Dr. Francis Mechner

profile

Interview By: Adam Hockman

Dr. Francis Mechner

Born in Vienna, Austria in 1931, Francis Mechner came to the United States in 1944. He received his Ph.D. in Experimental Psychology (1957) from Columbia University where he studied with Fred S. Keller and William N. Schoenfeld, and taught Experimental Psychology until 1960, when he formed his non-profit corporation (now named the Mechner Foundation) to carry on his basic and applied work in the behavioral sciences. In 1959 he began work on an instructional technology based on behavioral analysis, which he then applied to the development of training systems for industrial corporations, medical education, governmental agencies, and high school science education. In 1963 he created a precursor of the Office of Equal Opportunity (OAE) Job Corps Training Centers; worked with UNESCO to upgrade science education in South America and Asia; and designed manpower development programs that were promoted by the Organization for Economic Cooperation of Development (OECD) to their member states. In the 1970s, Mechner participated in the design of Sesame Street and created a comprehensive early childhood development and educational daycare system that was implemented by four states and endorsed by the U.S. Department of Health, Education, and Welfare.

As part of his basic research work, Mechner developed a formal symbolic language for codifying behavioral contingencies with applications in economics, sociology, law, and education. In the late 1960s, Mechner founded the Paideia School where he demonstrated his Paideia Individualized Education (PIE) model as an exemplar of personalized K-12 education; work that he is currently carrying forward at Queens Paideia School in Long Island City, NY.

To fund his work, Mechner founded and built a series of companies (eleven in total), several of which introduced technological innovations that revolutionized their respective industries. Mechner is also an accomplished painter, musician, and pianist of concert caliber. He achieved a Master rating in chess (2236) and a 5-dan rating in the Asian strategy game of Go. Dr. Mechner is fluent in German, French, Spanish, English, and Portuguese (See also the Mechner Foundation web site).

I understand that you had a rather tempestuous childhood. Is there anything you would be willing to tell us about that?

At age seven, after fleeing 1938 Vienna, I changed residence 16 times, covering 9 cities, 4 countries, 4 languages, and many different perspectives on the world--a cultural anthropology course in which I learned that most of what people believe, me included, isn't so—good preparation for a career in science and technology.

So you grew up in Vienna?

Yes, in the Vienna of the 1930s, where typical middle class Jewish families believed that a good education inculcates intellectual values and proficiency in music and the arts. But my subsequent travels taught me that different cultures have very different ideas about those things and also about how one speaks, *what* one talks about and doesn't, the questions one asks and doesn't, what one pays attention to and doesn't, what is or isn't considered real, and so forth. There is no better way for a child to learn the arbitrariness of firmly entrenched beliefs than immersion in societies that hold different ones.

How did these childhood experiences and early interests lead you to behavioral science?

Since early childhood, my main passion had always been drawing and painting, and this naturally led to a preoccupation with perception—why things looked

the way they looked, illusion, visualization, perspective, and so forth; and from there, it was only a small step to an interest in beliefs—what's real and what isn't—why people believe some truths to be self-evident and some not. By the time I got to Columbia University I had already discovered Freud, but then saw that Skinner offered a far more satisfying and more scientific account of behavior, one that also had wide-ranging societal implications for how people live and manage their affairs. I was excited to learn that thinking is behavior and that Skinner's behavior modification techniques together with the Hull/Skinner/Keller/Schoenfeld conceptualization of "concept" can serve as important tools of educational technology.

In what way did Professor William Schoenfeld influence you?

I resonated with his approach when he tried to convince the class of how little we all knew and how many mistaken beliefs we hold or take for granted. He changed my life when he said that we can't yet even observe the effect of a single reinforcer on a single response. I decided, on the spot, that I would figure out a way to do that, and got started on what became my "revealed operant" work—a technique for studying the characteristics of individual occurrences of operants. I came to see that although it is sometimes useful to define operants as discrete instantaneous events—like a single switch closure—the answers we seek are often hidden in the operant's other attributes—the ones that we are *not* observing.

Can you give us some examples of where this technique can be applied?

There are many areas of behavior research where it would be very helpful to be able to track changes in a stream of operants. Given the plasticity of behavior—its amazing sensitivity to environmental factors that evolution generated—I believe that an organism's behavior can never reach a "steady state." When a behavior pattern becomes less effective or less reinforcing, it reverts to earlier forms. This realization got me interested in "resurgence" as a basic mechanism of learning. I saw this concept as opening a new highway to the analysis of learning and practicing any skilled performance, including piano, which had always been one of my passions. These lines of research depend on the ability to observe changes in individual occurrences of operants as a function of time or repetition, and to identify and track variants and variations, including so-called "mistakes."

In 1959 you published an article in JEAB on your notation system for behavioral contingencies, the system that Jack Michael and others used to teach to their students. What made you decide to work on that system again in recent years?

I saw that in the history of science, the progress of a discipline tended to accelerate when it adopted a formal symbolic language for the codification of its units. I'm referring to the symbolic languages of chemistry, mathematics, logic, musical notation, and even choreography. I thought that behavioral science would expand its range of applications and that its power would become more evident if it had its own formal symbolic language for codifying the behavioral events and contingencies with which it is able to deal.

What exactly do you mean by the term "behavioral contingency"?

It's a statement that specifies what acts are available in a given situation or circumstance, and the possible consequences of those acts. It never describes or codifies what *actually* happens, only what *can* happen. In that sense it is somewhat like Skinner's concept of the reinforcement contingency. "If you drop the glass on a hard floor, it may break" states a behavioral contingency, whether or not you ever drop the glass. The behavioral contingency statement is silent as to what you may *actually* do—drop the glass, hold on to it, or something else yet. Laws are an example of behavioral contingencies.

So why did you decide to modify your original formal language?

Since the original contingency language was pretty much limited to single-organism contingencies, I wanted to make it applicable to human affairs in general, including interactive behavior. By adding only one new symbol, for the *agent* of the act, I was able to accommodate the far more complex multi-party contingencies we care about. I came to see that a truly useful language had to be able to codify such complexities of human interactions as, for instance, perception (or misperception) of another individual's mistaken belief or misperception; the effects of different histories with respect to a situation and its behavioral contingencies; and ways to codify, with a 5-symbol vocabulary and a simple syntax, consequences and their attributes, intents, beliefs, probabilities, uncertainty; and contingencies that change progressively as a function of time or of specified events.

What do you feel you achieved by expanding the applicability of your contingency language?

I was able to illustrate its applicability to economics, law, sociology, conflict analysis, business, environment, education, and other human affairs. And by illustrating this wide range of applications, I felt that I was thereby demonstrating the virtually unlimited reach of the behavioral approach itself to human affairs. But as in the case of any language, for the behavioral contingency language to be useful in practice, the user must have a certain degree of fluency in it.

Suppose a behavioral scientist wanted to become sufficiently fluent and proficient in the language to apply it in a certain field. How would one go about that?

I would suggest starting by reading some of the articles that describe the language and its applications. (*The Mechner Foundation website has a bibliography, and articles are available under "Downloads, Theory"*). To achieve fluency, one would have to practice applying the language to a variety of simple familiar situations, and create or join a community of like-minded individuals who want to become proficient in the use of the language. The language itself is simple and easy to master; what is more difficult is to identify the critical features of the contingencies that are to be encoded for a particular application. The language has been translated into Spanish, and used, by Maria del Rocio Hernandez Pozo of Mexico. Others, too, have used it in scientific papers. Mechner Foundation personnel generally try to be responsive to inquiries regarding the contingency language.

Much of your work has been in the application of behavioral science to educational technology. What was the initial catalyst for this interest?

Skinner's 1954 and 1958 articles inspired me to experiment with new instructional systems. In 1960, I developed the first programmed instruction course that was actually used to train industrial personnel, at Schering Corporation. The program was based on a "behavioral analysis" method I had been devising for breaking down cognitive content and text into its component "concepts" and "chains" and then sequencing these in a pedagogically effective way (see *Behavioral Analysis for Programmers*, 1962; *Behavioral Analysis and Instructional Sequencing*, 1967). Over

the next few years I applied this method to the development of instructional programs for middle school and high school science subjects, for medical education, and for industrial training.

Can you give us an example of one of your industrial training programs that became particularly successful?

Sure. In 1962, I developed a simulation method for learning interpersonal competencies like consultative selling or supervision of personnel. It involved simulating the typical interpersonal situations that are encountered and the thought processes and actions those situations required. During the training, the trainees responded, usually orally, as if they were in those situations, and they received appropriate feedback. In 1963 I used that technique to develop the training program Professional Selling Skills ("PSS"), which allegedly became the most widely used training system of all time, and numerous derivative versions of it spawned today's nine-figure sales training industry.

Weren't your educational programs also used in medical education?

Yes, in the 1960s we developed instructional programs in electrocardiography, allergy and immunology, thyroid disease, rheumatoid arthritis, endocrinology, and many other medical subjects. Close to a million copies came to be used "in virtually all of the country's 91 medical schools and 1100 teaching hospitals" according to a report published by one of the programs' distributors.

How do you explain these successes, considering that programmed instruction generally did not work out very well?

I think the reason ours worked out is that we always started out with a careful behavioral analysis of the subject matter, for example, identifying the concepts that require attention and breaking these down into instances and non-instances. During the development process, we put all of our programs through several testing and revision cycles. Others in the field didn't do those things, and it made all the difference.

How did your work in educational technology lead to your Job Corps Training Center work?

In 1964, the US Office of Economic Opportunity (OEO) started creating Job Corps Centers intended to bring economically and educationally disadvantaged youths into the country's economic mainstream. I had already designed such a training center in 1963 under a contract with the Office of Governor Peabody of Massachusetts. The design included the management system, the behavioral contingencies of the center's operation, the policies and procedures, the functions of the staff, and the training systems for the trainees. This design became the model for our OEO contract to operate the Huntington West Virginia Job Corps Center, which in turn was then adapted for the OEO's nationwide chain of such Centers. We also developed training and management systems for those centers.

You also worked with some international organizations. Can you tell us about that?

UNESCO wanted to train South American and Asian science teachers to learn and adopt more modern science teaching methods, like lab work and scientific inquiry. They hired me to train teachers from 30 South American countries and in the next year from 30 Asian countries. Those projects were headquartered in Brazil and Thailand respectively. At the same time Europe's OECD recommended our training methodology to their member states for their manpower development programs, as a result of which we became involved with several countries.

You are an exemplar for applying behavioral science outside of the traditional domains. What are areas of opportunity for the behavior analysis community to further impact the world?

It's probably not necessary to convince most readers of *Operants* that most of the world's problems involve human behavior, and that behavioral science is the key discipline for solving them. I believe that the necessary steps are to analyze every problem correctly in terms of the variables and dynamics that are at work. This requires good analytic tools, like a formal symbolic language that may help develop a clear and correct understanding of the controlling contingencies. Given a good analysis, promising and practical interventions can then follow more easily. That's what I have been trying to do in K-12 education reform.

Your educational innovation work has permeated much of your career, as I understand it. What led to your interest in early childhood education?

Biologists know that in all higher animal species, the most important competencies are either learned very early in life, or else the windows of opportunity for the fastest and most permanent learning are missed. Humans are no exception. The only thing that keeps changing as our world becomes more complex are our beliefs as to which competencies are the most important ones, and these vary from culture to culture. In 1965, when Xerox Corporation bought my educational technology company, Basic Systems, I was able to convince them of the overarching importance of a child's early learning, and they then provided generous funding for the development of an infancy and pre-school education program over several years.

Were you ever able to bring that program to life?

Yes, but it's a long story. In 1969, when Xerox (wisely) decided to concentrate their marketing efforts on PSS (my instructional program "Professional Selling Skills"), they freed me to seek other funding for my work on early learning, I turned to the capital markets and raised $11 million (approximately $75 million in 2016 dollars) for the development of a major early childhood development and educational daycare system that included a thinking skills curriculum and parent education. In parallel, I worked with Joan Cooney, Lloyd Morisett, Ed Palmer, Gerald Lesser, and the Carnegie Corporation's Childrens' Television Workshop on the original design of the Sesame Street programs. My company UEC obtained large contracts to implement our educational daycare systems in four states, received official endorsement from the U.S. Department of Health, Education, and Welfare, and I testified before the Senate Finance Committee on behalf of the Comprehensive Childhood Development Act of 1971, which was passed by both houses of congress. This legislation would clearly have been transformative had President Nixon not vetoed it. That was a sad day for American education.

Despite this disappointment, didn't your company also create the Armonk Paideia School and its Paideia Individualized Education (PIE) system?

Yes. That system was inspired in part by Professor Fred Keller's Personalized Systems of Instruction (PSI). The PIE technology I demonstrated in that school was considered Polyannish at the time. Though it is no longer viewed that way, mainstream acceptance took many decades. The main novel features of the PIE technology are the focus on the details of the behavior and progress of individual students (individualization or personalization) made possible by a 6:1 student-teacher ratio; defining the role of teachers as "learning managers" (Keller's idea); the need to configure the

school so as to accommodate its real functions, including the roles of the learning managers; and simulation within the school setting of the situations and contingencies for which the students are ostensibly being prepared—namely the student's future work and family situations. On the curriculum side, we place as much emphasis on the social-emotional, self-management and thinking competencies, as we do on the traditional academic ones.

I understand that you funded your work by founding and building technology companies. How were you able to transition from behavior research to the type of thinking that these diverse business endeavors required?

It wasn't that much of a transition. I always begin with the assumption that I know nothing, and that what others "know" is usually not so. In business, I would take a fresh look at a technology that is unsatisfactory in some important way and try to come up with a better one, or find a partner who can. The hardest part, always, is to ignore the many convincing and heart-felt explanations of why it can't be done and shouldn't be attempted.

Can you give us some examples of that from your business career?

I can give you many. The first one was the 1960 general wisdom that there can be no such thing as an educational technology business. History has answered that one. A second example was the general wisdom that sales ability can't be learned, because it's innate. Along came PSS. A third was that programmed instruction is good only for rote learning. So we demonstrated that with proper behavioral analysis it can teach the high level conceptual material of medical education and interpersonal judgment. I could give you five more examples of how ignoring prevailing certitudes enabled us to introduce new technologies that then came into worldwide use.

Does this approach also apply to education reform?

Very much so. The traditional teacher-in-front-of-class format had long been considered immutable. The PIE model redefined the concepts of classroom, teacher, and school. A K-12 PIE school modular unit has 30-40 students of mixed ages under the tutelage of a team of learning managers. The world of education still considers it self-evident that the 6:1 student-teacher ratio is ruled out by virtue of being too expensive. Far from being ruled out, I believe that it is necessary. When such small 30-40-student modular school units are aggregated to form a larger 400-600 student school, this low ratio can be maintained, with far better results, at no per-student cost increase over present-day public school costs per student.

There seems to be a developing emphasis on the so-called "21st Century Skills," as in the new Every Student Succeeds Act. How do you view this?

In the 1970s we didn't call them 21st Century Skills, but these non-academic competencies were an important aspect of the PIE system already at that time. In those days, we were told that schools couldn't and shouldn't address those aspects of education—that it was the parents' job. But while this belief is now changing, the change is still mainly at the verbal level, with few new instructional practices or learning systems for those competencies having yet been introduced. Terms like grit, collaboration, self-management, growth mindset, social-emotional skills, etc. refer to constructs. Constructs may be *defined* by behaviors that can be addressed by educational interventions, but the constructs themselves can't be addressed directly. Only actual behavior can be addressed directly.

So how do you go about teaching those competencies?

By teaching the child the relevant behavior. We ignore those constructs. We teach kids the behavior of thinking—how to actually do it. The learner thinks out loud at first. We teach them self-queries that are appropriate in the various situations they encounter such as "What's my goal?" "What are my options?" "What is the other person thinking?" or "What do I want to find out?" With practice, these self-queries become increasingly covert. We call such self-queries "heuristics," Every type of situation requires its own heuristics—social situations, decisions, problems that need to be solved, concepts that need to be analyzed, and situations that require self-management. It is via the learning of useful heuristics that our students acquire thinking competencies and inquiry skills in science, social studies, math, and English language arts. We treat thinking as behavior that can be modeled, observed, practiced, and shaped by feedback.

What is your current focus of activity?

K-12 education reform, in all its aspects. We operate a research and development laboratory for new educational technologies and tools. The PIE system itself is one of these, but we are also developing some that can be used in other educational settings, including today's public schools, to deliver instruction that is more genuinely personalized and addresses the diverse requirements of a child's K-12 educational development. My goal now is to persuade educational policy makers that we have a valid roadmap for comprehensive education reform. We have demonstrated some of the key technologies and I have assembled the nucleus of a team of highly talented individuals who know how to implement them. I hope to strengthen that team further and secure the funding that will bring our work to life. I may be old, but hopefully not too old to finish up. We are motivated by our belief that the technologies we are developing will become the workhorses of future K-12 education.

Your life's work has evidently been highly diverse—basic behavior research, far ranging applications of behavioral technology, education, music, art, and literature. Is there a common thread or theme that runs through all of these?

Perhaps. I have always tried to demonstrate the breadth and reach of Skinner's behavioral approach—a goal that has driven much of my basic research as well as my applied work. A recent example is an article in which I try to show how a behavioral/biological analysis of aesthetics in the arts and sciences can be fruitful in an area that has tended to stay mired in verbiage. I suppose that the driver of most of my work has been my desire to convince the world that behavioral science holds the keys to the solution of many of its problems.

Dr. Mechner, I appreciate your providing us with this glimpse of your life and career. There is no doubt that your circuitous journey will provide inspiration and direction to those who believe in our science's potential impact on the world and wish to participate in extending it into uncharted territory.