Towards Design Theory and expandable rationality : The unfinished program of Herbert Simon.[1]

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To be published in the *Journal of Management and Governance* 5:3-4 2002.

It is said that Herbert Simon would have described himself as follows : «*I am a monomaniac. What I am a monomaniac about is decision making* ». In spite of its shares of legend and humour, this self-portrait deeply reflects the main logic of Herbert Simon's works. From his early papers on administrative behaviour to his last investigations on thought and learning, Simon kept a same goal : to explain complex and mysterious human behaviour by simple and constrained, yet informed, decision rules. « Bounded rationality » was the name he gave to a research orientation[2] wich rejected the maximizing behaviour assumed by classic economics. But beyond this critical aim, Simon attempted to build an empirically grounded theory of human problem solving. A theory that was intended to settle the foundation stone of « behavioural economics ».

Problem solving also soon became the key entry to what he labeled a « science of the artificial » or a « Science of Design ». This *second program* took growing importance in connection with his own involvement in Artificial intelligence and cognitive psychology. Here one can be grateful to Simon's outstanding shrewdness and insight. Although there is now an increased awareness to innovation and growth processes, still few economists would spontaneously think that a good theory of Design is important for their own discipline.

Yet, Simon's attempts to develope a Design theory remain unfinished. I will discuss in this paper the two central reasons that support this point : i) Simon's always maintained that Design and creativity were special forms of problem solving while it is more likely that Decision making and problem solving are restricted forms of Design ; ii) Simon's limited interest for the construction of social interaction which is a key resource of design processes[3]. This discussion will allow me to introduce a concept of « expandable rationality » as a potential paradigm for design theory. To conclude, I will suggest that, in spite of human agents limitations in problem solving and decision making, economic growth and value creation may result from their expandable design abilities.

I. From Decision making to Design theory :

[1] I am very grateful to Mie Augier, Nicolai J. Foss, Jetta Frost, Anna Grandori, Siegwart lindenberg, and Margit Osterloh for their comments on an ealier draft.

[2] Simon never thought « bounded rationality » was a theory ; this has been confirmed recently by his interview by Augier (Augier 2001).

[3] My point of view bears on the results of a research program, both theoretical and empirical on Design. The more technical aspects of this work are still to be published but some results have been presented in several papers and conferences (Hatchuel 2001, Hatchuel and Weil 1998, Hatchuel, Lemasson and Weil 2001a, 2001b)

During the fifties and sixties, most economic researchers accepted the idea that the technical and practical meaning of « rational behaviour » was « optimization », either in its simple form (deterministic), or in its sophisticated one (Expected utility theory). The shift of economic and organization sciences towards a « decision » paradigm has been a complex and varied process. Actually, Operations research, micro-economics, statistical theory were all dependant of the same fundamental model of behaviour : how do we efficiently choose between some set of alternatives ? The impact of this conception was such that it did'nt even appear as a paradigm.

a) Bounded rationality and the « decision paradigm ».

We all learned Simon's classical critics of such « substantive rationality » and his seminal view on « bounded rationality ». The latter was a conceptual weapon against the « optimization » school which dominated the decision paradigm. Thus « bounded rationality » was a refutation of all the classic hypotheses of optimal choice : perfect knowledge of alternatives and consequences, perfect preferences between consequences and so on. But if Simon was critical to maximization theories, he persistently understood the concept of rationality through one specific operationalization : an empirically grounded theory of human problem solving.

Simon also proposed to build such theory of decision making and problem solving on a « satisficing » principle. This principle introduces subjectivity, « rules of thumb », heuristics or ad hoc moves as basic decision making processes. *For sure, there can be no universal « satisficing » principle or it would appear as a new form of « optimization »*. And « satisfaction » should be endogeneously defined within the decision process. Consequently, Simon often insisted that facing a problem we simultaneously discuss alternatives, goals, constraints and procedures (time, computational costs…). In his view, Decision making was a natural phenomenon that could be studied by computer simulation, empirical analysis or laboratory experiment. This research program lead him to investigate problem solving by lay men or experts in specific situations like games and puzzles where he tried to understand how they muddle through mazes, messes, and ill-structured problems looking for « satisficing solutions ».

b) Creativity and design as problem solving

However, the pure description of human decision making seemed a too narrow program for him and Simon revitalized the distinction between « natural sciences » and « sciences of the artificial» or « Design sciences » (Simon 1969) : « *the former study how is the world and exclude the normative* », the latter are concerned by « *how things ought to be in order to attain goals* ». At multiple occasions he insisted on the importance of Design theory as a main purpose of his work, a theory where all his works on learning, thought, and discovery could converge[4].

How did he approach conceptually a Design process ? Not surprisingly, he investigated Design through the lenses of a decision making and problem solving paradigm. One of its first

[4] Before his death, Herbert Simon had accepted recently the invitation to give a lecture through videoconference, in a conference in Lyon (France) devoted to Design sciences that will take place in March 2002..

systematic approach of the subject appeared in his paper with A. Newell and J.C. Shaw, « *The processes of creative thinking* » (1962). Design was clearly described as a form of creative thinking. A situation where « *the product of thinking has novelty and value,…, the thinking is unconventional,…, the problem was vague and ill defined so part of the task was to formulate the problem itself* » .(reprint in Simon 1979 p.144). The main idea of the paper was that the tree-structured or « branch and bound » heuristics used for the simulation of chess playing or logic proofs were a good proxy of Design processes and creativity. However, in this paper, the authors also recognized that « *we are still far from having all the mechanisms that will be required for a complete theory of creativity : these last pages are necessarily extrapolations and more speculative than the earlier sections* » (p163). In such pages, we find mainly a discussion of « imagery » (or imagination) viewed as a natural process which provides « *a plan to the problem solver at least in the sense of a list of the elements he his dealing with and a list of which of these are related* (p.166)». Hence, imagination was necessary to the creative process but its role was to offer a first list of options that were progressively explored until a satisficing solution appeared (we will come back later to this point).

The same line of argument was maintained in later works. In the « Sciences of the artificial » Simon insists again on the importance of the Sciences of Design and on the fact that a general theory of Design was no more an impossible target. In Chapter 5 and 6 of the book he presents a research agenda towards Design theory where he insists again on the fact that a large part of Design situations can be solved by heuristics belonging to bounded decision making. He also comes back to the question of imagination as a useful entry to ill-defined problems. Yet, an entry that doest'nt change the nature of the heuristics used.

This line of thought had its rationale. Simon was undoubtedly interested by engineering design and Architecture and he was convinced that such design activities presented no major difference with the other types of mental activities he was studying and simulating : « *When we study the process of design we discover that design is problem solving. If you have a basic theory of problem solving then you are well on your way to a theory of Design* ». (Simon 1995).

He also reached the same idea for Scientific discovery. In his paper with D.Kulkarni « *the proces of Scientific discovery : the strategy of experimentation* » (1988 reprint in Simon 1989) he simulated the reasoning of the chemist Hans Krebs during the experiments which lead him to discover the « ornithine's cycle ». The program simulates search procedures where hypotheses are generated and evaluated. After several iterations, a satisficing level of comparative confidence characterizes the discovered effect. Finally, for Simon Design, creativity, discovery (even in Art or Science) were composed of the same repertoire of heuristics that we can find in usual problem solving within a bounded rationality perspective.

Fore sure we owe to Simon a shrewd revitalization of Design, a subject largely neglected by economists. *But, can we consider that Simon reached a consistent Design theory ?* Or, that bounded rationality could encompass Design theory and decision making theory under the same umbrella ? I believe that it is not the case. In this note, I will very briefly give some arguments in favour of the idea that Design theory cannot be restricted to problem solving and that problem solving is only a moment in a design process. I will also suggest, with intuitive means, why substantial steps towards a Design theory require a concept of « expandable rationality » and a principle of collective action. I will conclude this short comment by insisting on the importance of design theory for the economics of innovation and contemporary organization theory.

II) An approach to Design theory : the limits of a problem solving perspective

In this note, it would be too long to present extensively the formal design theory that I have been developing recently. However, I will introduce some important notions of this approach through simple examples, a method also extensively used by Simon who explained his basic views through popular games : the towers of Hanoï, the chess player, the labyrinth,… In his examples, complexity came from the combinatorial explosion of solutions which defeated any attempt to explore all existing alternatives. In such contexts, satisficing solutions were strongly dependant upon previous expertise (memorised patterns allowing quick recognition) and were obtained through rules-of-thumb choices between promising ways. Now, having in mind all the notions developed by Simon, let us introduce *some differences between problem solving and design theory* by comparing, not games, but simple real life situations. This comparison will help us to introduce the notion of «*expandable rationality* » as a paradigmatic condition of Design theory

II.1. Going to the pictures or a nice party ?

Two groups of friends living in a big town have to organize their next Saturday evening. Group 1 is discussing of a « good movie » and Group 2 of a « nice party ». With intuitive means and simple observations we can get a first distinction between problem solving theory which is well adapted to the « movie case » and something we can call « Design theory » which captures better the « nice party » case.

- First remark : *we can apply to the « good movie » problem all the classics of bounded rationality*. It is impossible to see all the movies in order to choose the best one (an absurd solution). There may exist competing objectives and tastes. Search strategies are needed. The meaning of « good » is vague and a satisficing criteria will be necessary. Computational costs will interact with the explored solutions : the group will not read all the movie critics or will not phone to all friends that have been recently to the pictures. Knowing strategies are required : do group 1 members trust the judgement of critics or do they discuss it ? Logics of discovery and exploration can also be adopted : like choosing the first movie made by a young an unknown director. Finally, expertise will be a powerful mean to orient the problem : some members of the group may know which movie has been selected or awarded in Cannes, Venice, or Berlin and will consider these facts as efficient « cues » (Simon 1996).

- Second remark : Exactly the same set of problem solving procedures will be required in the Group 2 for the « nice party » case. Yet, and this is our crucial point, « party » is an infinitely expandable concept and *different processes will also appear in group 2.* Let us discuss three of them : the unexpected expansions of the initial concepts, the design of learning devices, social interaction as a design resource.

a) The unexpected expansions of the initial concepts :

When Group 1 ends his work a movie has been selected. Moreover, during the discussions and procedures the understanding of what is «a movie we can see in a theater downtown next saturday » will remain unchanged. Yet, in spite of this stability, case 1 requires all the problem solving procedures that have been described by Simon as models of « bounded rationality ». But, in case 2, there is something more : *unexpected designs of what is a « party »* *can emerge from the process* ! This is only a possible outcome also recognized by Simon when he approached « creativity » (Simon, Newell and, Shaw 1962). But what makes such emergence possible ? Exploring this question helps to distinguish Design activity from problem solving through some crucial aspects :

- having to organize a « nice party » would appear in Simon's terms as a vague, and ill-structured problem. He would suggest that the first step is to define the problem space, to « *form* » it. From the point of view of design theory, the *project* of a « nice party » can be described in quite opposite words : *it is a semantically clear and well formulated departure point.* In Simon's language it appears as some vague agenda or goal setting, but such notions miss the specificities of the formulation[5]. By being apparently vague and ill-structured, the concept of « nice party » allows either for conformity to usual party standards or for innovative suggestions. Constraints (cost, time, location…) will be investigated and selected but their composition and impact on the design work is not deterministic. There is nothing one can call « the problem » or « the set of constraints ». There is *a project* (a more adequate designation than « problem »*)* to handle and there is no mechanistic relation between this project and the undefined number of « problems » that the design work will meet.

- This explains why some so-called design problems are not real design projects. If a machine is well defined by a set of organs and control parameters, a lot of modifications of such machine can be treated by problem solving procedures. We face a real design project only if the formulation of the initial concepts allows for unexpected expansion. The economic litterature has often described the notion of a « dominant design » in some sectors : in such cases, new products projects are under so many constraints that they tend to disappear, until some innovative player appears.

- Design projects are not necessarily creative. But creativity needs a design logic in the approach of a project (e.g. concepts allowing surprising expansion). To capture creativity Simon introduced « imagination » within a problem solving approach. He thought that the task of imagination was to provide the first list of actions, and that the rest of the process was problem solving heuristics. There are several difficulties raised by such approach. The first one, is that « imagination » appears as an exogeneous entry to the design process and not as something that can be triggered by designable procedures. The second difficulty is that imagination (as defined by Simon) can appear *everywhere* in the process, at early or late phases. For example in case 2, its is always possible to add new events or facets to a party even during the party itself. And these events can actually change the perception of the party. To avoid these difficulties, a more thorough analysis of what we call « imagination » is needed, otherwise one could claim that the concept encompasses all the process and dismantles the value of problem solving heuristics as a grounded theory.

What are the consequences of these remarks ? If, unexpected expansions of the initial concepts are integral to a design process, hence a design situation is not a special case of problem solving. A « feline » is not a special case of « cat », but the reverse proposition is true. Design theory contains problem solving theory because any design process can use all problem solving procedures. Moreover, the unexpected expansions of the initial concept controls the generation of problems, and these will or will not be solved. Hence, Design theory is not only

[5] This kind of short sentence containing rich semantic possibilities often serves to organize design competitions. In design practice they are often called « briefs », a label well adapted to the laconic description of the project.

problem forming or solving, it has to capture the process of conceptual expansions. A key aspect of this process is the design of « learning devices ».

b)The design of learning devices :

At the end of case 1 (the movie case), some learning is observable. The films that one can see dowtown are better known ; some critics have been read ; new movie theaters may have been discovered. The expertise of all participants has increased. The same learnings occur in group 2. Yet, other learning paths appear again. In case 1, learning is caused by the exploration of already recognized knowing areas : films, theaters, comedians, members preferences... While in case 2, it has no such predetermined structure. Somebody could suggest a fancy party or to organize the party on cruise. In each case, the learning process will focus on unpredictable areas. Hence, in case 2, learning determines the generation of problems and has to be considered as a design area i.e. as a process designed to generate new concepts and problems. We call « learning devices » such processes because they are more than means to test solutions. They are designed *to learn about what has to be learned or could be learned :*.a drawing, a mock-up, a prototype, a scientific experimental model, a rehearsal are usual « learning devices »[6]. Simon's 1988 paper (Simon and kulkarni 1988) contains an excellent example of learning device. In this paper, the authors attempt to simulate the discovery logic of a great biologist Hans Krebs. One of their conclusions was that « *The tissue culture method acquired here was his secret weapon, his source of comparative advantage* » (p.381). Krebs had adapted for his own purposes the « tissue culture » method (for experimentation and observation) that was developed by another scientist and this method opened the learning path that reached the ornithine discovery. In this case, the main design action was the innovative reuse of an experimental model or, in our terms, of a crucial learning device. Undoubtedly, this paper is one of the *richest modelling of problem generation and solving.* Yet, the model focused exclusively on the experimental tactics of Krebs, once selected the « tissue culture » method[7]. Anyway, designing the appropriate learning devices is a central aspect of a design process as search procedures are dependent from the properties of such devices.

c) Social interaction as a design resource and a designable area :

Between case 1 and case 2, there is a third significant difference. *The decision makers of group 1 are also the « clients » of their own choices*. In case 2, this is no more true : group 2 have at least to take into account the expected judgements and behaviour of the selected guests. This means that the success of the party cannot be completely controlled by the designers. This is also a common aspect of decision-making in organizations (Hatchuel and Molet 1986). For sure, existing knowledge about the clients can impact the satisficing process. Even a computerized chess player could adapt his strategy by learning from the moves of his human opponent. But we should not *forget that understanding and designing the social interactions of a design process is an essential part of the design process itself*. Let us come back to case 2, the guests can be perceived as a resource of the design process : some of them, if previously informed, could organize surprising events ; they could also help for drinks and meal preparation and so on. *The social interaction becomes both a resource and a designable area*. This is an obvious aspect of the design of services and an essential element for the understanding of design worlds (Hatchuel 2001) like architecture or Art. It also captures the empirical fact that design is dependant of the information and education required from the « client » (Suh 1988). Thus, Design theory is both *an output and a resource* of social

[6] In the case of nice party one can think of some forms of rehearsals or some preparatory drawings.

[7] This can be explained by the complexity to simulate the generation and comparison of distinct learning devices

interaction : this is obvious in Art and it is universally true. (Hatchuel 2001). Considering social interaction as a designable area is a key feature for economic and organization theory as it directly implies that value creation and creativity are dependant of organizational forms and of the social interactions that shape economic transactions.[8]

These three differences can be considered as a partial agenda for an extension of problem solving theory towards Design theory. In chapter 5 of « the Sciences of the Artificial », Simon was not far from a similar research agenda. Nevertheless, he also insisted on the idea that Design theory would need *no new theoretical langage i.e. no new modelling logic*. Later, he gave several indications of his good recognition of the requisits of a research program on design : « *Today's expert system make use of problem representations that already exist. But major advances in human knowledge frequently derive from New ways of thinking about problems* » (Simon 1986). However, a thorough examination of these texts (too long to undertake here) shows that all his arguments aimed to avoid any substantial difference with problem solving theory. There is no room here to discuss in detail this position. Let us mention that the departure point of our work was quite opposite to Simon's one : we think that design theory requires different conceptual instruments than problem solving. And, using the same examples I will briefly introduce a theoretical discussion on concepts and a principle of « expandable rationality » (Hatchuel 2001) that could help the reader to understand why Simon's position was perhaps too restrictive.

II.2. Concepts and non-countable sets : a definition of « expandable rationality »

A basic procedure of problem solving is the generation of a short list of possible solutions that could be evaluated and compared. In case1, the set of all solutions (all the movies presented in the town) is clearly a *countable* set (a list of solutions may be infinite but countable), a classic concept in standard Set theory. Consequently, the short list appears as an extraction from the existing list of films.

In case 2, we face a different landscape. The set of all possible « parties » is a *non-countable* one if we refer to the definition of non countable sets in Set theory. Why is it so ? Intuitively : the number of parameters defining a « party » can be made infinite (let us only assume that the party contains some games or shows and infinity is there). But, more technically, we can also mimic the constructive proof of the non countability of Real numbers in Set theory : if one assumes that there exists a countable set of possible « parties », it will always be possible to create new parties by combination of the listed ones and so on…(an important argument here is that two concepts of a « party » can always be merged in a new concept of party, infinitely).

Now, these abstract propositions have two important consequences.

- Bounded rationality revisited : what means « exploring » an infinite and non-countable set ? What means an exhaustive listing of the real numbers ? Our limits are no more caused by human, cognitive or computational bounds. We have to accept that the issue *has no*

[8] The literature on organizational learning and knowledge creating firms also insists on the importance of social interactions in knowledge creation. However, most often there is no contingency theory that links the content of knowledge produced to the shape and logic of the social interaction. It is one of the advantages of design theory to offer such contingency views : Planes and cars are complex technical systems, their design needs complex social interactions but not the same ones (for a discussion of the literature on this point see Hatchuel and Weil 1998, Hatchuel, lemasson, weil 2001).

theoretical sense. Even a theoretical exploration method having infinite time and resources would fail. Hence, it is the basic concept of « exploring » a space of possiblities that we have to abandon. Like almost all common nouns, the word « party » is undefinable as a closed list of objects. In case 1, « films » form a countable set only because the inquiry was restricted to « films that can be seen in dowtown theaters on Saturday ». These specific «films » have been made countable *by previous designs and previous social conventions*. Hence, Group 1 has no design work to do but they have a problem to solve. In real design processes, we have to manipulate concepts which correspond to non-countable sets. Therefore, there is no way to extract lists of solutions from previous lists of solutions. The only approach left is to *expand* the initial concept by adding usual or innovative qualifying properties. Exactly in the same way that we define subsets of the Reals by adding properties and not by selecting numbers from a list. Practically, group 2 will probably begin by formulating different contrasting « stories » of nice parties ; these stories will be discussed and reworked in order to progressively reach a « grammar » of attracting nice parties. Then learning devices will be settled (call to friends, contacts with suppliers…). They will bring new knowledge and new concept of parties and the expansion process will begin.

- A concept of « expandable rationality » : Non countable sets are infinitely expandable. So, the concept of a « party » is also infinitely expandable while the concept of the « movies that we can see downtown » is not. This conveys a new perspective on rationality : *what means rational behaviour in infinitely expandable and non countable sets of actions* ? We will not attempt here a technical definition of such behaviour ; but, there is at least one property that one expects from a consistent rationality concept in such context : *to be expandable.* A first characteristic of such rationality is *our ability to manipulate (individually and collectively) infinitely expandable concepts*. A capacity that is a necessary condition for any Design process and that we consider as a *potential paradigm* for economics of innovation and organization theory (Hatchuel 2001). In classic combinatorial problems, like in chess playing, there is no real design project, and we have no other choice than to adopt models of bounded rationality. However, creativity is still possible when the space of strategies seems infinitely expandable to the players [9]. This probably means that very innovative players think like designers. In a fascinating paper on chess skill, entitled «*The mind's eye in chess* » (Simon and Chase 1973) Simon tried to capture Chess skill. In this paper Simon recognizes the existence of « a perceptual structure » which captures long term memory and practice, and also allows the recognition and generation of innovative patterns. In our terms, this means that such perceptual structures are not lists of previous games, but *expandable concepts* about games. These concepts can be innovatively expanded by highly skilled and trained players. In this paper, Simon is obviously facing a new perspective : « *hence, the overriding factor in chess skill is practice…and the same is true of any skilled task (e.g. football, music)* ». A perspective rather far from problem solving heuristics.

III. Concluding remarks and Openings : Design theory, economics and organization theory

Simon was one the very few authors of the last century (at least in social and and psychological research.) to understand the theoretical importance of Design (in engineering, architecture or elsewhere). He also called for the elaboration of a design theory. Nevertheless, he thought that we already had all the theoretical instruments required for such endeavour and

9 This is only how it appears to us, but in reality it is not infinitely expandable as it is a finite and countable set.
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that they could be found in the models he developed to simulate complex problem solving in bounded rationality contexts. One can doubt that this was a valid position. Our concept of expandable rationality brings us within the problems of the continuum hypothesis and not in the world of discrete mathematics which is the necessary realm of computers. This is at least a piece of evidence in favour of our doubts.

But why Design theory matters for economics or organization theory ? *And why should researchers in these fields bother with Simon's models of thought, or more modestly with the discussion on the frontiers between problem solving and Design theory that we offered here ?* I will follow here the same line of argument than Grandori's view about the importance of a logic of discovery in governance forms (Grandori 2001) ?

We all know that growth is not only the consequence of cost reduction through competition. Innovation, be it technical, esthetical or organizational, is a major process for the expansion of wealth. Simon tried to prove that we could capture complex problem solving, even creativity, in terms of simple heuristics and satisficing criteria. This position was an extremely fruitful critic of the « optimizing » school. Yet, it did'nt capture and explain *the expansion of goods, wealth and values in advanced contemporary economies* and how collective action within firms and between firms and clients could create a so huge number of concepts, values, and objects (for better or worse). The idea of Bounded rationality seems to diminish the computational abilities of economic agents. They deal with uncertainties and complexity with the limited help of rules of the thumb principles. They use short list of actions instead of rich spaces of possibilities. They suffer from cognitive and practical limitations. All this has been perfectly taught to us by Simon. But from these ideas, considered as basics of the program of « behavioural economics » that Simon called for (Mie Augier 2001), one could conclude that the efficency of economies

and organizations is necessarily *hindered* by our problem solving limitations. Then, why do we observe Growth and wealth ? There one can see the theoretical importance of distinguishing between Design and problem solving.

Our main hypothesis is that human agents are limited decision makers but « good » natural designers (including social interaction as a design area). This hypothesis fits well with all what we learned from Simon and avoids some of its consequences. Human agents have a surprising and infinitely expandable ability to create stories, forms, and concepts. Thus even if good design also needs problem solving procedures, at least it can compensate their weaknesses. Moreover, our design ability can be improved at least through the three crucial processes we evoked :

- *improving concept expandability* : learning to manipulate concepts that correspond to non countable sets or perceptual structures (Simon and Chase 1973 : in some way all schools of Art try to do that).
- *Designing new learning devices* : New prototyping, virtual mock-ups, video aided rehearsals, cooperation aiding software…
- *Looking for new forms of social interaction in design* : for example, involving users or other stakeholders in the design process.

However, economic agents and economic theory still look at human agents as « decision makers ». Most often agents cannot recognize their design capabilities because they have no design theory to mirror their own thinking. This also explains why classic organizational or market failures are not so important for growth. Imperfect competition or agency behaviour are major problems within a decision paradigm. Yet, within a paradigm of expandable rationality these failures become acceptable if they do not inhibit the value creation process. A very unefficient company in terms of cost control could create much more profit and social wealth than a well controlled one if the former has a better design process than the latter.

So, new theoretical questions appear. What makes that a company has a better design process than an other ? What are the consequences of design theory on organization theory ? What are the consequences of expandable rationality in terms of organizational principles and processes ? As these questions have been developed in other papers (Hatchuel and Weil 1998, Hatchuel, Lemasson and Weil 2001a, 2001b), I will conclude this note by brief comments on the two examples.

Let us imagine that group 1 and group 2 are not groups of friends but small companies. Group 1 wants to offer a new service : assistance to movie information and selection while group 2 offers to design and organize « nice parties » for ordering clients. Obviously, group 2 and group 1 will not adopt the same organization and the same type of prices and their relation to clients will be very different. Yet, both are service companies, so where are the driving forces behind different structures and governance forms ? The answer is in the design procedures of these two services. Group 1 will offer problem solving procedures (e.g. Web sites, journals, data banks, critics, chat rooms, clients judgements about movies) while group 2 will propose design assistance (team working, consultancy, artists, experts plus all the same devices offered by group 1). The economic literature has recognized the specific properties of such services. Both need interaction between the producer and consumer (this is obvious in group 2 and group 1 can ask clients to feed the system with their evaluations). They also require mutual trust as the quality of such services cannot be easily assessed by the consumer. However due to the contrasted design processes of these goods, interaction and trust will not be similarly shaped or related to the same contents in both cases. In case 2, the interactions can take place during all the design of the party and even during it. While, group 1, will rarely offer more than information, debates and meetings with film makers and comedians. This indicates how a good design theory is a necessary ground for Economic theory and organization theory.

Herbert Simon opened the way towards a major improvement in the economic and social sciences. Not only by criticizing perfect choice theory, but also by understanding the necessity to build Design as a Science and a theory. However, he was convinced that Design and creativity was just a special case of problem solving. If there is no doubt that problem solving is part of a design process, yet it is not the whole process. Simon's identification of design theory to problem solving theory may have also limited the awareness of economists and organization theorists to the implications of human capacities in design for a theory of wealth and growth. If design is mere problem solving so why should we give to such activity any specific theoretical place ?

Thus, one could not reduce the importance of Simon's outstanding scientific contribution by considering that his attempts to build a design theory remain unfinished. Research goes on. And we hope that this short note, while reflecting our debt to Herbert Simon'second program, also has some flavour of progress.

References

Augier Mie, 2001, « Simon says : Bounded rationality matters. Introduction and interview ». *Journal of management inquiry*, 10, 3, 268-275

Grandori, A 2001, « Cognitive failures and combinative governance » (forthcoming*) Journal of Management and Governance.*

Hatchuel, A & Molet, H (1986), . « Rational modelling in understanding and aiding human decision making » *EJOR*, 23,4.

Hatchuel, A. & Weil, B. (1998), « Design oriented organizations » *Proceedings of the EIASM Product Development Conference, Cambridge.*

Hatchuel A.& Lemasson P.& Weil,B. (2001a), « From R&D to RID. Design strategies and the management of innovation fields ». *Proceedings of The EIASM Product Development Conference, Enstchedde.*

Hatchuel A.& Lemasson P.& Weil,B. (2001b), « from knowledge management to Design oriented organizations », *International Journal of the Social Sciences* (forthcoming 2001)

Hatchuel A. (2001) : «Design theory and organization theory. Collective action in Design worlds » *Plenary lecture* at the EGOS Conference, Lyon July 6-8. Working paper.

Simon A.H., Newell A., JC Shaw (1962). « The processes of creative thinking ». Reprint in Simon A.H., (1979) «*Models of Thought 1* » New haven and london yale university press p.144-174.

Simon, A.H. (1969), « *The sciences of the artificial* » MIT Press Cambridge MA. USA.

Simon A.H, W. G. Chase, (1973), « The mind's eye in chess » in William G. Chase (ed.) « the visual information processing », pp.215-281. Academic Press. (reprint in Models of Thought 1)

Simon A.H (1978), « Rationality as a process ans as a product of thought » *AER* 68 : 1-14.

Simon A. H. (1986), « *Decision making and problem solving* », Research Briefings 1986, Report on the research briefing panel on decision making and problem solving. The National Academy of Sciences. National Academy Press Washington D.C.

Simon A.H. , Kulkarni. D. (1988), « The proces of Scientific discovery : the strategy of experimentation » (1988) reprint in Simon A.H. (1989) « *Models of thought 2,* » New haven and London, Yale university press . p.357-382.

Simon A.H (1995) , « The Scientist as problem solver » in David Klahr and Kenneth Kotovsky (eds) « *Complex information processing : the impact of Herbert Simon* » Hillsdale, NJ, Lawrence ErlBaum associates..

Simon A.H, (1996), « Cue recognition and cue elaboration in learning from examples » *Proceedings of the national Academy of Sciences* 93, 1346-1351

Simon A.H. (1997), « What we know about learning », *Frontiers in Education Conference*

Suh N.P, (1988), « *The principles of Design* » Wiley & sons NY.