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# A perspective on grant-funding for mathematics research

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The importance of grants is a source of dialogue within our department and college and no doubt within the university as well. Speaking as a researcher whose main interests are in fundamental mathematics*, I would like to add to that dialogue here.

**Input vs. output.** I readily acknowledge that grant funding can speak to the quality of the research that supports the successful grant proposal, that a grant can have value as a service to students and the university, and that in some fields such funding is necessary in order to obtain research output. Nonetheless, I see grants primarily as an input that should be distinguished from an end-goal of research output when assessing research productivity. From the point of view of furthering the discipline of mathematics, I place a very high (although by no means exclusive) value on the publication output of new mathematical results and perspectives. Such a priority is even more strongly rendered by the American Mathematical Society (AMS) in its assertion that the legacy of the mathematical community is its publication record [2].

**The nature of mathematics research.** The Council for the Mathematical Sciences (CMS) is a London-based organization that speaks on the role of the mathematical sciences in the UK. The CMS represents the United Kingdom's Institute for Mathematics and its Applications, the London Mathematical Society (Britain's counterpart to the AMS), and the Royal Statistical Society. As observed by the CMS, in contrast to research in some other science fields, the nature of mathematics research is that most results are obtained by individuals and small groups without significant external resources [3]. In the case of fundamental mathematics research, the main resource is time. I believe this at least partially accounts for the disparity in funding for mathematics in comparison with some other sciences.†

**Funding disparities.** As evidence of this funding disparity consider, for example, federal obligations for supporting research at colleges and universities during the fiscal years 2004-2005 for the biological sciences (including environmental biology but excluding agricultural and medical sciences), chemistry (excluding chemical engineering), physics (excluding engineering), and mathematics (excluding computer science) [4], [5]. One sees that 70.33% of the total funding in these four areas was for biological sciences, 11.23% for chemistry, 14.44% for physics, and 4.00% for mathematics. One way to gauge the relative sizes of the university research communities in these areas is to look at the sizes of the relevant departments at some research universities. With its 2005 classification scheme, the Carnegie Foundation for the Advancement of Teaching‡ identifies 198 U.S. public or private-not-for-profit research universities with high or very high research activity.§ For a random sample of 15 of these 198 universities, my (admittedly somewhat rough¶) counts of the regular research faculty from departments in the relevant areas are 1028 in biology, 516 in chemistry, 669 in physics, and 699 in mathematics.

**Competition for funding within mathematics.** However one accounts for such funding disparities, it is reasonable to expect that a large group of researchers competing for a relatively small pool of funds is

* "Fundamental" mathematics is concerned with mathematical objects and properties that are ubiquitous (arising naturally and sometimes surprisingly in many mathematical settings), essential (necessary for our understanding of what mathematics is), and inevitable (we would imagine that alien intelligences must understand fundamental mathematical structures in the same way that we do). For example, the fundamental mathematical notions of 'number' and 'symmetry' must surely be universal. A top priority for fundamental mathematics researchers is to further our understanding of the mathematical reality of the world we inhabit.

† Another reason might be perceptions concerning the lack of immediacy of application for some fundamental mathematics research. On the other hand, for some commentary on the usefulness of mathematics and its cultural value, see the essay "The Importance of Mathematics" by Fields Medalist Timothy Gowers [1].

‡ `http://www.carnegiefoundation.org`

§ These are public or private-not-for-profit U.S. universities with 2005 Carnegie Basic Classification RU/VH or RU/H.

¶ While I excluded engineering departments and schools of medicine, I believe I otherwise generally erred on the side of inclusiveness in my counts.

going to make funding highly competitive. This reality is well-known within the community of mathematics researchers. To get a more concrete sense of this reality, consider for example the following data. When I studied the list of 1,835 grant awards from the NSF's Division of Mathematical Sciences for grants with original award date in 2004-05‖, I found that only 3.25% of this total funding ($11,561,513 out of $354,528,409) went to four-year or master's level schools.** (In view of such a statistic, the grant-writing success in recent years of my department colleagues Drs. Renee Fister and Maeve McCarthy is all the more noteworthy.) Of this funding that went to four-year or master's level schools, 77.01% ($8,903,709 out of $11,561,513) was for a student program; conference/seminar support; or research in applied mathematics, computational mathematics, an interdisciplinary area (e.g. mathematical biology), or statistics. That is, only 0.75% ($2,657,804) of total DMS funding went to schools comparable to Murray State to support mathematical work other than the kind mentioned in the previous sentence. Removing selective four-year colleges from the set of schools comparable to Murray State leaves only 0.42% ($1,503,279) of total DMS funding. About 3.18% ($11,272,468) of total DMS funding went to the RUI and EPSCoR special programs, for which MSU would likely be more competitive. However, only $2,648,709 of RUI/EPSCoR DMS funds went to master's level universities†† (of which $1,870,951 was awarded in support of student programs or work in applied mathematics, computational mathematics, an interdisciplinary area, or statistics), the remainder going to research universities ($7,842,652) or selective four-year colleges ($781,107).

**Concluding remarks.** As a matter of principle – the principles being academic freedom and a reasonable accounting of the costs/benefits of investing time and energy applying for grants given the realities of competition for funding in mathematics and particularly for funding of fundamental mathematics research – I have chosen to use my research time pursuing output with few external inputs. In my view, when a key part of the mission is pursuing mathematical excellence and generating mathematical knowledge, then the successful pursuit of these goals should be encouraged, whether or not an absence of grant funding fits the model of other disciplines.

**References.** NOTE: All websites given below were functioning as of August 13, 2008.


[1] Timothy Gowers, "The importance of mathematics," 2000. Available at:
`http://www.dpmms.cam.ac.uk/~wtg10/importance.pdf`
Gowers is a Cambridge mathematician and a 1998 Fields Medalist. This paper is basically a transcript of his address of the same title given in 2000 in Paris for a conference held by the Clay Mathematics Institute announcing the Millennium Prize Problems.

[2] `http://www.ams.org/secretary/ethics.html`
American Mathematical Society Ethical Guidelines, adopted by the Society January 2005.

[3] `http://www.cms.ac.uk/reports/2006/Reform_of_HE_research_asess_response.pdf`
The published response by the CMS to a proposed regimen for reforming the system of assessment and evaluation of research productivity in higher education in the UK. Document dated October 11, 2006.

[4] `http://www.nsf.gov/statistics/nsf06323/pdf/tab69.pdf`
A table summarizing almost all federal research and development expenditures at colleges and universities for fiscal year 2004. Data reported in 2006.

[5] `http://www.nsf.gov/statistics/nsf07318/pdf/tab71.pdf`
A table summarizing almost all federal research and development expenditures at colleges and universities for fiscal year 2005. Data reported in 2007.


‖ `http://www.nsf.gov/awardsearch/`

** This excludes schools with a PhD program in mathematics or schools with Carnegie classification RU/VH, RU/H, or DRU.

†† There are 658 public or private universities in the U.S. with Carnegie classification Master's S, M, or L.