Searching for Scientifically Talented Youth?

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When the Study of Mathematically Precocious Youth (SMPY) began in 1971, it had a longer name—"Study of Mathematically *and Scientifically* Precocious Youth." Its first talent search, in 1972, was two contests, one in math as judged by performance of youngsters, chiefly seventh and eighth graders, on the mathematics section of the Scholastic Aptitude Test (SAT), and the other in science as judged by performance of similar-aged students on two forms of a college-level test of general science knowledge. Several factors led to the Study's limiting its focus to mathematically talented. First, the type and level of science one pursues depends primarily on how much mathematics one knows. Second, knowledge of science information alone does not indicate presence of the kinds of logical and analytical reasoning abilities for which the Study's staff were looking. One youngster who participated in both the mathematics and science contests scored extraordinarily high in general science knowledge but much lower in mathematics reasoning ability. His major interests in science centered on geology and polishing gems. Such talents are valuable, but it was for youths with greater potential for superb quantitative reasoning (as might be needed for innovative contributions in theoretical physics, theoretical chemistry, or pure mathematics) that Julian Stanley and his colleagues sought. So the Study became SMPY—the Study of Mathematically Precocious Youth.

In subsequent talent searches, however, other talents in addition to mathematical reasoning ability were found to influence student performance in some educationally accelerative learning situations developed and studied by SMPY. For a brilliant math reasoner to do well in a class or tutorial program, which might cover as much as four and a half years worth of mathematics in a single year (meeting for two hours once a week), a certain level of verbal reasoning ability is needed to read and understand material quickly. In another instance, highly developed abilities in space relations and mechanical comprehension make learning physics relatively easy for excellent quantitative reasoners. Moreover, capacity to discipline oneself to initate and persist in completing homework assignments was found to be a crucial factor in determining the student's level of accomplishment.

By 1976 a particular phenomenon became clear. At that time not a single early entrant to college, or other radical accelerant, had declared an interest in pursuing chemistry as a career. (Only one accelerant since then, a girl, has expressed *real* interest in chemistry.) Few SMPY students major in physics either. The Camille and Henry Dreyfus Foundation, providers of National Merit Scholarship funds for potential chemists, bio-chemists, and chemical engineers noticed that youths who received such money rarely ended up pursuing a chemistry career. An SMPY study supported by the Dreyfus Foundation was conducted to investigate the phenomenon. The study along with a similar physics study funded by the Geraldine Rockefeller Dodge Foundation began in 1978.

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For a youngster to participate in SMPY's Summer 1978 chemistry-physics facilitation study, he had to have taken part in the 1976 Talent Search and return for a full day of testing. After testing, students were ranked according to the sum of standardized scores earned on the eight cognitive ability tests. Only the top 130 of the 507 male contestants were invited to a third testing session. Too few girls participated in the talent search to garner a large enough sample of them for this study. Ninety-seven boys (mostly eighth graders) came to the third session. Five additional cognitive measures were given, bringing the ability measures to 13. All the boys were invited to participate in the chemistry-physics study. Fifty-four did so.

These boys were clearly abler in general intellectual abilities than those who turned down the chance, based on the difference in the average sum of standard scores on the 13 cognitive measures between the two groups. We wondered which tests, if any, discriminated against those boys who did not take part. Three tests did differentiate the two groups. Participants were abler in space relations. Perhaps this was the result of self-selection as students were told that geometry would be part of the facilitation program. Participants also scored higher on the College Board's Physics Achievement Test before having a physics course, and higher on both forms of the college-level general science information test, one of the Sequential Tests of Educational Progress, published by the Educational Testing Service. Just one of the 23 affective scales administered to them discriminated the two groups, the Theoretical Value Scale from the Allport, Vernon, Lindzey *Study of Values*. High scores on this scale show that theoretical interests have high or highest priority over social, political, aesthetic, economic, and religious attitudes.

What can we infer from the results? Data suggest that successful participants in these kinds of facilitative activities are *able* specifically in mathematical reasoning ability, verbal reasoning ability, and space relations. (Facilitative options in less quantitative and more naturalistic science would require a different constellation of talents.) Moreover, data suggest that, beyond being able, participants are also *curious* and *committed*.

We need, then, to focus our search on those youngsters who are *able* in talent dimensions needed by a given field, *curious* about that science, science in general, and themselves, and *committed* to develop their special potentialities.

An important question remains: How might we apply these findings to typical high school and junior high school systems? The answer involves several steps.

Step 1: To establish eligibility for a facilitative program, use a summary measure from a profile of specific ability tests with the caveat that no single score be below a defined minimum. For example eligible seventh- and eighth-grade students would have to score in the top three percentiles on the summary score from the Iowa Tests of Basic Skills, as long as no single score is below the 80th percentile. Depending on the difficulty level of the facilitation, you could give harder tests of mathematical and verbal reasoning abilities to separate the extraordinarily talented from those who are very talented, but relatively less so. One should use a summary score from a battery of tests rather than a global intelligence measure like IQ. The IQ score does not contain enough specific information for adequate educational planning. By using a summary score from a battery of tests, specific information about a person's set of abilities from the score profile emerges. The summary score is similar to other estimates of mental age, but the value of using batteries of tests that offer more than a single score rests in information about types and levels of specific abilities a person has.

Step 2: To create efficient and effective programs, find out how much general and specific science information each student knows by giving appropriately difficult achievement tests to eligible students who *want* to take them.

Step 3: Invite those who are able and who are curious about themselves to choose from several facilitative options. Options may range from an Advanced Placement Program (APP) style course to an introductory level but stimulating short-term seminar. Students can then self-select.

Different sciences need different constellations of abilities. This fact should effect choice of identification and facilitation strategies. The affective variables of curiosity and commitment are crucial for students to make good use of their abilities and should be included in the selection processes. Identification strategies that are wedded to the type of science, the level of difficulty, and character of facilitation are most likely to be effective. The importance of students *self-selecting* to participate in a program, after good counsel, cannot be overemphasized.

NOTE: *The March 1979 issue of* Science and Children *was dedicated to the topic of science education for gifted and talented students.*