Martin Shubik Interview by Matthew Sobel, December 8, 2017, Branford, CT

Early Life

MATTHEW SOBEL: It's a great pleasure today to be interviewing Martin Shubik. Martin is an extraordinarily accomplished person in the INFORMS community. He's received the Lanchester Prize, the Koopman prize. Perhaps, he's the only one who's received both.

Besides that though, he's at least equally distinguished in some other communities-- in game theory, in economics, in political science. So it's really an extraordinary opportunity to, in some sense, intrude on our friendship and draw Martin out in ways that I haven't asked him to be forthcoming during our friendship.

Martin is an emeritus professor. However, since achieving his emeritus status, he has done more in research than most mortals achieve in an entire career. He's had 3 books and more than 40 papers, and he still appears to be going strong.

Martin, I'd appreciate it if you'd begin by giving us a capsule biography from birth to pre-collegiate times, including your parents and your siblings.

MARTIN SHUBIK: I might as well begin at ground zero. By fluke, I was born in New York City, March the 24th, 1926, when my father was working for a Scottish company. He was selling their flax crop in New York and he established his offices at the Flatiron building in New York and lived in New York for a little under two years.

So at the age of a few months, I was an international traveler and took the ship to London, where I was brought up until the age of 13. My early days were in England, where my father had settled down after having managed to get out of Russia after the Russian Revolution, which is a story in and of itself.

In England, we lived in London and I had an elder brother, who is now since dead, and a younger sister. My older brother, by the name of Dr. Philippe Shubik, became a rather well-known doctor in the cancer research end of things. He headed something called the Eppley Institute and also had a large lab at the Chicago School in Mt. Sinai attached to the University of Chicago. He founded something called the Toxicology Forum, which tested for carcinogenic substances.

I have a younger sister who, again unfortunately, developed some form of brain degeneration. It's hard to define these days what is Alzheimer's versus what is dementia. And she is classified as with dementia. She was a well-known TV producer, producing items such as The Jewels of the Crown, and Rumpole of the Bailey, and various other well-known TV series.

My father was a not particularly successful businessman, but made enough to live on and survive the 1929 crash rather well. Interestingly enough-- and things slip into history-- people who

survived the '29 crash were not unlike people who had gone through a horrendous earthquake. It influenced them for the rest of their lives.

Well, in England, I dragged through the various schools. I was not a particularly great scholar, but I was an erratic scholar. By that, I mean that I could almost fail a subject, and then do extremely well in an allied subject.

MATTHEW SOBEL: On which side was mathematics?

MARTIN SHUBIK: Well, the answer is schizophrenic. Because what I had in mind when you asked the question was how I passed my mathematics exam at University College School London. It had two parts to it, algebra and geometry.

The scores were on-- memory is sometimes tricky, but I believe they were 0 to 100. I scored 2 on my geometry exam and 100 on my algebra exam. And the passing grade was 51 averaged in mathematics.

MATTHEW SOBEL: In those years, did you have an interest or know that you had an interest in social sciences, in general, economics in particular?

MARTIN SHUBIK: No. I didn't even know what economics was at the time. I was fascinated with science. But to a certain extent, I suspected that I was no good at aiming to become a physicist, because I talked my parents into sponsoring me to go to a series at the Royal Academy. They had physics lectures for the very young.

And I went and I decided that I really liked the subject, but really wasn't-- I looked around and I saw a few people really grasp the understanding like that. And I was a plodder and I knew that somehow, things had to connect. And they didn't quite connect for me.

MATTHEW SOBEL: How did you glom onto economics, which was, if I understand, the field in which you did your graduate education? So what was the transition from that point to a graduate student in economics? What drew you to it?

MARTIN SHUBIK: Well, we have to take a fast forward. We'll skip the rest of my time in England. I did go to a different public school by the name of Canford, in South England, and I didn't do terribly well.

I did well there in history. I did mediocrely in mathematics and dreadfully in something else.

High School and College

However, I then went to Canada in the 1940s. And in Canada--

MATTHEW SOBEL: Excuse me, was that because of the bombing in London?

MARTIN SHUBIK: Yes. My father decided to send my mother, and myself, and my sister to Canada to relatives. So we moved to Toronto, Ontario.

And in Toronto, I went to school. I finished high school somewhat north of Toronto in a town called Newmarket, Ontario, which then was 30 miles north of Toronto and now is a suburb of Toronto.

At Newmarket, Ontario, I started to take courses. History, I loved. English, I loved. There was a political science course of some variety, which I found interesting, and there was algebra, and geometry, and trigonometry.

It's interesting to note in education that there are some high school teachers whose only interest is *their* record, how well they do. And my teacher was a gentleman by the name of Robert Rourke, and his only interest was in proving to the world he was the best high school math teacher in Ontario.

And in order to do so, he did what we now know in the trade, selective sampling. Whenever he saw that there were a few kids who were no good in his class, he tried to throw them out. And this way, he managed to get a much higher level of kid.

So on one occasion, geometry being a bad subject for me-- I see well in many dimensions as long as the dimensions are around two-- I did particularly lousily in geometry. And he observed that I was taking three math courses and really only needed two, so he threw me out of geometry.

This so infuriated me that I decided that I would study geometry outside of class by myself. And I read the rules. I could apply to the provincial exams without having to have the blessings of a high school teacher.

So to cut the story short, I creamed the geometry exam at the end of high school. Although I wasn't particularly good, he gave me the right motivation. I graduated from Pickering College in general proficiency with specifically high marks in history.

I arrived at the University of Toronto and had to decide what to do. I had really been perked up and interested in the social sciences in general at the end of high school.

As I say, I loved history, and I then had to make some hard choices. I looked over the calendar at the University of Toronto and decided if I wanted to really enjoy myself, I'd go into history. But how was I going to make a living out of history after?

I then looked further and concluded that my eventual goal had to be the social sciences. But I then looked at what the social sciences had to offer in 1942, and it looked like finger-painting as far as I was concerned. It seemed ridiculously elementary.

So in 1942, I made the decision that I was a lousy mathematician and was probably not going to ever become a competent mathematician. But I appreciated mathematics, I appreciated the fact that I might be able to work with competent mathematicians.

And I also made the wild guess that in the future decades, the social sciences were going to become highly mathematized. So I said to myself, look. You know what you want to do. Go into mathematics and physics.

You are sufficiently lousy that you may end at the bottom of the class, but you'll crawl through. And by crawling through, you will have now been exposed to virtually all types of mathematics and physics, and you will know what they have to offer. You will be a consumer. You won't be a good producer because that's not your bag. But if and when the social sciences start to open up, you'll have a lot to offer to them.

So at that point, I didn't quite know what a formal model was, but sure enough, the first course in physics taught me what a formal model was. And I found that I could start to think about modeling in the social sciences the same way as they thought about modeling in physics.

Well, to cut the story a little shorter, I did graduate in math and physics. I did graduate near the bottom of the class. And I got letters from most of the faculty saying, we're completely puzzled by this student. He is rotten in these formal exams, but seems to be highly intelligent and asks very hard and bizarre questions.

Canadian Navy and Introduction to Economics and Game Theory

So at this point (this was the graduation in 1947), the war having been on when I first started as an undergraduate, one of the conditions in Canada of going to college at that time was that you enlisted in an officer training program. So I enlisted in the Naval program, and I spent part of the year in Halifax, Nova Scotia, and part of the year possibly at sea in one of the Canadian Naval ships, and the rest of the year at the University of Toronto.

While in the Navy, I more and more started to see questions that were operations research-like. Among the other questions, in fact, quite fascinating to me, were daily routines. As an intelligent individual, I wondered why we had daily boat drill. It seemed so idiotic to jump up, get out of wherever one was, charge up to the deck, get next to the boat, get prepared to lower lifeboats, tie up lifeboats, do all sorts of little dances. And whenever you asked a petty officer, why do you do that, the answer was always because that's the way it's done. And this completely threw me.

Now, the interesting feature-- moving the clock many years forward-- is that it turned out that they simultaneously were wrong and right. And it turned out that it was exactly an operations research mix of what was an optimal procedure and how did you get a bunch of slobs to behave, to behave automatically, in the right way to follow through an optimal procedure?

And years later, I learned in United States operations research that the Navy routines are a bunch of optimizing routines designed to be run by people who don't necessarily know what they're doing. And this required both good mathematical optimization and a good perception of what the human error was, in fact, all about.

MATTHEW SOBEL: When you left the Navy, did you go immediately to graduate study?

MARTIN SHUBIK: No. I stayed in Naval Reserve until several years after I was at Princeton.

MATTHEW SOBEL: While you were in the Navy, did your interests crystallize on economics?

MARTIN SHUBIK: No, they crystallized more or less on the question of, where can you use mathematical model building? I remember being at sea in HMCS Warrior, which was the first Canadian aircraft carrier.

The only book that I had to read with me was Hardy's Theory of Numbers, which I didn't really understand. It merely convinced me more that I was never going to be a pure mathematician, but how important mathematics was.

I came back to Toronto, finished my bachelor's degree, had to decide what to do for a living after finishing my bachelor's degree. I realized that high school teaching was not my bag. And I wasn't quite sure so, just for the heck of it, I decided I'd get an MA.

And I looked over things and I realized that although I could learn enough mathematics to barely pass an undergraduate, if I went into applied mathematics, it was going to kill me. I actually spent a week or two in shopping period, and I realized that applied maths was not going to work for me.

I decided then that there was a strange man by the name of Harold Adam Innis, who was a crazy economist and social scientist. And he had a great books series. And I decided that I would switch and get a master's degree in political economy, which is what I did.

And during political economy, I read a lot of the great books and two things happened. I got interested in communication and there was a gentleman by the name of Marshall McLuhan, who was clowning around at the time at the University of Toronto. And he claimed to be a disciple of Innis. And Innis' greatest claims were communication was the thing. And in fact, he had a piece arguing that Canada itself was a railroad looking for a country. Communication was virtually everything.

So having said that, I was moved to do my master's thesis on communication in the Inca kingdom. And so I spent my time studying Quipos, which were the way the Incans accounted for their inventories and their strings, which they knotted.

And I also found out that they had a road system of over 1,000-- probably 1,500 miles long, which went from South Chile into North Ecuador. And they kept records all the way, and they had inventory houses scattered through them.

I wound up knowing more about Quipos and the Inca kingdom than Innis ever thought, and I disputed some of his hypotheses with him. But anyhow, that launched me.

And then on a side issue, what really launched me into real operations research, was I decided, OK. I was highly motivated in politics, and thought that I might actually run as a politician in Toronto. And so in order to run as a politician, I had to join a party and learn a party doctrine.

And I actually joined something called the CCF, which was a mild left-wing liberal party modeled on the Fabian society in England. They assigned me, having studied political economy, to work out an electrification plan for North Ontario.

I studied North Ontario population, potential population, cost of electrical transmission per mile, cost of generators, and the future of North Ontario. And I concluded that it was absolute nonsense to electrify North Ontario. It was far cheaper to buy every inhabitant of North Ontario an independent generator and let them generate by themselves.

This didn't please the party in the least. I was meant to prove that truth, beauty, and electrification was going to be brought to everywhere. So at this particular point, I parted company with the CCF and running for politics.

However, also at this point, I had to produce a book review for my econometrics class. And the econometrician said, go to the library, pick out a new book roughly related to econometrics, and write a review of it.

I went to the library. I picked up the Theory of Games and Economic Behavior--

MATTHEW SOBEL: And the rest is history.

MARTIN SHUBIK: And the rest is history.

MATTHEW SOBEL: It's good econometrics.

Graduate Studies at Princeton

MARTIN SHUBIK: I add a little feature to the history. Not only did I write the essay on the theory of games. The light bulb went on and I decided that I had to have a PhD in game theory. And so I grabbed all PhD catalogs and narrowed the choices. The three places to go if you were going to go into mathematics in the social sciences, were clearly to me Caltech, MIT, and Princeton. And this was 1948.

I thought of applying to all three. But then I said, I don't have the money and it's really too far away. I just can't go to Caltech. That's really pushing the envelope. So I struck off Caltech. That left me with Princeton and with MIT. So I applied to both Princeton and MIT.

So within a week, I got two responses, one from Princeton, one from MIT. Both said we would be delighted to consider you as a graduate student. Princeton said, please write a two- or three-page essay as to why you want to study what you want to study at Princeton. And that was it. MIT sent me a five-foot length questionnaire to fill-in saying, please state all of the classes you have ever had since junior high school, and the grades, and the this, and the that, and the something else.

I lifted up the MIT form and it cascaded down to the floor. And I said to myself, life is too short. So I burned the MIT form and merely wrote an essay to Princeton.

MATTHEW SOBEL: Let's jump into the time at Princeton, which was notable, after all, not only in game theory at that time, but in other fields as well. While you were a doctoral student, who would you say your major influences were?

MARTIN SHUBIK: Well, that's the interesting feature to me. I went to Princeton under the sponsorship of Oskar Morgenstern. I studied with Oskar. I did my PhD with Oskar and with Albert Tucker. They were the two main people. There's a third I can't remember. But the point being at Princeton, I took a whole series of economics courses and most of them I was bored with.

And I looked around and the students were middle league--

MATTHEW SOBEL: In economics?

MARTIN SHUBIK: In economics. There was maybe one or two bright students. One was an Iranian by the name of Djahangir Boushehri, who went to the International Monetary Fund eventually. And the other was an English Jewish student by the name of Maurice Peston, who became a Labor Lord. He became Lord Peston of-- he purposely chose a slum district of London to become Lord Peston of. I made friends with both of them and they remained friends for the rest of their lives.

However, after being assigned rooms, I was assigned to share a joint suite with Shapley and Nash.

And I immediately worked out a working relationship with Shapley. And immediately assessed Nash as semi-psychotic and extremely bright. And I won't go into the details-- I've published them elsewhere-- (about Nash) but Nash was fit to be institutionalized.

MATTHEW SOBEL: Even at that point?

MARTIN SHUBIK: Even at that point. And I can tell you horrendous stories, but I've told them elsewhere, and I'll skip them. But to get to the point, having worked up the rapport with Shapley, having understood the brilliance of Nash, I figured I might as well go over to Fine Hall, which was the math department at Princeton, at tea time to see who was there. And that I would probably make better friends there than just the two individuals I mentioned in economics.

Well, I went there and it was-- it was literally heaven. The people I met-- and I'll mention all of them because they all meant a great deal to me in future life. Among the older ones, sort of the post-graduate students or visiting junior professors, there was Sam Karlin and Dick Bellman. There was Harold Kuhn.

And then among the graduate students, who all became truly close friends and colleagues, there was Lloyd Shapley, whose career was spectacular. There was Marvin Minsky, who named and went on to work in artificial intelligence. There was John McCarthy, who invented the Lisp language.

There were other people, such as Melvin Hausner, Martin Davis, who is a famous logician, and several others. But McCarthy, Minsky, Shapley were all good, close friends. And I learned an enormous amount from them.

And the impetus of Lloyd was such that it turned out we were a perfect duo in the sense that Lloyd knew no economics whatsoever, was not particularly interested to begin with in modeling social phenomena. But I found that I could do the mathematical modeling. The taking an outside phenomenon, projecting it into an economic model, and Shapley would immediately find what was wrong with the model and argue about it, and test it mathematically. And then literally, solve it through to the end.

And so while we were mere graduate students, Lloyd and I had already worked on fair division and two-person. And we'd been in competition with Nash, and I have to admit openly that Nash beat us in competition to a very explicit problem that we were all working on, which was fair division with variable threats. And Nash got the last piece to do a variable threat correctly.

And in fact, the only joint paper I ever wrote with Nash was to take his variable threat model and translate it into economics, and show how it worked out in a duopoly. But the interesting feature was that Lloyd had a brilliant idea on how to take fair division and project it into n people. And this turned out to be the Shapley value.

But while he was doing it, I was asking him for examples of three, four, and five people. And he presented the examples and, in order to simplify the examples, he gave me voting examples. And as soon as he did this, I said, Lloyd, we can put this out into political science as the way to handle the measurement of power in a committee system. Because what you have taught me was that power has to be a nonlinear function.

Why? Because if everybody's got the same vote, it's quite easy to say each has 1 over n of the power. But if you've got five people, if you've got five votes, and you give three votes to one person, he's got all the power. Therefore, there has to be a nonlinear function. And this was what Shapley was getting at, and that's what the Shapley value got.

But if you simplify the characteristic function just to 0 and 1, you then get a voting structure. And we did that, and we wrote a few page article on what we called the power index in a committee system.

Lloyd didn't know anything about political science, per se, and he knew even less about the journals. So I went to the political science department and I talked to a couple of the associate professors there, and explained to them what we've done. And they said, this really looks interesting. Submit it to the American Political Science Review.

We did so as two unknown graduate students. And believe it or not, it was accepted within six weeks and, in fact, it was probably the quickest accepted paper in all of our history. So that went on.

And then, it was fairly obvious that Shapley and I were on the right wavelength for joint work, which we carried through.

Introduction to Operations Research

MATTHEW SOBEL: You spoke about your earlier interests in operations research or operational phenomena. By that point in time-- or I should ask, at what point in time was there congruence of your interests and a academic, intellectual political structure that made it comfortable to try to marry your, in some ways, diverse interests to include operations research?

MARTIN SHUBIK: Morse and Kimball. I read Morse and Kimball as soon as it came out.

As a matter of fact, I was doing a Canadian Navy Reserve at the time when I read Morse and Kimball. And in particular, I was already at Princeton, and I was in particular, interested in seeing the randomization in the firing of anti-aircraft guns. And that this was clearly two-person dueling theory, and I really was into dueling theory.

And then when I got back to Princeton-- and in fact, one of the things that got me to resume my US naturalization was that I, via Shapley, was asked to work at Rand.

And at Rand, ostensibly, although I did a lot of straight game theory with Lloyd, it was military operations research. And I absolutely enjoyed military operations research. And it's far too long for this interview.

It was also clear to me at that time that dueling could also be looked at experimentally. And experimentally meant you could start to think about experimental games in the behavioral sciences. Military operations research being a behavioral science.

And this got me to thinking about all of the work at the Naval War College. And this cascaded into my being a correspondent and a viewer and participant in war-gaming, which I pushed at the Naval War College.

And one other quickie, because this weaves between the quantitative and qualitative. In doing war-gaming, I discovered quickly that there had to be two types of war games-- and Rand was interested in both of them-- hard war games and soft war games.

Hard war games could be completely mathematized, could use machine simulations like crazy. Soft war gaming involved political science. People like Schelling and people like Olaf Helmer, where you had an underlying hard science war game, such as, how does a tank gun fire? But at the same time, what are good tank tactics? And that's qualitative. And the soft war games had people stop in the middle of the war game and a referee group would argue, was that or wasn't that feasible?

MATTHEW SOBEL: It might interest you to know that Kimball was my undergraduate advisor, but I never heard the words "operations research" from him. Let's look to the future a little bit.

When you think about the evolution of the nexus of operations research and the mathematical social sciences, including game theory, and you look ahead, what do you think looking forward 10 years or so? Will there be more of the same, or do you foresee some particular changes?

Central Research Interests

MARTIN SHUBIK: I think it's going to be heavily different, many more splits before future unification. I haven't even mentioned my central interest in research, because it's relevant.

MATTHEW SOBEL: Please do.

MARTIN SHUBIK: My central interest in research has been the theory of money. Now, you would think that that's a far stretch, but it isn't.

Thomas Stearns Eliot said all there is in life is birth, copulation, and death. He should have added birth, copulation, death, and money. And, in essence, we're obviously entering or have entered a network world, but we haven't caught on yet as to what the implications of a network world are. And the implications are calling it some areas mergers of operations research, economics, and biology.

And all of them, if you want to sum up literally the world, methods of measurement. Why money is so important is that it's not only a means of exchange. It's a very tricky variable measure of measurement, of variable measure.

Now, I say "variable measure." In physics, the population thinks that there is only one invariable measure in physics. There is a measure for things that exist in Euclidean physics. And in the world, there is a measure, as long as we consider only a mile or two around us. When we consider the whole globe, we've got variations to take care of. When we consider our galaxy, we've got other variations to take care of. When we consider more than our galaxy, we've still got different measures.

The growth of science is highly related to what can be quantified and what can't be quantified. And when something can be quantified and when somebody can break off a little piece and get a good measure for a particular set of questions.

MATTHEW SOBEL: I wish we could go on for hours, but you make the future sound very exciting.

MARTIN SHUBIK: Well, let me just add that science is not just measurement. But the way science is going, we're going to be able to measure more and more in context. And context and measurement are probably everything.

MATTHEW SOBEL: So different measures depending on the context?

MARTIN SHUBIK: Absolutely. And as we evolve, we break off subjects and begin to study them. So law is going to measure much more. Biology is going to measure much more.

Operations research is going to manifest itself in all of these things. And as we improve, evolution is, in some sense, measurement.

I think that I'll close this way. Science studies the very, very small. and the very, very large. As we get smaller and smaller and smaller, science can no longer see. As we get bigger and bigger and bigger, science can no longer see. And so currently, we're probably in meter terms at 10 to the minus 22, 10 to the plus 22. We can't see beyond that.

A few years ago, we were probably only at 10 to the minus 10, 10 to the plus 10. And so science pushed out those limits, but there don't appear to be any limits. The limits of science are now 10 to the minus 22 and plus 22. Beyond that, I am willing to cede the rest of that stuff to cosmology and to theology.

Do I think there is a god? I don't know, but God is out there. And maybe when we get to 10 to plus 185, we might get an answer. But I'm not worried about the answer. I'm worried about the journey.

And the journey says, where is operations research going? It's going where science is going. And where is science going? It's going out of 10 to the plus 22 and beneath 10 to the minus 22. And it's still going.

MATTHEW SOBEL: Exciting. Thank you very much.

MARTIN SHUBIK: OK.