

research within an ERC contract, and I have been surprised by the way it has worked. In fact, our collaboration looked like the surrealistic game “Cadavres exquis.”<sup>3</sup> Each person added a piece to the game and the final result was somewhat surprising: a simple topological characterization of hyper-Kähler fourfolds of Hilb<sup>2</sup>(K3)-type.

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Claire Voisin

**Credits**

Photo of Claire Voisin is courtesy of the author.

## What to Do When You Are Stuck or Confused on a Research Project

*Michael Hutchings*

**Stuck**

Being stuck is bad. Time is passing by and it feels like you are not making any progress on your project. What to do about this depends on the reasons why you are stuck. Here are some possibilities to consider.

**Break Problems into Simpler Pieces**

When possible, work out examples, starting with the simplest nontrivial case you can think of. Just as a picture is worth a thousand words, a good example is worth a thousand theorems!

Use the examples to map out conjectural lemmas that would help, and try to prove them.

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<sup>3</sup>The name “cadavres exquis” was invented around 1925 by Jacques Prévert, who in his early life participated actively in the Surrealist movement.

**Ask (Concisely) for Help**

It can be good to talk to another mathematician, and a great time to do so is when you work in area X and you need to use methods or results from area Y with which you are not so familiar. Instead of struggling in area Y alone, it can be much more efficient to ask an expert in Y for at least a little help.

Try asking your initial question as concisely as possible without much preamble. A very long email may end up in the “I will deal with this later” pile and never get answered, and similarly, a long in-person discussion may leave your conversation partner lost and confused before you get to the point of your question.

An expert may give you a few tips to point you in the right direction; in this case don’t forget to thank them in the acknowledgments in your paper. If you find that substantial work needs to be done in area Y, this may lead to a productive collaboration. It sounds too obvious to be worth saying, but you can accomplish so much more if you work with people who can do things that you can’t!

**Take a Break**

You may be able to figure things out subconsciously while doing something else. In addition to healthy non-mathematical activities, this could mean working on different projects in parallel, following your curiosity to read the literature, or going to seminars on new topics.

**Don’t Be Afraid to Finish Your Paper**

There are a lot of reasons for not getting your work out the door.

Some people seem very eager to explore several new projects before finishing up the current paper, perhaps feeling worried about what to do afterwards. I believe that such fears are generally unfounded; each theorem proved raises many new questions.

One has to find a balance: It can become problematic if you are working on so many things that you never finish any of them.

The feeling that you can never find time for your project could be a warning sign that it is not a good fit for you, at least for now (see below).

There may be some annoying technical issues that need to be dealt with before the paper is complete. I try to remember that there is no partial credit for papers that never appear. It can help to make a list of the remaining items to take care of, work through them one at a time, and celebrate when you are done.

Avoid perfectionism in writing; do your best in the time you have. If your paper doesn’t accomplish everything you had hoped for, you can always write another paper later. If your manuscript is getting unmanageably long and complicated, see if you can split off a portion which is at least 1 LPU (Least Publishable Unit) and finish that first.

## Know When to (at Least Temporarily) Abandon a Project

Perhaps, even after trying everything, you still feel like you can't get anywhere. Maybe you can't focus on your project and instead find yourself starting a time-consuming new hobby. This could be because you are just not that into the project, or you don't feel that it is worthwhile (in this case try to get a second opinion), or maybe it is just currently not feasible.

Some novelists speak of a "drawer" containing manuscripts that they could never finish to a satisfactory state, and it is possible that your project belongs there. If so, be sure to note down a summary of what you were thinking and where you got stuck; you can always revisit the problem another time. Meanwhile, maybe throw a goodbye party for your project.

## Confused

Being confused is fundamentally different from being stuck. It means that you have identified a specific place where there is a gap in your understanding. Many things can cause confusion. Something you are reading in a paper may seem wrong (it's probably right). Something you think you can prove can seem too good to be true. You may think you have found a contradiction. You know that an isomorphism exists but you can't tell whether or not it is canonical.

Being confused is good! It means you are about to learn something. Avoid reading from more sources; this can just increase the confusion. Carefully work through the logic step by step, use simple examples to debug, ask for help if needed, and soon you may have made an important bit of progress.



Michael Hutchings

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## How to Help Your Graduate Students and Postdocs Find a Problem

*Izzet Coskun*

When I am asked how to advise graduate students and postdocs, I often think of my niece and nephew. My nephew has always been an adventurous eater. Eggplant, cauliflower, kale, mushrooms, beans, shishito peppers—he enjoys it all. His younger sister subsisted on mac and cheese, blueberries, and cheerios for a long while. My sister-in-law would often wonder how the two kids had such different palates, even though they were raising them the same way. I often puzzle over the analogous question for my graduate students.

In my experience, being an advisor shares many similarities with parenting. An advisor's role is to model good and productive practices, while supporting and encouraging younger mathematicians as they develop to their potential. We must respect students and postdocs as individuals. They will have different interests and talents, and reach milestones at their own pace.

## Awake at Night

Settling on a thesis problem is one of the most consequential decisions in graduate school. Unsurprisingly, each of my students have found their thesis problems through different paths. Above all, I advise my students to work on a problem that inspires them.

Of course at any stage, there are many factors one could consider when choosing what to work on: Is this question significant? Is it fashionable (this can be good or bad)? If I solve the problem, will I get a job? Will this work lead to a research program, and will such a program lead to funding? These are important questions and play some role in how I steer the students. However, I always tell my students to find a problem that keeps them awake at night. It is crucial that students and postdocs (everyone really) be invested in and passionate about their work.

## Exposure to Ideas

It takes effort and time to hone in on a good thesis problem. I ask beginning students to read papers on a variety of topics to see what sparks their interest. I meet them weekly and introduce them to problems that I am thinking about. I run reading courses and seminars on current research where I introduce the students to many open problems. Since I'm an algebraic geometer, I urge my students to attend the algebraic geometry seminar. Beginning students can resist

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