|  |  |
| --- | --- |
| **Focus Group 3 – 09.08.19** | |
| Aantal minuten: | 70 |
| Aantal sprekers: | 4 |
| Taal: | English |

SP1: Maybe last time I didn't do that. Maybe I will introduce myself. You know a bit about [name of research project leader] project. [Research project leader] is here in [Dutch research institution] I am an applied ethicist and I work in the [Dutch research institution] in the medical faculty. I do a lot of these sorts of things: I talk with a lot of people about moral problems, about ethics, about topics such as this today also a lot of ethical issues in medicine. From here on, it's mostly you who will be talking. We start with a very easy but important question for us: Can you briefly introduce yourself by telling us your name, your discipline and your research interest or research topic.

SP2: I am [name]. I am a theoretical physicist currently working in [name of department], a sub-department of applied sciences. I am working in the field of quantum dynamics in equilibrium, out of equilibrium. Throughout my career I have been meandering between different topics: a bit of gravity, a bit of particles colliding with something else and now it's dynamics of spin scene, some kinds of magnets which interact through data and whatever to study their dynamics and how they behave under certain conditions. This is what I do at the moment in this department.

SP1: And mostly theoretical work?

SP2: Theoretical work in the sense of sometimes just pencil and paper and sometimes simulations on the computer, a balance between the two.

SP3: My name is [name]. I am a final year PhD student in the [name department]. I am by training a physicist but I've moved towards biophysics and now I'm working on DNA chromosome dynamics inside artificial cells.

SP1: Interesting. Is it also partly lab work?

SP3: It's completely experimental work. Yes, everything is in the lab.

SP4: My name is [name]. I am a last year postdoc. My background is in theoretic physics where I studied driven systems that are inspired by biological problems and for my postdoc I switched to learn the experimental work, and now towards the end of the postdoc interested in more information, theoretical approaches that emerge out of the biophysics route that I went. I still stick to the things I did during my postdoc and my PhD, I'm still working doing simulations working on some models, and do the experimental work in the lab.

SP1: So, both computer simulations and lab work?

SP4: Yes.

SP1: Interesting. Could you say a little bit is your work commonly individual or more group work?

SP2: Overwhelmingly individual in the sense you're the first people I'm talking to today. Almost. Yes, so it's very individual. Theoretical physicists usually work in small groups. There are a few exceptions, of course, there are some large groups which heavily collaborate with internally but in my case for the whole time it’s just me and my supervisor and no-one else. It’s just two of us and sometimes we see each other during the day. Yes, it's very individual.

SP1: How is it for you?

SP3: For me, it's difficult to say because people have a different interpretation of work group, teamwork is. But compared to you, it will definitely be more group work. I work together with many other people in our lab, even though the particular project I have is my project. Everybody has their own project but we all work together; there is always some overlap and there's definitely people helping people each other all the time. In that sense, not everybody’s working on one project. In that sense, it's not teamwork but in other senses definitely.

SP1: The experiments are sometimes related?

SP3: Yes, there are many related experiments. People have their own topic but very much related experiments.

SP4: I can relate to [name SP3]. The system works in our group as well. It's a bit less intense though; everybody is working very similar topic and we help each other platonically, so we talk a lot and discuss a lot but we literally don’t contribute to the actual work in the lab unless it's explicitly required. It's just occasionally in the day from two different people are coming together.

SP1: Do you have thoughts whether you want to stay in science or are you thinking about leaving science?

SP4: All the time. Every day can be different.

SP1: Why is that? Do you want to say something about that?

SP4: Science has a great appeal and also has great drawbacks. The appeal for me is in the years I've spent, I don’t think there's any other employer that would let me do this journey that I did. I'm immensely grateful for that and I see when my next step is coming to an end, at that point I say, well, if my work’s going to be consisting of trying to write grants and get funded, then I can equally just work in a company and do any other that I don’t really like as much as meandering. That’s why it's a more split view in the future.

SP1: How is it with you? Do you already have an idea?

SP3: For me, a long time ago I was saying, okay, I'll just do the PhD and then I will probably go to industry, but now I'm a bit more not making up my mind quite yet. It's 50:50 now. I think the main issue really is the kind of more permanent things in science in the work you do is very different from the work you do when you're in a temporary contract on the PhD and postdoc level. When you become the permanent person, you're suddenly doing a completely different job.

SP4: [unclear]

SP3: I mean a PI. At least, in experimental fields they don’t do the science anymore; they're the guiding people in a sense. I would have no idea how that would be. I know how it is to work in the lab but obviously you don’t get a permanent job working in the lab, so it's a bit of do I want to stay in science? I like working in the lab, but sitting in the office writing grants all day doesn’t sound appealing. So, it's a bit a strange situation that I like doing science but when I see what permanent science means I'm not quite sure.

SP2: [Name SP3] probably similar in a sense that I would like primarily to stay in science as long as I can but, of course, I am aware of the fact the filter you need to go through becomes narrow, narrow and narrower the closer you are to a permanent position. My primary goal is to stay in science but, of course, one needs to have at each time, every day you need to have sometimes plan A, B, what if this does not work out, what shall I do outside science or outside the scope I'm having at the moment? Do I get a grant applied or don’t I get it? But primarily I would like to stay in science.

The main complaint I hear from people which left academia is they don’t feel intellectually challenged in the sense they say, well, we have a lot of work which is interesting blah, blah, but somehow at the end of the day it was all small, easy pieces, but they don’t feel this challenge and they don’t feel they’re doing something for themselves but for someone else. This is the reward for doing science to do something for myself and to fit in the right place.

SP1: It helped us to place where your ideas are and to place a couple of the answers to coming questions. As you all know by now, maybe since a couple of minutes, but the topic of the focus group is luck in science. We are very curious about your associations and ideas are when you hear that. I'm just going to write on the white board but feel free just what comes to mind, anything you associate with luck in science: What does it mean to you? What is it?

SP4: I’d say discovery.

SP1: What do you mean with that?

SP4: You can always plan something and that’s rather rational, you think what you're going to do figure something out. That’s nice, that’s fine but that’s very limited and as soon as you step into something which was not planned, only then would you actually call this a discovery, so you can't write a grant and write ‘discovery’ down in the comment. This is not how it works. That’s why a discovery totally depends on luck and what just happens in the moment.

SP4: I think there are facilitating circumstances to make discoveries; it can be a chat over coffee.

SP1: Facilitating circumstances. Do you have an idea what that could be?

SP4: For example, there's specific summer courses in biophysics and biology, and they explicitly try to get in a discovery mode where people who are (? 00:13:43) and not written down grants before, and then people try all kinds of weird stuff as well and probably too risky to address in real life, and when nothing’s expected then you can survive probably. Then history plays an important part because people have demonstrated this work for these kinds of settings where everybody signs up and hopes it happens again.

SP3: I think there are many elements of luck: luck in the people you meet because they might give you some idea. You have to make hundreds of choices every day to try to do something and you can't do a hundred things every day so you also have to sometimes make the right choice. That’s also partially luck.

SP4: Does this apply to you when you have so many choices? Choices, of what do you mean?

SP3: For instance, in lab experimental choices. You have to choose the amounts of reagents you mix, how to solve a certain problem, etc.

SP2: I wonder if you also choose that many-,

SP4: Do you mean on an everyday basis when I've made something? Sure, in the sense I can take up several directions to pursue. Sure. Yes, in the sense of mixing some substances but maybe pushing some (? 00:15:56) additionally to change something and then go for other facts or whatever. Of course, there is some kind of freedom.

SP3: Also, the questions you ask; sometimes you're just asking random questions and it turns out the random questions might be an interesting one. Or you write a paper and for some reason it doesn’t get accepted and another reason it does get accepted, then you're like: Okay, well, I guess I got lucky it got accepted this time in this journal. The next time you try it again and it doesn’t work and you have no idea why. These kinds of things. That’s also luck. There's a lot of luck.

SP1: Do you also consider things being rejected as luck having a role or do you associate luck with good, positive outcomes?

SP3: Bad things are luck? I don’t think it's lucky to be in a car crash; that becomes chance. It’s both chance, it's just when it's positive it's called luck, I feel.

SP2: But failure in science, where there's failure in a sense it could mean you intuitively expect something to be 100 percent sure to result in some calculations and it does not result. This is usually the starting point for something.

SP3: But then again, its luck so luck starts with a failure, surely? If it's a failure and it doesn’t lead to luck then you don’t call it luck.

SP2: Failure, for example, if your paper is rejected. According to my experience, it's mostly due to the fact people either don’t read the paper properly or they just don’t like it in the first place and just reject. Whether this is probably the opinion of most people, so read many papers and they can reject that. This is my individual experience with rejected papers. I would not say this is a kind luck if it’s rejected. I mean, we only learn from this in the first place. We just learn that people didn't understand.

SP4: I can relate to this. I don’t think it’s luck to be accepted per se, I would more probably say it's luck if your own perception of what you did coincides with the perception of the people who are supposed to judge over it. And that’s then very independent of the situation: Oh yes, let's just try some great journal because probably we are lucky, right? So, this can be a strategy to say: Probably we’re lucky, we submitted to the best journal ever despite the fact we know well it’s probably not that significant. Then I would say, yes, this is totally luck and I've been throwing dices all the time, but then also I don’t care, right? In the best case, then I know I'm in the casino then, right?

SP1: I'm not sure I quite understand that.

SP4: For luck’s sake, one could try. You have a piece of work and you think it's great, it's pretty solid, let's send it to *Nature* and then probably we’re lucky. This sometimes works out, of course. Then when I have luck in my thinking then I probably do it. If I have reason in my thinking, I probably don’t do it but I go to a journal where I think that’s probably the right people who will read it and will probably understand it also in the way I wrote it up. Then I could still feel lucky, of course, if it's accepted but I didn't put heavy, but I was not lucky it was accepted because I knew these are the guys who are going to read it, they can understand what I wrote down because it's exactly the audience of whatever I produce. And then it's immediately no luck if you publish or not.

When I see my projects fail having high impact, I don’t think it's really a failure and the project I usually work on I don’t have a very long breadth, for example. So, with this limitation, my breadth on certain projects is not very deep and very long that I work five years my ass off to get something, that’s also the reason why I'm probably not going to revolutionise a particular field and would deserve to publish in *Nature*. I accept this because I know my breadth is just like it is so I have to live with other stuff and other journals. Then I honestly can't be disappointed if I send something to *Science* and it's rejected.

SP1: You say already in the decision to send something out to *Nature*, you already feel like you're going to be lucky or you have to anticipate luck?

SP4: I know I need luck because I go to the casino. I could also go to the bakery and then I will go out with my pretzel.

SP1: Are there other things related to the topic?

SP2: I would maybe add something which is connected probably to discovery. It may sound pathetic but I guess luck, you feel at least lucky or feel happiness or you feel the reward for doing something, is when you understand the thing you just understood you are the first one who understands it. Of course, it's a very narrow scope and it's something very specific and not revolutionising the whole business but, nevertheless, you're working on some problem and with some high probability you're the only one or among a few in the world who is just at the moment working on this particular topic, then you understand something and probably you’re the first one who understood it.

SP4: Probably you meant with discovery.

SP2: This is discovery, and discovery means you're the first one. This is the reward.

SP4: You're right, this can be very small. So, the first time you make an experiment and the first time it works out so you go out and: Whoa! It worked for the first time, awesome.

SP1: And you feel lucky?

SP2: Yes. I just remember randomly the first physicist who discovered inside the atom there is a core and inside the core there is a spin, and he was the first one who discovered there are spins in all nuclear cores that we built there are some spins inside. And he was the first one to discover. And then he writes on the paper when he went outside in the morning after the first experiment ran and he sees the snow around him and then he says: Well, I'm the first one who understands in all the snow there are nuclear spins around us and no one else knows. This is the reward, he says.

SP1: I see for you it has some link to chance, there is a bit of link to people you meet, to circumstances and to reward, so it has a positive connotation with luck.

SP4: And there is an opposition to planning. When it's purposefully or intentionally done with some sort of forward-looking effort to arrange things and then it's not surprising if it works out. That’s how I understand your narrative you have chosen the reviewers and it's not much of a surprise, in a sense, they have a positive attitude to your work.

SP3: It depends. There are many different ways of planning. The most very obvious example is people trying to attach gravitation waves or making particle colliders to find the Higgs boson or something like this. They had to do a lot of planning but in the end, it could have gone either way: you might see something you might not see something. In that sense, the fact you see something, it can be lucky you did all your planning correctly, that the machine works the way it should work. In that sense, planning can be focused in some way that there is some luck involved that your strict planning works out in a way. So, it's not that all planned experiments there's no luck involved.

SP4: I think if the public knew how much luck they needed to detect this gravitational wave, they would have never sunken so much money in it. It could be.

SP3: There are different types. In smaller scale experiments there's less planning so these are all examples that are large-scale, multiple countries and you need planning; but for small things in the lab, smaller scale, you can sometimes do slightly random things. But luck. And it's difficult to know what's a random experiment. You can't do a random experiment, I think. Or you can't just take this. There's always some kind of idea behind what you're doing.

SP1: It's probably not science otherwise.

SP3: No. There has to be some kind of idea or hunch because otherwise you have to make all these choices. You can't just say: Okay, I'm going to make a device and the dimension is going to be this. I mean, it's never going to work then. It's informed choices.

SP1: I think now we have a bit of a broad overview of different associations you have with the topic in science. I’m very interested in your own experience. Have you ever come across luck in your own scientific work or career? Could you give an example?

SP2: I can give an example regarding people in the sense of PhD supervisors. In English, PhD ‘supervisor’ is a neutral expression. In German, for example it's Dr father, so you're a father. I didn't understand before I did my PhD, but now I'm starting to understand what it really means. It's really a kind of a father in the sense if you don’t meet the right one you will quit. I had the experience I started a PhD which I broke up after half a year, and I know for sure if I continued it the very first I would have terminated at some point of time, that after the PhD I would be out of science. There's luck in the sense meeting the right people. The right people teach you the right things, motivate you at the right time to do the right way. I experienced this with respect to a PhD supervisor. Or supervisors actually, in the broad sense postdoc, master or diploma supervisors.

SP1: A good example. Have you ever come across luck in your work?

SP4: This can be very broad. Somehow, I'm lucky to still be around, right? In life, even that. To be in science, to get along with the people around me, it will be in the lab that’s fun, people I like, I've got nice colleagues. That’s much more random factors that I can be lucky about than, for example, how my project goes. How my project goes, my feeling is I have incredible control over it but that does not mean I always execute this control, and usually I don’t execute much control on my projects but more listen to other people, talk to other people and develop projects based on that that are probably more interesting than the project I'm already involved in. So, the execution of the project is often the minor, important part to how I do science: It has to be done well and then you have some idea what kind of prediction you want to confirm or undermine with the experiments, and if you try hard and manage to figure it out then you can be lucky. But this depends most of the time on execution and being sharp in the end. So, I would say there's relatively little luck.

SP1: Is this a project you applied for yourself or was this an existing project?

SP4: I did not get hired for a specific project; I got hired more for my complementary skills to the people who are already in the lab. The projects I came up with in the lab are projects that complement my skills and not necessarily thought out before. This is also very different from planning. I just don’t do this, which makes me a very risky to hire probably.

SP1: It sounds part of the things you're saying have to do also with experimental work you're doing so there are different projects and you do complementary things to that, and you say the execution of the projects is not so much the most determining part of the work, if I understood correctly; it’s more to do with people who are around you. Did I summarise it correctly?

SP4: The way I do science I try to minimise the luck I need to get good data. That’s what I do for a living, basically. So, this mean I can compare it to theoretical approaches so if I would have complex experiments where I would probably need luck to observe something, I could not do this because I would spend years trying to be lucky in the lab but I would never be able to compare it to anything that I calculate on a statistically mechanic basis. Statistically, it has to happen all the time: it needs to be robust, and if it's not then it's not the right project for me. I don’t want to play on luck and do experiments randomly and hope that something comes up because that’s not going to work. Obvious, right? It’s informed. As a field changer, I take the step I'm not going to complicate anything, I'm going to do very simple things I can reproduce at a very, very high quality. So, I don’t need luck for my experiment, at least, but I need luck in how my project becomes an interesting project, for example, that’s much more difficult for me because then it can also be very boring if you do very simple experiments, very simple theories. It's more luck on a different level than on actually the execution level.

SP1: Is that the same for you or is your position different?

SP3: In the lab I work in, we do a lot of fancy things, so lots of experiments and projects have a lot of moving parts and if all the moving parts align then it might work. If it doesn’t align it doesn’t work and then you end up having to -,

SP1: - get lucky.

SP3: Yes, then you have to get really lucky to observe anything that might be of interest to be able to be published. As all projects start out, if all the moving parts align and we can measure this, this or that, then everything is fantastic but it takes a lot of-, Well, it feels like luck because sometimes you feel you have no control in the success or failure of something, so in that sense it might feel like luck, but then there's definitely some people that are consistently lucky so then you feel, okay, maybe there is some way of guiding yourself towards somewhere. But it's sometimes difficult to know this because of the person or because of the project. So, it's easier just to call everything luck because then you feel better about everything.

SP1: Would you think it's not luck if someone is repetitively lucky?

SP3: It can be, but it can also be by the project he/she chooses. This is also a thing. I don’t know. It's very difficult to say this definitively. It's always an association you have.

SP1: Is it for you the same? I think because the comparison between experimental and more theoretical approaches is interesting. Do you have the same considerations in your work like making simple experiments or making simple-,

SP2: Simple in the sense you try to arrange and find out some optimal way to do something, do you mean?

SP1: I mean more do you also have some sort of considerations that you don’t need luck in your work?

SP2: No. If you do some calculations and you don’t have concrete expectations what should come out in the first place, so you have several ideas what can be the end result but you don’t know probably where you're going to end up. So, in this sense, you need luck. Say, you're making some calculations and some boring stuff comes out and then after a few minutes thinking you would just say: Ah, of course, I could know this in advance. But if something more interesting comes up then you need to conduct at the right place. I have the impression that luck is, in this respect, something indispensable.

I'm currently in the situation that for a few months we tried to reach some effect and it doesn’t come out at all, so at this moment in time we are really disappointed that we conduct and conduct and conduct and it didn't come out what we expected. In this respect, if we were lucky, maybe digging in different parameter regime, different energies, different times or whatever, but luck is definitely something I wouldn’t mind if it comes up.

SP1: So, you're actually looking for a bit of luck in your work?

SP2: Sure, yes.

SP1: Interesting. So, where you say you're trying to reduce the amount of luck I need in my experiment you're trying to find it.

SP4: For you this is a hard fact now. You have a system set out and you're looking to confirm what you think is happening and prediction, so it's in the science where you can look, and if you're lucky you will find it. For me, I felt lucky when I realised one of the proteins I worked with does something completely different in addition to what it does for me. That was for me: Oh, that’s weird. There's a completely different dimension I totally disregarded. That was for me one moment where I was: Oh yes, that’s a bit lucky. It's very boring in the first place and very repetitive and no variation, and then it turns out: Oh yes! This is also brought in and it makes this and that. It was not on the table and I just did not think about the random chemical ingredient to put. But it was the interaction with other people that helped realise this. For my case, I would say the luck happened not actually on the scientific side but by connection with the people in this specific case.

SP1: We've now spoken a bit about luck in your scientific work, have you ever been surprised by an outcome or a turn in your work that’s linked a bit to what you say: We found something because nothing really I was looking for but we found it nevertheless?

SP2: I would say yes. It's happened not all the time. Of course, unexpected things pop up and, sure, luck in this respect, yes, otherwise we wouldn’t be here. If we were to do some stuff with predetermined results it would be something demotivating.

SP4: And we are the people that actually respond to the luck in the science.

SP2: Yes, exactly. You're asking already a pre-filtered sample of people.

SP1: How is that for you? You said you work on complex experiments? Have you ever encountered any surprising outcomes or unexpected turns in one of these experiments?

SP3: Once I was listening to a talk from a seminar speaker here who was visiting, he was a theorist talking about computer simulations. I thought I could do with my system an experiment which would be equivalent of that computer simulation. It has partially to do with my project but kind of tangentially I unplanned to do that experiment. I thought we can try and do the experiment and we saw something nice, interesting. So, yes, I don’t know if that’s lucky? I guess it's lucky I went to that talk and then thought about I can do that experiment. Then it was lucky I talked to a master’s student who was looking for a project and this master’s student had talked to many, many people and then for some reason chose to do the project with me. Then, of course, you're also lucky that the master student works for nine months and then in the last month suddenly the experiment works. I mean, I don’t know. Sometimes it feels extremely random. It could’ve just not worked at all or I could’ve not gone to the talk and I would have been doing something different.

SP1: And are all of these steps luck for you? Do you consider all of them luck, like you went there?

SP3: For me, there’s a little bit of drive behind it. The thing is, if you drive something it doesn’t mean you get the outcome. That’s kind of the winner’s mentality, because people look back and look at their trajectory and they say: Well, I was working hard and I got the results I needed so it must’ve been because I was so driven. Just by driving, you don’t get there. I think there is definitely luck at every stage, to be honest. I can say: Yes, I did this experiment, I knew it was going to work – I think also on things like this, to be very honest. I think the humbler answer is: Yes, that was luck.

SP4: I think with the experiment success after nine months, it's also because of the sense of urgency of students often. Also, I think the project you actually conceived for your student, you thought it’s possibly it's nine months.

SP3: I don’t know.

SP4: Of course, you did because otherwise he wouldn’t have believed that he would actually measure this in nine months, and then if he wouldn’t believe then he wouldn’t feel the urgency to spend the time to do the experiment or go the extra mile. So, I think it matters a lot how we prime the people we work with, in particular students, and we’re lucky if we get-,

SP3: Sure. I think this is drive part but I think lots of it might be not very consciously, you’re not saying: I'm consciously saying this, this and this in order for this and this to happen. It's different than that.

SP1: We’ve spoken a little about what we understand about luck and about your own experiences. If we now transcend more a bit for the whole field of science and engineering, are there any other examples or ideas on how luck may affect science and engineering or do you feel you are the exception and other scientists and engineers do not have anything to do with luck?

SP3: I would hope if you’re building a bridge then there’s no luck. I mean, you design a bridge, you build a bridge, cars go over, and it should work. If you're trying to invent the concept of a bridge there might be luck involved, but I think after a couple of thousand years, engineering a bridge, it might go wrong but there is definitely less luck, I feel. That that kind of thing.

SP1: So, engineers are less dependent on luck?

SP3: It depends what kind of engineering they're doing. If you're building a bridge, I would hope there’s less luck; if you're trying to build a new mode of transport, sure, there might be luck there.

SP1: It has to do with the innovation part?

SP3: I guess so, yes. If you're trying to make the rocket to go to Mars, something like this, it hasn’t been done before then yes, sure, there is luck in the choices you make, but if something is extremely well-established with all kinds of regulations on how things have to be then there shouldn’t be any luck because otherwise people die.

SP4: But you probably mean something works by chance or not by chance, so a bridge works not by chance but by pre-determining all the parts. In this respect, I would agree, but luck in this respect is probably something you hit something by chance. I guess the advancement of science in general has several examples of something working just by chance, and in that respect if you really think some experiments or some theory works, you know now what they did, they did understand what they're doing but, say, some people just opened a new science direction by trying something out, it didn't work out they just published it, but then it turned out it's just something they detected chaos, whatever, quantum chaos or classical chaos. Many things work just by chance, something unexpectedly happens and you either throw it away and start something new or you ask yourself: What is this? - then you pursue it even maybe for several years without understanding it and then you just hit on something interesting. So, this is then by chance, that something works by chance. I would define this as being lucky in the sense something works by chance without knowing if it would.

SP3: I think there's lots of stuff in between. Engineering there's building bridges and there's going to Mars but there’s lots of stuff in between which is not quite as extreme as both those cases. I don’t know how much luck there is there. I don’t know.

SP4: It always depends on the execution as well. Even if you discover chaos, you still need to execute the work and make it accessible; you can be lucky and hit the lamppost and see a phenomenon nobody has seen before, but if you don’t go the mile and work several years to actually make it accessible then all the luck you have in this one moment is worth nothing if you didn't execute what's necessary to demonstrate it.

SP1: It actually links quite well to another question we wanted to ask: To what extent are scientists and engineers entirely in control of their work and their results they get?

SP2: They are, at least, expected to have more and more control with time. The institute writes a grant, every month you need to write down what you're going to do, so in this sense you're expected to have control.

SP1: Are they?

SP2: I guess not so. Whatever grants I wrote, in the end sometimes they just diverted from the actual plan, it was just completely something else. I know we’re diverting from the topic but here it's the interaction between politics and science. If someone gives someone money and expects him to work, then he also needs to report what he's doing and then this is why control is the essence: You give someone money and you want to have control of the money and you require some judgement about some things, you need to judge over the people by (agents? 00:53:15) and you need to judge about the outcome. Again, this is a kind of control: You look at where they publish, how much they publish and which journals they publish and so on. From this point of view, by funding someone, you demand control and the scientists need to adjust. They write the grants but in the end everyone knows it's not going to work the way it was written down. It’s some kind of unwritten law in the sense it will not work out the way it was meant.

SP1: Do you agree or do you have a different view?

SP4: I think grant applications that get funded sometimes read like dreams. That’s very true.

SP2: Do you mean dreams in the sense you're quite dismissive about what they wrote?

SP4: No, overly optimistic achieving totally unrealistic goals. This works well apparently. I always feel pity with PhD students that stand in front of their projects which are laid out in these grant applications and it's so obvious this is so unrealistic to achieve, and I really just feel pity. I'm so sorry.

SP1: How is that related to control?

SP4: It's the disconnection between doing the science and dreaming about it. Even the greatest experimenter sits on the bench and tries to hunt down some dream then it does not mean this is possible, then the person on the bench is in control not the PI that wrote the dream.

SP1: So, in order to get the dream to become true one might need a lot of luck?

SP4: I would say at the PhD level, it's not clear to you what a feasible project is and what’s not which means you sign up for something that sounds cool and you don’t know how it sucks if things don’t work. That makes luck also important because then now it actually has a role. Unfeasible projects are all the time written out and get funded, so in principle you need luck as a paradigm to help people tack on. This is probably a weird sentence, but even if all things fail then you can still be lucky. I would criticise this in the scientist, in general, this is not very fair to do. Not at all. And to me the part actually also not to funding.

SP1: Do you think because you say whether projects succeed or fail it's not always within control and sometimes it has to do with other factors than your own merits, do you think scientists can nevertheless be proud of their achievements or ashamed of their failures even if luck has been involved in their work?

SP3: Sure, why not? Feeling proud about something is how good you feel about it. If you feel good about it you feel proud about it. If you had something to do with how it went then you should feel proud, and if there are some other factors there, then, sure, it's okay. As long as you feel you had some agency over what happened a little bit maybe, you can feel proud about a very small thing. That’s fine.

SP2: You can feel ashamed when you're unlucky in science in the following sense, say, when you're among your peers, I’m assuming - I speak for myself, I'm not in singularity in the sense I'm not a genius (? 00:58:29) someone and being in this group of people, say for example, the people you study with and knowing there are really talented guys around you, but at some point of time in their career they did not have the luck you had, and then people even more talented than I am, needed to drop out of the job deliberately because of-, For example, I will use again the issue with the PhD supervisor, so did you have the right PhD supervisor for results? So, it's not about you as yourself being lucky but, again, do you meet the right people or come across the talk or whatever? Are you in the right place? If you were not in [location] but, say, London University where the exchange problem is not that extensive in terms of money, you would not encounter so many people and among these many people you meet the right one. In this respect, one can feel ashamed in the sense why I am not someone else.

SP2: Imagine there are two scientists who work equally hard and are equally talented, we can't distinguish (? 01:00:00) for example, one comes across a ground-breaking finding and the other one doesn’t. Do you think it would be fair to grant the discoverer a prize?

SP3: This is what happens.

SP4: If I could I’d say let's abolish prizes.

SP1: Why?

SP4: The merit comes anyway and the funding is not allocated well so it's just a misallocation of money, in my view. You would do better as a society if you-, well, you should celebrate successes of individuals to make them visible members of society that have a positive impact, at least, hopefully, but please distribute the money to everybody.

SP3: I think science is very similar to sports in that sense. You do sports and you get a prize. Prizes are there all the time; it's very natural for there to be prizes. But it's not like if you work in the hospital and this person saved the most lives this week so they get the prize, or this person at the market has sold the most apples. There are only very few fields of work where there's prizes: sports and science, and also music, for some reason. It's like a little race. That might be a bit weird. It's weird if the person who discovered it in the context of this kind of weird system, yes, then that person gets the prize just like when you run 100m and you come first you get the prize even though the other runner might be just as good as you. Well, I was the fastest.

SP4: The problem is because you don’t know what’s there to discover.

SP3: What do you mean?

SP1: There's no parkour like when you are running.

SP4: You earn the first prize running 9-something in 100m.

SP3: It's even more random.

SP4: Exactly.

SP3: So, it's similar to an arts prize: this person can paint so beautifully so this person gets the prize.

SP4: Are there art prizes?

SP3: There's art prizes, music prizes, best photograph. This photograph is better than the other photograph. But it's also random. It's very bad: I discovered something and you did not.

SP4: But painters, for example, is random.

SP1: Is that the same for science? Is it as random or unfair? How would you describe it?

SP3: To have the prizes or that people get a reward?

SP1: That some people get prizes and others don’t even if they work equally hard or are equally talented?

SP3: Mostly, the trick is you have two people and you're saying we have two people; one discovers something and the other doesn’t discover something. So, then it's very obvious in the context of that we give prizes to people is that person who discovered something gets the prize, but most of the time the fact is you get people working equally hard; one discovers something and the other also discovers something and then one person gets the prize. That, most of the time, is the situation. In others, many people have discovered many things but only a few people get a prize. Obviously, you don’t get a prize if you don’t discover anything. Then it's the other situation which is then becoming very lucky.

SP4: I have another argument why prizes in science are really bad, because it relies on friendships and connections: How do you know this is actually the discovery worth getting a prize?

SP3: Yes, exactly. That’s what I'm trying to say: If two people make the discovery and then one person gets a prize, it's exactly this.

SP4: So, it depends on the friends he has?

SP3: I don’t know.

SP2: Not really, it depends again on the prize or the level of the prize. Regarding your question, I would say, yes, the person should get the prize, the one who did the discovery. Not giving him the prize would mean, I mean we’re looking for fairness, so it's fair not to give him the prize because they worked the same amount and is important but it's just a matter of luck. But luck itself contains some aspect of unfairness. Why should the one discover something while equally working as the other one? But on the other hand, the one should get the prize because prizes also have some social impact.

If we’re talking about the highest prize, the Nobel Prize, each child knows of the Nobel Prize, in the sense it's sought in society and pointing children to the top ten, say, and then telling them you should be like them, for example. From this point of view, I would give him the prize but at the same time I would also admit that science is not fair. Science, by definition, is unfair and there is a joke in physics that whatever is named after someone is, for sure, not this person who invented this. The names are just given for some objects in mathematics and physics just by more or less – not randomly, it's unfair to say random - but it's very often the case that the first people who invented something these things are not named after the discoverer - which is kind of a prize again. So, science itself cannot arrange itself fairly so why not add some prizes?

SP1: Do you mean to counter the unfairness in science?

SP2: No. Of course, you have the reward but again the prize is also some additional reward.

SP1: Is there anything you want to ask or add or else I will close? Anything else you want to say, any further remarks or things that popped in your head and we haven’t spoken about yet, or any criticism you’ve been holding back?

SP2: In general, the definition of luck also changes in time. If we go 100 years back where just 100 people in the world were really the top scientists and they had some goal to climb the mountain and they go and they don’t know how to go and when they will arrive they also don’t know. This is kind of luck. It needs to involve luck in order to reach it. Nowadays, when there are not hundreds but thousands of hundreds of millions, it's more about incremental science in the sense it's smaller steps; it's not going to the top of the mountain but it's just smaller steps which is then again where luck is something else and chance is something else, and controls, again, becomes more pronounced.

SP1: Interesting. Thank you very much for all your effort and contribution today. We definitely learned a lot again. It was really interesting also in the light of the other focus groups, but we can't say too much about that yet. I'm going to pause this.

(End)