

the person. Both approaches tend to avoid putting the other person on the defensive and instead foster an atmosphere for productive conversation. I believe that it is also important that if you feel significant discontent that you find a way to attempt to resolve the issue. Allowing feelings of discontent to continue without resolution can lead to resentment over time, which undermines the atmosphere in your department. This being said, depending on the circumstances and involved parties, it may not be possible to have an open conversation about the issue, and if this is the case, I believe it's important to acknowledge and manage your feelings of discontent, perhaps by talking to a trusted friend or colleague and taking time for yourself (the next two points in this article).

I believe that it is also important to avoid labels. For instance, rather than calling someone racist, homophobic, etc., you might say, "I'm worried that saying that would make students from underrepresented groups feel uncomfortable. Perhaps you could rephrase what you just said as..." I believe that it's best to give everyone the benefit of the doubt in acknowledging that the members of your department likely chose their position because of a love of mathematics and a desire to share that love with others.

However, life circumstances change, and so there may be periods of time when department members are able to be more engaged and invested in their work than at other points in time. Depending on your relationships with your colleagues and what you know of what is going on in their personal lives, you might foster an atmosphere of support by reaching out to them. For instance, if a department member loses a loved one, your department might send flowers or offer to bring that person a home-cooked meal, or perhaps if a colleague has a baby, you could offer to bring over a meal or pick up groceries. I think it's important to realize that there isn't a time limit on grief, whether that grief is tangible to others (e.g., death of a parent or spouse) or less tangible to others (e.g., stillbirth, infertility, divorce—loss of hopes and dreams), and balancing a career with a young family is challenging. It's important to be compassionate with colleagues, acknowledging that there may be times when others are able to go "above and beyond" and other times when they are "doing the best that they can at the moment."

Talk to a Trusted Friend or Colleague

If an incident has occurred with your coworkers that leaves you feeling frustrated or unsure of how to proceed, you might find it helpful to talk about the situation with a trusted friend or colleague. Often talking about the situation provides you with a space to be able to unwind and a space to be able to brainstorm next steps. If the incident involves harassment or bullying though, you may be required to report it to your institution.

Take Some Time

If you are feeling particularly strong feelings in light of a workplace incident, it might be helpful to take some time to process your feelings and "cool off" before proceeding. Often when emotions are running strong, it can be more difficult to have a respectful conversation with someone. If you find that a conversation is becoming particularly heated, you might suggest a brief bathroom/water break to provide a space for people to calm down for a moment.

One final suggestion is to take time to take care of yourself on a regular basis, perhaps by exercising, getting a healthy amount of sleep, meditating, eating well—whatever helps you to feel grounded. If you feel balanced and grounded, then it's easier to be a positive force in your department rather than getting "swept away" by the busyness and daily stresses of work.

References

- C. Cain, *The #MeToo Moment: How to be a (Good) Bystander*, The New York Times, December 12, 2017. <https://www.nytimes.com/2017/12/12/us/the-metoo-moment-how-to-be-a-good-bystander.html>
- C. Cain, *Sexual Harassment Training Doesn't Work. But Some Things Do*, The New York Times, December 11, 2017. <https://www.nytimes.com/2017/12/11/upshot/sexual-harassment-workplace-prevention-effective.html>



Sarah Crown Rundell

Credits

Author photo is courtesy of the author.

Self-Doubt and Imposter Syndrome

Brian Lehmann

Failure is part of life as a mathematician. Mathematical research is genuinely hard—progress is accompanied by false starts, dead ends, and months of effort. Teaching can feel unrewarding, and its impact can be hard to assess. Taking into account the uncertainties of the academic career

Brian Lehmann is a professor of mathematics at Boston College. His email address is lehmann@bc.edu.

DOI: <https://dx.doi.org/10.1090/noti2039>

pathway and the competitiveness of the publishing and job markets, it is little wonder that mathematicians often feel stressed and discouraged.

At times these challenges can develop into a lack of confidence. In [Gro86, Introduction, Section 2] Grothendieck reflects on his career:

Since then I've had the chance...to meet quite a number of people, both among my "elders" and among young people in my general age group, who were much more brilliant, much more "gifted" than I was. I admired the facility with which they picked up, as if at play, new ideas, juggling them as if familiar with them from the cradle—while for myself I felt clumsy, even oafish, wandering painfully up an arduous track, like a dumb ox faced with an amorphous mountain of things that I had to learn...

Grothendieck's experience is quite common: mathematical difficulties can lead us to doubt our abilities and to worry that we are somehow unsuited for a career in academics.

In this article I will discuss self-doubt and imposter syndrome. My hope is that readers struggling with a lack of confidence will know that they are not alone and will feel encouraged to reach out to others. It is worth emphasizing that an article is no substitute for advice from a licensed mental health professional—if you need help, please reach out to a counseling service!

Self-Doubt in Mathematics

There are many types of self-doubt. Some mathematicians become discouraged by repeated failures and fear that they have hit an insurmountable mathematical wall. Some are obsessed with "natural talent" and feel like they are at a permanent disadvantage when compared to their peers. Some fear they will run out of ideas; others are unwilling to take on risky projects. It is also common for mathematicians to be concerned about looking foolish or vulnerable in front of their peers.

Imposter syndrome is something a bit more specific. The American Psychological Association Dictionary ([Ame15]) defines the "imposter phenomenon" as:

a situation in which highly accomplished, successful individuals paradoxically believe they are frauds who ultimately will fail and be unmasked as incompetent.

In other words, mathematicians with imposter syndrome will feel like failures despite all evidence to the contrary. The syndrome is characterized by certain markers—a fear of being "found out," difficulty accepting positive feedback, and anxiety about making mistakes. It can sap your motivation and energy, leading you to work less effectively and, in turn, to doubt yourself even more.

The pressures that cause imposter syndrome are particularly intense during the early stages of your career (although imposter syndrome is by no means exclusive to this period). In [GBGL08, VII.6.1], Atiyah writes:

The first year or two of research is the most difficult. There is so much to learn. One struggles unsuccessfully with small problems and one has serious doubts about one's ability to prove anything interesting. I went through such a period in my second year of research, and Jean-Pierre Serre, perhaps the outstanding mathematician of my generation, told me that he too had contemplated giving up at one stage.

Since there are many misconceptions about self-doubt in mathematics, let's start with a few facts:

Self-doubt is common. A couple of studies of graduate students across different fields have found that approximately 30% experience some form of imposter syndrome ([JBL+15], [HES98]). It is quite likely that some of your peers are struggling with self-doubt.

A lack of confidence does not equal a lack of ability. Your confidence as a mathematician is as much a factor of your personality as it is of your ability. In particular, self-doubt is simply not an accurate gauge of whether you will be able to "cut it" as a mathematician. If Atiyah and Grothendieck have felt unqualified for a career in academics, you shouldn't worry too much if you feel the same way.

Imposter syndrome is linked to discrimination. Negative stereotypes can contribute to imposter syndrome. When your peers treat you as if you do not belong, it can be hard not to internalize their incorrect assessment.

Strategies for Dealing with Self-Doubt

While self-doubt never entirely goes away, it is absolutely possible to feel better about who you are and what you have done. For some mathematicians this is a process that happens naturally as they build up confidence and experience. For others, it takes deliberate effort. Here are several concrete steps that may help.

Find community. The most pernicious effect of imposter syndrome is that it encourages isolation. When you feel like a fraud, it is natural to try to hide your flaws and to avoid situations that might "expose" you.

Perhaps the best way to combat imposter syndrome is to establish a support network of peers and mentors. Talk through your feelings with people you trust and who can relate with your situation. Find a mentor who can help give perspective on your situation and keep you grounded. This is particularly important if you are an underrepresented minority—find peers who can counteract the negative bias you receive.

Collaboration is another useful tool for overcoming imposter syndrome. By working closely with others, you can more easily see the value of your contributions. It is

also very reassuring to have someone else who is heavily invested in the success of your work. There are of course many other benefits—collaboration widens your mathematical horizons and helps shore up the areas where your understanding is lacking.

Separate fact and feeling. Failure is an integral part of meaningful research. It is important to learn to separate facts—“I have failed at this task”—from feelings—“I am a failure.” Identify how you respond to mistakes; if you have an unhealthy attitude, work on developing a new pattern of responses.

Be honest with yourself. As you progress in your mathematical career, it is very important to develop a sense of your own strengths and weaknesses. Part of being honest with yourself is celebrating what you have done well. Don't sell yourself short! It is undoubtedly true that there is an element of luck in your career—this is true for every mathematician. And there are undoubtedly many things you can improve on. Nevertheless you should strive to recognize and build upon your strengths.

Embrace humility. True humility is the ability to present yourself honestly. (Note the contrast with being self-critical.) It takes courage to admit when you do not know something. However, there is no better way to learn than to ask someone for help. Don't feel like you need to be an expert on every topic, and be sure to acknowledge those who know more than you do.

Evaluate feedback appropriately. One of the downsides of being an academic is that there are not many opportunities for positive feedback. When you do receive positive feedback, you have undoubtedly earned it—accept it with gratitude. On the other hand, negative feedback can be crushing! Try to separate valid criticism from the “noise” coming from caustic seminar attendees or lazy journal reviewers.

Value your own opinion. It is satisfying when your hard work is recognized and rewarded. However, these opportunities are less frequent than you might think. There are far fewer opportunities to reward excellent work than there are excellent mathematicians, and you should make sure to set your expectations accordingly.

Instead, you should try to identify success on your own terms. Grothendieck placed a high value on mathematical independence. He finishes the passage quoted earlier by the following assessment of his “more brilliant peers” ([Gro86]):

From the perspective of 30 or 35 years, I can state that their imprint upon the mathematics of our time has not been very profound.... [T]o have broken the bounds [of the past] they would have had to rediscover in themselves that capability which was their birth-right, as it was mine: the capacity to be alone.

In my opinion Grothendieck is overstating his case: the most compelling mathematics will interact with the work of others, and everyone should strive to find projects that will interest their peers. Nevertheless it is worth cultivating the ability to find contentment in your work independently of how others evaluate it.

Understand your identity. It sometimes seems like mathematicians impose a total ordering on their peers based on a perception of the quality of their research. It is tempting to “buy in” to this mental framework and to judge your own value—and the value of others—based on a few research accolades.

Please don't fall into this trap! It is patently ridiculous to judge yourself and your colleagues based on a few data points. The truth is that most mathematics is interesting and that all mathematicians have something to bring to the table. Your value as a person and as a professional extends far beyond the names of the journals that carry your research.

What If I Really Am Failing?

It may be that after honestly evaluating your strengths and weaknesses you decide that you are indeed failing to meet the standards of your current position. Perhaps you are unsure whether you will have success in taking the next career step. If you are in this situation, don't panic!

First, remember that your self-evaluation should not be based solely on your current situation. Just because you are currently struggling with math research doesn't mean you are incapable of doing good research. However, it is also important not to overestimate your situation. If you decide to pursue your current course you should anticipate difficulties, and drastic changes may be needed.

Second, decide how committed you are to a career in academics. Many graduate students and postdocs discover that they do not particularly like the math research process. This is an excellent outcome! If you feel unsure about your future prospects and are willing to consider taking a job outside of academics, this can greatly reduce your stress level as you enter the job market. On the other hand, if you can't countenance doing a job outside of academics, then it may make sense to stay the course.

Third, whatever you decide, take the initiative to pursue your path wholeheartedly. If you don't want to continue in academics, take the first steps to prepare for your new career pathway. Talk to some mathematicians who are working in business, industry, or government and ask them about their experiences. If you do want to continue in academics, give it your best shot. Consult with a mentor to see what you need to improve on. Work hard to fill in any background you are missing. Look for unexpected job opportunities, particularly if you are willing to compromise on certain fronts. Note however that if you take a sequence of short-term jobs the personal sacrifices required to continue in academics will accumulate over time.

References

- [Ame15] American Psychological Association, *Imposter phenomenon*, APA Dictionary of Psychology, 2015.
- [GBGL08] Timothy Gowers, June Barrow-Green, and Imre Leader (eds.), *The Princeton companion to mathematics*, Princeton University Press, Princeton, NJ, 2008. MR2467561
- [Gro86] Alexander Grothendieck, *Récoltes et semailles* (English translation), 1986.
- [HES98] Kris Henning, Sydney Ey, and Darlene Shaw, *Perfectionism, the impostor phenomenon and psychological adjustment in medical, dental, nursing and pharmacy students*, *Medical Education* 32 (1998), 456–464.
- [JBL+15] G. Jöstl, E. Bergsmann, M. Lüftenegger, B. Schober, and C. Spiel, *When will they blow my cover? The impostor phenomenon among Austrian doctoral students*, *Journal of Psychology* 220 (2015), no. 2, 109.

When and How to Say NO

Judy Walker

Mathematicians are often compared to toddlers in that we spend our professional lives asking why. Knowing that a theorem is true isn't enough for us: we must know why it is true. This is the entire basis for the idea of mathematical proof, and it's the drive that keeps us going.

Unfortunately, mathematicians—like most academics—tend to be unlike toddlers in a different way: While any parent of a toddler will tell you that the most common word they hear from their child is “No,” we find it very difficult to use that word ourselves. This is especially true of, and can be especially dangerous for, those early in their careers. When we look at the particular case of female faculty, or faculty from other groups traditionally underrepresented in mathematics or in academia more generally, the problem becomes even more acute: these individuals tend to be asked to do an inordinate amount of service by well-meaning colleagues and institutions who are concerned about having diverse perspectives represented. Adding in the informal and sometimes invisible work that these individuals often take on in mentoring students from minoritized groups can make the situation untenable. In this short piece, I offer some advice, especially for early-career mathematicians, about saying “no.”

Sometimes it's good to say “yes.” Saying “yes” to service commitments can make you feel more connected to your institution, allow you to meet peers from across campus, and serve as a mechanism to get yourself known by people who may eventually be reviewing your file for tenure and/or promotion. Service work can also be interesting and both personally and professionally rewarding. Getting

involved in a project about which you feel passionate can be an incredibly fulfilling experience.

But you should say “no” if the above conditions don't apply. Generally speaking, if the work you're being asked to do isn't interesting to you, say “no.” If you don't have time to do the work, say “no.” And, especially, if you won't be rewarded for doing the work, say “no.”

Deciding whether work is interesting, how much time it will take, and whether it will be viewed as valuable and rewarded can be difficult for the brand-new faculty member, and high-quality mentoring is crucial here. Seek advice from your department chair or another senior member of the faculty, as these individuals ought to be able to offer insights that will help you decide whether a particular committee assignment will be interesting and/or time-consuming. Most importantly, because they are the ones who will be evaluating you, they will be able to tell you whether the work will be valued.

Again, there are definitely situations in which saying “yes” is absolutely the right move. In my own career, I said “yes” as a second-year assistant professor to spearheading an effort to nominate my department for the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. We won that award, and it led to an opportunity for me to say “yes” to cofounding the Nebraska Conference for Undergraduate Women in Mathematics and to speaking at various conferences and workshops about our department's successful track record in mentoring female PhD students. Eventually I said “yes” to being the lead PI on a large NSF mentoring grant; to being graduate chair, and then department chair; and now to my current upper-level academic leadership position. At the same time, I was saying “yes” to research collaborations, and to organizing research conferences, and to speaking at conferences and at other institutions. But I was also saying “no” to opportunities that I didn't find interesting, that I didn't sense would be valued, or, more often, that I simply didn't have time to do.

So let's say that you've decided that the right answer to a particular request is “no.” Actually saying “no” can be very difficult, for a number of reasons: we don't want to disappoint people; we don't want people to think we're not good colleagues; we don't want to be seen as putting our own self-interest above the interests of our department or institution. Here are several strategies to help you say “no.”

Avoid giving a response on the spot. This is easy if the request comes via email: simply resist the urge to respond as soon as the email arrives and instead give yourself an opportunity to think through the request. If the request is made in person, respond with something like “Thank you for thinking of me. Can I have a day to check my other commitments and get back to you?” This will give you an opportunity to think through the request rather than giving a gut-reaction “yes.” Ask yourself: Is it interesting? Do

Judy Walker is Aaron Douglas Professor of Mathematics and associate vice chancellor for faculty and academic affairs at the University of Nebraska–Lincoln. Her email address is judy.walker@unl.edu.

DOI: <https://dx.doi.org/10.1090/noti2045>