), but the capability of identifying at over 50 times base-rate expectations as observed in this study is even more profound and constitutes, according to the great applied psychologist Donald G. Paterson, a difference (here in ability level) that makes a difference. This finding alone is noteworthy. Yet, it becomes even more extraordinary when one also considers the graduate schools that were attended by this sample. For participants pursuing doctorates in this study, 42% were attending universities ranked among the top 10 by NRC (1995) rankings, whereas, by contrast, only 21% of the Benbow et al. (2000) participants were doing so. The top 1 in 10,000 seem to be on a different and much steeper developmental trajectory than even the top 1 in 100.

This “difference that makes a difference” casts doubt on the tenability of an ability threshold (Gardner, 1993; MacKinnon, 1962; Renzulli, 1986). Doctoral recipients of these elite institutions make up a preponderance of future intellectual leaders (Albert, 1983; Zuckerman, 1977). Zuckerman's (1977) classic study, which uncovered that 55% of Nobel Laureates came from 10 universities, is but one example. The extrapolation procedures developed by Dawes and Meehl (1966) enable us, therefore, to infer more promise in the top 1 in 10,000 ability group than in the top 1 in 100 group for both creativity and innovation. Indeed, many participants had already produced a creative work or won notable awards by the time of the 10-year follow-up.

The psychological significance and real-world implications of general intelligence are undeniable (Campbell, 1990; Gottfredson, 1997b; Jensen, 1998; Lubinski & Dawis, 1992; F. L. Schmidt & Hunter, 1998) and are supported in this study. Yet, our data also suggest that only identifying adolescents with exceptional general cognitive ability is insufficient for predicting the specific nature of their future accomplishments. Even at the extremes, evaluating students for educational and vocational planning is most effective when using multiple specific-ability measures. Indeed, if Terman (1925–1959) had included a measure of mathematical reasoning ability in addition to the highly verbal Stanford-Binet, two Nobel Laureates, Luis Alvarez and William Shockley, would have been most likely included in his study (cf. Shurkin, 1992, p. 35), rather than falling short of qualifying! Alvarez and Shockley likely represent end-point extremes of an array of lost talent (false negatives) when talent identification procedures are restricted to only general ability, or highly verbal, measures. There are important nonverbal measures that provide incremental validity in identifying exceptional intellectual talent. Mathematical reasoning is certainly one. Yet benefits are lost if individual differences and configural relationships between mathematical and verbal reasoning abilities are not examined. It is not just the level of ability that is important but also the relative strength of one to the other.

To the extent that intellectually talented participants have tilted ability profiles, they are likely to choose to develop unevenly. Aggregating idiographic and normative data across their favorite courses in high school and college (Figure 3), educational degrees (Table 1), and special accomplishments (Table 3), for example, paints a clear and consistent picture: High-math participants were much more likely to gravitate toward quantitatively demanding (inorganic) sciences, whereas high-verbal participants were more likely to pursue verbally demanding (organic) disciplines. Because the choices that these exceptional participants made were a function of contrasting ability configurations (high-math vs. high-verbal), there are applied and possibly policy implications. This implies that advising intellectually talented individuals that they may build on their strength (if they wish to) may be fruitful.

In our culture, however, we seem to value broad development (well-roundedness) over a more specific focus. Yet, there appears to be little evidence that suggests that focusing on ability strength (or somewhat uneven development) is psychologically harmful or a source of future regrets. A contemporary study of top math/science students (Lubinski, Benbow, Shea, Eftekhari-Sanjani, & Halvorson, 2001), identified during their 1st or 2nd year in graduate school (368 men, 346 women), revealed developmental histories of an early commitment to and focus on math/science. Beginning in the seventh grade (regardless of gender), they usually found math or science to be their favorite subject, they joined science clubs, and they participated in science fairs significantly more than students at least as gifted but identified by talent searches. Their commitment to a specialization in math/science continued to build through high school and college, and their intense, but perhaps more narrow experiences, undoubtedly contributed to securing admissions to some of the world's best graduate training institutions. Excellence does seem to beget excellence. Given the human capital specialization needed to make modern scientific advances, having uneven development is likely to be at premium in a number of disciplines. It is also likely to be rewarded in private industry where the need for innovative approaches is ever present, and where complex systems of social capital are routinely assembled through the building of multidisciplinary teams.

Because society is becoming more technical, we regret that our Time 1 assessments did not consistently include spatial ability. This is definitely a shortcoming of this research. Spatial ability measures have manifested applied psychological import (incremental validity relative to mathematical and verbal reasoning abilities) for predicting a host of educational and vocational criteria even for students in the top quartile of general intellectual ability (Humphreys & Lubinski, 1996; Humphreys, Lubinski, & Yao, 1993). Taking the level and pattern of all three abilities into account would likely refine further predictions about this special population (cf. Shea, Lubinski, & Benbow, 2001).

It is important to note another trend in these data that is likely to persist even when ability configuration (across mathematical, spatial, and verbal reasoning) is held constant. That is, profoundly gifted male and female students appear to diverge in areas of career aspirations and educational choice even when their ability level and pattern is similar—a finding also observed in less exceptional populations. Female students tend to gravitate more toward educational opportunities and careers involving organic disciplines and the humanities, whereas male students more frequently prefer to develop their talents in more inorganic technological math/science domains (Achter et al., 1999; Benbow et al., 2000). Collectively, this broad generalization aligns with gender differences in preferences for people versus things that is characteristically observed on conventional interest inventories (Achter, Lubinski, & Benbow, 1996; Lippa, 1998; Lubinski & Benbow, 1992). Of course, this is only one of several interest dimensions to consider when (a) evaluating gifted youths for appropriate developmental placement opportunities (Achter et al., 1999; D. B. Schmidt, Lubinski, & Benbow, 1998), (b) evaluating the study of expertise and talent development more generally (Lubinski & Benbow, 2000; Simonton, 1999), and (c) modeling gender differences in educational–vocational choice (Lubinski, Benbow, & Morelock, 2000). For example, in concluding their elegant analysis on the identification of four trait complexes (viz., clerical/conventional, intellectual/cultural, science/math, and social), which were composed of ability, interest, and personality dimensions, Ackerman and Heggestad (1997) remarked: “We have not considered the nature of potential gender differences among the various trait relations, even though significant gender differences are often found among all three of the trait families [abilities, interests, and personality] under consideration” (p. 240). Nevertheless, with the female minus male ES so pronounced on the broad people versus things interest dimension (ES > 1.0; Lippa, 1998; Lubinski, 2000, p. 421), this difference points to a likely determinant of gender differences in educational–vocational outcomes and, hence, to another salient “difference that makes a difference.” That interest assessments were not consistently available at Time 1 is a second limitation of this study.

In conclusion, identifying profound precocity during early adolescence isolates a population at promise for exceptional adult achievement and creative production. Over half of the participants in this study are pursuing doctorates and, almost without exception, attending some of the best universities in the world. By their mid-twenties, many of them have published scientific articles, written for literary publications, or secured patents for their inventions, and a number of them have also won prestigious awards or secured talent development opportunities for doing so. Like other special populations (Dawis, 1992), however, forecasting the specific nature of their educational–vocational pursuits (and facilitating their development) requires a multidimensional lens. Although some individuals have expressed concern that this population is at risk for underachievement because they are so different from typical students their age, we did not find evidence to support this idea. Yet, 95% of these participants experienced some type of educational acceleration; a control group deprived of these opportunities might not have fared as well. Indeed, for their educational development, regardless of ability profile or gender, participants strongly preferred appropriate developmental placement, allowing the curriculum to move at a pace commensurate with their level of mastery, and as adults they expressed many positive sentiments and few regrets about having had such experiences, even though many have pursued relatively narrow paths.

Finally, it appears that the arm of the human genome project, aimed at identifying genetic markers of general and specific cognitive abilities, is examining a population that is on a highly distinguished developmental trajectory. It is not focusing simply on a population that has bookish strength with no value in the real world. This study provides a better understanding of their differential educational and vocational proclivities as a function of contrasting ability strength (e.g., high-verbal vs. high-math). Future advances might distinguish differential gene frequencies that aggregate to foster these contrasting phenotypic expressions (Chorney et al., 1998; Plomin, 1999), just as differential response patterns to test items aggregate in different ways to form contrasting ability profiles.

FOOTNOTES

1 SMPY, started at Johns Hopkins University in 1971 under the direction of Julian C. Stanley, is a planned 50-year longitudinal study dedicated to understanding the optimal development of intellectual talent (Lubinski & Benbow, 1994). SMPY's five cohorts total over 6,000 participants, most of whom were identified in seventh and eighth grade from their scores on standardized tests routinely administered in their schools. Those who scored within the top few percentage points were invited to participate in talent searches. Through these talent searches, these students took college entrance exams (e.g., the SAT) and reliably generated score distributions similar to those of high school seniors. Those scoring above the high school mean were invited to summer-residential programs for learning experiences on the basis of their profiles of intellectual abilities and preferences. Actually, today, SMPY is a misnomer, because by the late 1970s as much emphasis was placed on verbal talents as on mathematical reasoning; in addition, at this time, many adolescents originally identified in the early 1970s are now in their 40s, making SMPY no longer a study of youth.

2 In the text, we refer to the SAT as the Scholastic Aptitude Test because that is what the SAT was called in the 1980s when these participants were identified; however, the College Board has recently renamed the SAT the Scholastic Assessment Test.

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