GERMANY

Statistics in My Life:

From deep mathematics to popular statistics education through global cooperation

Joachim Engel*

When I finished high school with the German Abitur, I was a shy young man, grown up in a well-protected conservative environment, and I had many social-romantic ideas in my head. In school I was more of a dreamer than an ambitious student, but I was very good at math. That's why I started studying mathematics at the University of Bonn when I was 18. Right from the beginning, I was fascinated by the mathematics of uncertainty. When I graduated with a Diplom in mathematics five years later, I knew about stochastic control theory (the topic of my diplom thesis) and commutative algebra (my focus in pure mathematics), but I felt that I had no ideas and experiences about life outside the mathematical ivory tower. I couldn't even speak English properly because I had to study Latin and Greek for many years in school. I decided to become a teacher because I liked the social interaction with young people. In Germany, this requires a second subject, and to broaden my view of the world, I chose a subject that was as far away from mathematics as possible: Catholic theology. During my studies, I made friends with people who had traveled a lot and worked in other countries. One friend, a pacifist, had done his civil service, i.e. the alternative to military service, in a social institution in Israel, which impressed me very much. I also decided to work in a kibbutz in Israel for a while. I belong to the post-war generation in Germany who grew up under the motto "Never again war". Those were the years of the nuclear arms race

between NATO and Warsaw Pact at its height with military overkill capabilities, i.e. enough nuclear weapons to annihilate the other side about 50 times over – nuclear overkill. We thought there had to be other ways of settling international conflicts than blowing up the world. When I came up to be drafted, I also opted for alternative service which I ended up doing – as part of an international peace and justice organization–in the United States. I worked for one year in Ohio as a youth counselor in a group home for delinquent teenagers and later with a politically very active community of people serving the homeless in Los Angeles. What a change from my well sheltered upbringing in rural Germany! After two years in LA time had come to move on.

I thought of becoming a school teacher in LA, but needed a recognition of my German degrees. When I contacted the University of Southern California to assess my German diplomas, they offered me a place in the PhD program at USC including financial support.

After several years away from Math, I felt that I had made up for my earlier lack of experience in the "real" world. I was ready to re-enter academic life, yet wanted to work in a field that had tangible impact on the world. Since there was no statistics major at USC, I chose Applied Mathematics. After passing the qualifying exam, I chose a statistician as my PhD advisor. Louis Gordon,
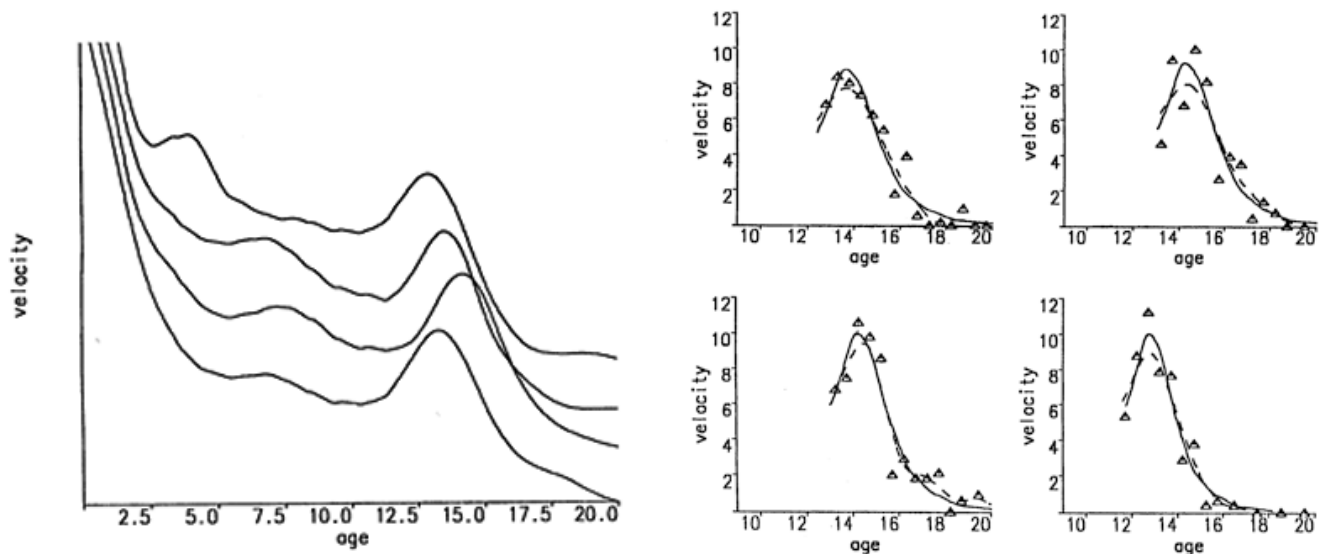
Fig 1: Left: Velocity curves for growth of four boys from Zurich growth study, estimated with nonparametric kernel estimators. Right: Comparison of two different estimates of the pubertal growth spurt (From: A.Kneip & J.Engel (1995), Model estimation in nonlinear regression under shape invariance, Ann Stat 23(2), 551-570)

himself a former student of Brad Efron, told me about the CART algorithm and handed me a book by Luc Devroye on L1 density estimation. He asked me to look for a connection between Haar series (the simplest form of wavelets) and histograms, and explore if there is a relation to the stepwise decision rule characterizing the CART algorithm. Thus, after having been away for several years from academia, I dove deep into mathematical statistics again. For my thesis, I was soon able to split the problem posed to me into a stochastic and a numeric part. The stochastic part could be solved with Devroye's book. For the numeric part, I buried myself in the library for a few days and discovered – what a lucky coincidence –that the numeric part more or less had been solved only two years earlier by a Polish mathematician. With my fresh PhD, I spent the academic year 1988/89 as visiting assistant professor at the University of Michigan in Ann Arbor where I taught various classes in applied statistics (sampling theory, stats for pre-med and for economic students). When the one-year assignment at U of M was over, I decided to return back home to Germany accepting a post-doc position at the University of Heidelberg. These were the early days of the S language and I started to learn about programming and statistical applications. In Heidelberg, I joined a research group led by Theo Gasser who had established his own school of nonparametric curve estimation. These were the last three years of a Sonderforschungsbereich – a special research program funded by the German government for a total of 15 years. The research group was cutting edge and was visited by world renowned mathematical statisticians such as Rudi Beran, Trevor Hastie, Jianqing Fan, Peter Hall and Matthew Wand. It took me quite some time to grasp and understand the theories and methods the group had developed the 12 years before I joined.

Major tangible results of our group's work applied to studies of human bodily growth. These were based on data from the Zurich longitudinal growth study which included detailed time series of body measurement of about 300 children, taken between 1954 to 1974. One concrete result was the discovery – by methods of nonparametric curve estimation – of the pre-puberty growth spurt at around age 8 found in all children of the study.

When the funding for the research project was over, I accepted another post-doc position at the economics department of the University of Bonn. In a research project lead by economist Werner Hildenbrand and statistician Alois Kneip I applied the statistical technology we had developed in Heidelberg to investigate empirically economic theories about household expenditures and market demand. Theories in this field go back to a Saxon economist named Ernst Engel (1821-1898), a namesake of mine. Thus, one of my contributions at that time was a paper on nonparametric estimation of Engel curves.

As a next step, because of my genuine preference for teaching and interacting with young people, I accepted teaching positions to prepare students to become school teachers at Hannover University and Ludwigsburg University of Education. Returning (remember, I started out as a teacher) to teacher education made me, in some sense, a "general practitioner" rather than a "heart surgeon" that had determined my path in Heidelberg and Bonn. On the one hand, my teaching in Ludwigsburg covered the preparation of prospective teacher ranging from elementary to upper secondary level and included mathematics from the didactics of algebra to geometry and applied math. On the other hand, the size of the faculty allowed me to focus on probability and statistics

Back to Contents

Fig. 2 Organizing Team IASE Satellite 2003 in Berlin. Back: Markus Vogel, Brian Phillips, Rolf Biehler. Front Joachim Engel, Larry Weldon, Laura Martignon, Carmen Batanero

Fig. 3: Satellite conference 2019 Kuala Lumpur

as the main domain of my work. In 1995, I joined the International Association for Statistical Education and was inspired by the growing contacts and network through attending conferences in Helsinki (WSC 1999) and Berlin (satellite and WSC 2003).

I joined the network of statistics educators in German speaking countries and started an extended cooperation with Rolf Biehler, Manfred Borovcnik and many others, nurtured by yearly conferences, lively exchange of ideas and editorial work for Stochastik in der Schule, a German language journal in the spirit of the international Teaching Statistics journal. Support from and cooperation with Carmen Batanero from the University of Granada helped my integration into an international network of statistics educators.

The focus of my teaching shifted from teaching the "orthodox" theory towards bridging human understanding and sense making. A curriculum change in Germany around 2005 gave much more emphasis to data and chance, so new courses had to be developed to prepare future teachers to teach these topics. When my friend Laura Martignon joined the faculty in Ludwigsburg, I gained new perspectives and inspiration for teaching probability and statistics. She, a mathematician by training, had worked with neuro- and cognitive scientists at Ulm University and the Max-Planck-Institute for Human Development for many years and initiated a broader and enlightened view towards learning about statistics by focusing on human reasoning and behavior in situations of risk and uncertainty. The cooperation with the Max-Planck-Institute and its director Gerd Gigerenzer not only allowed us to host several international conferences in Berlin (including the 2003 IASE satellite conference and the 2016 IASE Roundtable), but also inspired our overall approach to statistics education by embracing concepts and ideas from cognitive sciences.

At the 2013 joint IASE/ IAOS satellite conference in Macao, preceding the 2013 WSC, I listened to a keynote lecture by Jim Ridgway on challenges and threats to Official Statistics and Statistics Education and the potential for synergies in the area of high tech and big data. I myself gave a talk on Stats Ed and human rights monitoring. Jim and I met and we both felt that educating the public to better understand statistics about society is a burning issue where statistics education can make an important contribution to society: Empowering people to engage in informed decision making and participate in influencing public policy. The idea was born to launch an international project to develop tools to help the public to better understand data and statistics about society: ProCivicStat, funded with support of the Erasmus program of the European Community. We were fortunate to be joined by other dedicated statistics educators from Haifa, Porto, Paderborn and Szeged with their expertise under the umbrella of Erasmus: Iddo Gal, Pedro Campos, Rolf Biehler and Peter Kovacs and their respective teams.

ProCiviStat created a framework for understanding statistics about society and developed a comprehensive set of teaching resources available in several languages. Also, after formal funding had ended, the team wrote a comprehensive book entitled Statistics for Empowerment and Social Engagement. At last, my early involvement in social issues affecting the well-being of individuals and entire societies and my acquired knowledge and expertise in mathematics and statistics came to a point of convergence.

Equipping people with skills to make sense of our data-infused world and empowering them to make informed decisions based on data has far-reaching implications and reaches deeply into society. For democracy to function, citizens must have a critical understanding

Fig 4: ProCivicStat Team : Back: Pedro Campos, Achim Schiller, Rolf Biehler, Sonia Teixeira, Jim Ridgway, Joachim Engel, James Nicholson, Iddo Gal, Susanne Podworny; Front row: Dani Ben-Zvi, Peter Kovacs. (Missing: Daniel Frischemeier, Elena Grassler, Klara Kazar, Eva Kuruczleki, Laura Martignon, Rosie Ridgway, Anna Trostianitser)

of quantitative evidence on key issues related to the social and economic well-being and human rights. This implies the capacity and knowledge to access data, critically evaluate the reliability of data, and to understand representations and analyses of data, e.g. as through innovative visualizations. However, there are major problems posed to social progress that stem from large gaps in public understanding. A great deal of the public inability to reason with evidence can be attributed to problems with education systems world-wide. This is where the International Statistical Literacy Project and the International Association for Statistical Education play an essential role with their worldwide educational program. From my experience as IASE President (2019–2021), I can say that collaboration across continents gives a great boost and encouragement to our mission and, not least, is a process of intercultural encounter that expands friendships across borders.

After my formal retirement in 2020 I still continue to teach some courses and do editorial work, with a focus
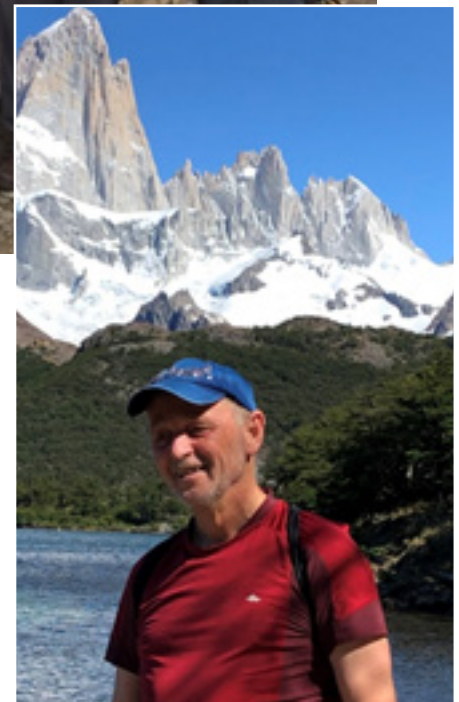

Fig 5: Visiting Argentina in 2021 in preparation of ICOTS 11 included hiking around mount Fitz Roy

on enhancing the public's understanding of statistics in the areas of health, environment and democratic values.

Mi intención para los próximos años es expandir mis actividades al mundo latino. En preparación para ICOTS 11, visité Argentina en noviembre de 2021, incluyendo algunas caminatas en la Patagonia.

*IASE President 2019-2021
engel_joachim@icloud.com