

Report on activities
August 1, 2018-July 30, 2019
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Summary I regard my stay successful academically and extremely pleasant from the perspective of the non-academic aspects. I have completed/written several papers on different topics I was working on during my stay and started writing a book on foundations of probability; I have organized workshops on issues related to my research; I have delivered talks at a number of international conferences/workshops; I gave talks at different academic institutions in Germany; I have contributed to undergraduate, masters and PhD level teaching at the host institution. In addition to the narrowly defined academic life, I used the opportunity offered by my staying in Munich to experience the rich cultural life of Munich and improve my German language skills. In this report further details of my activities are described that should confirm the summary assessment. **I wish to thank the Humboldt Foundations and especially my host, Professor Dr. S. Hartmann for honouring me with the Award and hosting me in Munich.**

1 Support and duration

I have used the *Carl Friedrich von Siemens-Forschungspreis der Alexander von Humboldt-Stiftung* (henceforth: Award) to stay at the Munich Center for Mathematical Philosophy at the Ludwig-Maximilians University in Munich for the whole 2018-2019 academic year. I arrived in Munich on August 1, 2018 and left on July 30, 2019. Making myself free from the duties at my home institution (London School of Economics (LSE)) for the whole academic year was made possible by the fact that LSE granted me sabbatical for the whole 2018-2019 academic year.

I was lucky to be able to rent an apartment in the Guesthouse of the *Internationales Begegnungszentrum der Wissenschaftlern* (IBZ) in Munich during the duration of my stay. Given the tight housing market in Munich and the fact that IBZ is next to the main building of LMU, staying in the Guesthouse was extremely pleasant and it facilitated greatly the participation in the academic life in the university.

2 Research

During my stay I conducted research on the following topics (with the resulting papers finished during the stay indicated and listed in the Bibliography):

- Foundations of probability theory, investigating properties of conditionalization; in particular analysing properties of the set of probability measures on a Boolean algebra that cannot be obtained as conditional probability measure on the basis of a fixed prior probability. (The technical term that was introduced in an earlier paper to refer to this set is the *Bayes Blind Spot*.) This research is relevant from the perspective of Bayesian learning. The main result in this paper is that the Bayes Blind Spot is a very large set, in cardinality, in measure and also topologically, if the Boolean algebra is finite. The large size of the Bayes Blind Spot displays an aspect of the restricting role of the prior probability in Bayesianism that has not been noticed before. [1]
- Investigating the tension between mathematics and physics. As stated in the abstract of the paper [4] I wrote on this topic: "Because of the complex interdependence of physics and mathematics their relation is not free of tensions." I looked at how the tension has been perceived and articulated by some physicists, mathematicians and mathematical physicists and tried to identify some sources of the tension. The main message of the paper is that the tension is both natural and fruitful for both physics and mathematics. An attempt is also made in the paper to explain why mathematical precision is typically not welcome in physics. [4]
- Analyzing Robert Musil's concept of philosophy of science in his major work "*Mann ohne Eigenschaften*". Musil is a major figure in 20th century German literature and he is known to be a very philosophical writer: he has been called the "literary face of logical positivism". His "*Mann ohne Eigenschaften*" is especially rich in philosophical passages and it is an intriguing question what Musil's intention were with his philosophical characterization of science in this work. My paper's thesis (written in German):

"Meine These in diesem Artikel ist, dass man Musils Roman als einen Versuch ansehen kann, die lebensphilosophischen Konsequenzen der Wissenschaftsauffassung des logischen Positivismus zu ziehen und dadurch auch eine implizite Kritik der Wissenschaftsphilosophie des Positivismus zu geben. Wo der logische Positivismus ein einfaches Demarkationsproblem sah, welches nach den Vertretern des Positivismus durch ein einziges Prinzip, das Prinzip der Verifikation, im Prinzip beseitigt werden kann, sieht aber Musil den Zusammenstoß von zwei wesentlichen Seiten der menschlichen Existenz, die nicht offensichtlich kompatibel sind." [3]
- Comparing some aspects of Gödel's and von Neumann's understanding of mathematics, highlighting the parallels and divergencies between their careers and philosophical views. John von Neumann (1903-1957) and Kurt Gödel (1906-1974) were two towering figures of 20th century science, contributing in particular to mathematics in exceptionally significant ways that had a lasting impact on modern mathematics. Their life and scientific careers had many parallels and their research interests overlapped. But their philosophical views about sciences, especially about the nature and foundations of mathematics were very different. The paper [2] highlights some parallels and what appears to be a correlation between the divergences of their philosophical positions and differences in their scientific research and career.
- I finished a commissioned entry (written with C. Hitchcock, Caltech) on the Common Cause Principle for the Stanford Encyclopedia of Philosophy [5].

- I started writing (with my co-author of several recent joint papers) a small book on foundations of probability theory. We aim at publishing with Springer.

3 Conference/workshop/seminar talks

I have delivered a number of talks, at large and smaller conferences, workshops, and on the invitation of seminar organizers. Below is the list of all the talks I gave during the period of my stay in Munich (in chronological order).

1. “Physics Meets Philosophy”, Workshop, Institute of Philosophy, Hungarian Academy of Sciences, Budapest, Hungary (September 25, 2018)
Title of talk “On the tension between mathematics and physics”
2. “Robert Musil und die Modernen Wissenschaften”, Workshop, Institute Vienna Circle, University of Vienna, Vienna, Austria (October 18-19, 2018)
Title of talk: “Wissenschaftstheoretische Eigenschaften der Wissenschaften in Musils ‘Mann ohne Eigenschaften’ ”
3. “Biennial Conference of the Philosophy of Science Association (PSA2018)” (November 1-4, 2018, Seattle, U.S.A.), Symposium organiser and joint talk with Z. Gyenis
Title of talk: “Features of Bayesian learning based on conditioning using conditional expectations”
4. Logic and Philosophy of Science Colloquium at Munich Center for Mathematical Philosophy, Ludwig-Maximilians University, Munich, Germany (November 21, 2018)
Title of talk: “Some features of Bayesian learning based on conditioning using conditional expectations”
5. Work in Progress Seminar at Munich Center for Mathematical Philosophy, Ludwig-Maximilians University, Munich, Germany (January 24, 2019)
Title of talk: “On the tension between mathematics and physics”
6. “German Philosophy of Science Society Annual Conference”, Cologne, Germany, (February 25-28, 2019) (joint talk with Z. Gyenis)
Title of talk: ”Features of Bayesian learning based on conditioning using conditional expectations”
7. “Frühjahrstagung der Deutschen Physikalischen Gesellschaft”, Munich, Germany (March 19, 2019) (invited plenary talk)
Title of talk: “On the tension between mathematics and physics”
8. Technical University of Munich, Garching, Germany (March 26, 2019)
Title of talk: “On the tension between mathematics and physics”
9. “Interpreting Quantum Mechanics: Old and New Philosophical Problems”, Workshop, Department of Mathematics of the Polytechnic University of Milan, Milan, Italy (March 11, 2019)
Title of talk: “Structural similarities and interpretational differences between classical and quantum probability theory”
10. Theoretical Philosophy Forum, Institute of Philosophy, Eötvös University, Budapest, Hungary (April 10, 2019) (joint talk with W. Brown and Z. Gyenis)
Title of talk: “Bayesian learning and modal logics”

11. Department of Theoretical Philosophy, University of Bucharest, Bucharest, Romania, (April 3, 2019)
Title of talk: “On the tension between mathematics and physics”
12. Department of Philosophy, University of Geneva, Geneva, Switzerland (April 17, 2019)
Title of talk: “Categorical Local Quantum Physics”
13. “Relativistic Locality”, Workshop, Munich Center for Mathematical Philosophy, Ludwig-Maximilians University, Munich, Germany (May 4, 2019)
Title of talk: “How to express locality in categorical local quantum field theory”
14. Department of Philosophy, University of Salzburg, Salzburg, Austria (June 3, 2019)
Title of talk: “On the tension between mathematics and physics”
15. Physics Colloquium, Department of Physics, University of Heidelberg, Heidelberg, Germany (June 7, 2019)
Title of talk: “On the tension between mathematics and physics”
16. “12th MUST Conference & Workshop ‘Perspectives on Scientific Error’”, Munich, Germany (July 1-4, 2019) (invited keynote talk)
Title of talk: “A bird’s eye view of conditioning in probability theory”
17. “All things Reichenbach”, conference, Munich Center for Mathematical Philosophy, Ludwig-Maximilians University, Munich, Germany (July 22-24, 2019) (invited talk)
Title of talk: “Reichenbach’s Common Cause Principle”

4 Organizing and teaching activities

4.1 Organizing

I organized (with the support and help of MCMP) two small workshops on topics related to my research. The *Idea & Motivation* below are taken from the webpages of the workshops (accessible through the webpage of MCMP). Both workshops were successful.

- Relativistic locality (May 4, 2019)

Idea & Motivation:

The problem of whether quantum theory is compatible with the causal structure of the space-time as this is understood by the theory of relativity is an old and central problem in contemporary physics and philosophy of physics. The talks of this mini-workshop address this issue from different perspectives, paying special attention to the diversity of the locality concepts that have been suggested to test whether quantum theory is relativistically local.

- Conditioning (July 13, 2019)

Idea & Motivation:

Conditioning and conditional probability are fundamental concepts in probability theory. The mini-workshop discusses recent results that analyse features of conditioning and conditional probability that are relevant from the perspective of foundations of probability theory, belief revision and Bayesianism.

4.2 Contributing to the teaching at the host institution

- I offered and delivered a Masters/PhD level course on foundations of probability theory. The course consisted in lectures interspersed with extensive discussion. The topics covered included:

- (i) Basic concepts of measure theoretic probability theory; (ii) conditionalization; (iii) treating some famous paradoxes in probability theory: Bertrand's paradox and the Borel Kolmogorov paradox. The lectures incorporated the content of my (co-authored) recent papers on the respective topics. The lectures were delivered on February 8, 2019 at LMU. The slides of the lectures had been made available to the participants. Feedback was positive, students appreciated the course.
- My host, Prof. S. Hartmann offered me the opportunity to teach two seminars, one in each of the two courses he was teaching:
 - I was leading the *Philosophy of Science Seminar* on December 4, 2018. The topic of the seminar was Imre Lakatos' philosophy of science.
 - I was leading the *Philosophische Probleme der Quantenmechanik* seminar on January 14, 2019. The topic of the seminar was entanglement in quantum theory.

Both seminars went smoothly and I had subsequent out-of-classroom discussions with several MSc students taking the courses.

5 Other academic activities at MCMP/Munich

- I was attending an MCMP reading group organized by a young colleague (Assistant Professor) at MCMP. We were reading Klaas Landsman: *Foundations of Quantum Theory. From Classical Concepts to Operator Algebras* (Springer, 2017). The reading group consisted of 4-5 colleagues; we met weekly for 2 hours during term time. The book is a very substantial (800 pages) work, so we were unable to finish it but the group members (me included) benefited from the discussion greatly.
- I attended the regular seminar series at MCMP (*Philosophy of Science Colloquium, Work in Progress Seminar, Logic Colloquium*), and participated in the discussions. I also have attended some of the ad hoc workshops and smaller conferences taking place at MCMP without giving a talk (e.g. "Analogical Reasoning in Science and Mathematics MCMP, October 26-28, 2018, Foundations of Categorical Philosophy of Science, April 26-27, 2019; MCMP-Western Ontario Workshop on Computation in Scientific Theory and Practice (May 31-June 2, 2019).
- I established contact to the *Forschungsinstitut für Technik- und Wissenschaftsgeschichte des Deutschen Museums* in Munich. I visited the institute and had discussion with Prof. Dr. Ulf Hashagen (director of the research division) and his colleagues. Professor Hashagen is an expert on John von Neumann's life and work, which I also had published. I have learned from him interesting details about von Neumann's 1927 habilitation in the University of Berlin.

6 Non-academic activities

- I have attended an advanced conversation course in German organized by MCMP (October 2018 - January 2019). This course was offered free of charge by a volunteer through MCMP and was very useful. Attending the course helped to polish my rusty German and I also learned a lot about local customs and Bavarian cultural-linguistic specialities.
- I have attended a some events and talks organized by the Humboldt Foundation jointly with the Carl Friedrich von Siemens Foundation in Nymphenburg Castle in Munich. The events were extremely pleasant and I got to know a number of colleagues and also representatives of the Humboldt Foundations.

- IBZ regularly organized events for the tenants and IBZ club members. These included talks, musical events (chamber music, and recitals, "Liederabende"), barbecues, Christmas carols. I have enjoyed all the ones I attended very much and got to know a large number of academics working in Munich in fields outside of my own.

7 Humboldt events

I attended the two major conferences to which the Humboldt Foundations invited me:

- The Bamberg conference (March 28-31, 2019), at which the *Forschungspreis* was officially conferred. The event was a pleasure from beginning to the end. I was especially happy that my host, Prof. S. Hartmann, also attended the ceremony. The event also put me in touch with colleagues whom I would otherwise not have got to know. The conversations we had on a wide range of topics were very enriching.
- I attended the Humboldt Annual Meeting (Berlin June 26-28, 2019). Again, the event was a pleasure. I felt honoured that both the *Bundespräsident* and the *Bundeskanzlerin* devoted time to receive (and to address) the Humboltianers. The Humboldt Foundations did an impeccable job in organizing this very large scale event.

References

- [1] Z. Gyenis and M. Rédei. Having a look at the Bayes Blind Spot. *Synthese*, 2019. forthcoming, online first: July 11, 2019.
- [2] M. Rédei. Parallels and divergencies: Gödel and von Neumann. *Magyar Filozófiai Szemle*, 62(4):168–181, 2018.
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- [4] M. Rédei. On the tension between physics and mathematics. *Journal for General Philosophy of Science*, 2020. accepted for publication.
- [5] M. Rédei and C. Hitchcock. The Common Cause Principle. Stanford Encyclopedia of Philosophy entry, 2019. Under final technical editing before going public.