Does one have to be a genius to do maths?

> *Better beware of notions like genius and inspiration; they are a sort of magic wand and should be used sparingly by anybody who wants to see things clearly.* (José Ortega y Gasset, "Notes on the novel")

Does one have to be a genius to do mathematics?

The answer is an emphatic **NO**. In order to make good and useful contributions to mathematics, one does need to work hard, learn one's field well, learn other fields and tools, ask questions, talk to other mathematicians, and think about the "big picture". And yes, a reasonable amount of intelligence, patience, and maturity is also required. But one does **not** need some sort of magic "genius gene" that spontaneously generates *ex nihilo* deep insights, unexpected solutions to problems, or other supernatural abilities.

The popular image of the lone (and possibly slightly mad) genius – who ignores the literature and other conventional wisdom and manages by some inexplicable inspiration (enhanced, perhaps, with a liberal dash of suffering) to come up with a breathtakingly original solution to a problem that confounded all the experts – is a charming and romantic image, but also a wildly inaccurate one, at least in the world of modern mathematics. We do have spectacular, deep and remarkable results and insights in this subject, of course, but they are the hard-won and cumulative achievement of years, decades, or even centuries of steady work and progress of many good and great mathematicians; the advance from one stage of understanding to the next can be highly non-trivial, and sometimes rather unexpected, but still builds upon the foundation of earlier work rather than starting totally anew. (This is for instance the case with Wiles' work on Fermat's last theorem, or Perelman's work on the Poincaré conjecture.)

Actually, I find the reality of mathematical research today – in which progress is obtained naturally and cumulatively as a consequence of hard work, directed by intuition, literature, and a bit of luck – to be far more satisfying than the romantic image that I had as a student of mathematics being advanced primarily by the mystic inspirations of some rare breed of "geniuses". This "cult of genius" in fact causes a number of problems, since **nobody** is able to produce these (very rare) inspirations on anything approaching a regular basis, and with reliably consistent correctness. (If someone affects to do so, I advise you to be *very* sceptical of their claims.) The pressure to try to behave in this impossible manner can cause some to become overly obsessed with "big problems" or "big theories", others to lose any healthy scepticism in their own work or in their tools, and yet others still to become too discouraged to continue working in mathematics. Also, attributing success to innate talent (which is beyond one's control) rather than effort, planning, and education (which are within one's control) can lead to some other problems as well.

Of course, even if one dismisses the notion of genius, it is still the case that at any given point in time, some mathematicians are faster, more experienced, more knowledgeable, more efficient, more careful, or more creative than others. This does not imply, though, that only the "best" mathematicians should do mathematics; this is the common error of mistaking absolute advantage for comparative advantage. The number of interesting mathematical research areas and problems to work on is vast – far more than can be covered in detail just by the "best" mathematicians, and sometimes the set of tools or ideas that you have will find something that other

good mathematicians have overlooked, especially given that even the greatest mathematicians still have weaknesses in some aspects of mathematical research. As long as you have education, interest, and a reasonable amount of talent, there will be some part of mathematics where you can make a solid and useful contribution. It might not be the most glamorous part of mathematics, but actually this tends to be a healthy thing; in many cases the mundane nuts-and-bolts of a subject turn out to actually be more important than any fancy applications. Also, it is necessary to "cut one's teeth" on the non-glamorous parts of a field before one really has any chance at all to tackle the famous problems in the area; take a look at the early publications of any of today's great mathematicians to see what I mean by this.

In some cases, an abundance of raw talent may end up (somewhat perversely) to actually be *harmful* for one's long-term mathematical development; if solutions to problems come too easily, for instance, one may not put as much energy into working hard, asking dumb questions, or increasing one's range, and thus may eventually cause one's skills to stagnate. Also, if one is accustomed to easy success, one may not develop the patience necessary to deal with truly difficult problems (see also this talk by Peter Norvig for an analogous phenomenon in software engineering, though see this clarification). Talent is important, of course; but how one develops and nurtures it is even more so.

It's also good to remember that **professional mathematics is not a sport** (in sharp contrast to mathematics competitions). The objective in mathematics is not to obtain the highest ranking, the highest "score", or the highest number of prizes and awards; instead, it is to increase understanding of mathematics (both for yourself, and for your colleagues and students), and to contribute to its development and applications. For these tasks, mathematics needs all the good people it can get.

Further reading:

"How to be a genius", David Dobbs, New Scientist, 15 September 2006. [Thanks to Samir Chomsky for this link.]

"The mundanity of excellence", Daniel Chambliss, Sociological Theory, Vol. 7, No. 1, (Spring, 1989), 70-86. [Thanks to John Baez for this link.]

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