

## **The role of luck in a successful scientific career**

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I knew once a PI that used to say – “To be successful in science you need two out of three things: To be smart, to work hard or to be lucky. Since you are probably smart and cannot control luck, you better work really hard”. This is a very memorable statement but should it be the right way to think of luck in science?

When you openly talk to scientists they often bring up luck as a factor in their success: “I was really lucky to discover this” or “I was lucky that the job opened up exactly when I was searching” or “I was so lucky to get into the lab that I wanted”. But can luck really carry you through in science? And if not, why do we refer to it so often?

### **Chance favors only the prepared mind?**

Louis Pasteur said, “...Chance favors only the prepared mind” meaning that when there is a chance for a “Eureka” moment, only a person that is open in the right way to observe it and has trained himself to understand it, would actually gain the insight. So, while some people believe that it was luck that allowed a person to “see” something that others did not, often this was actually a thought process of allowing one to carry a specific experiment, examine the results in the eyes of a hypothesis and then re-examining it without any prior convictions. This underlines that good science is probably the combination of chance AND the product of hard work, perseverance and preparation.

Similarly, such “chance” can occur not only in the scientific process itself (e.g. discovery) but also in managing a scientific career. Indeed, to anyone doing science it is clear that there is some element of randomness in how things turn out in our lives, or maybe that there are simply things that are out of our control. And hence, hard work and perseverance doesn’t seem to always cut it. For example, you could be a really talented and hard-working PhD student but work in a lab whose PI is not excited about your work or does not have time to promote your studies. Or, you might have discovered something earth-shattering but as you are writing-up the paper it gets scooped by another group with an identical discovery.

Another example is once you send out a paper that you have worked hard to produce, and then you still need to pass editorial decisions and a “random” set of reviewers, both of which are out of your control to some extent. Finally, most of the external accolades like a position, PhD award, Postdoc fellowships or scientific grant are also dependent on external committees that get to make these important decisions.

As scientists we like to control our environment. Unfortunately, in all of the above examples, the situations make us feel rather like we are out of control. In such situations it is therefore easy to start believing that fate, or luck, or just other people, have more control over our life than we do ourselves. While focusing on any singular occasion or instance it is true that there can be a certain element of “luck”, chance or randomness in many aspects of scientific life. However, in a scientific career or trajectory “luck” has very little place. The reality is that over time we have a lot of control. Our control is about how we prepare ourselves for situations that have an element of randomness in them, how we choose to approach them and what we make out of them once they do not go our way.

### **Building an Internal Locus of Control**

How much we believe that we are in charge of our own destiny or how much we throw responsibility onto others has been well studied in psychology. Psychologists dub an “Internal locus of control” the extent to which people believe that they have power over events in their lives. For example, when having their paper accepted/rejected, scientists with an internal locus of control tend to praise or blame themselves and their abilities (I chose the

right/wrong journal for this work, I made the figures clear/unclear etc...). On the other hand, scientists with an external locus of control tend to praise or blame external factors such as the editors, the reviewers or luck. Of course, most people are somewhere on the scale between internal and external but scientists often tend to swerve towards the external. There are also some that take credit for their success but blame others for their failure but this is a different issue altogether...

Psychologists used to think that how your locus of control was built was something inborn. However, today it is clear that it is something that can be developed, practiced and shaped. Why do scientists swerve towards the external and why would you want to practice your internal locus of control?

### **The Imposter Syndrome and learning from failure**

One universal feature of high achieving individuals such as scientists, is that we tend to suffer from the imposter syndrome. Scientists who feel this way find that no matter how good their research and regardless of how many external accolades they receive, that they are still unable to internalize their success. These feelings have been found to occur in more than 50% of scientists in academia. As an “imposterist” myself, for many years I have dealt with the feelings of unworthiness – thinking that luck or chance were the reasons that I succeeded in the way that I did.

There are many reasons for why people in science tend to have this syndrome but the bottom line is that the imposter syndrome is the strongest example of an “External locus of control” - by not taking pride in ones own achievements but rather thinking that they arise from luck or chance, we not only take away from our enjoyment of the scientific process but also from our ability to take responsibility for our success and failures, learn from them and improve our capacities.

My road to dealing with the impostor syndrome started over 12 years ago after I nearly left science because I was always worried that I was not really worthy. Upon making the decision to stick to science, I decided to try and find a way to overcome the imposter feelings. One surprising outcome of this process was that, as I started taking responsibility for my success, I could also more clearly start to see my own role in my failures.

Now, this may not sound that great...It might be nicer to be able to carry a belief that if you failed it was “not your fault”. In fact, it may be that many scientists “hold on” to the external locus of control as it allows them to protect their feelings when things do not work out well. But, for me, realizing that failing was my responsibility and was not random, was very helpful. If failing was my doing than I could often determine an objective, tractable reason for it – a reason which I could understand, learn from and then maybe circumvent in the future. Acknowledging that failure and success were my own doing allowed me to grow.

### **Taking the reins back into your own hands**

If you always think that luck is what guides success or failure in science than it can become very frustrating. What is the point of trying hard if, in the end, things are out of your hands? However, when you take responsibility for your success and failures you regain a sense of control, can increase the learning value of your failures and continuously improve. In addition (and maybe as importantly) you can grow from your successes and re-energize. Scientists often say that there are not a lot of moments of rewards in science but I do not find that is true. I think that science rewards us on a daily basis – a good thought or idea, a good experiment, a good discussion with a colleague or an ability to help or mentor someone that you care about. But if we do not take responsibility for those small successes then we also cannot rejoice in them and they cannot fulfill us. So, below is what I think that you can do to increase your own control over your scientific trajectory:

1. Plan ahead – To make good decisions on your future trajectory it is worth-while to have a plan. Having a plan in advance allows you to define your dreams and then create short and long-term goals which will take you towards achieving them. If you don't have dreams or goals you will drift randomly and then it will really be luck as to which coast you will end up landing on. For example, if your dream is to find a great job in industry developing a new drug, then you can find out years in advance what qualifications give you priority for such positions and work towards acquiring them.
2. "Information is power" - The more information you have about your future goals the better equipped you are to achieve them. So if you are applying for your dream position, be proactive and get as much intel as possible about the job, the environment, the search committee, the interview process etc....
3. Be flexible – You can't always get what you want, but you may get what you need....If you set goals that are too narrow or strict you are setting yourself up to fail. For example, if you set as a goal to go to a specific, singular, lab then there is a good chance that you will fail for reasons that are not up to you (the lab is too full, there is no current funding option etc...). But if you set yourself a goal to go to a good lab in a specific field (so 3-5 labs are now an option for you) then your chances of success increase dramatically.
4. Have a plan B - If you always make sure to have a backup plan, for when randomness occurs and the situation does not go your way, then you can grab back the control and not give in to the aspect of 'luck'.
5. Leave time for mistakes and reruns – Since there is an element of randomness in life, you have to do things enough in advance so that if unexpected events hit, you have time to respond adaptively and turn to your plan B. For example, if you know that you want to continue to a Post-doc after your PhD, don't wait for the last minute to start looking for the optimal lab for you. Try to start the process a year in advance so that if it does not work in the first round you still have time for a second round (which will be superior as you have learnt so much from the first).
6. Learn from others what helped them succeed: actively looking for mentors that will give you advice on how to steer your career can really improve your "luck". For example, if you are writing a fellowship for the first time, find someone who did well and ask for an example from them – it is always good to see what a winning proposal looks like. Take time to talk to people that have done a certain career step before you and establish what worked well and what did not. Admit to yourself and others what you know and what you do not know – sometimes people do not want to ask for help as they are worried that this is something that they should already know and then they miss out on potential insights from more experienced people.
7. Gain perspective - The role of luck looks bigger at the beginning of a career than in the end. While at the start of a PhD small, potentially random, events (fluctuations) can create differences that look very big between students (for example, one gets to publish three papers and the other only one), over time these differences smoothen out to give a trend line – people that consistently succeed vs those that do not. So in a way, your personal capacities determine the trend but at any given moment some element of randomness can determine the fluctuations. If you decide to go for a life in science, than you will see than with time the fluctuations wind down and it becomes more about you and your choices.
8. Take responsibility: There is some comfort in being able to throw blame for your failures on others. But when you do that you do not learn from your own contribution to the failure and will do it again in the future. For example, many PhD students

blame their PIs for not providing them all that they need to succeed. However, any relationship, including one with your PI, is the product of both sides. So try to think if there is something more that you could be doing to steer the situation in a way that will be productive for you. Or if not, try to think what you learn from this so as to make better decisions about mentors in the future.

9. Work on your “internal locus of control” – Science is all about knowing how to brush your knees-up and get-up quickly from the fall. We all fail. A lot. If you blame luck for each time you fail you will never get better. On the other hand if you wallow in your failures you will spend your entire scientific career angry at yourself and others. So, teach yourself the middle way – take responsibility, learn from your mistakes, but don’t blame yourself. It is like having an internal “no fault policy” to guard you – if you intended well, did your best and it did not work out then don’t give yourself a hard time. Find one thing that you can take home from this experience and this will allow you to do better next time.
10. Enjoy the way – we are in science to discover the unexpected. Don’t expect your life to be any different. Life in science is in many ways about embracing the unknown and this also has to have some impact on our own lives. You can play it safe but might miss out on a lot of the fun – so balance between the safe and the risky. Rejoice in the fact that life in science is almost never boring. Ultimately, what makes science so great is that there are many ways to succeed and that you can follow your different interests and experience your passions.

So, how do you succeed in science – there are many ways and we each have to find our own style. But if I had to break it down to a saying I would say “To be successful in science you need three things: To be smart, to work hard and to have an internal locus of control. Since you are probably smart and are already working really hard, spend time developing your locus of control”.

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