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| **Focus Group 2 – 04.07.2019** | |
| Aantal minuten: | 61 |
| Aantal sprekers: | 4 |
| Taal: | English |

SP1: This is switched on. We will start with a bit of an easy but very important question: Can you introduce yourself briefly by telling us your name, your discipline and what you work on so we have an idea what work you do?

SP2: My name is [name] I just graduated from a PhD two months ago so now I'm a postdoc. We’re here in the department of bio Nano science and my project is related to building some device and sensors to analyse proteins at the single molecule level with a method called Nano pores.

SP3: My name is [name]. I am from Denmark. I am doing a postdoc here. I'm working on point of care diagnosis so we want to detect specific sequence of the DNA in the field where people have the disease; we able to detect any given disease in the field people have the disease, in broad terms.

SP4: I am [name], a second-year PhD student. I also work on Nano pores not on current detection but on optical detection analysis.

SP1: Is your work mostly individual or group-based? Do you work in labs or mostly behind a computer?

SP2: The work is mostly experimental so mostly in the lab. Of course, you also need data analysis and put things together to interpret the data but it's mostly experimental. I was the first one to start the project but the group has grown a little bit. Mostly I have my own project but there is a support group around the project and now we have a team of 8 people or so working on the same topic.

SP1: Do you do the same experiments or are they slightly different?

SP2: Slightly different experiments. I work more in the Nano pore part, more particular in the current detection method but other people who work in the chemistry, bioinformatics part so I mostly do the project on my own but now I have more collaboration.

SP3: It similar. I also do a lot of work in the lab; I also have data analysis and these kinds of things on the computer. I think it’s maybe 60:40. I am part of a group in point of care diagnosis and work on the same publication, for now at least, but I have my own area in this publication I dive into.

SP4: It's roughly the same. We’re in a super-group like Nano pores but everybody is fighting for himself. We ask other people for advice but it's not someone asks me what do you do tomorrow this will be good for me; it's rather I plan and do my stuff and then I get feedback and ask for help. Is it different for you?

SP3: It seems like we talk more. Our group is small and you’re quite large.

SP4: It depends what you define as a group.

SP3: We have three people and we talk a lot. I have the end thing of our detection scheme and the other guys have the earlier ones and we want to link them.

SP1: Your group is bigger?

SP2: Yes, our projects are more defined. Each of us has a big project and then we collaborate and interact but you have your own specific. It's more we work in parallel. It's more independent in that sense.

SP1: If you don’t want to answer its fine, but do you already know if you want to stay in science or is it still open.

SP2: I already know I don’t want to stay in science so I'm currently exploring other options.

SP3: I don’t know yet. I pursue the opportunity of staying in science but I don’t if it's what. I want to do the sacrifices that are required. I am pursuing it now, at least.

SP4: I have the same opinion as [name SP3]. If it works out it's fine, if it doesn’t work out I will find something else which will be nice.

SP1: Then we start with the topic ‘luck in science.’ I will write on the white board but could say what are your associations and what do you think of when you hear the topic ‘luck in science?’ What comes to mind?

SP3: When I initially joined the group, my previous supervisor said: Science is 90 percent hard work and 10 percent luck and very little to do with brains. I thought it was quite correct and when I repeat it to her she can't recognise it. If you work hard you can minimise the amount of luck you require but, of course, you also need some luck that you're on the correct path at the same time, maybe with the correct collaborators.

SP1: So it all interacts a bit.

SP3: Yes.

SP4: I immediately thought of these big discoveries are pure luck but I always ask myself: Is this representative of the actual science or is it just the ones that make it to the media? It's so nice, the lucky scientist who typically thinks but, in the end, relies on luck.

SP3: But it's not only luck because they pursue, they found some things they didn't initially understand but they didn't think: I don’t understand, I will just give up. They pursued their work on the ideas. Of course, it's still luck-based but you still need to understand what you're doing and work on it.

SP2: And the right training to almost identify that this happens by luck but this, this and that and I will explore it more. Some examples I can think of [name of colleague #1] became so famous and it was not just luck but, in a way,, he was in the right moment in the right situation. For example, our supervisor was pursuing a project he wanted to make sure a current in some polymers, as far as I understand, and they had all the devices ready to measure, everything was there. In the end, they realised it was impossible, the resistors in the input was too high and were unable to measure what they wanted but then at the same time the carbon Nano tubes fever started and he had everything ready and just started measuring the carbon Nano tube samples and get in a science paper every month essentially so he became really famous. He's a very smart guy and he knew what he was doing but that was not his original plan, he was not going to measure that initially, it just happened. Also, I think a lot of times collaboration are important. You start with an idea and it happens your technique can be used for so many other things. And I think is it luck? It could be luck and it's also your input making connections and expanding your network and being open to discuss with other people.

SP1: Also with this, you mean hardworking?

SP2: I think so.

SP1: Anything else? Have you ever come across luck in your own work?

SP3: Possibly. It's hard to identify at this point. It's not like a specific thing. It's also about positioning yourself correctly and then suddenly you just happen to be lucky. I recently got this award from a previous university but they only introduced the award this year because the institute has got very good candidates and they put them up for the big PhD prize at the university but never did anyone every get the prize from molecular biology way of training, so this year they said fuck it, we will make our own also and then I was luckily one of the ones who actually had done a lot different things, had a fairly good publication record and stuff so I get this award. But that’s also luck. But it's not only luck, I had also been working hard to do some stuff and write this.

SP1: So only with luck you don’t make it?

SP3: Yes, you also need to.

SP2: I don’t think so because you need to able to recognise and identify the potential of things, because if you’re not an expert in the field, you're not into it, you don’t have the right training then I don’t think you can identify the potential when luck happens.

SP3: But you also need to be able to ride on the wave. As you explained with [name of colleague #1], and I think that’s also one of his forces is he's very enthusiastic. I can imagine he would be good at building up the wave he's also riding on.

SP2: Yes, I think so.

SP4: Is that [name of colleague #1]?

SP1: Yes.

SP4: When I think back of my master’s thesis and stumbled into this project, I had no idea of it and I completely relied on my professor at that time, so in that sense it was lucky that in the end something worked out. In some sense, we make decisions for pursuing a project and if the initial project works that’s pure luck typically because people think for an hour about the project and then give it to a masters student who then works for a year on the project so maybe it's well-informed luck but in the end it's some luck. The non-lucky part comes in, for example, in my master’s thesis after half a year, I decided this isn’t going to work and I now shift the project and then the rest of the half year something worked out. But also ways these decisions going into some direction it's quite luck based, at least for me. Typically, projects are not so well understood that we say we can do this, this and this and then it works out.

SP1: Does shifting come from more understanding?

SP3: The shift away from something came from more understanding but shifting toward something came more or less luck again.

SP2: Yes, I think so. I also see from my colleagues when you start a PhD, you start a crazy project they thought about in one hour and you go into it knowing very little about it so you naively think it's going to work and then over time as you gain more experience you realise it will not work and you start exploring other directions and sometimes there things usually work. Is it luck? I don’t know if it's luck or statistics that you just try so many ideas that eventually one works.

SP4: But it's how luck also relates to hard work. If you just assume every project has a 10 percent chance of success, you just need to start enough projects and then you will be lucky.

SP3: Has your own PhD path already taken a different course than you expected when you started?

SP4: I didn't expect too much, I must admit. I really had no idea of my PhD when starting it. Maybe yes but on the other hand it's not a major shift. It's still going to the same direction. But the initial direction was not very well defined.

SP1: How does what you spoke about relate to the right moment at the right time? You said maybe it's statistics but maybe it's the right moment at the right time. Do you have any idea how that is both luck? Is it different types of luck? Does it relate to each other?

SP4: For the science, it doesn’t matter which time or moment because the scientific result is the same whatever the circumstance, but how it's perceived is the lucky part. So that is the right moment at the right time, whether you get the publication in the high ranked journal or lower ranked journal or you get the PI position or you don’t. These things are what I think of when I read ‘right moment, right time.’

SP3: It's also projects. You can also be at the right moment at the right time and get the right projects and then you get the right opportunity, or you can have a good day when you have an interview. That’s also part of the luck in science.

SP4: I'm thinking you have all the machines now, you need to do this project, have everything assembled like the device assembled and the outcome will always be the same; it will be today the same - of course, if the humidity or whatever changes but, in principle, at least that’s what we’re working for to make reputable science. (? 00:15:18) Luck depends. Of course, there can be some statistics in there and you have 10 percent chance, you have to repeat it a hundred times and see how it works. I agree you can call luck or statistics. When I think of ‘right moment, right time’ I rather think of these career things: the non-scientific and science part or prizes or getting hired.

SP2: There are topics that are hot at certain moments and all the interest, the press is there. There is these topics like CRISPR last year also, so if you happen to be one of the first ones measuring that you're going to have a science paper. Maybe we will work in this for two years and you don’t know if it will take-off or not but luckily it took off and then you're there at the right moment with the right measurements. In science, it's easier to get funding normally when you’ve got one of these topics that are hot at the moment. In that sense, the interest in the moment in your topic matters. It can be considered luck because sometimes you start a topic and you have no idea it's going to be so hot and important in two years.

One of my ex-PhD colleagues, [name of colleague #2], when he started his first PhD project it didn't work and my superior suggested why don’t you work with CRISPR? He had no idea what that was and he almost turned the project down thinking it wasn’t going to be interesting and everybody in the lab told him to go for it, that it can become a very exciting topic. He stayed in the topic and got a very nice paper but he initially didn't know and maybe he could’ve walked away from the project. So it was luck he was offered that project but also you have to be smart or knowledgeable to take the opportunity or not.

SP1: So that has to do with the right project. It's not only luck but also being smart?

SP2: Yes, recognising the potential of a project.

SP3: But that was part of networking. He listened to the people in the lab. He was able to recognise that. It's also a big thing. [Name SP4], you talked about the clash between luck when you produce something when you have a result and use statistics, so you say it's significantly different when it's a five percent chance the results are the same by chance, but it's also luck or chance you have incorporated inside, we just accept if it's a five percent chance it's by random the same then it's good enough it's only maximum five percent.

SP2: It's true. Also, when you have a project when you have to build, like in Nano fabrication, you have so many steps and so much can go wrong in multiple steps, and making your final device you make one out of 100 successfully. I don’t know if that’s considered luck? It could be.

SP4: Some people would call it knowledge and others don’t; they call it luck. I mean afterwards, you're always clever.

SP3: But you also have to build up the thing, afterwards you have to acknowledge it was not only luck. I think you have to do that also.

SP2: But how do you define luck normally? Now I'm thinking is it just statistics? It is statistics.

SP1: Often in focus groups people say something but now it's about you.

SP3: I find luck as a favourable outcome by chance. That’s for everything. It could also be in a relationship and the chance of it actually happening and then it has to be less than half a percent.

SP1: So something that would be an unfavourable outcome would never be dependent on luck?

SP3: If it's unfavourable for you then it was not luck; you would not say: I was lucky that I was hit by the car, you would say: I was unlucky I was hit by the car. You could also say the guy who took the decision was lucky because I was hit. It's subjective. It relates to the subject who has luck.

SP1: You conceptualise luck more as something positive so it can be on your side?

SP3: Yes.

SP1: Do you want to ask anything about that?

SP4: I'm interested in the point you mentioned before. Do you think the openness of a project is better to make lucky findings than closing it down and focusing on one specific point? What do you think about that? For instance, if you had a bit more liberty in your research, that there were interesting things you would pursue if you weren’t forced to get back to the main course of your scientific track? How do think about how you organise science?

SP2: Openness helps because as we said before when you start getting knowledge about a topic, you start thinking about all the different directions you can explore, you get enough feeling which could be more successful directions. I always think in our PhD and postdoc cycle, there is a balance between how much you explore in the finite time you have to finish a project, have a result and a publication. In principle, it will be nice if we can explore indefinitely – and that is what science maybe used to be before, but now it can take ten years exploring until you find something that is very good, maybe something that’s extremely good because you’ve had enough time to explore a lot and maybe it can be very meaningful but nobody gives you ten years’ funding without a result now. I think we have to find a balance between exploring enough. Normally, in your first one or two years of your PhD you explore and when you start it in the third year, supervisors start to be: Let's choose one or two projects to focus on because you don’t have time to continue all of them.

SP3: It's good to pursue all these different, intriguing aspects and you suddenly find, and you can use years to try to study these, and stuff. I think it's good you actually push to also publish because part of university is justified by the fact you try to develop knowledge and communicate the knowledge, so you try to make it open to the public. If you just have openness free, let's say you get a lot of money to do stuff in university, and then people don’t look at it, you get the money funding every year then the unlucky outcome would be you don’t have anything that drives you to do anything but let's say you still do the work but you go too deep into yourself that maybe doesn’t even relate to something you want to communicate. At least, for me, it's good I have some kind of thing that drives me to get out there and to publish this stuff. But it's a balancing thing because openness is very good and you couldn’t have done it without these cool things if you didn’t have openness. Fundamental science is often why you get all these ground-breaking discoveries.

CRISPR/CAS you talked about was very hard to get funding for a lot of years because it was like a bacterial immune system, and who cares about a bacterial immune system, until suddenly they found out it could be used for these cool, cool things and then suddenly it became hot.

SP1: How is that? I know that case quite well, but do you think they were actually looking for this, or was it more something unexpected? What is the role of luck there? How does that relate to luck?

SP2: The scientists were also able to translate something. They saw by understanding nature something you can apply it to. It's somebody who can make this connection. I don’t know if it's luck why this system ended up working so nicely? I don’t know if it's luck.

SP3: Because it's in the science; you can say it was lucky for the people who worked on it at the time when it was big, for those people it was luck, but the guys who were in it prior to that and changed fields because it didn't publish very well, they were unlucky. It depends on the subject.

SP4: But there's still a difference between discovering the abilities of CRISPR/CAS and discovering the Higgs boson, for example. Higgs boson, nobody doubted anymore it exists and it was just a matter of time it would be discovered by a huge machine that has been built for the last 20 years. So both are great discoveries and I would say there’s a fundamental difference in it: In the one, people were looking for exactly this thing; and the other one it was rather a coincidence that the right people were looking at the right data and then translating it. This, I would call lucky.

SP3: Luck for those people?

SP4: Yes, also for society.

All: Yes, sure.

SP4: But you're right, luck is always positively connotated. We could also call it a coincidence.

SP1: So, for the Higgs boson you wouldn’t say its luck?

SP4: There was definitely some luck involved but not a super-lucky thing like one person just sat there.

SP3: I don’t know about the Higgs boson.

SP4: It's discovered at CERN. The last stage of CERN was built to discover the Higgs boson, one of their main particles.

SP1: The God’s particle.

SP2: They were essentially measuring and measuring?

SP3: There is a big theory underlying, a theoretical physics theory, and 90 percent of all these particles have been found in there and there’s one link missing, and people were saying: Let's head out to find this. It could only go well because you find it, great, they found it, or they don’t find it and then it's also super-astonishing. But there were thousands of people were working on that so you can't just build it on some good guess.

SP4: No.

SP1: It's sounds as if what you say relates to control? There's a difference between the people with the CRISPR discovery and the Higgs boson. Is that what you mean?

SP4: I don’t know what control you mean but it is a difference in the theoretical underlying of this discovery. In the one case, there was no idea how this works; it was really just looking at it, or something, and then studying how it works and the other one, you headed out to find this with very, very good evidence that there was something.

SP3: Yes, in one case you knew what you were looking or otherwise it was a chance discovery.

SP1: Maybe we’d have to say is your work more like a CRISPR sort of thing or more like the Higgs boson?

SP3: Mine is the Higgs, I think. I try to build this thing that we want to use so it's very applied in that way. It's not a fundamental science, in that way. I'm not sure if you would say the Higgs was fundamental science?

SP2: Maybe mine is in between because we want to build something so when you want to build a sensor or so, you need to make other parts work nicely but you know where you're going, you know what you want to see, but there are some other components that we’re not sure are going to work the way we think about and there's maybe not so much evidence that it's really going to work. Then those parts are really unknown and you might have to explore more options.

SP4: As we’re both rather in the same boat, I agree with you but I would go even further that we’re on this lucky discovery side because many aspects of our work will not in the near future be understood in a way that you could sit at the table with a sheet of paper and calculate everything that says it has to work. We just don’t know whether it will work or will not work. My feeling is there was not a lot of time invested in the theoretical study if it actually is physically possible to work.

Some things come up. I was at a conference once and people were trying to measure florescence signal of a particle in a super-tiny volume with a camera that doesn’t have the time resolution. So, someone headed out and said: Ja, just measure it with our setup. I talked to the person and he had never thought about the time difference between the effect he wants to measure and the device he has at hand – and somehow we’re in this regime and you then at some point find out my camera is much too slow for the effect and then you change the camera. But you didn't think of it before. You didn't invest so much time and, of course, it's a question: Is this a project where you can invest enough time? Like for the Higgs boson theory is there to calculate a lot, things have been measured, and then you build the device, and then you know it works. I mean that’s super simplified but in our case it would probably take more time to calculate everything than just to try it. You would know as a PhD.

SP2: Yes, and then we normally try maybe four or five different ideas, some of them in parallel and some of them one after the other one, and then when something seems to work slightly better or is more promising you will go more in that direction.

SP1: Do you ever come across unexpected, surprising outcomes like unexpected turns in your work and then dive more into that or do you leave it aside?

SP2: I think it's common to find things that are unexpected but sometimes it's not for a good reason, it's badly unexpected. You already think you have a very nice idea and you think this is going to work to this or that, and then you try and then you realise it doesn’t really work. But often when you start thinking more about it, there is a reason for it not working it's just there's a factor you didn't consider. But I think it happens quite often. Actually, it's more the opposite: when it actually works so smoothly the way you designed it and the way you thought about it – that’s luck. That’s actually very lucky. Sure. I think now I almost more often expect that it it's not going to work smoothly and then try to figure out why and if it really works smoothly from the first this is very rare, it's very lucky.

SP4: So when something so unexpected happens, the first thing you would think is: There was a mistake in the experiment itself of in the electronics, something like that?

SP2: Yes, when something doesn’t go as you initially maybe thought, you had an idea and you go and test it. It's not necessarily even the setup, it's just that we have very complex systems. We work with proteins or living cells and so on, and there are so many factors that come into play and sometimes you just cannot consider everything so then you're just missing some things out and they influence your results sometimes. But I think that’s normal.

SP4: I think it's very normal, yes.

SP3: It's rare I lose a lot of time if my experiment went the rogue way on me and I don’t know what happened. I often think about it a bit but it's not like I want to lose a lot of time on it, depending on the results, because often I just need to repeat. And, of course, if you keep repeating it and you get the same then you can try to-, it depends.

SP1: Do you think scientists and engineers, in general, but you can also speak for yourself, are in control of their work and their results they get?

SP2: It depends maybe on the field. I think overall if you have enough experience and good knowledge, well, you can in a way control a lot of things. For example, if you're doing fabrication, things like that, I feel like you can reproducibly control things. I always feel like the more you go towards working with living organisms, the more complex things can get. But I think some parts of it you can control quite well.

SP1: ‘Complex,’ do you mean unpredictable?

SP2: Yes.

SP3: There are so many unknown effects working when you start working with living organisms that often you just maybe have to try and see even if it works, unless what complexity is problematic for you and you use Nano pores.

SP2: We use Nano pores. One thing is that, for example, with biological pores, at least, most people have worked and built are often better for solid state pores and they don’t apply to biological pores because you have a very complex geometry, complex charge distribution. You have more like to exactly predict the force, or exactly predict interactions of another protein with your Nano pore. It's very hard to do. Maybe you can do simulations or so but even there it's because again you have not a living entity but you have proteins interacting with proteins and then there are so many things that can happen.

SP4: You asked for the role of control or what we think and whether people have control over their system, and I would say we’re always aiming for control and if a project is about to be finished then we have control maybe but on the way to there we always just try to get more control. So control maybe in the sense of getting the results that we expect. We’re always driving because otherwise it's not reproducible so we want to always for every step gain more control about the system we’re working with, and this might be a little system or whatever system.

SP2: Yes, and I think you have to understand and you get there.

SP1: Understanding and control are related?

SP2: Yes, I think so because something unexpected, you can already start to identify why they happen, and I think most of our experiments you often include controls in your experiments as well to discard some possible causes of things not working, so you always introduce several levels of controls so things that you know should work for sure, things that should not work, and then you add different layers to identify what's going on like checks. You need to include some checkpoints in your experiments.

SP1: Do you want to ask anything else?

SP3: No.

SP1: Do you think scientists can be proud of their achievements or ashamed of their failures even if luck has been involved in their work? So luck can mean lucky and unlucky.

SP3: Yes, I think so and I think because luck is involved in everything. We also have to acknowledge that we try to minimise the amount of luck needed by doing all these other things but there will be luck involved and we have to be proud of what we actually achieved then otherwise-, I'm not sure. Like, we also need the pat on the shoulder once we have done something good, and that is the way-, ja, I don’t know where I'm going with this. Rambling.

SP1: If I understand you correctly, it's about the results or the consequences, in the end?

SP3: Yes. It's also that you try. That’s also part of the thing. I think that you can both feel proud that you actually tried and did your best but you can also be proud if the outcome is successful and you got something good. But, of course, it's also luck-related.

SP2: I think so, too. I think when people are very successful and something really good happens, I think it's very easy to say: It was me, it was not luck. Or for some people to say: It was me, it was not luck. But, yes, definitely luck plays a big role. Also, when you try a lot of things and things don’t work out in the same way, I think you could equally use the same amount of effort and just because you're lucky and you have the right topic, you become really famous in the topic. If you are two years too late, nobody cares anymore and that means your paper ends up in an impact factor of 30 or three or one. This can really be the difference even if you did the same amount of work and quality. So, yes, it plays an important role.

SP1: But this person can still be proud of his achievements the first one?

SP2: Yes, I think so. And I think if it doesn’t work out, you should still be proud and acknowledge that it's not all in your hands.

SP3: But it is a lot about maybe you can be more proud of the actual effort that you applied to something than the actual outcome because, of course, luck can have an effect also. But you can also minimise the luck by applying yourself more and then working more. That’s how I think of it, at least. Yes, it's hard when you can feel proud of something. But I think you are, by definition, also more proud, like when you feel more proud is when you actually tried and you did something. If you have a game where you just roll a die and see who roles the highest, you won't feel very proud winning the game but if you have a game where there is strategy where you outlive somebody, you feel better.

SP2: But I feel like in science it's almost impossible to go through it by pure luck. I don’t think I know anybody who goes through it by pure luck.

SP3: No, you can't. You have to do some work, at least.

SP2: Yes, you have to anyway. Not everything is going to work out the same shot like the first shot right away.

SP4: Is that what you would say about [name of colleague #1], that he can still think there is something that I contributed to this: I was lucky but there is still something that I contributed, and for this contribution I am proud?

SP2: I think so because they had everything ready to measure. They had a good system to their measurements and so on. I think that is a key part why things worked out for him. So I think, yes.

SP3: But also that he was just able to use that momentum, there wasn’t that field and he was able to see then use if for his own gain also, and he was able to build onto it also. That’s also a very important factor, I would think, of his success. And that is, of course, luck-related but it's not only luck-related.

SP2: No, I think there is also a lot of drive. You could have said: Oh, I have one science paper, I'm good, but you need to also have the drive and will to keep exploring that-,

SP3: But it's not only his publication, I also think it's his engagement in a lot of different things also.

SP2: I'm talking now more about the carbon Nano tube.

SP3: But he built up this whole image of himself also which he can also benefit from.

SP1: Imagine there are two scientists who work equally hard and are equally talented. They are like twin brothers who are equal in everything, and one comes to a ground-breaking finding and the other one doesn’t. Do you think it would be fair to grant the discoverer a prize?

SP3: Yes, I think it would. It doesn’t matter if it's fair.

SP2: Depending on the prize.

SP3: Exactly, but if you grant the prize to acknowledge the achievement and the person who did it, then he still did good work so he still did goodwill – it doesn’t say he did better work than his brother, he was actually there and got the thing done for some reason. But it's also a way to expose this scientific discovery to the world also. It's kind of branding when you give this prize. That is also one of the reasons you give them and why they are valid, even though it is also luck.

SP2: Yes, in a way you also acknowledge the person for doing the work but also what he did, so in that sense I think that makes sense.

SP1: What do you think?

SP4: As I said, I ask myself what is the idea of the prize? Is the prize to either communicate to the outside there is something cool and new and, therefore, we just need an occasion, or is the prize to attract other people going into this direction because there is a prize so people might work harder in order to achieve something like this? We have many prizes around and we all often glorify individuals which in that sense is unfair because two equally hardworking people and one is lucky and one is not. I mean, the prize is not given out for hard work, in some sense; it's for the academic achievement that the one has and the other doesn’t. Still, I mean you both probably will get that PhD, if there were PhDs, because the PhD will rather grant something like you did hard work for the last four years and worked scientifically. So typically, I think even here it's not required to publish in your PhD. Typically, this is not. Of course, it's perceived as a requirement but it's not a formal requirement and so there might be different things and we would need to clarify first what is the prize for and then we can say whether it's fair or unfair.

SP1: Then a question which is very related to this example but a bit more abstract maybe: Do you think that scientists deserve praise and rewards such as prizes, or blame if their results rest on lucky insights or findings?

SP4: But they do to some extent rest on lucky insights, luck. So in that way, yes, I think they could. It depends on what you want to use the prizes for. If it's just to glorify specific persons then you boost their career with it but to some extent it relies on luck. When you give grants, you look at what people have achieved but you also look at the project so you have this aspect where you have some luck involved but it's also a lot of hard work so you can maybe get one prize for hard work but if you get a lot of prizes it will be very unlikely it's only because of luck, or journals and good publications. Of course, that is why we build up the way when we apply for funding, when we perceive prizes, it's not only from one aspect normally, it's like-,

[Name of colleague #1] was in the right field at the right time and he also built on it so he's also able to capitalise. Maybe other people could also capitalise but he capitalise but he capitalised on it and a lot of other people who are in the field probably didn't get as much out of it as they could also and now they are probably doing something else maybe. I'm not sure. So it relates to luck, of course. We try to minimise it in the way we do things in science but you need luck. We also need luck, definitely.

SP2: I think PIs have many years of experience. I think they're able to almost smell a good opportunity. They jump into the field at the right moment when they see something emerging as a promising field they jump into it right away if they can: if they have the right network, if they are proactive enough and, of course, if it's related to their field, but that in the end they get more rewards, better publications, more grants.

But the situation of the sibling, I find it harder especially when you think about the academic path because it happens a lot that people want to become a professor but if they're just unlucky with their PhDs and postdocs and don’t get enough publications and so on then it's not going to happen.

SP3: But as a society, do we even care? We care that we have very qualified, good people doing this research but then we have equally qualified and good people who didn't make it. Do we then care? We have the people doing the good science that we need and then some have fallen off, and maybe they weren’t as good or maybe they weren’t as hardworking but they weren’t as lucky; or they were equally hardworking and brilliant but they did just have that (? 00:50:44) then we would still have the people we need to do the good science. I think it's rare that we have people on this, the cream of the crop, doing this real research having a lot of funding and they're not very good. You don’t come up there and are you really able to use it? Then we have some people that don’t get there, and it doesn’t mean they're not as good, but it's just we build up the system. You shouldn’t blame; you should just acknowledge the people. The prize thing is really-,

SP2: Yes, it tough because when you see people who have tried really hard and they make it there, I also wonder if they were unlucky in all the steps or if also it was the way they navigated the system?

SP3: Because you can also build on different way. You can try, then if you can see you're good enough, early enough to see your project isn’t doesn’t go anywhere, then you change fields, as you did, and that’s also an achievement also to do, and you can try to build up your career in a different way, expose yourself more to the public and then maybe use that public image to then develop to something also.

SP4: I had the impression, we stumbled across this before with the scientific achievement and then the public recognition for it, and I think this question goes in the same direction, so if people should be proud, I would say they should be proud of the academic achievement and not because of the high impact factor journal they published in or the prize. Especially, I think these spread a bit, so if you get prizes then you get more prizes because you're more publicly visible. Especially, I don’t know how prizes on these areas are given but I know how prizes on areas like your thesis and stuff are given and then it's just super-lucky because nobody has the time to look into the stuff actually and then they just look what came out of it, and maybe read a report about it.

I would hope that I, as a scientist, would be more proud of the academic achievement than of the things that come along with it irrespective it's well perceived or not. But, of course, it's easier if everybody congratulates to this great thing because it's well perceived.

SP1: If I get you correctly, you say scientists should not be driven by getting the reward from outside? Is that what you mean?

SP4: No, I mean the driving thing is different. Driving should be driven in some societal thing, I would say. Who should decide what science is done? That, to my mind, society should decide and, therefore, they should have a measure to drive people to some direction, but whether somebody should be proud of something or not, that’s a personal thing and that’s what people consider as sympathic or not. I would consider sympathic someone who is proud of his academic achievement or scientific achievement rather than the things that come along with it because he’s riding a wave or something,

SP1: How would you see that in the sense of deserving it, that he then deserved a prize? That could be something that’s more from the external point.

SP4: It's the question again: What is the prize for? Is the prize for making things publicly available or having a high outreach? Maybe the Nobel Prize is a well-perceived thing in society and it's a big thing and it shows this is an academic achievement and we, as academic society, value, it should get the attention of the outreach. And then if you make a discovery that many people say is a thing that should have this outreach, then you deserve it, of course.

SP3: Then it's according to the prize. As I said before, for example, getting a master degree or PhD only basing on a great outcome, and this would be super-unfair because we said this might be lucky or not. Especially in the early phases, I would say. I mean, you don’t have too much time also to switch fields completely.

SP1: Do you have any further questions?

SP4: Maybe personal. If the fact that luck can make a change in your career is that something that holds you back from pursuing an academic career? I can consider that because no matter how hard you work, you might just not get the grants for reasons that are beyond your control that you say there are career pathways in industry that are much more certain and you decide because of that to leave academia.

SP4: Definitely. I mean, if someone grant me, okay, now if you work hard for the next ten years, well, it doesn’t mean hard work, I will not work day and night in the lab, but working hard in sense I consider as working hard, and then you get a professorship, then I would say: Okay, it sounds interesting, even though I might not know what a professorship is, or what I'm then responsible for everything. I would say it's (? 00:57:02) now to say: I will become professor at some point, and I steer everything in that direction because I would say this makes me unhappy, at some point. Because there is so much luck involved especially for these steps like prizes and stuff, and not necessarily the scientific, so luck and scientific things but luck and societal things.

SP3: But I agree also. It's also why I phrase it the way I do. I also get from you that I have the opportunities open so I don’t say that I don’t want to do it but I want to pursue it, then if I have the luck also to be able to have that career path open, I would look at it and then see how it compares to others. But, of course, that’s also the thing, the more you stay in academia also the harder the change can be also. I don’t think necessarily the first postdoc has closed down a lot of opportunities but at some point it starts to become hard to do the shift into industry.

SP2: Yes, I think it's always something that you have in the back of your mind because we just see how very talented colleagues are trying to find a position, and it's hard - so it's very hard to detach yourself from that. But for me personally, I think there are also other reasons more like I try to picture myself. I could see some parts of it but it didn’t fully fit. So I think that’s also why.

SP1: Do you have anything else you want to say about the topic we’ve been talking about? Is there anything that I haven’t asked for yet that you think is important? Or is there anything you want to clarify that you said earlier?

SP2: No, I think I want to hear, for example, now that you're so much into the topic of luck, how do you define it or how do you approach it because I didn't think about it that much before, so is it-,

SP4: Actually, I'm asking myself, of course, maybe that’s also your motivation of this study, we consider science to be so luck-untouched thing and maybe for the scientific part in the sense of if there is Higgs boson you can find it, if not then you can't. In that sense, yes, it is untouched. In the other senses like we discussed before, I think it's the same in every part of our society and if you get the job you like or if you get the partner you like, I mean, there is so much luck involved everywhere. I think these things are also the same in science. At least, (? 01:00:05) science.

SP2: Yes, I always find it funny - we always think science is so objective but I'm very sure if you give the same PhD project to two people, you end up with completely different outcomes in the end. So there's a lot of subjectivity involved in decision-making and all the different steps you take, so yes, it's something we don’t look at it so much but definitely it is there.

SP1: Thank you very much and then you can say something about the project. I will shut down this.

(End)