

# CMI Annual Report 2013



## CMI Workshops

CMI conducts a program of workshops at the Mathematical Institute in Oxford, UK which bring together a small set of researchers quickly, outside the usual grant and application cycle, when this is likely to result in significant progress.

### Developing Exceptional Talent in Mathematics

**August 16 – 18, 2013**

The workshop brought together invitees from the US and Europe to share their extensive experience, accumulated wisdom, questions and sometimes divergent opinions relating to the identification, encouragement, and training of exceptionally gifted young mathematicians. It was attended by representatives of a number of European programs for young mathematicians, as well as alumni of PROMYS and others with personal experience of work with talented high school students.

It was hugely useful to hear about different approaches to the problem that is common to the diverse education systems from which the attendees were drawn, that of nurturing the talent and enriching the mathematical lives of the small proportion of highly exceptional young mathematicians within an educational environment that has to cater for the needs of all. PROMYS, in which the CMI has been a partner for many years, stands on one end of the spectrum, in offering an extended period of immersion in mathematics over six weeks of the summer. At the other are programs such as MATHEON in Berlin, which focuses on the school curriculum, teacher training, and the development of specialized classes in close cooperation with the Berlin universities. There is also a divergence of emphasis, between those that offer collaborative work on open-ended ‘research problems’ and those that develop talent through training for competitions, notably the International Olympiad. But they are not mutually exclusive: the International Tournament for Young Mathematicians (ITYM), for example, is a competition based on teamwork and problems of a ‘research character’.

The divergence, sometimes more of perception than anything deeper, prompted lively debate. Some of the questions touched on the underlying philosophy: do competitions promote the habits of mind needed for later success? Do ‘immersion’ programs do no more than accelerate the talented along a path that they would follow in any case? Is it important to follow the Cambridge Mathematics Education Project in drawing a distinction between acceleration and enrichment? Others touched on more practical issues concerning the use of resources, and on concerns that programs might compete unproductively in fundraising and recruitment.

A central problem is the meaning of ‘exceptional’. First, there is the simple numerical problem of definition, highlighted by Martin Andler, who runs the French program Animath, and illustrated by his table showing percentages of the French population. In the context of the general population everyone who uses mathematics in a serious way in his or her working life is ‘exceptional’.

Fields Medals	Research Mathematicians	Academic Researchers in Quantitative Science	STEM Teachers, Engineers, Scientists	High School Graduates in STEM Subjects	High School Graduates
0-0.00002%	0.01%	0.10%	10.00%	20.00%	66.00%

A program designed for future potential Fields Medallists may not appear to have much in common with one aimed at enriching the education of the next generation of teachers, scientists and engineers. But, as Owen Patashnick (a PROMYS alumnus) remarked, the methods based on proof and collaboration on hard problems can also work with weaker students. He recounted the successful application of the PROMYS approach in teaching remedial students struggling to achieve college admission. The focus should perhaps be less on exceptional talent than on exceptional motivation, a point made strongly by Po-Shen Loh, the Lead Coach for the US International Olympiad Team.

Part of the discussion was around the specific issue of whether the PROMYS model could work in a European context. There are clearly practical obstacles, notably the problem of finding an appropriate six-week period during the summer that fits with all the different academic schedules of European countries. But the duration of the Boston summer schools is not their defining feature, nor is their focus on number theory. The distinctive elements are the engagement of alumni, the return visits in subsequent years as participants progress through high school, college, and, in some cases, their professional careers; and the focus on collaborative exploration ahead of lectures. Another PROMYS alumna, Claudia Scheimbauer, remarked on the important lessons she had taken from the program, that you do not have to be told what to do and that there was more than one way to do mathematics. Much of this philosophy, as well as the emphasis on proof, also finds expression in other programs.

Perhaps the most important elements of PROMYS are the leadership of the program and its success in selection of participants. All the programs represented at the workshop depend critically on the willingness of talented people to give freely and copiously of their time and expertise. The central problem in maintaining successful programs and developing new ones is in identifying leaders. There is no shortage of demand for participation.

Joshua Greene, a PROMYS alumnus now working outside the academic community, summarized his impressions as outside observer: “Several questions stand out: what do we mean by mathematical talent, how do we identify talent, what does it mean to develop that talent, and why do program leaders volunteer so much in this effort?”. There is no single metric which captures the variety of mathematical ability. There is no one true form of mathematical talent and no one right way to nurture it. Above all, it is clear that the mathematical community owes a huge debt to program leaders with a passion for public service in the mathematical community, often driven by their own experience in enrichment programs.

### Organizers

David Conlon (University of Oxford)  
 Joshua Greene (COMAC Capital LLP)  
 Jürg Kramer (Humboldt University of Berlin)  
 Dierk Schleicher (Jacobs University)  
 Glenn Stevens (Boston University)  
 Nicholas Woodhouse (Clay Mathematics Institute)

### Programs and organizations represented at the workshop

Animath: Association pour l’Animation Mathématique. [www.animath.fr](http://www.animath.fr)  
 ARK Schools: [www.arkschools.org](http://www.arkschools.org)  
 CMEP: Cambridge Mathematics Education Project. [www.maths.cam.ac.uk/cmep](http://www.maths.cam.ac.uk/cmep)  
 EGMO: European Girls’ Mathematical Olympiad. <https://www.egmo.org>  
 ESTALMAT: Estímulo Talento Matemático. [www.estalmat.org](http://www.estalmat.org)  
 ISSMYS: International Summer School of Mathematics for Young Students. [www.issmys.eu](http://www.issmys.eu)  
 King’s College London Maths School: [www.kcl.ac.uk/mathsschool/Home.aspx](http://www.kcl.ac.uk/mathsschool/Home.aspx)  
 MATHEON: Mathematik für Schlüsseltechnologien. [www.matheon.de](http://www.matheon.de)  
 NRICH: [nrich.maths.org/frontpage](http://nrich.maths.org/frontpage)

Oxford Masterclasses: [www.wadham.ox.ac.uk/news/2013/august/developing-exceptional-talent-in-maths](http://www.wadham.ox.ac.uk/news/2013/august/developing-exceptional-talent-in-maths)  
PROMYS: Program in Mathematics for Young Scientists. [www.promys.org](http://www.promys.org)  
UKMT: UK Mathematics Trust. [www.ukmt.org.uk](http://www.ukmt.org.uk)  
Westminster School: <https://www.westminster.org.uk/>