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News around the world

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a reflective conversation with Linda Brody: about math and giftedness

Linda Brody is Director of the Julian C. Stanley Study of Exceptional Talent (SET) at the Johns Hopkins University Center for Talented Youth in Baltimore, Maryland. She also directs the development of Cogito.org.

- **Linda, what are you currently involved in and researching?**

For readers who aren't familiar with the Study of Exceptional Talent (SET), this project, an outgrowth of the Study of Mathematically Precocious Youth, seeks to identify and serve students with exceptionally advanced mathematical or verbal reasoning abilities. Specifically, we identify students who score 700 or above on the Math or Critical Reading SAT before the age of 13 and provide a variety of services throughout high school to help them achieve their potential. The students are also part of an ongoing research study, the goal of which is to help us understand the characteristics and needs of highly gifted students and to evaluate the efficacy of programmatic interventions and strategies to meet those needs.

We follow SET alumni over time, and the oldest students who qualified for SET are now in their late 30s and early 40s and well-launched into their careers. We know that many of them have proven to be highly successful, some even achieving eminence in their fields. We are working on locating students who we have not heard from in

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some time in an effort to get a fuller picture of what has happened to the group as a whole. We are interested in identifying the factors and pathways that have been critical to their talent development, as well as understanding any barriers that may have gotten in the way. One particular interest is the achievement in math and science by females who were identified in middle school as exceptionally mathematically talented.

- **What exactly is Cogito.org and how did this get started?**

Cogito is a website and online community for students around the world with high abilities and interests in mathematics and the sciences. Most of the site is open to the public and is intended to be widely used by students, parents, and teachers, but the discussion forums are limited to student members who are nominated by a talent search, competition sponsor, or educator as exhibiting talent and interest in math or science. We are particularly interested in inviting educators in other countries to contact us about getting their students involved in the site.

Cogito was the vision of the John Templeton Foundation, which provided the initial funding for its development. It evolved from a concern that many gifted students lack resources to develop their talents and can be isolated from intellectual peers who truly share their interests and abilities. Since the Internet can transcend geographic boundaries, Cogito provides a vehicle to connect gifted students with each other, with resources, and with experts in their fields. The site aims to inspire students who have the greatest potential to solve the world's big problems in the future to consider a career in scientific research and/or public policy.

Cogito's goals very much reflect goals that CTY and SET have espoused over the years as we have developed programs and fostered networks to support the educational and social needs of students with advanced academic abilities. The site was developed by CTY in cooperation with CTD at Northwestern University, TIP at Duke University, the Rocky Mt. Talent Search at the University of Denver, C-MITES at Carnegie Mellon University, the Belin-Blank Center at the University of Iowa, the Davidson Institute for Talent Development, the Center for Excellence in Education, and the Society for Science and the Public. All of these program directors have nominated students for membership in Cogito, but other educators are welcome to nominate strong students as well.

- **What kinds of resources would parents and teachers find at Cogito.org?**

Parents and teachers looking for programs to challenge bright students can access Cogito's searchable database of summer programs, competitions, and other out-of-school opportunities. They can encourage their students who are interested in doing scientific research to read the profiles of other students whose efforts are profiled on the site for ideas about how to proceed. They can also enhance their students' career development by having them read about, and interact with, the experts interviewed on Cogito.

If parents and teachers are looking for an outlet for student writing, Cogito welcomes articles, essays, and book reviews for publication. Students can also assume more responsibility for the site as forum hosts and content-area specialists, thus enhancing the development of their leadership abilities and social skills. Cogito provides an intellectual alternative to other social networking sites by linking gifted students to peers with high

abilities and interests in the sciences. We hope parents and teachers will recognize the value of this opportunity and encourage students to participate.

- **Let's talk about math instruction and giftedness. Who is involved in working with talented math students?**

In recent years, we have witnessed a significant proportion of the middle school students qualifying for SET as being quite advanced in their math placement, some even taking Calculus by 7th or 8th grade. This suggests that somehow they have been able to access advanced courses—in some cases it has been through their schools, in others they have found opportunities outside of school. In general, however, most schools still resist the idea of accelerating students in math placement, which is very frustrating for students who are forced to repeat content they have already mastered. But a great deal is happening outside of school with regard to providing students with challenging opportunities in mathematics.

For example, there is a growing movement to establish Math Circles in local communities, bringing math-talented students together with their peers. All of the Talent Search centers, including CTY, offer summer and/or online courses that allow mathematically talented students to accelerate or augment their math learning. Students can also enroll in such math-intensive summer programs as AwesomeMath, the Ross Program, PROMYS, and the Hampshire College Summer Studies in Math, or they can do independent research in an internship program such as the Research Science Institute. Math competitions challenge students from the upper elementary grades through high school, culminating in the prestigious International Mathematics Olympiad, and online preparation for competing is available through Art of Problem Solving and AwesomeMath. Students engaged in independent research can submit projects to such competitions as the Intel Science Talent Search, and a math project won the first place prize this year in that contest.

Clearly, all of these supplemental out-of-school opportunities greatly enhance the learning and motivation of mathematically talented students. Many of these programs also provide ways for students to meet and interact with students who share their interests and abilities in math and math-related topics.

- **What are some of the main approaches to teaching math to gifted students?**

As in most of the gifted education field, the main approaches are acceleration and enrichment. Clearly, most mathematically talented students benefit from some degree of acceleration, and the effectiveness of acceleration as a strategy to serve gifted students has been well documented through research.

It's important to recognize that much of the math content traditionally taught in school builds in a great deal of repetition—we refer to it as a spiral curriculum—and most gifted students don't need this repetition. When Julian Stanley wrote about students mastering years of math in a short period of time, it was because they were allowed to test out of what they already knew and move ahead without unnecessary repetition. It is quite amazing how much mathematically talented students may already know in advance of formal study. We need to pre-test students on their knowledge of math and then provide instruction at a level and pace that is appropriate for their ability and achievement

levels. For many gifted students, this means finding a way to let them access more advanced content.

What poses as enrichment in many pull-out programs can be problematic if it is simply exposure to a segment of the next year's curriculum, without crediting the student for having completed it so that he or she will not have to redo it when the next year comes around. On the other hand, exposing students to sophisticated problem solving, such as that offered by the competition community, or to an area of math not typically covered in school, such as cryptology, provides enrichment that is a valuable and important addition to a mathematically gifted student's learning of mathematics.

- **Are the schools adequately addressing the needs of the gifted in terms of math instruction?**

Unfortunately, in most cases they aren't. As I've already suggested, the biggest problem with school-based instruction is that the level and pace are inappropriate for most mathematically gifted students, and schools are unwilling or unable to adjust it. Some schools attempt to challenge students by placing them in classes with older students—a good solution for many mathematically talented students—but they are still unable to find a way to adjust the pace of instruction for those students who really need to move faster. For this reason, many students are turning to online learning, where they can progress through the curriculum at their own pace. In some cases, schools are purchasing the online services as a way to differentiate instruction for their most advanced students.

On a positive note, there are an increasing number of magnet schools, especially at the high school level, that focus on math and science, and most of them are truly excellent. They seem to be aware of the needs of advanced students, have a critical mass of students with similar needs, and have highly capable teachers who can teach the advanced courses.

- **What are some of the important things that parents need to know about mathematically precocious youth?**

In terms of their mathematics education, parents should know that most mathematically precocious students are capable of moving at a faster pace and learning more advanced math earlier than other students their age and that it is important that they be challenged. Typically, these students also benefit from being able to interact with other mathematically talented students, interaction that is enhanced through participation in math competitions and other special supplemental programs. Parents should seek opportunities whenever possible for their children to meet intellectual peers.

It is wrong, however, to assume that all mathematically precocious students have the same needs. Even in terms of math, students with high math ability may still vary in the level of that ability, as well as in their math content knowledge and the degree of their math interest. Such differences have implications for programming. Mathematically talented students, as a group, are also quite heterogeneous in their other abilities, in their interests and goals, in their social and emotional development, and in their learning styles and motivation. Parents need to get to know their children as individuals in order to make appropriate decisions about their unique needs, and assessment can help inform this knowledge. Available resources in the school and community also factor into decision-making.

For example, a student who is advanced verbally as well as mathematically might be a candidate for grade acceleration while a mathematically talented student without similar verbal gifts might only need to accelerate in mathematics. A math-talented student who attends a rigorous magnet school may be well-served by regular classroom instruction while a similar student at a less rigorous school may need a differentiated program. And a student with a passionate interest in math may want to devote his extracurricular pursuits to math competitions while another equally talented student may have stronger interests in a different direction. These differences affect curricular and extracurricular choices.

- **Is there any research about personality factors that seem to contribute to mathematically precocious youth?**

Yes, there is. Researchers at Johns Hopkins have found that students with exceptional math abilities are more likely to be introverts than the general population. They also tend to value theoretical and investigative interests, especially the males. All of these traits can be useful in pursuing mathematical and scientific career paths. Other studies of mathematically talented students have shown them to be well-adjusted, independent, and flexible, all good traits if students must take risks in order to be appropriately challenged. Studies have also been done on perfectionism and found it not to be a problem for most of the mathematically talented students studied.

- **Can we turn to science instruction now. Who do you see as some of the leaders in providing appropriate instruction for gifted students in terms of science?**

Science education in general suffers from what we refer to as teaching in silos: biology, chemistry, and physics as separate disciplines. Yet, this isn't what the real world of science is about today; scientific inquiry is, in fact, very interdisciplinary. There also isn't enough emphasis on problem solving. This is particularly problematic for gifted students who need to be challenged. We need more curricula that is interdisciplinary in its focus and that stimulates thinking.

The Center for Gifted Education at William and Mary, under the leadership of Dr. Joyce VanTassel-Baska, has developed a science curriculum for grades 1-8 that emphasizes critical thinking skills and is quite exciting. At the high school level, the Advanced Placement Program offers a fairly rigorous curriculum; however, students need to be allowed to not wait until senior year if they are to be able to access all of the AP science courses. Our most advanced science students also try to include a science research experience in their high school programs, and an increasing number of high schools have teachers in place to support that focus, though more need to do so. Specialized math and science high schools typically offer the most opportunities to serve students with scientific talents and interests.

Out-of-school opportunities augment students' interests to advance in science, just as they do in math. There are International Olympiads in Biology, Chemistry, Physics, Informatics, Computational Linguistics, and Astronomy (although the United States doesn't participate in Astronomy), as well as numerous other challenging competitions in which students can test their knowledge, such as the Brain Bee. Students compete with individual projects at local and regional science fairs, with top students going on to participate in the International Science and Engineering Fair and/or the prestigious Intel Science Talent Search. Numerous summer programs, internships, and online courses also provide students with access to

advanced content in science. We need to be concerned, however, about talented students who do not have access to such opportunities.

- **Are our gifted students getting the scientific thinking skills they need?**

Typically, no. When we look at the top winners in our most competitive high school science competitions, they are asking and answering questions that would have challenged graduate students a generation ago, so that's impressive. But the number of students involved is fairly small. Many other students sit in their high school science classes with little exposure to the real problems the world faces, and, in spite of the availability of out-of-school options, they are not accessible for a variety of reasons to all students who would benefit from them.

- **Some schools do these science fairs. Is this an adequate approach to helping gifted students grow into gifted scientists?**

I love science fairs. As a result of doing independent projects, students learn about the scientific research process and can experience the thrill of scientific discovery. However, they can't make up for an unchallenging academic program. Preparing for a science fair should be just one part of the science education experience. Students first need a comprehensive content background in order to be able to engage in research at a high level, and they need exposure to scientists to understand their work and to want to follow in their footsteps. Cogito hopes to provide some of the content students need, as well as exposure to students and experts engaged in scientific investigation. But schools must provide appropriately challenging coursework if they are to nurture future scientists.

- **Who are some of the leaders in the field of science education there at Johns Hopkins? How frequently do you work with them?**

Science content specialists at CTY develop our summer and online science offerings, sometimes in consultation with departments at Johns Hopkins such as Engineering and sometimes with outside experts. With regard to Cogito, in particular, Johns Hopkins faculty across the university from the Schools of Arts and Sciences, Engineering, and Public Health serve on our Advisory Board and have been the subjects of interviews for the Web site. Johns Hopkins doesn't have a science education focus in its School of Education, so I can't point to any leaders in science education there per se. But CTY is very proud of the science coursework we offer through our summer and online programs.

- **What are some of your plans for the next decade in terms of carrying on the work of Julian Stanley? What do you see as his legacy?**

Julian Stanley's most immediate legacy is the many hundreds of students his work directly touched while he was alive. He always took time to counsel individual students and families, and many are paying that effort back by making important contributions to society. Stanley also left numerous programs in place that continue to thrive including university-based Talent Searches, early college entrance programs, and numerous school-based initiatives. In addition, his research left a legacy that continues to guide many of us in our work with academically talented students. He demonstrated the power of above-level testing for identifying students with advanced academic abilities, provided evidence that acceleration is an effective strategy for serving advanced students and revealed a wide variety of

ways to accelerate students, shed light on the social and emotional needs of highly gifted students, and developed numerous research-based program models to serve academically talented students.

SET was re-named the Julian C. Stanley Study of Exceptional Talent in 2005 and is actually the only gifted education initiative that bears Stanley's name. As such, we feel a special obligation to honor his memory, and it is fitting that SET's mission reflects much of what Stanley did as director of the Study of Mathematically Precocious Youth, i.e., a combination of providing direct counseling to students with exceptional academic talents and furthering our knowledge of their needs through research.

Going forward, we plan to intensify SET's research efforts related to studying and following up students who have gone through the SET program. We are also planning a series of academic symposia in Stanley's honor that will highlight relevant research findings, the first of which will be held in 2010 and will focus on the development of mathematical talent. We remain committed to serving talented students directly through our counseling and other services (including Cogito), and will continue to seek outside funding to support these efforts.

- **What are some of the key issues that need to be investigated in terms of math/science instruction and gifted children over the next few years?**

The catalysts involved in talent development are still not well understood. How can we explain two students with similar abilities who receive similar services, yet one is highly successful and another struggles to be successful? What else could/should we be doing for the struggling student? Concerns persist about females and under-represented minorities not pursuing careers in STEM fields—what can we be doing to attract them? With the knowledge explosion in scientific areas, it is critical that our instruction focus primarily on problem solving and teaching kids where to find information, but unfortunately many schools still emphasize teaching facts. Many of the out-of-school programs are excellent but not accessible to everyone. So we need more curriculum development, targeted programs, guidance to alert students to opportunities, and additional research in order to better serve mathematically and scientifically gifted students.