Chapter 16

Academic Competitions and Programs Designed to Challenge the Exceptionally Talented

JAMES REED CAMPBELL
St. John’s University, Jamaica, New York, U.S.A.

HAROLD WAGNER
Institute Bildung und Begabung, Bonn, Germany

HERBERT J. WALBERG
University of Illinois at Chicago, U.S.A.

Introduction

Many chapters of this International Handbook concern in-school programs or conceptual frameworks designed for schools with gifted programs. The intent of both of these advances involves the development of talent. This chapter deals with a variety of out-of-school programs that are designed to challenge the exceptionally talented. We examine after school programs, competitions, including national academic Olympiads, and summer programs that have the same objective -- the development of talent.

Bloom (1985) conducted a series of studies about how extraordinary talent is developed for concert pianists, sculptors, research mathematicians, research neurologists, Olympic swimmers, and tennis champions. His research teams examined the roles that teachers, parents, and out-of-school personnel played in the developmental process. One of the findings of these studies was that once parents became aware of their child’s exceptional talent, they took a more active role in developing that talent. In many cases parents used out-of-school resources to develop their child’s talent. They secured coaches, specialized teachers, or programs.

In this chapter we will continue this research focus by examining the ways teachers, parents, and other individuals (mentors) contribute to the development of academic talent.

A Framework for the Development of Talent

A useful framework for the development and fostering of talent was proposed by Weinert (Weinert & Wagner, 1987). It may serve as a theoretical underpinning for programs for the talented. He concluded that effective measures to support the development of potential in young people should contain the following features:

(1) Incitements: Curiosity, quest for knowledge and the interest in learning has to be incited by a multitude of attractive sources of information within easy access.

(2) Options: A variety of options has to be available to engage in learning activities such as workshops, courses, summer programs or competitions.
(3) Challenges: The difficulty and the level of the activities should match the level of ability so that very able pupils feel sufficiently challenged and have to exert considerable effort to reach the goal.

(4) Incentives: The activities should be exciting and attractive and should provide the experience of success, rewards, and personal recognition.

(5) Counseling: The young people, their parents and teachers should be able to obtain qualified information on the specific aspects of the students' potential and on available support programs.

(6) Cooperation: Very able young people should be brought up and educated in a community of peers to experience a variety of social contacts to acquire social responsibility and to facilitate a harmonious development of their personality.

According to this framework, at least in the domain of intellectual abilities, it seems to be quite unrealistic to strive for a comprehensive, valid and reliable system of early assessment of potentials followed by a closed system of support programs. Instead, every effort should be made to provide a variety of measures to meet the needs of those who are eager to achieve and show a high degree of motivation. They should be able to be implemented pragmatically, to be easily accessible, differentiated and as open as possible.

In the ideal case such measures would be free of charge, the admission entirely voluntary and based on self selection and the treatment effective both for talent development and for the identification of the most able. Quite often, however, the specific properties of a support program and/or the large number of applicants demand a selection procedure.

There are essentially two ways to accomplish this task. One can create an arena where individuals are allowed to perform some task or set of tasks with those being selected as eligible whose level of performance is judged superior, by whatever definition or criterion. Alternatively, one can use a psychometric approach, relying on standardized tests that are, or at least should be, valid predictors of talent or high ability. The first approach is best exemplified by academic competitions; the second by the talent search.

In this chapter we examine the various facets of out-of-class programs and services, including the identification of high ability students through talent searches and academic competitions and special programs held after school, on weekends, or during summer holidays. While the chapter attempts to be inclusive in its coverage of the numerous out-of-class efforts currently in existence, detailed attention is paid to a small number of representative efforts in order to demonstrate in specific ways how these programs work and what they have accomplished.

After school and Saturday Programs

Parent Initiated Programs

Parents are generally the first adults in a child's life to become aware of the child's talent. When the child enters school, it may become especially necessary for parents to provide supplementary activities by introducing the child to exciting and fascinating subjects. For many parents this task is rather intimidating. When they seek professional help and advice from pediatricians, teachers, school psychologists or educational counselors they are sometimes confronted with ignorance and prejudice about the talented child and imputations that they are "pushy" parents.
Faced with the predicament of having to solve their problems more or less on their own, the parents of highly able children in many countries have established self-help groups in the form of associations such as the Gifted Child Society in the United States, the British National Association for Gifted Children (NAGC), the Deutsche Gesellschaft für das hochbegabte Kind in Germany, "Pharos" in The Netherlands, "Bekina" in Belgium, Association nationale pour les enfants intellectuellement precoces (ANPEIP) in France, or Elternverein für hochbegabte Kinder (EHK), Schweiz, in Switzerland. Their joint aims are to:

1. give help, advice and information to parents of gifted children.
2. increase community awareness and understanding of the need to develop links with and information for local professionals such as teachers, social workers and medical practitioners.
3. provide an opportunity for gifted and talented children to meet and to pursue their interests in company.
4. facilitate contact with interesting and informed adults, offering children intellectual stimulus and an introduction to a wide range of interests.

Most of the associations have formed regional branches in order to better serve the needs of their members. Joint activities or enrichment programs for the children are usually run by adult volunteers, often a parent of one of the children or someone who is generally interested in the children's progress. They determine to a large extent the selection of activities available.

**Long-term Courses**

The array of courses offered by parents' associations is dependent on diverse, often chance, influences such as the number of children of a certain age group interested and willing to participate, the availability of course instructors, or special rooms, materials and equipment. A considerably more intensive form of provision are intellectually demanding long-term courses which take place in the afternoons, on weekends, or during holidays and which allow for a more systematic approach to a specific area.

As an example of this type of program, the "Hamburg model" to find and foster mathematically able pupils will be described in more detail. In 1983, inspired by the work of Stanley and his group at Johns Hopkins University (Benbow & Stanley, 1983), a group of psychologists and mathematicians at the University of Hamburg developed an annual regional search for mathematically able pupils at the end of grade 6 (12-year-olds) (Wagner & Zimmermann, 1986). Selection criteria were (1) German versions of the mathematical parts of the Scholastic Aptitude Test (SAT) and (2) a test of mathematical problem solving consisting of seven items both of which were taken during an examination of three hours' duration.

Pupils interested in the talent search received a preparation booklet in advance containing a complete version of the mathematical parts of the SAT to be worked through and attempted at home. About 40 students, that is 20 to 25 percent of the participants in the talent search, are annually admitted to the program that takes place on Saturday mornings at Hamburg University. The pupils work in small groups on challenging mathematical problems, with topics that vary from week to week. Expert secondary school math teachers, mathematics students and mathematicians serve as instructors.
Rather than cover future curriculum material, the mathematical areas selected are predominantly those which pupils would find interesting and appealing and at the same time are important for the application of modern mathematics (e.g., graph theory, combinatorics, representation of numbers in connection with measuring, number theory, geometry and game theory). The problems are always chosen in such a way that they can be extended to allow the development of a small mathematical theory and put pupils in an elementary research situation. New problem areas are introduced by a short paper including a few initial questions which help motivate the pupils. In addition to developing and practicing strategies for problem solving, special importance is attached to recognizing, formulating and perhaps solving subsequent problems.

Despite the considerable length of the course (participation is possible for up to six consecutive years) and the very challenging course work, the extremely low dropout rate together with the high rate of attendance and the very positive opinions that the pupils have of the course are all indications that this type of program successfully meets such pupils' needs. The program's success is due, in part, to the stimulus provided by the assignments and to the informal manner of working in small groups, in pairs, or even alone, which is quite unlike that at school. There is, on the other hand, an important social motive for taking part: in this group pupils meet age-mates of a similarly high intellectual level and with mutual interests, without encountering incomprehension or even rejection. This type of separate provision for the highly able does not (as is sometimes implied) lead to social isolation but actually causes participants to feel less like outsiders. Most of them have for the first time been faced with a challenge commensurate with their capability and aptitude.

Funds from the German Federal Government initially helped to get the program started. After three years the program was self-supporting through contributions from the parents. Offshoots of the Hamburg project show that even when confronted with the typical transport and distance problems of a rural area the appeal of the program prevails despite the long journeys involved.

**Residential Programs**

The difficulties of commuter programs are overcome by residential programs which typically last from one to several weeks. This setting allows total involvement in a certain subject with intensive tutoring and a multitude of social contacts. Particularly in the United States, such programs have long been a fixed element of out-of-school provisions for highly able students (Olszewski-Kubilius, 1997). One of the most sound and consistent approaches was developed in 1979 at the Johns Hopkins University's Center for Talented Youth (CTY). It has been emulated by several institutions in the USA including Duke University, Northwestern University, the University of Denver, Arizona State University and California State University at Sacramento (Benbow & Lubinski, 1997).

By means of regional, national and international talent searches several thousand highly able students are identified annually. They are eligible for three-week residential summer programs which in 1999 serve about 4,000 participants at the CTY sites alone.

**The German Schülerakademien**
Inspired by the American approach to providing summer programs for highly able young people, in 1988 Bildung und Begabung, a non-profit German association, started residential summer programs for 16-19-year-old secondary school pupils, thus filling a critical gap between the last school years and higher education. Within a few years these "Schülerakademien" (pupils academies) have developed into an outstanding opportunity for academically highly talented and motivated adolescents which seems to be unique in continental Europe.

The main objectives of the academies are: (1) to offer several fields for scientific endeavor in order to develop and improve methods and abilities of knowledge acquisition, interdisciplinary thinking, research techniques and autonomous learning; (2) to challenge intellectual potentials to their limits; (3) to provide role models through encounters with highly creative, able, motivated and inspiring teachers and scientists; and (4) to experience a community of equally able and motivated peers, to develop lasting friendships and thus to accept one's own personality as valuable and "normal."

The 17-day academy typically embraces 90 boys and girls, each participating in one of six courses covering a broad range of diverse academic disciplines, e.g., mathematics, physics, foreign languages, creative writing, music, biology, chemistry, computer science, philosophy, history, economics, psychology, rhetoric and visual arts. The amount of time spent on course work within the 17 days is about 45 hours. The level of work is mostly comparable to advanced university seminars. Two teachers (scholars, expert school teachers or free-lancers) plan and conduct each of the courses with a minimum daily duration of 4-5 hours. The rest of the day is filled with additional optional activities such as sports, music, excursions, discussions and drama.

Between 1988 and 1998 42 academies with over 3,600 participants were held in boarding schools which have proven to be ideal locations for these programs in Germany. Within a few days, each of the academies develops a unique and special atmosphere, filled with enthusiasm and motivation of both participants and instructors, characterized by intensive and open personal relations and discussions until late at night.

The participants are expected to pay a fee that covers board and lodging, the rest of the expenses being subsidized by the Government, by foundations and private donations. Financial assistance is available to needy families. Pupils are invited to apply for a place after successful participation in one of the intellectually demanding competitions in Germany or being recommended by headmasters, teachers, educational consultants, or psychologists. In 1998, 1,015 (86%) of the 1,178 boys and girls who were invited applied for the 540 available places in six academies.

Extensive evaluations of the academies (Wagner, Neber & Heller 1995, Neber & Heller, 1997) have shown their long-lasting positive effects on the participants, especially with regard to their motivation, self-efficacy, self-assertion, self-reliance, cooperativeness and communication skills. Similar effects are reported from residential summer programs in the United States (Olszewski-Kubilius, 1997).

The major benefit of these programs seems to be that they provide opportunities for interaction with equally able and motivated peers. Pupils feel accepted often for the first time in their lives and many of them are astounded to discover how easy it is to communicate with and to make friends within this group. The results are frequently long-lasting relationships and communication networks.

Encounters with excellent instructors provide valuable role models for an academic orientation. They can be helpful in career counseling and might open perspectives into yet unconsidered professional areas. The intense atmosphere of
residential programs is capable of activating and stimulating dormant potentials. Many of these pupils relate with amazement what they were able to achieve in a short time.

In short, these programs have a tremendously beneficial impact on young lives. It would be highly desirable to increase the number of such programs, as the current demand far exceeds the existing supply of places.

**Academic Competitions**

Competitions are increasing by being made available to talented students in Europe, Asia, and the United States. In the United States 275 competitions (Karnes & Riley, 1996) are currently being used. These competitions have been developed in every academic area and in many nonacademic areas. Some of these competitions are targeted at elementary school children, others concern middle school children, and others are reserved for advanced high school students. Campbell (1998) found that American teachers use these competitions to challenge their gifted students.

**Potential Benefits and Liabilities of Competitions**

Competitions are funded by governments, foundations, and companies to develop extraordinary talent. Math, science, and engineering contests are conducted with the expectation of developing talent needed to supply the technical workforce (S & E work force). The S & E work force is essential for a nation’s economic health and development. In the United States several of the high school competitions were initially developed after the Russians launched Sputnik. One of President Eisenhower’s science advisors was Edwin Teller who urged the president to start academic contests that would get young people involved in the technical areas at early ages. This stimulus resulted in the initiation of several of the competitions that are still being used in America.

The chief benefit of these competitions for schools is their low cost. Competitions involving nationally administered tests can be done at very low costs per pupil. The supporters of competitions note that most societies are competitive. Certainly, businesses must, of necessity, be competitive, and the global economy has accelerated this process. Governments are also competitive not only in terms of their businesses but in many other areas. Competition exists even in academia where authors compete for publications and grants. Sports are competitive by definition; therefore, with all these levels of competition, it follows that competitions would emerge as a mechanism to uncover exceptional talent.

**Competitions in Europe, Russia, US, and Asia**

The Russians were the first to realize the potential of academic competitions and initiated the academic Olympics. The first academic Olympic program involved mathematics and was started in Leningrad in 1934 (Kukushkin, 1996). This Mathematics Olympic competition was extended to city programs in Moscow and Kiev in 1935. These Olympic programs eventually spread to the entire USSR and beyond. The Russians used these competitions to funnel talent into areas where they were needed. A student scoring exceptionally high on one of the academic Olympic exams was given automatic admission to some of the best universities. This admission placed the exceptional student in the Soviet S & E pipeline. In socialized countries national testing programs were
conducted that assured the identification of a steady stream of gifted individuals. Once identified, these talents could be funneled into areas where development was needed.

**European Competitions**

In Europe, the Federal Republic of Germany probably has the most elaborate system of competitions for school children at all levels. Competitions are considered to be important and valuable additional instruments in the educational process.

They are relatively easy to administer and to organize, they can be made accessible to a broad number of participants and they can be differentiated to suit any level of ability. Competitions are an excellent tool to elicit, stimulate and challenge talents in many different fields. They are supposed to activate and strengthen the inclination for the subject matter and thus to improve knowledge and ability. Struggling with the tasks of the competition enhances the abilities of working autonomously while researching, experimenting, problem solving, learning and practicing release energies and enhance perseverance.

By taking the challenge of a competition, the participants gain insight into their abilities and their position in comparison with peers beyond the confinement of their classroom and school. Coming together with other participants, they have the opportunity to meet similarly interested and able peers who are usually not so easily found. Attractive prizes like scholarships, summer programs, or money are additional incentives.

In Germany, there are more than twenty federal (nationwide) competitions and dozens of smaller competitions at the state or regional level. On the federal level well over 100,000 students participate annually either individually or in groups in disciplines such as mathematics, science (biology, chemistry, physics, technology, computer science, environmental studies), foreign languages, social studies, history, creative writing, music, composing, drama, film and video production. Most of these competitions are subsidized by the Federal Government, with a total allocation of c. 4 million Euro in 1999. In addition, a considerable part of the cost is covered by sponsoring foundations and industry. While most of the academic competitions are aimed at upper secondary school students (16+ years of age), there is, however, in most cases no lower limit for the age of participation thus granting admission to all kinds of accelerated talents.

Without doubt, one of the most remarkable competitions is the "Bundeswettbewerb Fremdsprachen" (Federal Languages Contest), as it is a unique comprehensive approach to support acquisition and application of foreign languages among secondary school students. The contest was initiated in 1979 by the Stifterverband für die Deutsche Wissenschaft (Donors' Association for the Promotion of Science in Germany) as a means to encourage students to learn foreign languages and to become interested in other countries and cultures at an early age. It has been developed and administered by independent experts from universities, schools and industry. Since 1985, the Federal Languages Contest has been sponsored mainly by the Federal Ministry of Education and Research. Bildung und Begabung e.V., a non-profit-making private association, is responsible for the organization and coordination of the contest.

The contest comprises four levels:

1. A group contest for students in grades 7-10 (13-16 years, in their third to sixth year of foreign language learning). The group contest encourages project work to produce a presentation (audio or video tape and additional written material) on a self-assigned subject (cf. Blüm, Hertel & Schröder, 1992).
(2) An individual junior contest for students in their fifth or sixth year of foreign language learning (15-16 years of age). It consists of an oral section (listening comprehension and oral production) and a written section (a cloze test, i.e., a text in which missing parts of words have to be filled in) and a creative writing task. The best participants in English usually demonstrate a higher proficiency than first year university students in English studies.

(3) An individual senior contest for students in grades 11-13 (17-19 years) in which at least two foreign languages must be presented. This contest consists of four rounds over a period of twelve months. It begins with an oral production in two languages (e.g., explaining the situation depicted in a cartoon, reading a text and answering questions on the text). The second round is a written examination with elements of translating, writing and summarizing. The task of the third round is writing a 3000-word essay on a given subject within a six-week period. The final round consists of a one-hour multilingual debating session in groups of four together with language experts and of individual oral examinations (cf. Hertel, Joppich, Schröder, & Stütz 1991). Placement in all rounds depends upon achievement only. The participants do not compete against each other as in a sports contest.

Successful participants can expect a variety of prizes. Winners of a first prize in the final round ("federal winners") are granted a scholarship for university studies from the most prestigious scholarship foundation in Germany (Studienstiftung des deutschen Volkes). Second and third prizes consist of cash. Several prizes (e.g., travel grants, books, records) are awarded by foreign embassies for special languages. The Federal Minister of Education and Research annually awards a five-week stay in a summer studies program at a university in the United States to three participants who wrote outstanding essays on U.S. related subjects.

(4) A group contest for apprentices and for students at vocational schools. Here, again, a presentation on audio or videotape is required which has to relate to their working sphere. Many of the entries are multilingual.

More than 20,000 students participate in these four contests each year, the main languages being English, Latin, French, Spanish, Italian and Russian. Additionally, special contests are offered to pupils who study Japanese or Chinese.

Some competitions are held at an international European level. To promote the idea of European integration the "European Competition" has been held since 1954. Each year students at all age levels in 19 European countries receive identical assignments to produce a pictorial or written treatment of European perspectives in social, economic, political or cultural affairs. In Germany alone over 100,000 students participate.

Most European countries run competitions for young researchers in the sciences. In 1990 the most famous science competition in Germany ("Jugend forscht") was sponsored by "Deutsche Bank" to initiate a European competition for environmental studies. Up to three entrants from (1998) 39 nations may participate in the "Young Europeans' Environmental Research (YEER)".

Another recent development was initiated by Romania in 1993: the Central European Olympiad in Informatics (CEOI) with (1998) Croatia, Poland, Slovak Republic, Czech Republic, Slovenia, and Hungary as participating countries. Other countries are expected to join in the following years.

Types of Competitions in the US
In the United States three types of competitions are currently employed. The first type uses teams of gifted students; the second type involves encouraging gifted students to do long-term independent research projects (preferably with scientists or scholars); and the third type utilizes a series of tests to identify the exceptionally talented.

The two most widely used American team competitions are Future Problem Solving and Odyssey of the Mind (Campbell, 1998). The Future Problem Solving Program has three levels of competition (junior, intermediate, senior) (Grades 4-12). The teams are given problems that require creativity and imagination to solve. Successful teams learn to work together. The problems frequently deal with futuristic scenarios. This program has local, state (state bowls), and international competitions.

The Odyssey of the Mind also emphasizes solving problems and creativity. Five problems are presented each year which require unique solutions. The problems range from engineering problems to literature analyses. The age range extends from K-12 and is organized into four divisions.

The next type of competition involves individual students doing independent research projects. Local Science and Engineering Fairs are very common in the US. At the high school level the projects become more advanced with many students working directly with scientists, mathematicians, and scholars (see Campbell, 1985; 1988). This direct involvement with the “producers” of technical knowledge has been accelerated by the Science Training Programs that are offered for talented students each summer throughout the United States. These programs are designed for advanced high school students to join research labs and participate in up-to-date research projects. These students become members of graduate research teams and serve as apprentices. The same process is used year-round for high schools located near universities or research labs. These projects are written up by the high school students and entered in the different competitions.

There are three national project competitions in the US of which the most prestigious is the Intel (Westinghouse) Talent Search (started in 1941). Each year this competition accepts applications from approximately 1,500 high school seniors. These applications must include descriptions of original research projects in mathematics, biology, physics, chemistry, engineering, or the social sciences (psychology, anthropology, sociology). The research papers follow standard scientific methods and scholarly reporting procedures.

The 300 best papers are selected by the Science Service as semifinalists. From this pool the top 40 (finalists) are then invited for a series of interviews in Washington, D.C. A final ranking is determined on the basis of the interviews, and $330,000 (US) in scholarships are awarded to the top finalists. Colleges and universities in the United States compete for the Intel winners (finalists and semifinalists). Their research skills are especially applicable at institutions that are committed to original research studies.

Over the 58-year history of this competition, 17,400 semifinalists and 2,320 finalists have been selected. The Science Service did a follow-up survey of the Intel finalists and found that they won five Nobel prizes, two Field Medals, and eight MacArthur Fellowships. However, the finalists comprise less than 13% of the Intel winners. There has been no comprehensive follow-up study to ascertain the number of the Intel winners in the United States S & E labor force.

Two other national research paper competitions are the Junior Science and Humanities Symposium (JSHS) and the International Science and Engineering Fair. The JSHS competitions are subdivided into 48 regionals, which are located in 50 states and
Puerto Rico. The finalists from each regional attend a national meeting and compete for scholarships. Each year this competition involves more than 3,000 high school students (Grades 9-12). The national conference has 240 finalists and awards $343,000 (US) in scholarships. Many of these finalists are also Intel winners.

The International Science and Engineering Fair is the largest research paper competition. In 1995 this competition reached 1,021,936 high school students (Grades 9-12). This competition is organized with local school fairs, regional, and state fairs and one national fair. Those selected for the national fair number 1,200 students. Again, many students enter other competitions and have the opportunity to win other contests.

The other types of national competitions involve testing of select groups of high school students. One of the largest is the National Merit Exam which tested 1,200,000 students in 1998. The top 50,000 students were contacted, and a sifting was performed where 34,000 received commendations and 16,000 are designated semifinalists. A further sifting narrowed down to 15,000 finalists who received $28,000,000 (US) in scholarships.

Another national program (Study of Mathematically Precocious Youth--SMPY) tests 7th-grade students with the SAT-M exam (Scholastic Aptitude Test Math). This program invites schools to test their top math students. These talent search programs identify the most talented math students and provide year-round activities and summer programs to help in developing this talent. These programs exist in every state and serve over 140,000 mathematically precocious participants (Goldstein, & Wagner, 1993).

The other national testing programs are the Olympiad Competitions (math, physics, chemistry). These competitions utilize multiple levels of tests to isolate very small sets of finalists. In math, three levels of tests are used to isolate the highest scoring eight students (6 finalists & 2 alternates), and in physics and chemistry the same process is used to isolate talent pools of 20 students from which the international finalists are selected (5 for physics; 6 for chemistry).

A total of 2,226,436 high school students participated in the competitions listed above (although many high ability students participated in multiple contests). The total US school age population in Grades 9-12 was 12,214,000, which indicates that a substantial percentage of talented students were involved in these competitions (Statistical Abstract of the United States, 1997).

**Rationale**

All competitions operate under a series of assumptions that constitute a distinctive rationale:

1. Children with talent need to be identified early.
2. Competitions are needed because most schools do not have the differentiated curriculum or the resources that are needed to develop the talents of extraordinary students.
3. Contests will attract participants with extraordinary talent.
4. Contests will motivate the early development of talent.
5. Once developed, this talent is expected to contribute to society.

Every expert since Lewis Terman (1922) has called for the early identification of talent. Terman used IQ tests to identify the intellectually talented. He believed that with
these tools schools could identify the gifted and then develop their talent accordingly. Unfortunately, Terman’s expectations were never realized due to limited administration of the early IQ tests or to the failure of the schools to initiate programs that would develop the talents of those children that were identified.

The second assumption gets at the heart of the problem. Few would argue that schools have developed the differentiated curriculum or obtained the resources that are needed to develop the talents of the full range of extraordinary students. Perhaps this failing rests with the extensive range of talents (both academic and nonacademic) that gifted students possess. Schools simply do not have the resources to accomplish this worthy goal.

The third assumption deals with the expectation that the talented will find out about the contests dealing with their special talent and this will stimulate their development (4th assumption). Both of these assumptions depend on getting the needed information to the students with the talent.

The last assumption -- once developed, this talent is expected to contribute to society -- is an open research question that is a vital topic to investigate. It must also be emphasized that in the United States millions of gifted students participate in academic competitions each year. Because of the sheer numbers that participate, it is crucial to see what the competitions achieve. The answer to this question can only come by conducting long-term follow-up studies that track down the winners of important competitions and determine the contribution they made to society.

Unfortunately, American schools have a poor record in evaluating gifted programs (Callahan & Caldwell, 1995). Campbell (1998) found that only 7% of the schools with gifted programs that he studied conducted rigorous evaluations. This reluctance to evaluate extends to the competitions. Many of the organizations sponsoring them operate on very limited funds and do not have the resources or the manpower to carry out follow-up studies. Furthermore the funding sources (governments, foundations, companies) might not want to conduct such studies when they realize the possibility that their investment might not be justified. It would be difficult to explain negative findings to government officials or to boards of directors.

**Academic Olympiad Studies**

A definitive answer to this question can only come when each of the different competitions undergoes long-term follow-up studies of their adult participants by outside evaluators. But we will provide a partial answer to this question by presenting information about three retrospective academic Olympiad studies.

Campbell, Feng, and Verna (1999) tracked down 15-27 years of winners of the American Math, Physics and Chemistry Olympiad programs. These long-term retrospective follow-up studies asked the following research questions:

**Research Questions**

Do the Olympiad competitions serve the national purpose? Do the academic Olympians make important contributions? Do they fulfill their high potential? The specific questions we asked within this framework included: What careers do the Olympians select? Do they do well in their careers? Do the Olympians remain in the field originally identified? How many doctoral degrees were earned by the Olympians? How productive
were the Olympians? How many publications and patents did they produce? Finally, we evaluated the effects of the Olympiad programs by asking the following questions: What effect did participation in the Olympiad program have on these talented individuals? Did it widen their horizons? Did it open doors for them? Were there negative side-effects?

To answer these questions we followed 229 Olympians through their college years to graduation (ages 15-22), into their graduate training (early careers) (ages 23-30), and finally onto their professional careers (career) (ages 30-46). They received information from substantial percentages of the national finalists (94% Math Olympians; 70% Physics Olympians, 68% Chemistry Olympians) (229 Olympians). Within the three age brackets there was much variation among the subject areas because of different starting dates for the programs. The Math Olympiad program started in 1972 and therefore contains the largest number of Olympians in the mature career bracket. The Chemistry Olympiad started in 1984, and the Physics Olympiad program started in 1986. These late starting points put more Olympians in the younger brackets. In the Physics study 49% of the Olympians are in the youngest age bracket, which means that fewer have had the time to establish publication records or to get advanced degrees.

One measure of success involves enrollment in the most selective colleges and the completion of college/universities degrees. The Olympians were successful in enrolling in the most prestigious colleges/universities in the United States (see Table 19.1). The institutions listed in this table constitute the most elite in the nation. The top five (Harvard, Princeton, MIT, U.C. Berkeley, University of Chicago) absorbed most of the Olympians and provided them with sound foundations for their careers. With their high GPA's and exceptional SAT scores, it is no surprise to find the Olympians at such institutions. However, a few of the Olympians had trouble completing their undergraduate degrees and some dropped out of college and took many years to finish. The majority finished their degrees within a four year period and enrolled in advanced degree programs.

The extent of the Olympians’ graduate training is evident from the graduate institutions listed in the table. The same selective colleges are listed at the graduate level. One hundred and sixteen Olympians completed, or are in the process of completing, doctoral degrees (MD; Ph.D.; JD). The average time the Olympians take in getting their doctorate degree is approximately 8 years from their high school graduation year. The shortest time any Olympian earned a doctorate degree was 6 years; the longest was 13 years. Overall, 51% of the Olympians have received, or will receive, doctorate degrees (Math 57%; Chemistry 49%; Physics 41% (see Table 19.2). Among the doctorate degrees there are five law degrees. The percentage for the Math Olympians is more illuminating because of the ages of these Olympians. The other subject areas contain many more college-age Olympians who will probably enroll in doctoral programs. Terman (1954), in his monumental longitudinal study, found that 26.3% of 800 gifted males had their doctorate or law degrees. The Olympians far exceed this percentage.

Most of the Olympians select careers in academia -- teaching at colleges or universities or doing research. These Olympians finish their doctorate degrees between 26 to 28 years of age and many go on to post doctorate experiences that take another two years. Consequently, most of these Olympians do not formally start their academic careers before the age of 30.

How successful are these Olympians? One measure of postsecondary faculty and staff productivity involves tabulating the number of publications produced. Table 19.4 contains the total publication data for the 229 Olympians. The Olympians have produced
a total of 2,921 publications. Most of these publications are written by the Olympians employed in colleges and universities, and most are in refereed journals. The Math Olympians published 1,865 items, the Chemistry Olympians produced 788 items, and the Physics Olympians produced 268. The bulk of these publications were written by Olympians in their thirties or forties.

The National Center for Educational Statistics has a national study underway of 11,000 higher education faculty in 480 institutions (National Survey of Postsecondary Faculty -- NSOFF) (Kirshstein, Matheson & Jing, 1997). The NSOFF data for 1992 showed the average number of publications for all college faculty was 4.6 per year. However, the faculty publication rate was much higher at research institutions (7.35/year for public colleges/universities; 7.95/year for private ones).

Some of Olympians have higher publication rates than the NSOFF faculty. Four of the Olympians have over 100 publications, and eight Olympians in their 30’s have produced between 50 and 99 publications. These academic “stars” are in positions of leadership. For example, one is director of Whitehead/MIT Center for Genome Research at 42 years of age and has already made contributions to cancer research. He has published 229 articles, research papers, technical reports, and two books, and serves on 12 editorial boards. Another 44 year old Olympian served as the editor for two journals, published one book, has 6 chapters in books, 51 articles in refereed journals, and 37 research papers. He is active in research dealing with electrical and computer engineering projects and in 1994 served as a member of the Defense Science Board studying Cruise Missile defense.

By contrast, some of the Olympians may be underachievers. Thirteen of the mature career Math Olympians have produced less than 10 publications. Some of these Olympians are in fields where publications are irrelevant to performance. Still, some Olympians reported psychological problems or drug problems, which have undermined their productivity.

The Olympians’ publication activities fit the pattern that Terman found in his longitudinal studies. Terman (1954) recorded the publications of 67 books and 1,400 articles and research papers for 800 gifted males. The average number of publications was 1.9 publications per person; for the Olympians the rate is greater at 12.8 publications per person. It must be emphasized that 69% of the Olympians are younger than 30 years old and can be expected to publish many more articles, books, papers, and secure more patents. The oldest cohort (ages 30-41), which has already produced 1,916 publications (26.6/person) can also be expected to continue to publish actively.

One factor involved in this high level of productivity is the mentoring done during the Olympians’ undergraduate and graduate years. The disparity between Olympians who have been mentored and those who were not mentored is startling (see Table 19.5). The majority of publications was done by those who were mentored.

A substantial number of Olympians have careers outside academia. Some gravitate to science and engineering careers, a good number are employed in computer areas, and still others are employed in the business sector (see Table 19.3). How successful are the Olympians in the noncollege/universities occupations? There is no way to determine the contribution made by the Olympians in the nonacademic community, but the job titles indicate a number of responsible positions. The most successful might include the eight Olympians employed by financial institutions on Wall Street. One is an executive at the prestigious Salomon Brothers; one is a bond trader; one is an associate with Goldman, Sachs; and two are financial analysts with major banks.
Two of these individuals are in charge of the research on derivatives. One of the lawyers is the council for the mayor’s office in one of the largest cities in the US.

There are several Olympians employed in the computer industry. Three Olympians founded software companies. Two are currently the CEO of their companies, and another remains an executive with his company. Another Olympian is the executive director of a nonprofit corporation.

A number of Olympians are scientists or engineers. One is a principal engineer with nine patents; another is a scientist at Los Alamos National lab; two are researchers at the Bell Labs (AT&T); two others are senior scientists at IBM; and one is a scientist with DuPont.

Two of the Olympians are Talmud scholars. Four of the Olympians are teachers, two of these teachers co-authored two textbooks. Another Olympian founded a journal that is in its 12th year, and another is a correspondent with a science magazine. One Olympian performed with a musical ensemble at Carnegie Hall; another is an independent film maker.

Would the Olympians have turned out as well without the Olympiad programs? This is a fundamental question to ask the adult Olympians and their parents. It is also a question that should be asked by independent evaluators who have no connection to these programs.

Both the Olympians (76%) and their parents (70%) expressed the view that they would not have accomplished as much without the programs. When asked if the programs helped or hindered their acceptance of their talents, 76% of the Olympians and 74% of their parents concluded that the program helped. Only 4% of the Olympians and none of the parents thought it hindered the development of their talent in any way. Most Olympians (76%) and their parents (83%) reported that the program helped to increase their awareness of educational opportunities.

**Delayed Recognition**

The Olympiad programs had some profound effects on the participants. When asked to comment about what the Olympiad experience meant to them, many responded with lengthy statements. Most of the Olympians had supportive families that nurtured confidence in their abilities, but to score in the top places in a national exam was a more important milestone for their confidence. They described their reactions to this achievement in these ways: “confirmation of my abilities,” “realization I had potential,” “confidence booster,” “discovering I had the right to believe in my own abilities,” “a chance to be recognized,” “made me aware, for the first time, that my talent was really unusual,” “validating,” “confirmed my merit,” “a more objective indication of my talent,” “It helped me gage my talent,” and “First indication I had of how good I really was.”

This theme is titled “delayed recognition” because so many of the Olympians did not realize the extent of their talent. Some of them had undervalued their capabilities and had set more modest goals for themselves. Their high scores on the Olympiad exams supplied them with much more confidence in their abilities. It also helped them to evaluate their potential more realistically and to set higher goals for themselves. The program also had several other benefits. After announcing the results of the exams, the Olympians were invited to an intensive summer training program. This training brought the Olympians in contact with other bright students and exposed them to stimulating presentations by well-known scientists and mathematicians. The effects of being
exposed to equally bright peers had beneficial effects. One of the side effects of the national training program was to alert the Olympians to a select number of colleges and universities where their talents could be optimally developed. It is our contention that this experience was somewhat responsible for so many of the Olympians enrolling in Harvard, Princeton, MIT, and U.C. Berkeley.

**Rewarding Accomplishment**

The Olympiad studies underscore the need to identify and develop those with most talent. But in America these needs clash with equity issues (Tannenbaum, 1997). Consequently, gifted and accomplished adolescents often go unrecognized and unrewarded for their efforts. Most of the federal supplemental funding of schools, for example, supports programs for disabled, limited-English speaking, and poor children. Within the past decade, new privately funded programs have arisen to support students of higher abilities and reward them for their effort. The National Alliance for Excellence, for example, gives strictly merit-based university scholarships for near perfect scores on matriculation examinations, the completion of university work in secondary school, and related criteria.

Some psychologists and other experts believe that even more immediate monetary rewards would have bigger effects in encouraging adolescents to put forth greater effort on advanced academic study. Walberg (1998) recently evaluated apparently the largest program of its kind—the Dallas, Texas-based O’Donnell Foundation’s Incentive Program.

The Foundation agreed to pay teachers $2,500 to take a course on how to teach Advanced Placement (AP) university-level courses and $100 for each of their students who passed. The students also received $100 for each AP exam they passed in English, calculus, statistics, computer science, biology, chemistry, and physics, plus a reimbursement for the cost of taking the exam.

In the nine participating Dallas schools, sharply increasing numbers of boys and girls of all major ethnic groups took and passed the AP exams. The number rose more than twelve-fold from 41 the year before the program began to 521 when it ended in 1994-95. After terminating, the program continued to have carry-over effects: in the 1996-97 school year, two years after the program ended, 442 students passed, about eleven times more than the number in the year before the program began.

Though these numbers speak for themselves, interviews with students, teachers, and college admission officers revealed high regard for the Incentive Program. They felt that even students who failed AP exams learned better study habits and the importance of hard work to meet high standards.

In addition, the program had other benefits: students could take more advanced courses in college. Those that passed a sufficient number of AP courses could graduate from college early, which saves their families tuition and tax payers subsidies. Those who passed AP courses also had a better chance for merit scholarships and entry into selective colleges.

The Incentive Program suggests that, at least in the U.S., incentivized standards work in schools as they do in many spheres of life. The lack of incentives in school seems an important reason why American students find academics so boring and sports so exciting. It may also account for the poor showing of typical U.S. students on international comparisons of achievement.

**Conclusions**
The data presented above supplies answers to the questions we asked earlier in this chapter: Do the Olympiad competitions serve the national purpose? Do the academic Olympians make important contributions? Do they fulfill their high potential? When the contributions are summed, including the number of doctorate degrees earned, the number of Olympians working as professors (many in technically needed areas), the number of scientists (some in sensitive and needed areas), the 2,921 publications produced, the number working in the computer industry, including several who have founded or managed software companies, and the Olympians working on Wall Street, we must conclude that the Olympians serve the national interest. They do make important contributions and a number of them fulfill their high potential. Overall, the quality of their contributions outweighs their small numerical numbers. Many of the Olympians are working in leadership positions that magnify their influence.

It must also be remembered that many of these contributions listed above are limited to the oldest Olympiad cohort (72 individuals between the ages of 30-42). These Olympians are in the prime of their careers and can be expected to make many more contributions over the next 20 or 30 years. Furthermore, the younger cohorts can also be expected to assemble a long list of their own contributions.

Having evaluated three competitions, what inferences can be made about the other American competitions? Do they serve the national interest? It is reasonable to infer that the Intel Talent Searches, the JSHS competitions, the SMPY programs, the Science Fairs, and the National Merit Exams all funnel talented students into the United States’ science and engineering pipeline. Perhaps this is one of the secrets of America’s uncanny ways of developing talent. Campbell (1985, 1992) studied the impact of the Intel Talent Searches on the participants and found that in order to succeed in this competition the students needed to develop the following skills, attitudes, and orientations: learn to manage time; develop library skills needed to conduct technical searches; learn how to read scientific and other advanced material; develop the organization skills to manage a research project; and finally develop the discipline needed to conduct scholarly research studies or to learn how to study for challenging examinations. These enhanced skills not only help the student do well in the contests but can also be applied in future schooling or later in their careers. Even if participants do not win the contest, these newly developed skills will prove very useful. In this sense there may be no “losers” in a competition where the participants learn things that they can use to enhance their development.

There are some international implications from these analyses. The cost of most of the American competitions is surprisingly low. For example, participation in the Math Olympiad program costs the school only $15.00 (US) and 75 cents per pupil. The costs for the science fairs, the Intel Talent Search, the JSHS regionals and national, and the National Merit Exams are paid by companies, foundations, or by the government. For the most part students competing in these contests use resources outside the schools. Campbell (1985) found that individual teachers in exemplary schools negotiated lab space for their gifted students in universities or research labs nearby. There was no need to improve or upgrade facilities or computers at the schools.

Therefore, many of these competitions are cost-effective, inexpensive ways to develop talent. Any extra expenses, including transportation costs, are willingly met by the parents. Consequently, we believe that competitions should be much more widely
used internationally. Third world developing countries with limited financial resources for education should develop a wide range of competitions to nurture the indigenous talent that exists in these countries.

References


Table 16.1
Colleges and Universities Attended by Olympians

<table>
<thead>
<tr>
<th>Colleges/Universities</th>
<th>Number enrolled Undergraduate</th>
<th>Number enrolled Graduate</th>
<th>Total enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard</td>
<td>46</td>
<td>37</td>
<td>83</td>
</tr>
<tr>
<td>MIT</td>
<td>17</td>
<td>21</td>
<td>38</td>
</tr>
<tr>
<td>Princeton</td>
<td>22</td>
<td>12</td>
<td>34</td>
</tr>
<tr>
<td>Stanford</td>
<td>8</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>U.C. Berkley</td>
<td>8</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Cal. Tech.</td>
<td>10</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>U. Chicago</td>
<td>5</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Cambridge (UK)</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>U. Illinois</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Duke</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Rice</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Carnegie Mellon</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>U. Michigan</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Yale</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Cornell</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Northwestern</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>UCLA</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Oxford (UK)</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Johns Hopkins</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Columbia</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 16.2
Doctoral Degrees Attained by Olympians

<table>
<thead>
<tr>
<th>Advanced Degrees</th>
<th>Mathematics</th>
<th>Physics</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>48</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>M.D.</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>J.D.</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>21</td>
<td>45</td>
</tr>
</tbody>
</table>

Number of Olympians in Subject Areas

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Olympians</td>
<td>87</td>
<td>51</td>
</tr>
</tbody>
</table>

Percent with Doctorate Degrees

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent with Doctorate Degrees</td>
<td>57%</td>
<td>41%</td>
</tr>
</tbody>
</table>
### Table 16.3
Olympians’ Occupations (not in Colleges and Universities)

<table>
<thead>
<tr>
<th>Number</th>
<th>Occupation/Job Title</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Computer Occupations</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Computer Programmer/Analyst</td>
</tr>
<tr>
<td>2</td>
<td>Computer Music Companies</td>
</tr>
<tr>
<td>2</td>
<td>Software Developer</td>
</tr>
<tr>
<td>2</td>
<td>Software Engineer</td>
</tr>
<tr>
<td>2</td>
<td>Founded Software Companies</td>
</tr>
<tr>
<td>1</td>
<td>Software Company Exec.</td>
</tr>
<tr>
<td>1</td>
<td>Founder Internet Co.</td>
</tr>
<tr>
<td>1</td>
<td>Director Product Design (Software)</td>
</tr>
<tr>
<td>1</td>
<td>Microsoft Program Manager</td>
</tr>
<tr>
<td>1</td>
<td>Computer Programmer/Algorithm Designer</td>
</tr>
<tr>
<td><strong>Scientific Occupations</strong></td>
<td></td>
</tr>
</tbody>
</table>
| 18 | Scientists/Engineers  
(including 1 Principal Engineer with 9 patents, 1 at Los Alamos Nat. Lab, 2 at Bell labs (ATT), 1 at IBM, 1 at DuPont) |
| 1 | Consultant -- Scientific Programmer |
| 1 | President & CEO Technology Corp. |
| 1 | System Integrator |
| 1 | Product Line Manager |
| **Other Occupations** | |
| 8 | Wall Street  
(including 3 financial analysts, 1 bond trader) |
| 5 | Lawyer |
| 4 | Teacher (2 Authored Text Books) |
| 2 | Talmud Scholar |
| 1 | Executive Director of Nonprofit Corp. |
| 1 | Correspondent (Scientific Magazine) |
| 1 | Independent film Maker |
### Table 16.4
Total Publications

<table>
<thead>
<tr>
<th>Age Cohorts</th>
<th>Mathematics</th>
<th>Physics</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ages 15-22</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreCollege/College</td>
<td>10 (1.4/person)</td>
<td>113 (6.3/person)</td>
<td>107 (4.9/person)</td>
</tr>
<tr>
<td>N=7</td>
<td>N=25</td>
<td>N=31</td>
<td></td>
</tr>
<tr>
<td><strong>Ages 23-29</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Career</td>
<td>231 (7.7/person)</td>
<td>141 (7.4/person)</td>
<td>401 (18.2/person)</td>
</tr>
<tr>
<td>N=30</td>
<td>N=23</td>
<td>N=41</td>
<td></td>
</tr>
<tr>
<td><strong>Ages 30-46</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature Career</td>
<td>1,622 (32/person)</td>
<td>14 (14/person)</td>
<td>280 (23.3/person)</td>
</tr>
<tr>
<td>N=50</td>
<td>N=3</td>
<td>N=19</td>
<td></td>
</tr>
<tr>
<td><strong>Total Publications in Subject Areas</strong></td>
<td>1,865</td>
<td>268</td>
<td>788</td>
</tr>
<tr>
<td>N=87</td>
<td>N=51</td>
<td>N=91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mentored</td>
<td>Nonmentored</td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Math Olympians</td>
<td>84%</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>Chemistry Olympians</td>
<td>64%</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>Physics Olympians</td>
<td>72%</td>
<td>28%</td>
<td></td>
</tr>
</tbody>
</table>