The unsatisfactoriness of satisficing: from bounded rationality to innovative rationality*

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Traditional theory allows for uncertainty in the form of risk or random shocks, without altering the form of the problem of rational choice. Theories of bounded rationality introduce genuine constraints upon the chooser, such as limitations upon the chooser’s processing capabilities relative to the complexity of the problem. Three analyses in this newer tradition are examined here (Heiner, Nelson and Winter, and Simon). All three tend to conclude that complexity will engender behaviour governed by rules and routines. This leaves us short of a theory to account for changes in the routines themselves. The paper shows how a learning procedure must be introduced which renders the process of change endogenous. Rationality in this context must involve search activity which is linked to the recognition of a problem situation and ends up enlarging the set of possible alternative solutions.

1 Introduction

The crucial issue for any theory of decision and choice is how to model the impact of uncertainty on behaviour, while allowing to agents’ an ability to learn and to adapt. Recent models of choice – those having a common reference to the notion of bounded rationality – try to show how the presence of uncertainty strongly alters individual decision rules. In these models uncertainty arises because the subjective computational abilities of agents are limited and partial when compared with the complexity of a changing environment. Under these circumstances the individual’s response consists in restricting the process of choice to simple behavioural rules.

This way of representing choice is contrapositely to the standard one, where uncertainty does not seem to really affect choice. In fact, if uncertainty takes the form of unpredictable exogenous shocks, it is modelled by introducing uncorrelated error terms. If uncertainty, on the other hand, is represented as risk, what is required is a more complex kind of behaviour, involving increasing skills of computation and of detecting information. In either case

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uncertainty does not alter the way choice is portrayed. The structure of behaviour remains based on the formally unchanged optimization rule (in the second case, even more strengthened).

In the recent alternative ways of representing choice the role, but also the meaning of uncertainty, has clearly changed. The uncertainty does not belong any more to a supposed nature of the environment but to the chooser. In the new framework in fact uncertainty captures the perceived difficulty of processing information, decoding signals, framing problems, decomposing complex systems.

Thus we have in these models a new sense of uncertainty introduced, different from the dual possibility that uncertainty stems from unpredictability or from risk. This is an important contribution, rich in potential implications. Consider the already substantial array of attempts to endogenize uncertainty and formalize the individual and social behavioural rules that emerge from the interaction of environmental complexity and computational insufficiency. Examples here include the new institutional theory, and in particular, analyses of strategic behaviour linked to the emergence of norms and other institutions (Schotter, 1981); evolutionary models applied to economic change and organizations; and some of the psychological literature on heuristic processes (Kahneman et al., 1982).

In this article I select three exemplars of this already vast and increasing literature, the work of Heiner, Nelson and Winter, and Simon. Despite differing standpoints and purposes, the three analyses have in common that uncertainty in the new sense specified above directly engenders rules and routinized behaviour. Rules, habits, routines are the behavioural responses by which the complexity of choice is handled. As already noted, the perspectives opened up by these complementary explanations are important, challenging the old optimization rule with different, uncertainty-driven rules of behaviour. Nonetheless, there is a problem with these explanations. If the perceived uncertainty related to complex environmental change can explain routines, routines for their part cannot explain change. In other words, how routines themselves change, how new rules emerge, remains completely outside these analyses. This kind of change, however, has been explored. It is the Schumpeterian innovative change, which emerges 'from within' and not from an unexplained external motor. What search processes activate and discover is precisely this internal change. In this different perspective therefore uncertainty becomes, positively, the source of innovation and change and not only, negatively, a source of limiting behavioural rules.

All the models we refer to show an internal struggle in trying to cope with this kind of endogenous change. While they emphasize the importance of search activity, the routinized result of searches which they posit directs

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1 Examples of evolutionary models are to be found in Day and Eliasson, 1986. Useful analyses from among the burgeoning organizational literature are in Morgan, 1986.
attention to a permanent aspect of behaviour rather than to its change. The solution in fact usually consists of invoking an otherwise unexplained exogenous change as the source of changing routines: just because routines are a self-perpetuating form of behaviour, they can change only exogenously.

By reformulating the sequence of the search process explicitly in terms of learning procedures and problem-solving situations we can begin to see how this endogenous change may be handled. Along these lines many interesting suggestions and examples are to be found in the literature on learning and organizations (see, for example, the holographic approach to organizations and the newer literature on self referential systems as is discussed in Morgan (1986), and Loasby's original contributions to the analysis of decision procedures (1976; 1986)).

I shall return to this later in the paper. First we focus on our three chosen exemplars within the bounded rationality tradition starting with Heiner. His theory of routinized behaviour will then be contrasted with the endogenous innovation approach of Schumpeter. Nelson and Winter may be seen as trying to provide a possible synthesis of routines and innovative change. Their work is examined in Section IV. A comparison with Simon (Section V) shows, however, that a deeper analysis of a search process must be undertaken. Some suggestions toward that end are made in the final section.

II A theory of constrained behaviour

Heiner's thesis is the following. 'Uncertainty' exists because individual competence and perceptual abilities cannot entirely cope with the processes of rightly interpreting information and selecting potential actions (1983: 585). Even when information is complete, therefore, there still remains the problem of correctly responding to it (see for example Heiner, 1988a: 30).²

In order to reduce this gap between the agent's competence and the 'difficulty of decision' (what Heiner calls the C-D gap), standard choice theory simply assumes a perfect ability on the part of the agent to respond to the available information. By providing individuals with the most sophisticated learning procedures and probability adjustment processes, the behavioural uncertainty is removed and encapsulated in an innocuous stochastic 'error' term. In this way the theory in fact makes behaviour deterministic and therefore perfectly predictable. Heiner's critique overturns

² Hodgson correctly stresses that information problems are not simply those connected with its scarcity, as is typically held. More often the problem is that of an overload of information, of an excess of sense data: '...rationality is not simply "bounded" in the sense that there is too little information upon which reason can be based, but also that there is too much information to compute or to assess'. (1986: 81, 108–109).
this argument (1983: 569–70). Perfect ability to respond to information does not improve predictability of behaviour, rather it seems to reduce it. Examples of decision-making problems, such as the prisoner’s dilemma, Rubic’s cube, Simon’s studies on heuristic processes (and their simulation by digital computer), show that the best performances derive from those strategies that specify more restricted behavioural rules, rather than from those that infinitely amplify the individual’s prediction abilities. These examples show in fact that it is not simply from a lack of information, but from an inability to decipher and decode heterogeneous and complex signals that the difficulty of selecting an optimal course of action arises.

The ‘simple analytical engine’ that Heiner constructs to investigate the problem of the C-D gap (1983: 75) is based on the concept of a ‘reliability condition’ combined with the principles suggested by psychological studies of detection skills and cognitive tasks.

The intuition behind this approach is that agents who are not fully competent to always select preferred actions (i.e. who are not able to maximize in the traditional sense) may consequently not be sufficiently reliable to benefit from selecting successively more actions. This will tend to restrict agents to smaller repertoires, with resulting behavioural patterns that are simpler than if all potentially optimal actions could be correctly chosen. In this way, regularities manifested in behaviour are indirectly generated by uncertainty that limits the reliability of selecting potential actions (1973: 72).

In short, increases in uncertainty, i.e., increases in the complexity of the environment or decreases in agents’ perceptual abilities, or both, will decrease the range of reliable possible actions. This causes a decrease in the flexibility of behaviour in a direction that is thus quantitatively predictable.

This analytical engine, Heiner argues, may be applied simply and efficaciously to reformulate many traditional economic problems, such as the law of demand; supply behaviour in production theory; or lagged reactions and imperfect responses (Heiner, 1988b); or even restrictive moral rules (Heiner, 1989). The result, he says (1989: 23) is ‘to extend existing theory so that optimal decision rules become limiting cases within a larger set of behavioural possibilities’.

The nub of the matter, then, is this. If in the standard theory of choice objective difficulties of decision are simply transferred and solved via a supposed increase in the agent’s subjective power of computation, in Heiner the same difficulties are given as the reason for restrictions on behaviour. Moreover, if the uncertainty factors that standard theory places in the stochastic ‘error’ terms play no role in explaining choice, in Heiner the same

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3 in the game of chess, as in Rubic’s cube, it is possible in principle ‘to exhibit every possible sequence of moves on a gigantic decision tree’. Nonetheless ‘... a detailed consideration of a small number of moves selected by informal judgement is more effective than an attempt to evaluate every possible move’. (Loasby, 1976: 42).
factors are responsible for producing behavioural regularities. Finally, while constrained behavioural rules are for Heiner at the basis of predictable patterns of behaviour, the traditional supposed ability of agents to respond with perfect flexibility to information will, as he sees it, tend to produce systematic deviations from these patterns.

What are the limitations of this ingenious and challenging construction? We anticipate two, postponing a more complete analysis to our examination of the models of bounded rationality with which Heiner shares many analytical assumptions.

We have seen in the standard theory of choice and in Heiner's alternative that the behavioural hypotheses are quite opposed. But, despite this opposition, the framework within which choice is conceived is exactly the same. In both cases in fact actors are seen as simply reacting to given external constraints. These constraints, in the form of environmental complexities or limited computational capabilities, are the real motor of individual choice as well as of its changes. People's behaviour simply responds to different environmental settings (Heiner, 1985: 263), either with the the best or something less than the best adaptation.

Heiner's tacit adoption of the traditional framework of choice prevents him from analysing the active role of search activity and confines his attention only to the negative role of the complexity of decisions. Uncertainty activates only defensive, constrained responses: how to prevent, how to minimize errors by constructing limiting rules, is the only aspect of choice he analyses.

Thus the sense in which choice implies search activity and a learning procedure is absent from Heiner's analysis, even if his mention of some feedback mechanism in choice (1985: 263) may suggest the presence of some kind of learning process (see also Heiner, 1989: 27). But if we try to introduce a learning procedure in Heiner's model we are faced with two possibly paradoxical results.

On the one hand, the introduction of learning may mean the improvement of individual perceptual abilities, an increase in the reliability condition and an increase in the flexibility of behaviour. Through learning therefore, agents in Heiner's own model may reach or approximate the same optimal solution that is otherwise rejected.

On the other hand, Heiner clearly stresses that more flexibility in responding to perturbations in the environment does not facilitate improved performance in choice and does not produce easily recognizable patterns (1983: 562). The result of introducing learning thus may be, either an increasing individual inability to choose, or an increasing rigidity in behaviour.

We may escape these conclusions only by clarifying the role played by learning and the possible changes that learning activates. Solving problems through learning may imply exploring new opportunities and modifying the
given set of difficulties. Learning therefore may enlarge the range of possible alternatives rather than restricting them. We will see how search problems may be analysed when we turn to Simon; but the real precursor of the view that behaviour may actively exploit unexplored possibilities and create new frontiers of action is Schumpeter.

III Innovative change

1 Endogenous change

Schumpeter distinguishes between two kinds of change. One is the continuous, imperceptible change that characterizes economic life in its 'circular flow', in its tendency towards an equilibrium. Like the circulation of the blood, the 'circular flow' runs on in channels that are essentially the same year after year, always within the same framework. But there are also changes which involve a change of the framework, of the traditional course itself. They '... cannot be understood by means of any analysis of the circular flow, although they are purely economic and although their explanation is obviously among the tasks of pure theory' (Schumpeter, 1934: 61).

This second kind of change on which, for Schumpeter, the evolutionary character of the economic process is dependent, is not due merely to changes in the social and natural environment. Those changes, such as wars and revolutions, or the quasi-automatic increase in population, or the vagaries of the monetary system, often condition industrial change, but they are not its prime movers. The fundamental impulse 'that sets and keeps the capitalistic engine in motion' and 'incessantly revolutionizes' the economic structure, comes from within, not from without (Schumpeter, 1950: 82).

So we have, in Schumpeter:

1) a mechanism of economic change conceived not as continuous change in the data of static theory, but as discontinuous, revolutionary, innovative change;
2) a mechanism that is endogenous, not exogenous;
3) a strong result, namely that the lack of a solution to the problem of change means a lack of understanding of the very mechanism of economic development.

2 The new combinations

This internal source of development consists in the carrying out of new combinations: new goods, new methods of production, new markets, new

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4 As an aside, we might note that the literary example Heiner offers of constrained behaviour - Ulysses voluntarily binding himself to prevent the temptation of the sirens (1983: 573) - strangely seems to prove the opposite of his thesis. Ulysses constrains himself in the presence of the known temptation in order to be free to explore the unknown world, to follow 'virtue and knowledge'.
sources of supply, new organization. 'Enterprise' and 'entrepreneurs' are the levers of these newly discovered combinations. They do not exist in the circular flow, where there is neither profit nor loss.

But why is the carrying out of new combinations a special process and the object of a special kind of 'function'? Schumpeter's answer relies on a sharp distinction between the routines which channel the circular flow and the new structures arising from within. This is where entrepreneurship comes in, where true leadership plays a role (1950: 84).

The ability of the entrepreneur to discover and exploit opportunities is based on 'values' and motivations that are the opposite of the traditional, 'utilitarian' ones:

In one sense, he [the entrepreneur] may be called the most rational and the most egoistical of all. For, as we have seen, conscious rationality enters much more into the carrying out of new plans ... than into the mere running of an established business, which is largely a matter of routine. And the typical entrepreneur is more self-centred than other types, because he relies less than they do on tradition and connection and because his characteristic task ... consists precisely in breaking up old, and creating new, traditions (1950: 91-92).

But he is rational in no other sense. In no sense is his motivation of the hedonistic kind. Hedonistically, his conduct would be irrational. He 'does not seem to verify the picture of economic man balancing probable results against disutility of effort and reaching in due course a point of equilibrium beyond which he is not willing to go. Effort, in our case, does not seem to weigh at all in the sense of being felt as a reason to stop' (p. 92). And his motivations - the will to conquer, the impulse to fight, the joy of creating, of getting things done, or simply of exercising one's energy and ingenuity, seeking out difficulties, changing in order to change, delighting in ventures - are most distinctly anti-hedonistic motivations (pp. 93-94) (unless we make wants include any impulse whatsoever, reducing our definition to tautology (p. 92)).

In Schumpeter, then, the endogenous mechanism of change and innovation is tightly linked to the role of the entrepreneur and his ability to exploit unexplored alternatives and create new solutions. He transforms uncertainty due to new opportunities into a source of profits, discovering new ways of producing goods, enlarging and developing the old pattern of production. Through this economic figure, uncertainty is no more a 'noise' in the regular economic flow, or simply the source of new 'regularities', but represents the very spring of economic change. In this sense uncertainty is not just a difficulty impinging on choice, it actually plays a positive role.

5 The additional induced change produced by a new or improved product, or technology, flowing across industry boundaries, is analysed and exemplified by Scherer in his flows matrix applied to the USA (1984: 32 ff).
In the same way Schumpeter clearly sees how in this searching behaviour the laws of traditional rationality are reversed: they are not simply temporarily suspended or weakened in restricted behavioural rules, but transformed in an active exploration of new solutions which endogenously change the givens.

We may note however that despite Schumpeter's insistence on an endogenous mechanism, the way in which innovations really manifest themselves is not explained. They start where the boundaries of routine stop, when former accustomed activities become obsolete, and the will and action of the entrepreneur may exercise their creative powers. But we do not know, nor we are able to reconstruct, this shift of behaviour from routine to innovation. We do not know when this outsider, this newcomer makes his innovative contribution. The conditions of this contribution remain external, temporary, episodic.

Even the internal mechanism of innovation is difficult to reconstruct. It relies on a particular individual function, on a psychological virtue, whose subjectivity makes it difficult to analyse and predict. And in fact when this function loses its importance in the social process - because economic progress tends to become depersonalized and automatized or because innovation itself is reduced to routine - then the process of innovation ceases or is undermined (as Schumpeter shows in his Capitalism, socialism and democracy, 1950).

Change, then, starts from within, but only by chance. It is endogenous, but can appear only spontaneously, casually. So, the distinction between endogenous and exogenous change, even if it is drawn, is not clear, and the move from a routinized, conservative situation where no change at all occurs to an innovative one is left unexplored.

Only by linking this innovative process to the more general features of search and learning activities are we likely to be able to reconstruct 'internally', as was Schumpeter's intention, this process of change.

IV An evolutionary theory of change

Nelson and Winter share and develop the Schumpeterian view of economic change as an endogenous breach of equilibrium conditions. Their effort consists in modeling the external conditions that permit, or inhibit, this internal change and consequently in reconstructing the processes that link 'changes in firm decision rules and procedures (including productive techniques) to a changing economic environment' (Nelson and Winter, 1982: 36).

The dynamics of the internal adjustment to the changing external conditions is described as an evolutionary selection process whose 'organizational genetics' (1982: 135) is based on the routinized behaviour of the firms. The selective response and adaptation of the firms consists in fact in con-
structuring, developing and transmitting routines (diachronically, through ‘genetic inheritance’ and synchronically, through imitation).

Routines are conceived as the targets and components that operate to channel the organizational change; they constitute memory and specific operational knowledge: they may engender truce (1982: 98 ff.). Routines store and facilitate the diffusion of information and help co-ordinate actions. Much of the knowledge that is embedded in rules is tacit, not consciously known nor articulable (1982: 134). Information of this sort does not run in codifiable channels.

Routines thus inform the process of developing and adopting new routines (heuristics, or routines as strategies). In this way innovations, changes of routines, may be incorporated in the pattern of rules and behavioural processes that form the organizational structure of the firm, the opposition between change and sameness being attenuated in a form of ‘routinized innovation’ (1982: 133).

This process of adapting routines is opposed to the optimal behavioural rule of the standard theory of choice. The formation of routines, in fact, captures the objective difficulty of coping with a complex reality (diversity of firms, nature of time, information costs) as well as with the limited subjective computation capabilities of firms. The rational action rule is contracted from an unbounded maximization to a profit-seeking, satisficing behaviour (1982: 31; see also Nelson and Winter, 1974). Consequently, the range of possible actions is restricted to specific, limited, socially transmitted skills.

The models Nelson and Winter build try to generate empirical correlations between the external conditions (market structure, technological regimes, firm size) and the internal behavioural structure of firms. The results of their simulation models show the responses in technique changes and investment decisions to profit signals activated by exogenous changes (1982: 227; cf. also Nelson, 1986: 149). At the same time the ‘search and selection’ evolutionary metaphor and the improbability of procedure assumption allow for a diversity and pluralism of responses (1982: 402; Winter, 1986).6

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6 Consider for example Winter (1986). In the paper it is proposed that Schumpeter’s two positions on innovation (1912; 1942) are associated with different technological regimes (the entrepreneurial and the routinized regime). These are obtained by postulating different parameter values concerning the ‘quality’ of external R&D. In the routinized regime the probability of successfully tapping this external R&D is much lower (because of the routinized behaviour of the large firms), but the benefits of a successful ‘draw’ are correspondingly higher (because of the high barriers to entry and the presence of secrecy and patent protection). This implies that the routinized regime has lower prices, higher output and higher R&D expenditures. Moreover, in the entrepreneurial regime adopted innovations associated with new entry outnumber those by established firms, whereas in the routinized regime the numbers of new-entry innovations are very low (because of the incremental innovation process of the routinized regime); for the same reasons the routinized regime generates more innovative policies among firms than does the entrepreneurial regime (Winter, 1986: 221).

The great diversity of technological progress and industrial development is therefore a reflection of the underlying system of knowledge sources that feed the progress (1986: 228).
The importance of this empirical exploration is that it offers new factual evidence on the external conditions of inventing (Nelson, 1981), but the structure within which this relationship takes place is similar to the traditional one. In this analysis, in fact, the problem of explaining the mechanism of endogenous change is shifted to the problem of describing routinized adaptation to an exogenous change. Even if this process of adaptation now incorporates a (probabilistic) chance of innovative behaviour, of changing rules, the analysis of the sequence of innovation, of the learning and decisional pattern of the firm, being conditional upon the appearance of an exogenous change, is left unexplored. Better put, the sequence is restricted to the mechanism of profit-seeking responses to the exogenous changes in a way predetermined by the ‘genetic’ code and via imitation (Nelson and Winter, 1982: 149, 211).

Strangely enough, while understanding change is the central point of this analysis, the result turns out to be an analysis of rules of how to prevent, structure and channel change and novelties. Also, the strong Schumpeterian intuition of enterprises actively searching for new solutions is lost in this world of predictable routines, or, rather, of given probabilities of tapping new routines.

This is not to undervalue the importance and the role of routines. Rules may be regarded as the organizational structure of a search activity, the ordering selective process of a problem-solving activity. But the search process itself is nonroutine. It starts with a break, a crisis, a failure of organized solutions. It activates a process of discovery of tentative new solutions, and it is this process that it is crucial to reconstruct if change is be understood.

Routines do not exhaust the range of a firm’s behaviour. They represent only the conservative, economizing aspect of this behaviour, so that the main selective effort can be devoted to problem-solving activity. But it is this decision process that must be reconstructed in order to analyse change.

The strongest effort to address this is Simon’s, whose view of computationally bounded rationality is strictly linked to the problem of understanding procedures for reaching rational decisions.

V Bounded rationality

In the analysis of Nelson and Winter and in that of Heiner we have seen that the perceived environmental difficulties involve subjective constraints...

*The theoretical problem with this model is that the learning procedures connected with discoveries and problem-solving activities are absent. Probably, once introduced, many of the data would become endogenous variables and the distinction between the two regimes would be less stringent (see, for example, how ‘learning externalities’ involved in R&D may affect the technological opportunities, as shown by Von Hiengem-Sternberg in his comment of Winter’s article – 1986: 239).*
on behaviour. This form of constrained behaviour is what Simon has called subjective or bounded rationality. For Simon theories of bounded rationality already exist in traditional economic theory. They can be constructed by modifying the classical assumptions of the theory of choice in a variety of ways: by altering the nature of the constraints (risk and uncertainty can be introduced in the demand and cost functions); by altering the nature of the given conditions (the alternatives may be assumed to be incompletely known); or by altering the nature of the given goals (goals different from the classical goal of maximization may be postulated).

Expected utility theory, search theories, monopoly theories are the consequences of these new boundaries added to the classical constraints on choice. These alternative ways of constraining rational behaviour mostly locate the new constraints in the environment, outside the 'skin' of the rational actor (Simon, 1972: 409), in the form of probability distributions of unknown events, limits upon and costs of information. In this way they 'do nothing to alleviate the computational complexities facing the decision maker...but simply magnify and multiply them' (Simon, 1979: 504) by requiring an increased effort to control a (still) more complex environment.

The theory of bounded rationality that Simon constructs, by contrast, incorporates the constraints in the very information-processing and computing capabilities of the actor. The hypothesis of bounded rationality in fact claims, as Heiner later reasserted, that human computation skills are too limited compared to the difficulty of the perceived environment – the innumerable variables and information to which the actors might attend (Simon, 1986: 34).

Under conditions of bounded rationality it is the process of choice which becomes relevant. Search processes and selecting activities are the new required skills (Simon, 1978a: 2; 1976).

Simon distinguishes two kinds of decision processes: 'programmed' and 'nonprogrammed' decisions. (This distinction, Simon reminds us, is analogous to the distinction between 'habitual' behaviour and 'genuine' decisions made by Katona, or between 'routine' and 'critical' decisions made by Selznik (Simon, 1958: 380). (It is recurrent, we may add, in all the analyses we have referred to.)

Programmed decision making is decision making in the context of a fixed and specified frame of reference, with alternatives given in advance and with

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7 Thus, as Simon clearly puts it: 'the domains where a theory of computation, normative or descriptive, is likely to prove useful are the domains that are too complex, too full of uncertainty, too rapidly changing to permit the objectively optimal actions to be discovered and implemented' (1978b: 504).

8 The corresponding idea that choices are optimal or nearly so in a steady or immutable world, and that choices are not optimal in a world of discontinuous changes, is also widely held (see, for example, Winston, 1982). This distinction holds only if choices are seen as simply reflecting the external environment.
known (or probabilistically known) connections between alternatives and their consequences. The classical theory of the firm is, for Simon, a good example of rational programmed decision making, even if, as he notes, also in such a simple economic model as this a number of simplifying assumptions have to be made in order to bring the problem within the bounds of practical solvability.

In the nonprogrammed decision on the other hand, where the alternatives are not given in advance, and where the means-ends connection is not known, a search process must be activated to discover the new alternatives and in order to explore the consequences of choices.

Nonprogrammed decisions in fact are those characterized: 1) by a search process which is highly unsystematic and nonexhaustive; and 2) by an unsystematic change of 'set', i.e., by a sudden switch from one frame of reference (or set) to another.

Given Simon's dual characterization of choices the crucial question is the following: when do actors shift from a determinate framework of choice to another one? In other words, the problem is to determine when the search process becomes operative, when the new alternatives must be discovered, when the world is perceived as being so complex that a selective activity is required. This also amounts to answering the question of why actors do not remain within the limits of their habitual behaviour. The problem is that of Schumpeter - habits become dragchains; what was formerly a help becomes a hindrance (Schumpeter, 1934: 80, 88).

A first answer Simon gives to his own question follows immediately from the previous analysis. A nonprogrammed decision is required when the external situation presents a genuine novelty. In this situation, characterized, for example, by exogenous shocks, we can imagine that the previous ranking of alternatives changes or becomes obsolete, the consequences of choice become less predictable, the complexity of the variables to control grows. In all these cases search activities must be initiated.

A second answer is related to what Simon calls 'aspiration level'. A search for a new concrete alternative to replace the old one is involved when the result the decision maker expects from a course of action is inferior to his aspiration level. A search for a new programme is initiated by 'the failure of the current one to satisfy aspirations' (Simon, 1958: 397).

Aspirations are expectations of the result of an action that can be reasonably attained (1958: 399). Contrary to the optimization hypothesis aspirations are not formed on the basis of a complete evaluation of all the possible alternatives. 'Indeed their principal usefulness lies in the fact that they remove the necessity for such evaluations until the failures of existing programs indicate the need for innovations' (1958: 399). The innovation process, then, represents the discovery of new programmes that can be regarded as good enough, as satisfactorily compatible with aspirations.

In his first answer Simon simply shifts the problem of when to begin a
search onto the emergence of an unexplained exogenous event. Through this second one he achieves the important result of analysing the very steps and sequences of search activity. Starting with the failure of the existing programmes to offer good solutions and a perceived need to discover new ones, the search process stops when a new satisfactory solution is found (Simon, 1979: 503). This result is relevant and new because through it Simon enters into and reconstructs the mechanism of choice, its selective activity, its looking for new alternatives. This mechanism produces change, a theoretical result that Simon shares with Schumpeter and ‘his domain of long term dynamics’ (search for new products and new marketing strategies – see Simon, 1978b: 505).

But there is a double difficulty in this second answer. The first lies in the concept of aspiration level. Even if it is described as not static, but changing with the environment (1979: 503), this behavioural feature remains difficult to define and to detect. It retains many of the psychological characteristics of the optimality principle it supplants and runs the same risk of being tautologous. Moreover, and more importantly, as long as search activity is involved, it suggests that, once the desired level of satisfaction has been reached, the process of search may be considered concluded until a new exogenous change and a new element of complexity in choice intervenes. Finally, the reference to subjective levels of aspirations does not seem strictly necessary. As we shall see in a moment, once choice is well specified as a process, as a search and selection of new alternatives, through error correction and the finding of tentative solutions, there is no more need to invoke assumptions about psychological motivations, drives and scales of preferences.

A second difficulty lies in the distinction Simon draws between routinized and nonroutinized behaviour (between programmed and nonprogrammed actions). This distinction, which is an assumption that all the analyses we have looked at accept without question, suggests and reinforces the idea that satisficing behaviour – the search process, the innovative solution are activities present only in extraordinary, exceptional circumstances. Why marginalize search in this way? Is it not part of choice under all circumstances?

VI Constrained versus maximized behaviour

At this point it may be helpful to summarize the contrasts we have uncovered.

The theories of constrained behaviour we have analysed utilize a concept of uncertainty whose role and meaning in the process of choice is rather different from the traditional one. While traditionally uncertainty represents

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9 As is shown in Newell and Simon, 1972.
the 'environmental' unpredictability of choice in the sense both of probabilistic and of stochastic uncertainty, here uncertainty represents the limited ability of the individual to comprehend and act in an unstable environment; it is the indecipherable complexity of all the possible alternatives and consequences of a decision problem; it is the difficulty of rightly selecting potential actions (on which see Rutherford, 1988).

This shift of meaning implies that uncertainty is internal to the choice problem, it is another way of defining the difficulty of choosing. It arises when choice arises, it becomes relevant whenever a decision process is involved. Hence we may properly call this uncertainty endogenous.\textsuperscript{10}

From this different representation of uncertainty there results a different view of the process of choosing. In the standard theory, choice proceeds from exogenous, known (or probabilistically known) constraints to the unique optimal solution, through a free, unbounded, maximization process (with the stochastic 'error' term capturing the casual exogenous shocks). By contrast, in this alternative view, choice proceeds from endogenous, complex and not completely known constraints, to a range of suboptimal solutions (satisficing solutions). The process is one of selection and ends in behavioural rules, habits, norms. Errors here begin to play a substantial, not a merely nominal, role.

The effects on behaviour too are different. In the standard theory the presence of environmental uncertainty simply requires agents to display an enhanced computational ability. In the alternative approach, perceived uncertainty goes together with a recognition of limited computational skills and restricted rules of behaviour.

But in the two constructions there are similarities too. Both solutions in fact refer to uncertainty as a negative event (cf, noise, constraints). In both cases action and choice are conceived uniquely as a process of reducing this negative uncertainty (successfully in the traditional theory, partially successfully in the theory of bounded rationality and its counterparts). Thus, even if the process of adaptation to the given conditions of uncertainty is different, the framework within which this process acts seems to be the same. It consists of finding the best solution, or the solution that is good enough, compatible with given conditions. In both cases the solution represents also the end of the search process, of the process of adaptation, until a new perceived event or a change in the aspiration level, any of which may change the starting conditions, activates a new search activity.

In the case of the alternative views we have seen that, the given conditions being different, the search process plays a different and more decisive role. But we cannot escape the impression that this process remains episodic, nonsystematic, conditional upon the appearance of an exogenous shock, and

\textsuperscript{10} For the difference between Simon and Muth, see Simon, 1979: 505.
is exhausted when the new shock is correctly channelled into the new rules. Not by chance this real search process is nonetheless always contraposed to a world of stability and repetitiveness where, the variables of choice being controllable and known, solutions would be optimal and search superfluous. Again, not by chance some critiques of bounded rationality have stressed substantial similarities between these two different views of choice (see, for example, Hodgson, 1986: 100).^{11}

These similarities, however, are often taken too far. Hahn, for example, tends to exploit them in order to reduce bounded rationality to a special case within the traditional framework. Simon’s aim, argues Hahn, is to enlarge the range of constraints upon choice, by including the time and effort spent in discovering the set of possible actions, or the trouble of self-scrutiny involved in identifying our own preferences. But after all ‘Simon’s argument gains what force it has by the existence of the pure theory which he finds wanting’ (Hahn, 1985: 15).

Hahn’s critique, for its part, has force as long as the choice process is represented as ending up only in routines: for then choice complexity may be translated into additional constraints. Similarly, if the search process is episodic, it may be regarded merely as a response to changed givens.

But the criticism is incorrect as long as satisficing behaviour is reformulated so as to emphasize the active role of search and its innovative character. Satisfactory solutions are inherently unstable, always open to challenge by some new, different or better solution. Satisfactory solutions have internal, ‘critical’ weaknesses and limitations; they are partial, subject to possible failures. How to discover, how to exploit, how to take advantage of this internal uncertainty in order to offer new solutions constitutes the true scope of search activity.

This carries an implication which has not been fully explored. Search activity does not need an external motor, an exogenous change, to be activated. It relies on the tentative, temporary character of a discovered new solution. It starts from the failure of an old solution to solve the problem for which it was advanced, and it temporarily stops when a new tentative solution is discovered. Hereby change becomes endogenous.

Once so reformulated the search process is not simply added to an already structured theory, but, by implying an endogenous change, changes the conditions of the theory itself. Search itself continuously modifies the givens.

Again, once so reformulated, the psychological framework of satisficing behaviour is no longer necessary and becomes redundant. In fact, a solution works or fails not because it matches, or does not, a psychological aspiration

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^{11} Hodgson, for example, argues that bounded rationality theory, like the traditional theory, retains the same rationalistic structure which proceeds through linear logical deductions from an individual’s premises and given knowledge to a set of outcomes (1986: 100).
level, but because it can or cannot cope with the problem to solve which it was advanced. Thus, the ability of a solution to prove itself a good solution is logical, not psychological.\textsuperscript{12}

\textbf{VII From a psychological to a logical theory of choice}

There are two points in the bounded rationality analyses we have referred to that are compelling. One is the idea that uncertainty is choice-related. That means that uncertainty does not simply lie outside in the changing environment, but it arises in connection with the selective activity of choice in the form of a perceived difficulty of choosing. Now we can add, and in so doing add precision, that this subjective difficulty does not simply lie inside the psychological or computational inabilities of the individual to cope with the complex environment; rather it arises in the form of a problem situation, unsolved questions, unexplored alternatives. Hence even if the complexity of the environment could be simplified (as in a hypothetical perennially stable environment) and the computational abilities improved (e.g., by the discovery of new computers), still problem-solving situations might arise, signalling the \textit{logically} temporary character of our solutions.

Uncertainty in fact arises as a break, a failure in the previous solutions to the choice problem. We do not know what to do on the basis of the old solutions. This is a signal that a selecting and searching activity must be activated in order to render choice possible. Uncertainty is the specific difficulty of a specific problem situation. In this form it endogenously affects choice.

A second point which it is interesting to stress is that a different process of choice results from this alternative perspective, a process in which not only rules and routines are formed but also active learning is stimulated. For the result of introducing uncertainty in choice is that we must learn from uncertainty, from errors; we must learn how to explore the weaknesses of the present solutions in order to suggest new, unperceived ones.

The idea, originally Schumpeter's, that the process of decision making involves essentially innovative behaviour has undergone recent important developments. Neo-Austrian economists such as Lachmann, and other theorists such as Shackleton and Bausor, all share, even if from different standpoints, the view that the choice process necessarily involves creativity. Historical time, the uniqueness of events, the irreversibility of choice are the ingredients that make choice refractory to any optimizing calculation and fundamentally unpredictable.\textsuperscript{13} The problem with these explanations of

\textsuperscript{12} Boland has stressed at length the importance of a logical reconstruction of the choice process. Still his analysis seems to stop at a methodological level rather than reconstructing the steps and results of the process itself.

\textsuperscript{13} As Shackleton points out (1984: 391), if economic theory 'could tell us what will take place, it would rob us of all claim to be, in the elemental sense, creatively original'. In the
choice in terms of imaginative search is that the positive relevance assigned to creativity is made completely unbounded and lawless, as well as unique and unpredictable. Knowledge is important but cannot be known.

By contrast, when search is represented explicitly in terms of learning, the openness and unending character of learning is retained but within a structure. Learning means the appearance of new possible solutions, but within the boundaries of the specific and concrete problem-solving situation within which it arises.

Interesting developments and suggestions in this direction may be found in Loasby (1976; 1986), as well as in the recent literature on organization which applies learning to the analysis of organizational structures.

Loasby's framework of 'partial ignorance' (1976: 9) is the basis of a choice process which must be logically preceded by a search for possible actions, but a search can start only if a problem is recognized. The analysis of the reference standards or models employed to detect a problem, to direct search, to evaluate choice, to implement and to appraise the result, gives us the criteria, as well as concrete directions in the several phases of this sequential decision process (1976: 96 ff).

The idea that organizations are complex communication systems is one of the basic issues of recent organizational analyses. In this framework, organizations are viewed as systems able to learn and to learn to learn ('double-loop' learning as opposed to the 'single-loop' learning of the more simple cybernetic systems (cf., for example, Argyris, 1982). They are able to detect and correct errors in operating norms and therefore change the rules and the standards that guide their actions. Reframing problems and changing reference standards become recognizable and important inherent elements of the decision process.

These final examples show the natural and unavoidable directions in which the introduction of learning processes into choice forces us. They open up the prospect of a useful shift from the study of bounded rationality to the study of rational innovativeness.

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irrepetible time's flow learning is powerless: '... the learning process is at all times eating its own heart' (1984: 392). Bausor, similarly, says: 'We may have sensory evidence and memory of the past, but only imagination of the future' (1986: 94; 1984).

'Uncertainty reduction may be the principal activity of both science and management; but it is uncertainty creation which provides the major opportunities for both' (Loasby, 1976: 103; see also Loasby, 1986: 52–53).

As Morgan says (1986: 90) '... highly sophisticated single-loop learning may actually serve to keep the organization in the wrong course, since people are unable ... to challenge underlying assumptions'. This kind of organization '... is rarely able to tolerate high levels of uncertainty'. On the problem of the levels of knowledge see also Watzlawick et al. (1967: 260).
VIII References


— 1986: The tension between process stories and equilibrium models:


