Herbert Simon's Interdisciplinary Project[1]

Introduction

Herbert Simon (1916-2001) was an unusual man. Among other curious habits, he was fond of striking up conversations with strangers on trains and airplanes. After discovering the profession to which his companion belonged, he would attempt to pass himself off as a fellow practitioner. He usually succeeded.[2]

Simon's career was much like a succession of such trips. Simon began his career as a political scientist, receiving his Ph.D. from the University of Chicago in 1943 for his dissertation on public administration, which he published in 1947 as Administrative Behavior.[3]

Simon did not remain a political scientist for long, however. In the late 1940s, he began work in economics for which he received the 1978 Nobel Prize. In the mid-1950s, he began research on the psychology of problem-solving, for which he later would receive the American Psychological Association's highest award for lifetime achievement. Also

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[1] This paper draws heavily on my book: Hunter Crowther-Heyck, *Herbert A. Simon: The Bounds of Reason in Modern America*, (JHU Press, 2005). A more detailed analysis of Simon's institutional agenda can be found in Hunter Crowther-Heyck, "Herbert Simon and the GSIA: Building an Interdisciplinary Community," *JHBS*, 42, 4 (Winter 2006): 311-334. A broader picture of postwar patronage for the behavioral sciences in the United States can be found in: Hunter Crowther-Heyck, "Patrons of the Revolution: Ideals and Institutions in Postwar Behavioral Science," *Isis*, 97 (Fall 2006): 420-46. A longer bibliographic essay on the sources used for the book and this paper can be found at: http://faculty-staff.ou.edu/C/Hunter.A.Crowther-Heyck-1/Essay%20on%20Sources.htm

[2] John R. Anderson, in *A Tribute to Herbert Simon*, (Pittsburgh: Carnegie-Mellon University, 3/19/01), p. 6.

[3] By the late 1950s this book, along with his later work, *Organizations*, had become staples in courses on business education, public administration, and organizational sociology. Administrative Behavior is now in its fourth edition and is arguably one of the ten most influential works in political science, public administration, and management of the twentieth century. *Organizations* has had a similar career, and it remains an essential text in sociology and management training. Herbert A. Simon, *Administrative Behavior* (NY: Macmillan, 1947), James G. March, Herbert A. Simon, and Harold Guetzkow, *Organizations* (NY: Wiley, 1958).

in the mid-1950s, he wrote his first computer programs, starting down a path that would lead him and his colleague Allen Newell to receive the Association for Computing Machinery's Turing Award, that discipline's highest honor.

His career path straightened out after the mid-1960s, as he eased into an endowed chair at Carnegie-Mellon University in computer science and psychology. He still found time, however, to deepen his explorations into the philosophy of science, the theory of design, and sociobiology. His list of publications runs to more than 800 items, and if they had to be categorized by discipline, the fields involved would include (at the least): political science, public administration, and management; operations research, systems theory, organization theory, decision theory, and economics (including the theory of the firm, game theory, economic history, and econometrics); sociology, sociobiology, social psychology, and cognitive psychology; pure mathematics, philosophy, linguistics, and computer science. 'Diverse' does not even begin to describe his intellectual interests or achievements.

When I first began to explore the career of Herbert Simon, I didn't think too much about the multi-disciplinary nature of Simon's work. The fact that Simon had been so important in so many fields simply seemed fortuitous to me. The original motivation for my thesis had been to understand the changes that transformed all the social sciences in the years after World War II, and looking at Simon appeared to be a way of looking at broad changes in several fields while still keeping the study within manageable bounds.

As I pursued my research, his multi-disciplinary interests became a source of both fascination and frustration as I discovered that writing the biography of someone active in many fields requires learning the history of many fields. Sometimes I pictured him as a

clever spider sitting at the center of a vast web whose strands I was striving to trace. But it was only as I came near to the end of my study that the importance of this obvious aspect of Simon's work really became clear to me. Simon's project, fundamentally, was an interdisciplinary one.

This realization was both exciting and alarming. Exciting because a great many things about Simon suddenly made sense. Alarming because, at first, it seemed to make Simon something of an aberration. As Dorothy Ross has argued so persuasively, the ambition of the social sciences in the twentieth century has been to create intellectually sound and institutionally stable disciplines.[4] Simon, on the other hand, consciously strove to defy disciplinary boundaries. Was Simon an aberration, then? Does his career teach us only that true genius is unique? Or did other spiders pattern their webs along similar lines, using the same anchors, making similar connections?

I believe that the webs Simon wove were both unique and representative. Unique in that few cast their nets quite so wide or wove them with such vigorous consistency as did he. Representative in that many others felt a need to create similar cross-disciplinary patterns in order to address the problems of a rapidly changing, ever-more interdependent world—and to take advantage of a new breed of patrons for social research who embraced such interdisciplinary work.

The remarkable influence Simon had in fields as diverse as political science, economics, and psychology and in institutions as powerful as the Ford Foundation, the SSRC, and the National Academy of Sciences attests to the strength of this

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[4] Dorothy Ross, "Changing Contours of the Social Science Disciplines," in *The Modern Social Sciences, Volume 7 of the Cambridge History of Science*, ed. Theodore Porter and Dorothy Ross (NY: Cambridge University Press, 2003): 205-37.

countercurrent to disciplinary specialization, especially in the first 25 years after World War II. Most of those who pursued such interdisciplinary projects did not seek to destroy the disciplines—they were still the anchors for their webs—but they did seek to reform and reorient them. It was an interdisciplinary, not a non-disciplinary project, and Simon was one of its most ardent—and most successful—promoters.[5]

Simon's project had several inter-related components: intellectual, institutional, social, and practical (by practical I mean, having to do with the practice of science). Intellectually, his goal was synthesis: specifically, a synthesis that reconciled the sciences of *choice* and those of *control*. Institutionally, his goal was 'big social science': research conducted by interdisciplinary teams, funded by extra-university patrons with problem- (not discipline-) based agendas, with the results of such research leading to real-world applications in the middle distance. Socially, his goal was to help advance a "third way" between capitalism and socialism, between anarchy and authoritarian rule, between mass politics and leadership by an elite few. Such debates in the interwar period, when Simon's basic outlook was formed, often hinged on how capable people were of behaving rationally; bounded rationality was thus vital not only to Simon's theories of the mind but also to his understanding of how society should be ordered. Practically, his goal was to develop methods, techniques, and technologies that would enable social scientists to model the workings of the human mind and the organizations to which it belonged. (He wasn't terribly interested in the human body, except insofar as physiology could provide structural models for interpreting the mind.)

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[5] For a broader picture of postwar patronage for interdisciplinary projects, see Crowther-Heyck, "Patrons of the Revolution."

In this essay, I will explore the roots of Simon's interdisciplinary project, trace its development and evolution, and highlight the aspects of Simon's project that were shared by other leaders of the social sciences in postwar America. The argument, simply put, is that, to Simon, effecting a synthesis of the sciences of choice and those of control was vital to the construction of a unified, usable social science.

Further, Simon's mature attempt at synthesis was grounded in a *bureaucratic worldview*, in which the world, the organization, the mind, and science, all were conceived as complex hierarchic systems—as tree structures. Humans were one subclass of such structures, a subclass characterized by adaptive (goal-seeking and error-correcting) behavior. By the later stages of his career, the proper model of man (and it always was man for Simon), was neither the perfectly rational *homo economicus* of the sciences of choice nor the infinitely malleable *homo administrativus* of the sciences of control, but the limited, yet capable, *homo adaptivus*, the finite problem-solver. To Simon, this worldview and its attendant model of man had direct implications for the proper organization of society and of the scientific enterprise, as well as for the understanding of the human mind.

Background: the roots of Simon's project

The place to begin when trying to understand Simon and his interdisciplinary project is the problem of choice. The necessity of choice was crucial to Simon's ethical beliefs and the problem of how choices are made—and influenced—was central to his intellectual work. Quite simply, he believed that "the task of ethical choice is implicit in the very definition of human dignity," and that the only real certainty in life "lies in the

acceptance of the burden of personal ethical choice."[6] Similarly, as he wrote in the introduction to his first book, "It is with this problem—the process of choice which leads to action" that all his scholarly work was concerned.[7]

Choice was a problem as well as a value to Simon. While the ability to choose freely was vital to his ethical beliefs, the ability to find patterns in the choices made by people was central to his intellectual goals. Simply put, to Simon, truth lay in pattern and in structure. Simon always sought to find the rule, not the exception, to take the instance and find the law, to take the complex and the chaotic and find the simplicity and order that must lie beneath them. To Simon "the rule is the important thing … I want some lackey to take care of the exceptions." He called this "drive" to "see pattern in things" his inherent "Platonism."[8]

It was an ambitious desire, this drive to find the pattern, especially since the patterns he sought were the most elusive of all: the structures underlying human thought and action. The most obvious source of such patterns, to the young Herbert Simon, was the social environment in which people made their choices. As a result, Simon was a believer in both the ethical necessity of choice and the empirical reality of social influence, or control. Reconciling these beliefs would be the labor of a lifetime.

Simon was not alone in his efforts to find a way to bring together these divergent perspectives. Indeed, Simon's work is perhaps best seen as part of a widespread attempt by social scientists to respond to the challenges of change, interdependence, and subjectivity posed by modern society, challenges that by the interwar period had led to

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[6] Herbert A. Simon, "Letter to Brother Benedict," in *HSP, CMU Archives* (1947), p. 1.
[7] Herbert A. Simon, *Administrative Behavior*, 2nd (@1957) ed. (NY: Macmillan, 1961), p. 1.
[8] Herbert A. Simon, *Models of My Life* (New York: Basic Books, 1991), p. 10.

two distinct approaches to human science. One of these approaches emphasized the ability of the individual human actor to make free rational choices, while the other emphasized the plastic nature of humans and the limits to their reason. The first of these approaches characterized what I have called the *sciences of choice*, such as neoclassical economics, game theory, and decision theory, while the latter belief characterized what I have called the *sciences of control*, such as sociology and social psychology.

To Simon, and to many of his contemporaries, a synthesis of these views was essential if a third way was to be found between the twin tyrannies of complete freedom and absolute authority. Only in new a philosophy of democratic authority—of the individual and the organization brought into harmony by science—could such a synthesis be found. To Simon, the path to such a synthesis was to redefine not only the organization but also the individual. Once redefined, the sciences of choice and control could be seen to be but branches of a bigger tree, nodes in a wider web. That broader way was "systems science": the structural, behavioral, and functional analysis of adaptive systems.

While the proponents of the sciences of choice and the sciences of control each saw their approaches as the key to a unified behavioral science, Simon thought both lacked something essential that only the other could provide. Talcott Parsons, for example, called his social theory a "voluntaristic" theory of social action, but there seemed precious little room for individual choice in structural-functionalism. This did not sit well with a man who believed that "the only real certainty" in life was the necessity of accepting "the burden of personal ethical choice."[9]

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[9] Simon, "Letter to Brother Benedict," p. 1.

At the same time, in the sciences of choice it appeared that the players chose every move in the game of life as if they had full knowledge and perfect reason. Quite simply, Simon thought these were "fantastic" assumptions.[10] As he wrote to a colleague, "we need a less God-like and more rat-like chooser."[11] The world was too complex for people even to approximate such supremely rational behavior.

How to create a unified science out of these two disparate models of human behavior? It was not an easy task, nor was the road straight. In the end, however, Simon's constant drive to harmonize all aspects of his work led him to develop an integrated worldview that brought together the sciences of choice and control in a nested set of models of science, humanity, and nature.

Simon did not begin his career seeking to create this integrated, multi-layered schema, however. Rather, he began with a few basic assumptions that he sought to elaborate, specify, and formalize: First, he believed that there was an order to nature, even human nature. All behavior was caused, and the causes were lawful, ordered. Second, he assumed that this order was universal, meaning that the complex and the local always were manifestations of the simple and the global. The reduction of complex phenomena to the simple mechanisms by which they were generated thus was the basic task of science. Third, he held that this order was accessible to humans through reason, not revelation. A rigorous science of human behavior was possible, if the proper concepts could be found and the proper methods employed.

Fourth, and finally, Simon believed that a theoretically robust and practically useful science of human behavior had to embrace both the power of the environment to

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[10] Herbert A. Simon, "Letter to George A. Miller (1955b)," in *HSP, CMU Archives* (1955), p. 1.
[11] Ward Edwards, "Letter to Herbert Simon," in *HSP, CMU Archives* (1954), p. 1.

shape human thoughts and actions and the power of humans to shape their environment. A true science of human behavior had to be able to describe actions as rational, within certain bounds, and it had to be able to specify the nature of those limits. In addition, it had to be able to account for the responsiveness of human actions to a changing environment, meaning that it had to be able to deal with contingent actions. It had to be able to deal with responses to those actions as well, meaning that it had to be able to deal with sequences of contingent actions unfolding in time.[12]

Within the broad frame formed by these assumptions, Simon worked to develop focused theories about specific aspects of human behavior, particularly those aspects having to do with decision-making in organizations. These investigations led him to re-examine, refine, and formalize his assumptions. These more fully elaborated assumptions then formed the basis for connecting his research in a range of fields. Thus, while Simon's early projects were linked to each other mainly by their relation to the problem of choice and by a gut feeling that it all had to be connected, somehow, his later works were related to each other intimately and explicitly. All his many projects became parts of an integrated program, and, after the mid-1950s, he took each new step with the development of this comprehensive schema in mind.

I call this comprehensive schema, this nested set of models, Simon's *bureaucratic worldview*. I give it this name because Simon came to define mind and machine, organism and organization, individual and institution, all as highly specialized yet tightly integrated hierarchical systems, each locked in a continual struggle to adapt to its

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[12] On the newfound importance Simon and his generation attached to understanding coherent sequences of behavior, see Hunter Crowther-Heyck, "The Program *Is* the Theory," paper presented to the HSS Annual Meeting, Austin, TX, 2004.

environment as best it could, given its limited powers. To him the mind and the computer were model bureaucracies, and a bureaucracy was a model mind.

Fittingly, this bureaucratization of Simon's world picture took place on multiple levels. It involved a redefinition of the world as a complex, hierarchical system, of the various sciences as the study of the subunits of that system, and of human science as the study of that class of complex systems characterized by purposeful, adaptive behavior.

In keeping with this model of science, Simon redefined the sciences of choice and control as components of this new, higher-level, science of adaptive systems. The goal of this new science was the construction of formal models of human behavior, and its method was to develop programs that would enable one complex system—such as the computer—to simulate the behavior of another, such as the human mind. Thus, his famous computer programs *The Logic Theorist, The General Problem Solver*, and *EPAM* (the *Elementary Perceiver and Memorizer*) were not merely novel computer programs but theories of how both science and the mind worked.

System and Structure[13]

The ideas of *system* and of *bounded rationality* were the pillars of this new outlook. To Simon, all the world was a system. In his view, the economy, the family, the individual organism, the cell, the atom, etc. all were complex, hierarchically structured systems. That they were systems meant that their component elements were strongly interdependent. That they were hierarchical meant that they had a tree-like structure and

[13] There is clearly a connection between the bureaucratic worldview of Simon and the structuralist worldview, especially as outlined by Jean Piaget in *Structuralism*. Jean Piaget, *Structuralism* (New York,: Basic Books, 1970). At the moment, however, I don't know enough about structuralism to be able to trace those connections in depth; doing so is one of the goals of my current project: *The Branching Tree: Structure, Process, and Hierarchy in the Scientific Revolution of the 20th Century*.

so were decomposable into subsystems, sub-subsystems and so on. That they were complex meant that the behavior of the system at one level of the hierarchy was difficult to predict from knowledge of the properties of the elements at lower levels.

This prefiguration of the world as system had important implications for both the questions Simon asked and the methods he used to answer them. First, seeing the world as system focused Simon's attention on systemic, structural properties, such as the organization of a system's components, the ways that they communicated with each other, the ways that the system maintained equilibrium, and the ways that the overall system adapted to its environment.

Second, seeing the world as system encouraged a *behavioral-functional* mode of analysis. In Simon's view, an individual could be known only by his behaviors, and his behaviors could be known and identified only by their effects upon the other elements of the system to which the individual belonged. This was true for objects just as it was for humans: to Simon, even such a seemingly natural and individual quality of an object as its mass actually was a property of that object in a particular system, not of the object itself.[14]

Behavioralism and functionalism also were products of a systems-based perspective in that both enabled the radical simplification of the analysis of phenomena by concentrating on the relational rather than the intrinsic, individual properties of system components. An individual performing a function is far easier to understand than an individual with a unique history and nature, and individuals can be analyzed in terms of their functions only if they are parts of systems.

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[14] Herbert A. Simon, "The Axioms of Newtonian Mechanics," in *HSP, CMU Archives* (1947).

Third, seeing the world as a system encouraged mathematical formalization. It did not lead inevitably to mathematical analysis (witness Talcott Parsons), but it did make the development of mathematical social science seem a natural next step. To Simon, there was no question that a reformed behavioral science would be mathematical, for mathematics was the essential "language of discovery" of science. He was fond of quoting Fourier's ode to mathematics:

> Mathematics is as extensive as nature itself; it defines all perceptible relations, measures time, spaces, forces … Its chief attribute is clearness; it has no marks to express confused notions. It brings together phenomena the most diverse, and discovers the hidden analogies which unite them. It seems to be a faculty of the human mind destined to supplement the shortness of life and the imperfections of the senses.[15]

One of the interesting things about Simon, however, was that he believed that the kind of mathematical formalism appropriate to the modeling of complex adaptive systems, such as humans and the worlds they make, would <u>not</u> look like the mathematical formalism that had characterized past science.

The new formalism would not be the system of differential equations that characterized classical physics nor the system of stochastic equations that characterized quantum mechanics. Rather, the formalism peculiar to the description of the behavior of complex adaptive systems would have to mirror the hierarchical structure of those systems while still being able to describe coherent sequences of behavior. The formalism that did so was the *program*. Simon did not invent the concept of the program, but he was the leading exponent of the idea that the program was the essential formalism for the sciences that studied adaptive systems.

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[15] This quotation serves as the epigraph for Herbert A. Simon, *Models of Man: Social and Rational. Mathematical Essays on Rational Behavior in a Social Setting* (NY: Wiley, 1957).

The Bounds of Reason

The second conceptual keystone of this bureaucratic worldview was Simon's trademark principle of bounded rationality. To Simon, human reason was bounded. Significantly, these bounds are not set by the passions or the unconscious but by the inherent limits of the human organism as an information processor. Simply put, "the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world." As a result, the human actor must "construct a simplified model of the real situation in order to deal with it."[16] Humans behave rationally with regard to these simplified models, but such behavior does not even approximate objective rationality. Rational choice exists and is meaningful, but it is severely bounded.

We just cannot know enough—or process it fast enough—to be rational all by ourselves. We need help, and that help is provided by the organizations to which we belong: our families, our places of work, and our political institutions. Indeed, in Simon's view, simplifying the problem-solving process is the main reason why we create organizations in the first place. Quite simply, "The behavior patterns which we call organizations are fundamental … to the achievement of human rationality in any broad sense. The rational individual is, and must be, an organized and institutionalized individual."[17] The constraints that organizations impose upon rationality thus are not

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[16] Ibid., pp. 198, 99.
[17] Herbert A. Simon, "Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization," (1945), p. 84.

Weberian "iron cages" of bureaucratic domination. Rather, they are what make rationality possible.

This principle of bounded rationality was Simon's basic building block in everything from public administration to economics to artificial intelligence. Though seemingly a simple concept, it had revolutionary implications in every one of these fields. In economics, for instance, the idea of bounded rationality undercut the reigning assumption of profit-maximizing rationality embodied in the neoclassical economist's *homo economicus*. Similarly, the concept of bounded rationality played an important role in the "cognitive revolution" against strict behaviorism in experimental psychology, for the idea of bounded rationality presumed that the mind was an active agent in constructing models of the world.

Bounded rationality also had deep implications for Simon's philosophy of science, for it suggested that the construction and testing of such simplified models was the essence of all thought, even scientific thought. An idea of the importance Simon attached to models and modeling can be gleaned from the titles of some of his books: Models of Man, Models of Thought, Models of Discovery, and Models of Bounded Rationality. He even titled his autobiography Models of My Life.

Bounded rationality also had implications for how Simon thought the scientific enterprise should be organized. It led him to advocate interdisciplinary research, for example, since disciplines could bound reason in unhealthy ways. While he did support the expansion of specialized research—social organizations, such as disciplines, were essential to rational problem-solving—he believed that such research had to be coordinated and synthesized else it would become sterile. To put it in Kuhnian terms, one

needed both discipline-based normal science and interdisciplinary revolutionary science.[18] Simon, however, wanted to institutionalize his revolutions. Therefore, Simon worked to make his institutional home, Carnegie Tech's GSIA, into an interdisciplinary research center, and he deliberately supported people and projects that crossed disciplinary boundaries.

From these principles, concepts, and goals, Simon eventually developed a new model of the human organism, its environment, and the science that would study the relationship between the two. His new model of the human organism I call *homo adaptivus*, for it depicted humans as adaptive, problem-solving organisms of finite powers that moved in an infinitely complex world. His new model of the environment, and of the organism within it, was the hierarchically organized complex system, typically depicted as a tree structure.

Significantly, although Simon saw the environment as infinitely complex, its treelike structure meant that it was fit to be known and thus fit to be shaped, even by the bounded reason of *homo adaptivus*. Simon's new model of human science followed naturally from these models of nature and humanity: human science was the study of *homo adaptivus* in relation to its environment. Its basic orientation was behavioral and functional, its characteristic method was simulation, and its essential formalism was the program.

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[18] The use of Kuhnian terminology is particularly apt here, since Kuhn was strongly influenced by the cognitive psychology of George A. Miller, who introduced Kuhn to Gestalt theory, among other things. Miller was a friend of Simon's and his landmark book, *Plans and the Structure of Behavior*, written at the Center for Advanced Study in the Behavioral Sciences while Kuhn was writing *The Structure of Scientific Revolutions* there, was deeply indebted to Simon's work. See George A. Miller, Eugene Galanter, and Karl Pribram, *Plans and the Structure of Behavior* (NY: Henry Holt, 1960), Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).

Homo Administrativus

Homo adaptivus was not Simon's first model of man. Rather, Simon's first attempt to integrate the sciences of choice and control centered on a model of the human actor that Simon called *homo administrativus*, or administrative man. *Homo administrativus* was an organization man. He was a member of a number of formal organizations, each of which specified a set of premises upon which he based his decisions. He identified with his organizational home and accepted the authority of his superiors, within the bounds set by his allegiances to other organizations, including the super-organization called society. *Homo administrativus* was rational, but his rationality was severely bounded by his organizational affiliations. At the same time, those affiliations and the limits they placed upon his reason were what made rational action possible.

Simon developed this model of human behavior during his years as a graduate student at the University of Chicago, his work at the Bureau of Public Administration at the University of California-Berkeley, and as a member of the Department of Political Science at the Illinois Institute of Technology.

At Chicago Simon found both teachers and kindred spirits, fellow investigators of the problems of choice and control. The department that Simon entered in 1936 was the leader in its field. Harvard and Columbia had dominated political science during the first quarter of the twentieth century, but after Charles Merriam took the departmental helm in 1923, Chicago quickly rose to equal, and then to surpass its eastern rivals, for the political scientists based or trained at Chicago in the 1920s-early 40s were easily the most innovative and productive group in the discipline. Charles Merriam, Harold Lasswell,

Harold Gosnell, Leonard White, Quincy Wright, Herbert Beyle, Gabriel Almond, David Truman, Herman Pritchett, Avery Leiserson, V.O. Key, Don K. Price, Herbert Simon—even this abbreviated list gives an indication of the remarkable quantity, quality (and influence) of the "Chicago School."

A large part of what made the Chicago School of political science so productive (and so influential) was that its members shared a common outlook, as had the members of the equally famous "Chicago School" of sociology that had flourished in the 1920s (and with whom they had much in common). This outlook was not a rigid, formal doctrine, but rather a linked set of beliefs about the science of politics. The most important of these common beliefs was the basic assumption that there could be such a thing as a science of politics. As Simon later wrote:

> "It was Lasswell's psychologizing and Gosnell's quantitative and empirical methods that most specifically symbolized the Chicago School. But what characterized it even more fundamentally for me, and I think for a number of other graduate students, was its commitment to the proposition that political science is science. Along with that commitment went a dissolving of departmental boundaries that made the whole university, and all of its methodologies, available to the students of political science."[19]

This "dissolving of departmental boundaries" that Simon emphasized was an integral part of the pursuit of social science at Chicago. It was so much so that Harold Lasswell described the intellectual environment at Chicago as a "cross-disciplinary manifold," oriented around social problems (and the theoretical issues they raised), not around disciplines.[20]

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[19] Simon, *Models of My Life*.

[20] Harold Lasswell, "The Cross-Disciplinary Manifold," in Quincy Wright et al., *The Search for World Order; Studies by Students and Colleagues of Quincy Wright* (New York,: Appleton-Century-Crofts, 1971).

A second characteristic feature of the Chicago School of political science was that the problems it addressed were the problems of the city. Political science at Chicago was oriented around understanding—and governing—the modern city in all its complexity. The fundamental obstacle to both was that the city was full of individuals, each with their own values and goals, who were dependent upon each other to an extent previously unheard of. This interdependence meant that some way of reconciling these different values and goals, some way of discovering the public interest and of persuading people to pursue it, had to be found.

This was no easy task, for though the studies of Merriam and Lasswell on WWI propaganda had shown that people could be influenced quite easily, the strongest influences were ones that catered to the emotions and that limited one's perspective: local/national identities, customs, traditions, religious values, affiliations with primary groups. Trying to educate people to hold a broader perspective and to make rational choices in favor of the common interest was far more difficult—a conclusion that led Lasswell and Merriam at times to despair of democracy's future.

In keeping with these two primary characteristics of Chicago political science, Herbert Simon's graduate training was grounded in the problems that arose in his work at the International City Manager's Association and at the Bureau of Public Administration, problems that he sought to solve with tools drawn from a variety of disciplines, applying economics here, social psychology there, and positivist logic everywhere. Indeed, his training was so directed around such problems that the only course on his graduate transcript was one in boxing, much to his thesis committee's surprise.

In his work at the International City Manager's Association and the Bureau of Public Administration, Simon repeatedly found himself faced with a seeming paradox. Human behavior, as seen in city government in particular, seemed to be both rational and irrational, both "messy" and predictable. In a particularly galling example, Chicago's voters kept electing "Boss" Edward Kelly Mayor, even though this was, to Simon, clearly against the best interests of the populace as Kelly's government was "maximally corrupt." Similarly, the California State Relief Administration seemed to do a great many irrational and inefficient things, yet the people making the decisions to do those things believed that they were making rational choices. What was rational to a member of one bureau seemed foolish or self-serving to a member of another. How to reconcile these divergent rationalities?

One response to this problem—the response of the "efficiency expert" and the scientific manager—was to seek a more universal definition of rationality to use as a consistent standard by which to judge the decisions of various actors. Economists, such as Simon's teacher Henry Schultz, were particularly interested in learning how to measure all the factors necessary for making a rational choice—and in using those measures (that wider knowledge of the "real" situation) as a standard for judging decisions. Simon pursued this path in his early work on Measuring Municipal Activities in which he defended the utility of the "standard of efficiency" in judging decisions.[21]

Another, quite different, response to this problem was that of the sociologist or social psychologist (two fields just beginning to define themselves at this time). In the

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[21] Clarence Ridley and Herbert Simon, *Measuring Municipal Activities: A Survey of Suggested Criteria and Reporting Forms for Appraising Administration* (Chicago: The International City Managers' Association, 1938).

1930s, a young sociologist named Talcott Parsons had begun to develop a theoretical system and institutional program that challenged the exclusion of the "subjective" from economics and from behaviorist psychology. The economists' model of human behavior, in which independent social atoms pursue their individual ends rationally in a free market system, excluded from consideration exactly the question that Parsons believed to be most important: how are the ends of such individual actors reconciled so as to produce social order?

Parsons believed that the only way to answer this question (what he termed "the Hobbesian problem of order") was to develop a "voluntaristic theory of social action" that would explain how social institutions shaped the values and hence the choices of their individual members. Simon internalized these ideas himself, finding in his study of Parsons' Structure of Social Action confirmation of his belief in the power of external constraints upon individual rationality and an explanation of how those external constraints became internalized in the individual. To him, institutionalized value systems could account for people's divergent ideas about rationality.

This belief in the power of external influences upon individual decisions rested uneasily (in Parsons and elsewhere) next to the commitment to seeing rationality and free will in the individual. As was his wont, Simon sought to resolve this dilemma by redefining his terms, particularly the concept of rationality. The work of the psychologist Edward C. Tolman and the philosopher Rudolf Carnap were the keys to Simon's creation of a new definition of rationality—one that would preserve both individual will and external influence, or so he believed.

Tolman's definition of rationality depended upon the existence of purpose: to him, rationality is displayed by learning to adapt means to ends, and the existence of ends entails the existence of purpose in action.[22] From Carnap's logic, Simon took away the notion that a decision is much like a logical proof in that it is based upon the application of logical rules to given premises. The result of the union of these ideas? Purpose, a la Tolman, could be found within the premises upon which decisions were based, reason in the degree to which those decisions achieved those purposes, and choice in the decision of the individual as to which set of value-laden premises one took for one's own.

Simon, like his teachers, was preoccupied with the limited range of human rationality, but even while still a graduate student, it was clear that he saw the constraints upon rational choice quite differently than his mentors did. Where they saw irrationality as the primary constraint, Simon looked to our cognitive limitations—our ability to process information—as setting the bounds on our ability to make rational decisions. As he wrote,

> "It is impossible for the behavior of a single, isolated individual to reach any high degree of rationality. The number of alternatives he must explore is so great, the information he would need to evaluate them so vast that even an approximation is hard to conceive. Individual choice takes place in an environment of 'givens'--premises that are accepted by the subject as bases for his choice; and behavior is adaptive [that is, rational] only within the limits set by these 'givens.'"[23]

We just can't know enough—or process it fast enough—to be rational by ourselves. We need help—and that help is provided by the organizations to which we belong. In fact, it is the main reason why we create organizations in the first place. Quite simply, "The behavior patterns which we call organizations are fundamental . . . to the

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[22] Edward C. Tolman, *Purposive Behavior in Animals and Men* (NY: The Century Co., 1932).
[23] Simon, *Administrative Behavior*, p. 79.

achievement of human rationality in any broad sense." Indeed, "if human rationality has any ethical meaning, if it is more than a pleasant game, then it gets its meaning . . . from the institutional setting in which it operates and by which it is molded." In short, "The rational individual is, and must be, an organized and institutionalized individual."[24]

This inversion of the traditional understanding of organizations was the key to Simon's attempt to reconcile individual purpose and rational choice with the power of social forces to shape those choices. To Simon, the constraints that organizations impose upon rationality were not "iron cages" of bureaucratic domination. Rather, they were what made rationality possible. To Simon, choice was not possible without limits, and freedom was not feasible without bounds.

Homo Adaptivus

These views continued to play a major role in his thought in his early years at Carnegie Tech, but by the time he reached Carnegie Tech Simon already had begun to look for ways to incorporate the powerful mathematical tools of the sciences of choice into his work. With such tools, he might be able to specify how *homo administrativus* behaved within the bounds of its reason.

At Carnegie Tech, Simon began to search for ways to broaden his model of human behavior and thus bring a new unity to social science. This synthesis would take place on many levels, he hoped, bringing together not just choice and control but also theory and application. Intellectually, he hoped to bring together the sciences of choice and control through the study of decision-making in social systems. Institutionally, he

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[24] Ibid., p. 102.

sought to create a set of interdisciplinary research centers and a network of patrons that would conduct and support social science that was mathematical, behavioral-functional, and problem-centered.

Simon's efforts to integrate the multiple "islands of theory" he saw floating about in postwar social science led him to a new synthesis.

He developed a new model of man to replace both the perfectly rational, perfectly free *homo economicus* of the sciences of choice and the perfectly malleable, perfectly docile *homo administrativus* of the sciences of control. This new model of man was *homo adaptivus*, the limited but still capable problem-solver, with problem-solving being understood as a process of conscious adaptation to one's environment.

Simon's work on administrative decision-making revealed to him the importance of the principle of bounded rationality and the centrality of the problem of choice, and it taught him to see both the individual and the organization as decision-making machines. From cybernetics and servomechanism theory he added the ideas that organisms, organizations, and adaptive machines were functionally equivalent, not merely similar, that feedback was an essential component of all adaptive systems, organic and mechanical, and that adaptive systems could evolve enormously complex behaviors by nesting rather than chaining simple behavior mechanisms. Here the term "evolve" is particularly important, for, in Simon's view, a process akin to natural selection was the mechanism that produced both adaptive behaviors and their organization into a hierarchical system of behavior.

Finally, from Gestalt theory Simon learned to think of learning and problem-solving as processes of cognitive adaptation. *Homo adaptivus* adapted to its environment

by learning to construct simplified mental models of that environment, models that served as the reference points not only for decisions as to how to achieve its goals but also as the basis for defining the goals themselves.

These ideas all came together for Simon in 1952 at RAND's Systems Research Laboratory (SRL). At the SRL, Simon first encountered the digital computer, the concept of the program, the technique of simulation, and the mind of his intellectual soul mate, Allen Newell. Together, Simon and Newell developed the model of *homo adaptivus*, focusing on its information-processing capabilities, and created the programs that would serve as the exemplars for cognitive psychology from the late 1950s to the present.

In the course of developing his model of *homo adaptivus*, Simon reoriented both his intellectual and his technical practice around the computer. On the technical level, digital computers became a focal point of his work as he attempted to program them to simulate human behaviors. On the intellectual level, his basic questions—and his answers—all were translated into the language of information processing. On the institutional level, the adoption of the computer as his primary research instrument also involved the creation of a new set of professional relations, including a new professional identity for Simon and a reconfigured network of patrons for his work.

Simon's own evolution did not cease with *homo adaptivus*, however. Rather, Simon's theories of heuristic problem-solving, as modified in response to certain discoveries and certain critiques, led him to develop ever more individualized and contextualized accounts of cognition. These new accounts were as mechanist and reductionist and as oriented towards the development of a general theory as his earlier work, but they increasingly focused on domain-specific cognition, usually described as

expertise. If the shift from his early work in public administration to his mature work in psychology can be described as a move from *homo administrativus* to *homo adaptivus*, with the former being a special case of the latter, the changes in Simon's later work can be described as the elaboration of *homo adaptivus* into *homo adaptivus expertus*, the expert problem solver.

This evolution reflected Simon's growing appreciation for experience and domain-specific expertise, which stood in marked contrast to his youthful enthusiasm for the development of theory and for interdisciplinary research. Significantly, as his work became more bounded by disciplinary agendas and supported by patrons of "basic science" (NSF, DARPA, NIMH), the distance grew between it and his original concerns with reconciling not only choice and control but also research and reform. The Simon who studied *homo administrativus* was "an intensely political animal" who created not only a new theoretical structure for administrative science but also a new rationale for an active—but accountable—government. The Simon who studied *homo adaptivus* no longer read the newspaper, except to solve the crossword puzzle.

Disciplines and Bounds

In this story of Simon and his interdisciplinary project we see a familiar pattern, common to a wide range of disciplines in postwar America. Time and again, interdisciplinary research centers were founded and flourished, often in close contact with similar centers, together forming a multi-disciplinary, multi-institutional research community supported principally by military research agencies and by the Ford, Rockefeller, and Carnegie Foundations. Some prominent examples of such communities,

other than the systems sciences, include molecular biology, solar system astronomy, materials science, and solid-state physics.

Such centers and communities often were spectacularly productive, but they also tended to be unstable because they depended upon the continued cohesion of groups held together by informal authority and by the shifting agendas of program officers at problem-oriented funding agencies. As a result, communities like the one oriented around the systems sciences usually dissolved into their component disciplines, perhaps changing them in the process, or coalesced into new disciplines—such as computer science—that fit traditional university structures.

Centers, such as Simon's Graduate School of Industrial Administration (GSIA) at Carnegie Tech, repeated this pattern, either reproducing traditional disciplinary divisions within themselves, devolving into university departments, or separating from the university world entirely and re-organizing themselves as business enterprises. Which path they followed correlated well with the nature of their financial support: institutes with multiple, problem-oriented patrons tended to maintain an interdisciplinary focus, while ones with one or two dominant patrons tended to form disciplines aligned with those patrons' interests, especially if those patrons were discipline-oriented patrons of "pure" science, such as the National Science Foundation, ARPA, or National Institutes of Health. Finally, institutes that supported themselves by producing marketable products or services tended to become businesses, as in the case of MITRE (a spin-off of MIT's Lincoln Laboratories).

Historians of science and technology are used to studying such communities when they become disciplines and such centers when they become permanent departments or

laboratories or firms. We like to have a concrete endpoint to provide an implicit teleology, and we like formal organizations because they produce extensive paper trails. Informal research communities—such as the systems sciences in Simon's day—are more troublesome. We know they exist because we can observe patterned relationships among researchers who shared a sense of common endeavor and used a common language. But since such communities often are unstable and evanescent, there is a tendency to treat them as failed or "immature" disciplines, especially if they do not organize themselves formally. There is some justification for this view, for leaders who seek an enduring presence for their community (or greater personal power within it) do strive to institutionalize their vision, as Simon did at Carnegie Tech.

In many cases, however, viewing such informal communities as "immature" disciplines is not the best way to understand them. Such communities and the networks of extra-departmental, interdisciplinary centers in which they found homes have been among the most important sources of innovation in postwar science. They thrive precisely because they provide an essential counterbalance to the otherwise insistent pressures towards specialization that pervade the academic world. In fact, I would argue that the tension between disciplinary specialization and interdisciplinary collaboration is essential to postwar science; they are the mainspring and escapement, the positive and negative poles of innovation.

Herbert Simon's career at Carnegie Tech illustrates both community and institution building on this interdisciplinary model. From the beginning, he sought to build the GSIA into an interdisciplinary research institution organized around the mathematical, behavioral study of decision-making in complex systems. At the same

time, he also sought to link the GSIA with other such centers, forming a community united by a common perspective, a common language, and a common network of patrons. In these tasks, the challenge always was to instill that perspective and teach that language without imposing formal central direction. The most common means of doing so was to create a network of interlocking memberships on research teams and coordinating committees.

Simon's ambitions suited the times, for the absence of any dominant single source of patronage for the social sciences in the first 25 years after the war meant that those prospered who were skilled at bringing together a variety of interests: scientific entrepreneurs and brokers. Those who were more comfortable with a stable, orderly system, or those who wished to be left alone, often found themselves on the outside looking in, puzzled and alarmed at how complicated their world had become. Simon saw this complexity as opportunity. Indeed, he was fond of telling his graduate students that they "needed to learn to live with chaos for a while."

Good advice, perhaps, but Simon was comfortable with chaos because he was always sure that an order lurked within. Similarly, when he embraced leadership rather than formal control, it was because he was confident that when he found the truth, others would see the light. If they did not—or even if they did—there was always another pattern to find, another program to found, another set of patrons that would fund. For this entrepreneur and broker, the world was always resource-full.

Conclusion: Simon's Legacies

Science. Objectivity. Expertise. Progress. For Simon these were words to conjure with, but to humanist scholars in the 21st Century they often summon not allegiance but knowing smiles. We who have tasted the fruit of the postmodern tree of power/knowledge believe ourselves wiser about the ways of experts than was Simon's generation, but with this wisdom has come a certain sadness, a certain loss of faith not only in science and experts, but in reason and, indeed, in democracy itself. What, then, is Simon's legacy to the postmodern world? Can we learn from him as well as about him?

As befits a man who moved from field to field, Simon's legacies are multiple. During the 1950s and 60s, the growing community of behavioral scientists shared Simon's bureaucratic worldview and aspired to create a behavioral-functional, mathematical, problem-oriented social science. Political science experienced a behavioral, economics an econometric, sociology a functionalist, and psychology a cognitive revolution, all linked by a shared vision of a new science of adaptive systems. (The economists left this fold rather rapidly, but there was a time when they could be counted as allies.)

This community diversified as it grew, however, and academia bought synthesis in much the same way Simon did, building an ever-expanding structure of specialized compartments. In each of the behavioral sciences, and in the "management science" that was built upon them, this compartmentalization led their leaders in the 1970s and 80s to proclaim that their fields were "adrift," "fragmented," in "crisis." Some blamed Simon and his behavioralist allies for the "descent" of political theory, the "crisis in public administration," the "coming crisis of Western sociology," or the "misdirection" of

psychology.[25] (The "crisis in economic theory" usually has been laid at other feet.[26]) Others, however, found virtue in fragmentation, holding that a community encompassing both Kantians and rational choice theorists, cognitive scientists and psychoanalysts, was stronger for the diversity.

With this diversification has come a divergence from the path Simon charted. This divergence is most notable in economics, where *homo economicus* now appears to reign triumphant, clothed in the calculus of subjective expected utility theory. Here Simon's legacy is like that of a grain of sand in an oyster: an irritant, yet to produce the pearl of a new paradigm.[27] Perhaps his calls for an empirically based microeconomics will be heeded by more than a minority in the new millennium, and the awarding of the 2002 Nobel Prize in Economics to Daniel Kahneman, a psychologist very much in the mold of Simon, gives Simonians reason for hope. Still, the enormous success of the economists over the past thirty years has given them great professional self-confidence, which makes major conceptual and methodological reforms appear unlikely, at least in the near future.[28]

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[25] John Gunnell, *The Descent of Political Theory: The Genealogy of an American Vocation* (Chicago: University of Chicago Press, 1993), Vincent Ostrom, *The Intellectual Crisis in American Public Administration*, 2nd ed. (Tuscaloosa, AL: University of Alabama Press, 1989), Alvin W. Gouldner, *The Coming Crisis of Western Sociology* (NY: Basic Books, Inc., 1970), Seymour Bernard Sarason, *Psychology Misdirected* (NY: Free Press, 1981).

[26] Daniel Bell and Irving Kristol, *The Crisis in Economic Theory* (New York: Basic Books, 1981).

[27] For Simon's recent views on the state of economics, see Herbert A. Simon, "Organizations and Markets," *Journal of Economic Perspectives* 5, no. 2 (1991): 25-44, Herbert A. Simon, "The State of Economic Science," in *The State of Economic Science: Views of Six Nobel Laureates*, ed. Werner Sichel (Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 1989), Herbert A. Simon and Claudio Dematt*á*e, *An Empirically Based Microeconomics*, *Raffaele Mattioli Lectures* (Cambridge, U.K.: Cambridge University Press, 1997).

[28] Robert M. Collins, *More: The Politics of Economic Growth in Postwar America* (NY: Oxford University Press, 2000), Michael Bernstein, *A Perilous Progress: Economists and Public Purpose in Twentieth-Century America* (Princeton, NJ: Princeton University Press, 2001), Herman E. Daly, John B. Cobb, and Clifford W. Cobb, *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future*, 2nd ed. (Boston: Beacon Press, 1994).

More fundamentally, the new hopes for synthesis in recent years have been the concepts of the network rather than the system, of complexity rather than hierarchy, flexibility rather than stability, and contextual rather than formal knowledge. Simon himself anticipated this shift to what one might call a "networked worldview" in his landmark essay on "the Architecture of Complexity," but, as the title indicates, it was the architecture of complex systems that still held his interest.[29] While Simon saw organization and complexity as two sides of the same coin, others took the discovery of complexity to be a repudiation of organization or, more precisely, of intervention. Since the 1970s, many social scientists, particularly but not exclusively neoconservative ones, have become entranced by the "law of unintended consequences" that supposedly dooms all efforts to intervene in our complex, interdependent society.[30]

At the same time, the excesses of both bureaucratized warfare and bureaucratized welfare have inspired many to look for new models of humanity and society. After a brief flirtation with more organic models in the late 1960s and 70s, public discourse in America seems to have returned to technological models, especially in the wake of the sudden advent of the Internet in the 1990s. In many ways, however, this new networked worldview is an evolutionary descendant of the bureaucratic worldview, not a species of thought descended from another line. The Internet, after all, has a decentralized

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[29] Herbert A. Simon, "The Architecture of Complexity," *Proceedings of the American Philosophical Society* 106 (1962): 467-82.

[30] Two classic statements of the perils of unintended consequences are: Jeffrey L. Pressman, Aaron B. Wildavsky, and Oakland Project., *Implementation: How Great Expectations in Washington Are Dashed in Oakland; or, Why It's Amazing That Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation of Ruined Hopes*, *The Oakland Project Series* (Berkeley,: University of California Press, 1973), Charles A. Murray, *Losing Ground: American Social Policy, 1950-1980* (New York: Basic Books, 1984). Losing Ground has been described as the "Bible" of the first Reagan administration.

hierarchic structure, not a fully distributed one.[31] Similarly, the network is a generalization of the concept of the system, not a repudiation of it; complexity often turns out to have a hierarchic structure, as evidenced by the prevalence of "self-similar" structures; flexibility frequently is valued for its contributions to maintaining stability; and contextual knowledge can be every bit as instrumental as formal, procedural knowledge. Thus, this new species of ideas has evolved through the adaptation of older forms to a new environment.

In the end, Simon's vision of humans as creatures of bounded but still meaningful rationality still seems to me to be a sound guide to designing our socio-political environment. His basic understanding of humans as both limited and capable, both plastic and purposed, certainly fits my understanding of my own mind. Our reason is limited but still powerful. Our knowledge of the world always will be incomplete, bounded, and biased, but it can become more complete, more expansive, and less parochial, and to these goals we should aspire. Only by such striving can we enlarge the bounds of reason and design a better world.

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[31] Here it is important to note the marked difference between the structure of the Internet as understood by those who design, build, and maintain it and the structure as it is experienced by the typical end user. The user experiences the Internet as a distributed network; the system designer experiences it as a decentralized but not fully distributed hierarchic network.