Policy Sciences **35**: 269–284, 2002.

Bounded rationality and public policy: Herbert A. Simon and the decisional foundation of collective choice[1]

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Abstract. By 1958, a model of human behavior capable of serving as the micro-level foundation for organizational and policy studies was in place, due primarily to the efforts of Herbert Simon, organization theorist James March, and computer scientist Allen Newell. Yet the fundamentals of that model, the *behavioral model of choice*, to this date have not been fully incorporated into policy studies and organizational analyses. The 'Simon program' remains incomplete. Much analysis continues to rely on thick or thin models of rational maximization. As is well-known, the behavioral model of choice links to organizational processes better than rational actor assumptions. But the behavioral model of choice also predicts distributions of organizational and policy outputs in a superior fashion, and need not draw in extraneous descriptive facets of human behavior to the analysis. As Herb Simon did beginning in 1945 until his death in 2001, I continue to advocate a solid behavioral base for the analysis of political and economic systems.

Introduction

Public policies are binding, authoritative collective choices. The study of public policy addresses how the thoughts and actions of people are translated into such collective decisions, and how those decisions impact the collectivity. So the study of public policies must address, directly or indirectly, issues in human cognition.

Most of us studying public policy, whether in a theoretical or applied vein, care little about the fine details of the specifics of human cognition; we are quite content to leave that to biologists, psychologists, and cognitive scientists. What we do need, however, is a model of the bases of human behavior in organizations. That model must fulfill three criteria: first it must do no harm (it should not mislead); second, it must allow us to move between individual level processes and organizational processes in a more or less seamless manner; and third, it should be efficient, in that it does not drag in specifics of human behavior that are not needed to understand the policymaking process.[2]

In this paper I show how the model of bounded rationality, as initially articulated by Herbert A. Simon and expanded by Simon, organizational theorists such as James A. March, and cognitive scientists, especially Allen Newell, serves such a purpose. As such, I address a common complaint of many social scientists that, because bounded rationality is open-ended and supposedly ill-defined, it cannot serve as a firm foundation for connecting individual behavior and collective choice. On the contrary, I show that it is

comprehensive rationality that fails to produce satisfactory scientific predictability, and that bounded rationality is a superior mechanism. It is superior in two respects. It performs better in linking the procedures of human choice with the organizational and policy processes, as is commonly argued. It also performs better in predicting organizational and policy outcomes in a very important class of collective behaviors. Neither approach does very well in 'point prediction' – predicting precise events – but bounded rationality makes distributional predictions in a manner not matched by assumptions of full rationality.

PART I: The tenets of bounded rationality

Simon made the first bold step toward the development of a model of decision-making capable of aiding the understanding of collective choice in organizations with the publication of *Administrative Behavior* (Simon, 1945). Simon admits that the model articulated there consisted largely of 'residual categories, and the positive characterization of the process of choice is very incomplete' (Simon, 1976: xxix). By 1958, however, all the elements for producing an organizational and policy science based on a positive model of choice were in place. The basic elements of that model have been confirmed and re-confirmed by cognitive scientists in the laboratory and by students of organizations and policy processes in the field. Unlike the competing model of fully rational choice, Simon's model is consistent as well with what we now know about the evolution of human cognitive capacities. Yet the approach, rather than serving as the undisputed decisional foundation for modern social science, has engendered much confusion and controversy.

Why do I choose 1958 as a critical year? Four pathbreaking lines of work converged at that time, and reached publication in 1957 or 1958. In all of these Simon was a crucial participant.

1. *Bounded rationality*. In 1957, Simon published a collection of his papers under the title *Models of Man.* The volume included his 1955 paper appearing in the *Quarterly Journal of Economics* entitled 'A Behavioral Model of Choice.' (It is this work for which Simon received the Nobel Prize in Economics in 1978.) With this work, bounded rationality became a positive theory of choice, not solely a critique of comprehensive rationality.
2. *Cognitive psychology*. Psychology of the 1950s was in the grips of Skinnerism: to be scientific, it was claimed, one could not rely on the artificial and unobservable constructs of mental processing. In 1958, Allen Newell and Herbert Simon published their paper 'Elements of a Theory of Human Problem-Solving' in the *Psychological Review*, a paper that formed the basis for modern cognitive psychology. Cognitive psychology gets 'inside the heads' of people to examine how they think and reason.
3. *Artificial intelligence*. In 1957, Newell, Simon, and Clifford Shaw published

their joint paper arguing that computers could be used to model human thought, a breakthrough in the field of artificial intelligence.

4. *Behavioral organization theory*. In 1958, March and Simon published *Organizations*, their tour de force establishing the field of behavioral organization theory. The work linked organizations and the newly-developed behavioral theory of choice. Behavioral organization theory 'gets inside the organization' to examine the role of organizational processes in determining bureau or firm outputs in a manner analogous to the way that behavioral decision theory does for the individual.

By 1958, then, all the elements of a scientifically-sound model of human choice, and the capacity to expand that model downward into psychological processes and upward into organizations and political and economic institutions were in place. It is fascinating to note how little of the stream of research in economics and political science actually made use of the model. In political science, much time was spent fighting Simon's approach as 'too scientific' for the humanistic study of politics; later the public choice approach simply ignored the model. Economists 'went on counting angels on the heads of neoclassical pins' (Simon, 1999: 113).

It is no accident that the behavioral model of choice came more-or-less directly from the behavioral discipline of political science. Simon gives great credit to his participation as a student in Charles Merriam's behavioral revolution at the University of Chicago's Department of Political Science in the 1930s (Simon, 1996: Chapter 4). The scientific tenets of political behavioralism were strong on observation and quantification and not so strong on theory; the movement had a clearly inductive flavor. It demanded real-world observation – Merriam wanted to make a difference in the conduct of public policy as well as in the conduct of scientific inquiry.

While great strides have been made in recent years by psychologists and behavioral economists studying choices in the controlled arrangements of the laboratory, only serious field study can indicate how real choices are made in the 'structured yet dynamic' environments of real choice situations. Bounded rationality and the behavioral theory of choice came from organization theory; indeed, March (1994) once noted that breakthroughs in the study of human cognition were likely to come from a study of organizations. Human adaptability and occasional lapses in it are best viewed in organizational settings; moreover, human organizations simultaneously free humans from their limits by extending their capacities to achieve goals and fall prey to those very limits (Jones, 2001). As a consequence, policy scientists have a continuing and critical role in the development of a more elaborated 'behavioral model' of human choice. Work in the field and with aggregate data does not solely rely on an articulated behavioral model of choice; in the best of worlds macro level studies should inform the micro level behavioral model.

Four principles

Bounded rationality emerged as a critique of fully rational decision-making; what Simon termed the 'behavioral theory of choice' was an attempt to state the positive aspects of a theory of human choice based on scientific principles of observation and experiment rather than the postulation and deduction characteristic of theoretical economics. I first review the principles of bounded rationality, and then turn to the modern conceptions of the behavioral theory of choice. The tenets of bounded rationality can be summarized in four straightforward principles. While research in many fields of social science have advanced our understanding over the years, their basic formulation occurred in *Administrative Behavior* (Simon, 1945).

Principle of intended rationality

Simon's model is enshrined in the crucial *principle of intended rationality*. That is, it starts with the notion that people are goal-oriented, but often fail to accomplish this intention because of the interaction between aspects of their cognitive architectures and the essential complexity of the environment they face (Simon, 1976: xxvii; March 1994). Intellectually, this notion did not begin with Simon; it may have begun with Vilfredo Pareto. In *Mind and Society* he distinguished logical, illogical, and non-logical behavior (Pareto, 1935).[3] Logical behavior is rational choice; it is ends-means reasoning where means are appropriate to goals. Illogical behavior is behavior not rooted in ends-means thinking; Pareto thought little human behavior (at least of interest to a social scientist) was illogical. Non-logical thought involved 'sentiments and residues' that could interfere with logical thinking. In a way, then, we might term the principle of intended rationality the *Pareto-Simon Principle*.[4]

The principle of intended rationality implies that we look at the goal-directed behavior of people, and investigate the manner in which their cognitive and emotional constitutions concomitantly promote and interfere with goal directed behavior. It implies, of course, that 'Rationality does not determine behavior… . Instead, behavior is determined by the irrational and nonrational elements that bound the area of rationality' (Simon, 1945: 241).

The notion of bounded rationality has been confused with a lack of calculational ability. Two rational choice scholars have recently claimed that 'Herbert Simon argued that, unlike *homo economicus*, people are not omniscient calculators – they do not do all of the calculations all of the time' (Lupia, McCubbins and Popkin, 2000: 9). Nowhere in *Administrative Behavior* or elsewhere in the work of Simon, March, or Newell is the lack of calculational abilities cited as central to bounded rationality. Indeed, they all were at pains to note that calculations were a minimal part of the difficulty, easily solved via notepads, calculating machines, or a bureau of accountants. Simon does write extensively, however, about attention, emotion, habit, and memory, exploring the functionality and dysfunctionality of these aspects of the architecture of human cognition. And it is true that a prime component of the behavioral model of choice is

difficulty in planning and executing long behavior sequences (Jones, 2001: 61). But this aspect of the model should not be confused with calculational difficulties.

Principle of adaptation

The principle of adaptation stems most directly from the studies of Allen Newell and Herbert Simon in human problem solving, and is best stated in Simon's *The Sciences of the Artificial* (1996). The claim is that most human behavior is explained by the nature of the 'task environment.' Given enough time, human thought takes on the shape of the tasks facing it – that is, human thought is adaptive and basically rational. Simon put it this way: 'There are only a few "intrinsic" characteristics of the inner environment of thinking beings that limit the adaptation of thought to the shape of the problem environment. All else in thinking and problem-solving behavior … is learned and is subject to improvement' (Simon, 1996: 54). From this principle comes the inference that, in general, the more time one spends on a problem, the more likely the decision-maker's understanding of the problem will approximate the actual task environment, and the limitations of human cognitive architecture fades (Newell, 1990).

The principle of adaptation is closely associated with the distinction between central and peripheral mental processing (Fiske and Taylor, 1991: 475–480). Kuklinski and Quirk (2000: 163) put it this way: 'In central processing, used when attention and motivation are high, people employ more mental resources, think more systematically, and allow data to shape inferences. In peripheral processing, used when attention and motivation are low, they employ fewer resources, rely on simple heuristics, and use top-down, stereotypic inferences.' What we lack at present is an organizationally-based understanding of when people shift from one processing approach to the other. Because attention is disjoint, the shift will be disjoint.

Principle of uncertainty

One of the major strategies of the rational choice approach in social science has been to understand uncertainty in light of the calculus of probabilities. We now speak of 'expected utility' and think of outcomes as following a probability distribution. Unfortunately this undeniable improvement does not come close to telling the entire story of human decision-making. Students of human choice in real world or in laboratory situations again and again find that people have great difficulties in working with probabilities, assessing risk, and making inferences where uncertainty is involved. Indeed, a whole field of endeavor has emerged that studies the factors responsible for perceptions of risk; clearly these perceptions are not just rooted in 'nature' but also involve human psychology.

An underlying tenet of bounded rationality from its early years centered on how human cognitive architecture interacted with an uncertain world; bounded rationalists saw uncertainty as far more fundamental to choice than the probability calculus implied (March 1994). If one's understanding of the

causal factors involved in a problem is hazy or ambiguous, then the uncertainty is not contained, but reverberates through the entire thought process. If one is uncertain about how to specify outcomes, then one must also be uncertain about how to specify one's utility function. We are not here referring to probabilities associated with well-specified outcomes; the probability calculus easily handles that. Simon termed this difficulty 'the design problem' to denote that the fundamental nature of specifying a problem-space within which to solve problems. Addressing this reverberation and its impacts on organizational decision-making is perhaps the key contribution of the work of James March.

Principle of trade-offs

It became evident very early in the study of human choice that people have a very difficult time with trading off one goal against another in a choice. The classical economic model depicts trade-offs as smooth indifference curves, and modern rational choice theory offers little new in the theoretical study of trade-offs. The first behavioral tool for understanding tradeoffs was Simon's notion of 'satisficing.' His idea that 'administrative man' – an individual in an organization – chooses alternatives that are 'good enough' has led critics to claim that the notion is just a poverty-stricken version of maximization. Recently, for example, Lupia, McCubbins, and Popkin claim that bounded rationality is consistent with maximizing behavior. They cite with approval Jensen and Meckling, who write that the use of the term 'satisficing' has 'undoubtedly contributed to this confusion because it suggests rejection of maximizing behavior rather than maximization subject to costs of information and decision-making' (Lupia, McCubbins and Popkin, 2000: 9).

If one adds information and decision-making cost constraints to choice, this will not cause bounded rationality to dissolve into maximizing behavior. The reason is that satisficing describes the cognitive difficulties people have with trade-offs. As a consequence, the notion of 'satisficing' has little to do with some sort of second-rate maximization approach. It addresses the problem of trade-offs among multiple goals. Because of the operation of limited attention spans, people generally work on goals sequentially. As a consequence, trade-offs among goals is very difficult. The response, argues Simon, is for people to set 'aspiration levels' on the goals they wish to achieve. If a choice is 'good enough' (that is, if it exceeds aspiration levels) on all goals, then it is chosen.

Other models of choice among multiple goals have been developed, including the lexicographic strategy (chose the strategy that maximizes gain on the most salient goal and ignore the rest) and elimination by aspects (use a lexicographic strategy unless there is a tie among alternatives; then and only then use a second goal to break the tie). In an important particular, people have considerable difficulty in trading off benefits against losses, something that standard utility maximization theory treats as straightforward (Kahneman and Tversky, 1979).

Tetlock (2000) has studied the cognitive and emotional capacities of people to make trade-offs under situations when information is brought to bear on

so-called 'taboo trade-offs.' Tetlock notes the defense mechanisms people raise when trade-offs are demanded, but shows through experiments that 'virtually everybody can be motivated to engage in trade-off reasoning when optimal conditions hold' (Tetlock, 2000: 246). The consequence is to add a psychological source for disjoint and episodic responsiveness to information: people tend to ignore or resist information when trade-off choices are implied, but will respond when 'optimal conditions hold'.

Elements of the behavioral theory of choice

Bounded rationality points to the limits of rational adaptation; behavioral choice theory provides a body of literature that shows how human choice works. As I noted above, bounded rationality and the associated behavioral theory of choice is open-ended; we do not know everything about human choice and we learn more every year. But we know a lot, and we know enough to specify the outlines of what aspects of human cognition must be incorporated to formulate a general theory of human choice. I would cite the following.

1. *Long term memory.* Humans learn by encoding experience (direct or secondary) into rules that specify action to be taken in response to categories of stimuli.
2. *Short-term memory.* Human cognitive capacities include a 'front end' that extracts features from the world around them, categorizes them as relevant or irrelevant (in the former case, they become 'stimuli') and prioritizes them.
3. *Emotions set priorities.* In an initial encounter with a choice situation, the major mechanism for weighting the relevance of stimuli is emotion.
4. *Central versus peripheral processing.* When attention and emotion are aroused, information processing shifts toward problem analysis and search. When they are not, the decision-maker relies on pre-packaged solutions.
5. *The preparation-search trade-off.* If the front-end system indicates a need for action, humans can take two paths: draw upon previously-prepared and stored rules specifying how to respond to the category that the stimulus has been placed in, or search for new responses.
6. *Identification.* People identify emotionally with the previously-prepared solutions that they have encoded in memory. They tend to become emotionally attached to their current repertoire of encoded solutions, even as the problems they face evolve. As a consequence, reliance on prepared solutions dominates search.

Clearly these aspects of human cognition do not tell the whole story. For example, in many cases in which attention and emotion are aroused, people may insist on rigidly following old rules. But the six aspects of human cognition

cover much ground, and lay the basis for a general behavioral theory of choice in organizations and institutions.

Organizations

While organizations clearly free humans by extending their capacities to achieve goals, being human inventions they also fall prey to aspects of human cognitive architecture in predictable ways. Major aspects of the behavioral theory of organization parallel major facets of the behavioral theory of human choice.

1. *Organizational memory.* Organizations encode experience into rules, routines, and standard operating procedures that specify action to be taken in response to categories of stimuli.
2. *Agenda-setting.* Organizational capacities include a 'front end' that extracts features from the world, categorizes them as relevant or irrelevant (in the former case, they become 'stimuli') and prioritizes them. Agenda setting in organizations parallels the short-term and attention 'bottleneck' (Simon's term) afflicting human cognition.
3. *Parallel processing.* A major way that organizations expand human capacities is the ability to process information in parallel. By decentralizing and delegating, organizations can process multiple streams of input simultaneously (Simon, 1983; Jones, 1994). This organizational strategy presupposes considerable 'peripheral processing' relying on pre-programmed solutions.
4. *Serial processing.* Search for new solutions is activated only when previously prepared solutions encoded in organizational routines are judged inadequate. Then organizations move from peripheral to central processing (or from parallel processing to serial processing).
5. *Emotional contagion.* In policymaking, emotional commitment and contagion are crucial elements in mobilizing for major initiatives. Moving from parallel to serial processing is invariably accompanied by emotional arousal by participants (Jones, 1994).
6. *Identification.* People identify emotionally as well as cognitively with the organizations they participate in, or even parts of an organization, which Simon termed 'sub goal identification.' Organizational identification is a great resource for leaders. Patriotism or religious zeal or even pride in performing their jobs can push people to actions that would be unthinkable in a calm cost-benefit analysis. But it also can make it difficult for leaders to shift strategies when they find it necessary to do so.

The relationships between organizational decision-making and individual decision-making are not metaphorical; they are *causal* (Jones, 2001). One cannot really understand how organizations operate without a strong sense of how individuals process information and make decisions. As a consequence, a firm scientific foundation for policy studies must be rooted in a behavioral approach to organizations (Green and Thompson, 2001).

PART II: Prediction in science: Inference from individual behavior to collective choice

Few social scientists today would disagree with Simon's premise that a sound organizational theory must rest on a defensible theory of human behavior. It is undeniable that bounded rationality is more open-ended in its basics than the rational model. How much should an unrealistic model of the behavioral underpinnings of public policy that is nevertheless well-specified be traded-off against a model that is more realistic but less well-specified? In making a judgment, we ought to apply scientific standards. Here the primary standard ought to be the extent to which the model in question can be used to understand and predict collective choices.

Thick and thin rationality

There are two versions of rationality as employed by formal theorists in economics and political science: thick and thin. The 'thick' version assumes self-interest, and is capable of strong predictions about individual behavior and collective choices. Unfortunately oftentimes people do not seem to act out of strict self-interest. Experimental studies have been unequivocal on the issue: in laboratory settings, many people do not act out of strictly selfish motives. As Frolich and Oppenheimer (2000: 106) write, 'A substantial set of individuals consider the welfare of others as a value in itself.'

As a consequence, the 'thin' version, a seemingly more plausible postulate, has been suggested. Thin rationality ignores the postulate of goals and focuses only on the process – assuming maximizing behavior regardless of what a person's goals are. '*A rational choice is one that is based on reasons, irrespective of what these reason may be*' (Lupia, McCubbins and Popkin, 200: 7). Unfortunately this leads absolutely nowhere, since it leads to no specific predictions about behavior (Simon, 1985). If people have goals reflecting both self-interest and the welfare of others, and formal theorists have no ways of discerning the trade-off, then no predictions can be made. In the famous 'divide the dollar' experiments, in which subjects are asked to divide a prize between themselves and others, specific predictions can be made using the postulate of thick rationality, but *any division is consistent with the postulate of thin rationality*.

To make predictions we presumably would need to study the formation of the reasons people use for the decisions they make. This is equivalent to exploring preference formation, and doing it inductively (since there are no a priori reasons (on the part of the investigator) for assuming any particular set of reasons (on the part of the subject). If we are going to go this far, why not treat the mechanisms of choices as subject to empirical study, rather than assuming maximization given the unspecified set of reasons used by the decision-maker?

Thick rational choice is capable of predictions, but many of them are wrong.

Thin rationality is not capable of scientific predictions without empirical study of the formation of reasons.

Process or outcome predictions?

Predictions can be made on processes or on outcomes. It has traditionally been conceded by proponents of rational choice that the approach is insufficient to predict processes, but that it matters little. The 'instrumental positivist' position, first articulated by Milton Friedman, insists that predictions not be made on processes, but on outcomes (Friedman, 1996). Outcome predictions will be satisfactory when decision-makers act 'as if' they are rational maximizers. Bounded rationality insists that processes matter, that successful science must properly link the process of making individual decisions to organizational processes responsible for collective choices. If that is done successfully, then the outcome predictions will take care of themselves.

The first set of serious predictions using bounded rationality to study public policy came from the budget studies of Wildavsky (1964) and his colleagues and Fenno (1966). Explicitly relying on bounded rationality, these scholars reasoned that budgets ought to be incremental, supported by organizational decision-rules that would stabilize the environment for participants. They examined both the process of budgeting directly, and they examined the pattern of budgetary outcomes.

The problem is that public budgets are not incremental, at least when viewed from a long enough time span or a broad enough sample (True, 2000; Jones, Baumgartner and True, 1998).[5] It seemed that the processes underlying incremental budgeting may have been misspecified (Padgett, 1980; 1981). Indeed, the new budgetary studies, based in outcome predictions but reliant on a proper appreciation of organizational processes, point to a glaring omission in the early budget studies. Focused as they were on organizational procedures that stabilize and make predictable a potentially chaotic environment, they missed how organizations cope with change they cannot ignore.

There are times when organizations must adjust their standard operating procedures to address signals from the environment that simply cannot be placed within pre-existing categories. Padgett's (1980; 1981) examination of federal budget routines found that sequential search for acceptable alternatives under conditions of changing political constraints would yield punctuated change.[6] Carpenter (1996) shows that federal agencies often ignore the budgetary signals sent by Congress unless those signals are sent repeatedly. The first attempt to cope with a radically changing environment seems to be to use the pre-existing set of rules; only when it becomes clear that the signals cannot be ignored will an agency respond. But respond they do, at the cost of considerable disruption to internal procedures.

While the early budget studies had much of the budgeting process right, they did not properly appreciate the role of shifting attention. The allocation of

attention is a critical component of agenda setting studies (Cohen, March and Olsen, 1972; Kingdon, 1996; Baumgartner and Jones, 1993). Attention shifts in policymaking imply changes in standard operating procedures, which, in turn, predict major punctuations in policy outcomes. So policy outcomes should be characterized by periods of stability or incremental adjustment punctuated by periods of rapid change. Further, both stability and change should be more pronounced than the information coming in to the organization (or, more generally, the policy subsystem). That is, whatever the information flow, a model of organizational processes based in bounded rationality predicts a more disjoint and episodic process in outcomes. Both individuals and organizations are *disproportionate information-processors* as they ignore many signals in the environment until they must overreact (Jones, 2001).

Disproportionate information processing and stochastic processes

In modern complex environments, neither individuals nor organizations respond simply to stimuli. They must attend, prioritize, and select an appropriate response. As a consequence, there is no clear, one-to-one mapping between potential stimuli or events and actions.

There are important implications for the conduct of policy studies. The traditional approaches to analysis based on point prediction and regression analysis can be misleading, because it is so difficult (and perhaps meaningless) to try to tie a particular event to a particular outcome. Students of organizational processes have begun to make use of a stochastic process approach, in which efforts are made to understand the processes underlying an entire distribution of outputs rather than a particular response to a policy innovation or other change (Padgett, 1980; 1981; Jones, Sulkin and Larsen, 2002). For example, the stochastic process approach predicts leptokurtic distributions in outputs regardless of the input distribution. That is, punctuations will occur when the normal organizational routines for processing information break down (Jones, 2001; Jones, Sulkin and Larsen, 2002).

The stochastic process approach captures predictions from bounded rationality and organizational processes better than the intervention/response models so common today in policy analysis. It eschews point prediction for a more comprehensive examination of full distributions. It follows the logic of extreme value theory, a stochastic process approach that requires that the tails of the distribution be taken seriously, not just the mean and variance, because these major punctuations can disrupt equilibria (Sornette, 2000).

Bounded rationality and behavioral choice lead to predictions about policy outcomes that imply that organizational outputs will be disjoint and episodic regardless of 1) the input stream and 2) the cost structure of the organization. It is clear that decision costs in the policymaking process can cause disjoint outputs. For example, in the American system of separated powers, considerable changes in the preferences of policymakers can occur without producing policy

change because of the need to assemble majorities in all responsible branches (Hammond and Miller, 1986). If we were able to discount these 'decision costs', bounded rationality implies that disjoint and episodic behavior would still occur. Examination of a number of different distributions of outcomes from political institutions and the policy-making process in the U.S., finds that, regardless of the institutional cost structure, outputs are punctuated (Jones, Sulkin and Larsen, 2002).

A model of human decision-making based in bounded rationality and behavioral choice leads to different outcome predictions than either thick or thin rationality. In the former, people are disproportionate information processors. In the words of mathematician Benoit Mandelbrot (1997: 28), 'Man tends to react by either overestimation or neglect.' People are hostage to their attention structures and their distaste for trade-off reasoning. In the current incarnation of rational models, people act proportionately to the information they receive. They attend to everything simultaneously and make trade-offs effortlessly. They avoid punctuated outputs except where inputs are disjoint and episodic. Organizations composed of boundedly rational participants cannot avoid punctuated outputs, because they cannot adjust their behaviors to incoming information of any degree of complexity. Organizations composed of rational participants respond directly and efficiently to information discounted by costs.

Organizational processes are better described by bounded rationality than by rational analyses – a point generally conceded by all. The two approaches yield different predictions on outcomes, and it is becoming clear that the bulk of the empirical evidence on outcomes also favors bounded rationality. The most promising tact of rational theorists has been to try to show that boundedly rational outcomes can be modeled through the use of rational models. This may yield results in the long run, but currently these models have an artificial and somewhat contorted flavor to them. A better approach may well be for theorists to take the empirical findings more seriously than they have to date, a move that would likely require moving beyond the 'maximization within constraints' methodology currently in vogue.

Bounded rationality and policy studies

Much disjointed and episodic behavior in the policy process cannot be adequately explained without reference to a behavioral model of human choice. In studying policy initiatives, we need an adequate model of the choice behaviors of the participants in policy formulation. Agenda setting becomes an enigma if we do not appreciate the roles that that selective attention and emotional arousal play.

In applied policy studies, the impact of a policy intervention cannot be adequately assessed without an appreciation of the role of selective attention to the panoply of potential incentives in the environment. In the assessment of policy impact, we need an adequate model of the target of the policy. Policy impact becomes an enigma if we do not understand the fundamental principles

of bounded rationality, particularly the manner in which human cognitive capacities interact with a highly complex environment.

The behavioral study of budgeting, insisting on a firm organizational process base, implies considerable punctuations in the budget process. These processes characterize US municipal budgeting (Jordan, 2001), and national budgeting in the United Kingdom (John, Margetts and Gilbert, 2001) shows that the punctuations are not unique to U.S. national budgeting. These findings have serious implications for budget analysts. Projecting expenditure patterns into the future based on the traditional regression models incorporating Normality will vastly underestimate the likelihood of rapid changes in budget outcomes. Behavioral budget theory strongly implies that budget analysts should turn to the study of extreme value theory in estimating confidence intervals for their projections.

Finally, the role of cognitive and emotional identification with means rather than ends, first isolated as a key aspect of organizational behavior by Simon in *Administrative Behavior*, is a key factor in policy choice and implementation. In one of the last pieces he published, Simon and Ronald Fernandes apply the process tracing methodology, initially developed by Newell and Simon (1972) in their problem-solving experiments, to the complex and ill-structured problems characteristic of policy issues (Fernandes and Simon, 1999). The initial problem-solving experiments studied well-specified problems, but the methods themselves are adaptable to less structured situations, as Fernandes and Simon show. Fernandes and Simon wonder if the professional identifications lead to different problem-solving strategies. One intriguing finding is the dominance of a KNOW → RECOMMEND strategy among some participants that hindered their use of information in problem-solving. This suggests that they are using a strategy, perhaps deriving from ideology, which may be independent of professional identification. Simon's notion of 'identification with the means' suggests emotional and cognitive identification with what Jones and Bachelor (1993) call 'solution sets' but gives us no particular reason for expecting identification with professional norms over, say, ideology or just previous ways of doing business in a bureaucracy. Steve Brown (2001) suggests a method that is capable of overcoming this limitation of the Fernendes-Simon approach.

I do hope that policy scientists will follow up on the Fernandes-Simon insights about the fundamental nature of problem-solving for public policy, as Brown is already doing. Ill-structured problems lend themselves to the application of pre-packaged solution sets that participants bring to the problem-solving enterprise. We know too little about how this process works, and the experimental method of Fernandes and Simon, and Brown, are capable of isolating the components of the process. Applications of these insights to organizational and field studies can follow.

An appreciation of the basic principles of bounded rationality and behavioral choice will lead to a firmer scientific basis for the study of public policy. Only an incomplete and immature science can rest on an unrealistic micro-foundation, as rational analysis requires. Herbert A. Simon was a crucial figure in the

development of a sound basis for the study of human choice, and by 1958 the outlines of this model were fundamentally complete. We have made great progress in understanding human choice and its implications for the study of public policy since then, but the 'rational choice controversy' has continued to plague social science. As Herb Simon did beginning in 1945 until his death in 2001, I continue to advocate a solid behavioral base for the analysis of political and economic systems.

Notes

1. I appreciate comments from Frank Baumgartner, Steve Brown, Jon Mercer, Tracy Sulkin, and Jim True.
2. Of course it may not be clear at any point in time what will be necessary for such an enterprise in the future. The best we can do is to keep the extraneous details to a minimum lest we fall back on thick description.
3. My thanks to Fred Thompson for drawing this link.
4. *Mind and Society* is a monumental and comprehensive work, oftentimes ponderous and intimidating. *Administrative Behavior* is direct and accessible. The nature of the vehicle can promote the idea.
5. Wildavsky 1964 relied in part on data from Fenno later published in 1966. In his intro (1966: xxiv), Fenno describes all of the major organizational changes that had been eliminated from his data set. Incorporating these changes implies a far different budgeting process.
6. Padgett's work on budgeting was both based in organizational processes and developed a decisional mechanism that implied not-solely-incremental budgetary outputs. These insights did not result in further understanding of the bounded rationality base of budgeting for a decade and a half, testimony to the lags in adaptation in the research enterprise.

References

Baumgartner, F. R. and B. D. Jones (1993). *Agendas and Instability in American Politics*. Chicago: University of Chicago Press.

Brown, S. R. (2001). 'Structural and functional information: A cautionary note to Fernandes and Simon.' New Haven Connecticut: Paper presented at the annual meeting of the Society for the Policy Sciences.

Carpenter, D. (1996). 'Adaptive signal processing, hierarchy, and budgetary control in federal regulation,' *American Political Science Review* 90: 283–302.

Cohen, M., J. G. March and J. Olsen (1972). 'A garbage can model of organizational choice,' *Administrative Science Quarterly* 17: 1–25.

Fenno, R. (1966). *The Power of the Purse*. Boston: Little, Brown.

Fernandes, R. and H. A. Simon (1999). 'A study of how individuals solve complex and Ill-structured problems,' *Policy Sciences* 32: 225–245.

Fiske, S. and S. Taylor (1991). *Social Cognition.* New York: McGraw-Hill.

Friedman, J. (1996). 'Economic approaches to politics,' in J. Friedman, ed., *The Rational Choice Controversy.* New Haven: Yale University Press.

Frolich, N. and J. Oppenheimer (2000). 'How people reason about ethics,' in A. Lupia, M. D. McCubbins and S. L. Popkin, eds., *Elements of Reason*. Cambridge: Cambridge University Press.

Green, M. T. and F. Thompson (2001). In J. Bartle, ed., *Research in Public Administration: Evolving Theories of Budgeting.* San Francisco: JAI Press.
Hammond, T. and G. J. Miller (1987). 'The core of the constitution,' *American Political Science Review* 81: 1155–1174.
John, P., H. Margetts and D. Gilbert (2001). 'Rollercoaster budgeting in the U.K.: Fluctuations and equilibria in U.K. Central Government Programme Expenditures since 1945.' Kent, U.K.: Paper Presented to the European Consortium for Political Research.
Jones, B. D. (2001). *Politics and the Architecture of Choice*. Chicago: University of Chicago.
Jones, B. D. (1994). *Reconceiving Decision-Making in Democratic Politics.* Chicago: University of Chicago Press.
Jones, B. D., F. R. Baumgartner and J. L. True (1996). 'The shape of change: Punctuations and stability in U.S. budgeting, 1947–94.' Paper presented at the Annual Meeting of The Midwest Political Science Association Chicago, Illinois.
Jones, B. D, F. R. Baumgartner and J. L. True (1998). 'Policy punctuations: U.S. budget authority, 1947–95,' *Journal of Politics* 60: 1–30.
Jones, B. D. and L. W. Bachelor (1993). *The Sustaining Hand, Second Edition Revised.* Lawrence, Kansas: University Press of Kansas.
Jones, B.D., T. Sulkin and H. Larsen (2002). 'Policy Punctuations in American Political Institutions,' *American Political Science Review*. In press.
Jordan, M. (2001). *Punctuations and Priorities: Local Government Expenditures.* Little Rock: Institute of Government, University of Arkansas at Little Rock.
Kahneman, D. and A. Tversky (1979). 'Prospect theory: An analysis of decision-making under risk,' *Econometrica* 47: 263–291.
Kuklinski, J. and P. Quirk (2000). 'Reconsidering the rational public; Cognition, heuristics, and mass opinion,' in A. Lupia, M. D. McCubbins and S. L. Popkin, eds., *Elements of Reason*. Cambridge: Cambridge University Press.
Lupia, A., M. D. McCubbins and S. L. Popkin (2000). 'Beyond rationality: Reason and the study of politics,' in A. Lupia, M. D. McCubbins and S. L. Popkin, eds., *Elements of Reason*. Cambridge: Cambridge University Press.
Mandelbrot, B. (1997). *Fractals and Scaling in Finance*. New York: Springer.
March, J. (1994). *A Primer on Decision-Making.* New York: The Free Press.
March, J. and H. A. Simon (1958). *Organizations.* New York: John Wiley.
Newell, A. (1990). *Unified Theories of Cognition.* Cambridge, MA: Harvard University Press.
Newell, A. and H. A. Simon (1972). *Human Problem Solving*. Englewood Cliffs, NJ: Prentice-Hall.
Padgett, J. F. (1980). 'Bounded rationality in budgetary research,' *American Political Science Review* 74: 354–372.
Padgett, J. (1981). 'Hierarchy and ecological control in federal budgetary decision making,' *American Journal of Sociology* 87: 75–128.
Simon, H. A. (1947). *Administrative Behavior.* New York: Macmillan.
Simon, H. A. (1957). *Models of Man*. New York: Wiley.
Simon, H. A. (1977). 'The logic of heuristic decision-making,' in R. S. Cohen and M. W. Wartofsky, eds., *Models of Discovery.* Boston: D. Reidel.
Simon, H A. (1979). 'Rational decision-making in business organizations,' *American Economic Review* 69: 495–501.
Simon, H. A. (1983). *Reason in Human Affairs.* Stanford CA: Stanford University Press.
Simon, H. A. (1985). 'Human nature in politics: The dialogue of psychology with political science,' *American Political Science Review* 79: 293–304.
Simon, H. A. (1989). *Models of Thought, Volume II*. New Haven: Yale University Press.
Simon, H. A. (1990). 'A mechanism for social selection and successful altruism,' *Science* 250: 1665–1668.
Simon, H. A. (1993). 'Altruism and economics,' *American Economic Review* 83: 151–161.
Simon, H. A. (1995). 'Rationality in political behavior,' *Political Psychology* 16: 45–61.
Simon, H. A. (1996a). *Models of My Life, MIT Edition.* Cambridge, MA: The MIT Press.

Simon, H. A. (1996b). *The Sciences of the Artificial, Third Edition.* Cambridge, MA: The MIT Press.
Sornette, D. (2000). *Critical Phenomena in Natural Sciences*. Berlin: Springer.
Tetlock, P. (2000). 'Coping with trade-offs: Psychological constraints and political implications,' in A. Lupia, M. D. McCubbins and S. L. Popkin, eds., *Elements of Reason*. Cambridge: Cambridge University Press.
True, J. L. (2000). 'Avalanches and incrementalism: Making policy and budgets in the United States,' *American Review of Public Administration* 30: 3–18.
Wildavsky, A. (1964). *The Politics of the Budgetary Process.* Boston: Little, Brown.