KNOWLEDGE, LEARNING, MEMORY AND FEEDBACK LOOPS WITHIN ORGANIZATIONS

Marco Visentin

Department of Management,
Alma Mater Studiorum – Università di Bologna, Italy
visentin@economia.unibo.it

Session G-4

Abstract

In this paper I propose a model to represent the organizational learning process at group level. In the first part of the work I set up an analytical framework starting from the variety of research purposes and epistemological premises peculiar of the multidiscipline context in which scholars study cognitive activities of collective agents. In this theoretical ground it is possible to deduce from literature and from empirical contexts an architectural proposal for the representation of the group learning process. According to this architecture, a group within an organization, herein intended as reified into firm, uses heuristics while performing cognitive activities activated from a market feedback different from what it was expected. The structure of the learning process following the perceived gap between measured and desired feedback, suggests a strong analogy with greedy structures of some heuristics in artificial intelligence, and starts methodological consideration on the simulation of the whole process.

Keywords: group heuristics, learning, knowledge, marketing.

Knowledge, Learning, Memory and Feedback Loops within Organizations

Marco Visentin

Department of Management
Alma Mater Studiorum – Università di Bologna
Bologna, Italy
visentin@economia.unibo.it

Abstract

In this paper I propose a model to represent the organizational learning process at group level. In the first part of the work I set up an analytical framework starting from the variety of research purposes and epistemological premises peculiar of the multidiscipline context in which scholars study cognitive activities of collective agents. In this theoretical ground it is possible to deduce from literature and from empirical contexts an architectural proposal for the representation of the group learning process. According to this architecture, a group within an organization, herein intended as reified into firm, uses heuristics while performing cognitive activities activated from a market feedback different from what it was expected. The structure of the learning process following the perceived gap between measured and desired feedback, suggests a strong analogy with greedy structures of some heuristics in artificial intelligence, and starts methodological consideration on the simulation of the whole process.

Keywords: group heuristics, learning, knowledge, marketing

Suggested track: G Organizational learning

1 Introduction

In this paper I suggest a methodological framework and a structural model of organizational learning within this framework. Organizational learning will be analyzed as a social behaviour at a group level, with a cognitive approach to memory, knowledge and learning extending concepts from individual cognition. I suppose that organizations are goal oriented social aggregates that possess more knowledge than individuals, that learning behaviour can happen at a social level and that cognitive processes of knowledge coding, storing and retrieval, and the use of information can be studied at a group level within the organization (Mayer et al. in Dierkes et al. 2001; Gherardi, 2003; Nelson and Winter 1982; March and Simon, 1958; Cyert and March, 1963; Hutchins in Meindl et al. 1996; Gherardi and Nicolini in Dierkes et al. 2001;

Holmqvist, 2003; Levinthal and Warglien, 1999). Coherently, decision-making, problem-solving and information-search activities can be considered social learning activities which manifest into the modification of the potential behaviour of the agent (Newell, 1990; Gherardi, 2003; Di Pace and Fabroncini, 1990; Cyert and March, 1963).

The cognitive effort due to the nature of market-based information gives interesting opportunities of analysis (Sinkula, 1994; Argote et al. 2003). Literature assigns to the marketing function within the firm the fundamental role of *sensing device* of the organization (Baker and Sinkula, 1999; Day, 1994; Day, 1999; Day and Montgomery, 1999; Day and Wensley, 1983; Grant, 1996b; Sinkula, 1994; Sinkula et al. 1997), and the natural disposition to monitor the external environment -consumer, competitors and macroeconomic context- assumes a strategic role from the perspective of the *learning organization*. The underlying idea herein is that a group acts on the modification of a part of the organizational memory, so taking the marketing function as the object of analysis doesn't limit the validity of conclusions but gives the opportunity to observe and analyze management learning processes involved in the interaction between the organization and its market (Day, 1994; Glazer, 1991). I argue that the interaction between the marketing group and its market happens trough a feedback mechanism (Gibson, 2002; Mayer et al. in Dierkes et al. 2001) that activates reinforcement or modification mechanism (Newell and Simon, 1972; Gibson, 2002) of the short-term memory -the temporary goals- and of the long-term memory -declarative and procedural productions- starting single-loop and double-loop learning processes (Argyris and Schon, 1978). The presence of the feedback loop imposes the contingent use of heuristics -search paths with less cognitive effort and bias informed (Allenby et al. 1995; Newell, 1990; Di Pace and Fabroncini, 1990; Ruminati and Bonini, 2003)- that human agents use when facing a trade-off between time and accuracy.

The particular shape of the learning process, given the recognition of a gap between measured and desired response from the market, structural, time and rationality limitations of the group, gives the opportunity to propose an architecture for the process of knowledge creation activated by the feedback. This structure is based on a recursive heuristics that at each stage tries to explain the residual gap coherently with a given heuristic criterion. It is possible to find strong analogies with the architecture of a family of AI heuristics called *greedy heuristics*. I discuss how the heuristic argument grounds on Simon's critics to the explicit dimension of the knowledge ("*The memo paradox*"), on Polanyi's thesis and on theories about learning activated by feedback. I will also discuss methodological issues about the idea to use AI simulations to analyze the

processual architecture of the organizational learning at a group level involving feedbacks. The approach is *soft AI* giving the opportunity to model and simulate the key aspects of the learning process such as memory body modification, decision rule creation and deletion, information use, storing and retrieving. This approach is opposite to the *hard AI* approach in which black-box methods coming from cybernetics or neural networks are used to replicate a positive causal relation among variables without giving the possibility to investigate the underlying process (Cooper and Giuffrida, 2000; Thieme et al. 2000). Transposed to the problem of learning, the question here is not to model the market response nor the management reaction but to represent the cognitive processes of knowledge creation and transfer for the management. This approach leads to various methodological issues about validation and validity of the simulation. I discuss these issues starting from ideas of Simon, and from modern philosophy of science (Bara, 2000, Gasperoni and Marradi, 1996; Reed, 1994; Feigenbaum and Feldman, 1963), and I finally propose an empirical schema to validate the theory.

2 The analytical framework and the model

Organizational learning studies acknowledge contributions from psychological, sociological and ethnographical disciplines, and from simulation studies in Artificial Intelligence. In the last decades it has appeared a vast and heterogeneous literature about organizational learning. This literature is characterized by a variety of epistemological basis, different methodologies and goals that mix concepts borrowed from different disciplines giving the term *organizational learning* itself various possible meanings. Psychology, sociology and cognition consider learning as a process, while management scholars (Nonaka, 1994; Grant, 1996b) recognize the central role played by knowledge as organizational variable, strategic asset and determinant of the performance. The difference herein is crucial and regards the manifestation of learning: in the cognitive tradition learning manifests into the modification of potential behaviour of the agent, based on experience, while in management learning manifests into the performance (Cyert and March, 1963; Argyris and Schon, 1978; Nonaka, 1994). A specific contribution is given by marketing literature that analyzes the impact of organizational learning on the market-orientation behaviours of firms (Day, 1994; Baker and Sinkula, 1999; Baker and Sinkula, 2002): the management daily faces not just the problem to recombine or recognize old variables, but it also has to consider

fundamental modifications into business logic and environmental context (Pawlowsky in Dierkes et al. 2001).

Furthermore, other questions arise transversally: organization can properly learn, or learning happens just in the mind of individuals (Gherardi, 2003)? Simon (1991) claims that "*All learning takes place in human heads*", others focus on knowledge diffusion problems (Nonaka, 1994; Nonaka and Takeuchi, 1995; Grant, 1996a; Grant, 1996b), while it is possible to exhibit social learning behaviours in which participants are not aware (Hutchins in Meindl et al. 1996), or group attribute-based decision that are different from the sum or the mean of pre-discussion individual decision (Arora and Allenby, 1999). Is it true that we know more than we can articulate (Polanyi, 1962), and how much is it important the exploration of the processes and levels of exploitation and sharing of the knowledge? The question also drives on memory localization: memory, and actually knowledge, is situated in the mind of individuals or groups and organizations know more (Argyris and Schon, 1978; Argote et al. 1995)? Walsh and Rivera Ungson (1991) treat organizational memory in terms of analogy, and other literature faces directly the problem of the level of knowledge sharing and localization of the memory (Cook and Brown, 1999; Walsh and Rivera Ungson, 1991; Holmqvist, 2003; Levinthal and Warglien, 1999). In the following I will face various questions to try and understand the optimal level of analysis, the object of the analysis for the purposes of this research, and to understand the terms the heuristic argument my be applied to group cognition.

2.1 Level of analysis

In this section I argue that, to the purposes of this paper, the optimal level of analysis is the group. I also argue that to prove the feedback activation of group learning and the contingent use of group heuristics arguments, it is not necessary to consider cross-level analysis issue concerning individual behaviours.

Organizational knowledge exists on various levels within organizations (Schulz, 2001; Shultz, 2003; Cook and Brown, 1999) and the appropriate level of analysis is an issue that depends on the goal of the study (Shoemaker, 2003, Levinthal and Warglien, 1999). It should be noted that if we admit that cognition within organization may be studied at different levels of analysis, we must clarify if at a chosen level it should be specified how learning processes act at lower level. Group and individual knowledge should be treated as distinct and coequal forms of knowledge (Cook and Brown, 1999)

and group decisions are different from the average of individual prediscussion responses (Arora and Allenby, 1999). A local domain of knowledge seems to be a good choice for an appropriate level of analysis when an organizational subunit must cope with local conditions or when it sources knowledge from the environment (Shultz, 2001). In this work learning capability will be considered as a social behaviour (Walsh and Rivera Ungson, 1991; Holmqvist, 2003, Gherardi, 2003). I assume that groups and organizations can learn, that they know more than individuals, that learning does not manifest just at individual level, but cognition is a social construct and any cognitive behaviour can be analyzed at a group level within the organization (Gherardi and Nicolini in Dierkes et al. 2001; Argote et al. 1995, Walsh and Rivera Ungson, 1991; Levinthal and Warglien, 1999). Moreover, group knowledge is held in common by the group. Cook and Brown (1999) give an example of it within physicians: *while only individual physicians know how to diagnose nephritis using palpation (groups do not have hands), the knowledge of what constitutes acceptable and unacceptable practice in nephrology is possessed by nephrologists as a group*.

There is a strict relation among memory, learning, knowledge and goal-oriented behaviours. In this analytical framework, where many concept are borrowed from individual cognition, if the knowledge is what can be used by an agent to inform its goal-oriented behaviours, than to act on potential behaviours means to act on knowledge base of the agent, or, in other words, on its memory. In the cognitive framework any task may be represented by a set of possible states that the agent can assume, that is by a problem space. The agent uses its knowledge to build and to explore this space, and this represents the possibility of potential behaviours. Therefore an organization learns if it modifies its base of knowledge, that is if it updates its memory on the basis of its experience. A group within an organization by modifying its base of knowledge on a local domain and on the basis of information coming from the outside of the organization, modifies the memory of the organization, acting on potential behaviours of the organization. While the opposite is not true in general, this fact proves that it is possible to study learning behaviours for a management group within a firm that exchanges information with the firm's marketplace, and this is true even if measuring learning with performance (Levinthal and Warglien, 1999).

It should be noted, furthermore, that coherently with Simon's theories, the purpose of this study is to decompose the final outcome of a group cognitive behaviour caused by a feedback. This means that a problem solution or a decision will be represented as a process in which possible solutions compete and are used as building blocks of the

final outcome. The attention is therefore on the process itself and not on the organizational configurations or variables that shape it, like is done for example in an interdependence perspective (Thompson, 1967). The key points here are that the level of analysis is the group intended as local domain of knowledge, that learning is activated by the perception of a gap between measured and desired outcome, and that group learning is different from individual learning. Consequently, following Levinthal and Warglien (1999), it is possible to study a group learning process with a single feedback source and a single outcome, without specifying individual behaviours of participants.

2.2 Object of the analysis

A suitable local context for organizational learning is given by local knowledge domains such as marketing knowledge or knowledge about government agencies, competitors and suppliers (Titus, 2000; Shultz, 2001; Day and Nedungadi, 1994; Deshpande, 1982; Deshpande and Webster, 1982; Denrell, 2003; Jaworski and Kohli, 1993; Kohli and Jaworski 1990; Glazer, 1991) when subunits of the firm interacts with their environment. Outcome feedback is a necessary condition for learning (Ross et al. 2000), and given no information overload, the more outcome feedback and less ambiguous the feedback, the more likely the manager is to develop expertise. The marketing group within the firm has a natural disposition to be the *sensing device* for the firm (Day, 1994; Glazer, 1991; Noble et al. 2002; Deshpande, 1982). Moreover the quality of the market-based information, equivocal, high frequency and often leading to information overloads, gives the opportunity (Sinkula, 1994; Argote et al. 2003; Baker and Sinkula, 2002; Narver and Slater, 1990) to observe the effects that feedback frequency has on management capability and quality of learning. In a marketing context it is shown that (Ross et al. 2000) decision makers are more likely to use simplifying heuristics in more uncertain environment.

Marketing literature and managerial practice acknowledge both the strategic role of learning capabilities, and the role of organizational learning in a domain explicitly or implicitly bounded within the marketing function of the firm (Glazer, 1991; Deshpande and Webster, 1989; Noble et al. 2002; Day and Montgomery, 1999; Day and Nedungadi, 1994; Sinkula, 1994; Baker and Sinkula, 2002; Narver and Slater, 1990). Marketing scholars assign a crucial role to the ability to listen to consumers and to the adaptation of products and services to what it has been learned (Glazer, 1991; Noble et al. 2002; Moriarty, 1985). The tasks to analyze, synthesize and produce

recommendations or decisions about the market are peculiar to the marketing function. Furthermore, although marketing departments are extremely heterogeneous in composition, geographical location, dimensions, backgrounds of components and in specific functions, we can say that most learning from the market happens within them.

Marketing literature, sometimes distinguish *marketing knowledge* as a local domain for learning, without specifying its localization (Glazer, 1991; Noble et al. 2002) implicitly referring to a shared knowledge that is distributed along a variety of forms and individuals and social aggregates (subgroups, sub units possibly geographically delocalized, external consultant). Nevertheless the marketing knowledge domain can be naturally identified (Titus, 2000; Deshpande and Webster, 1989; Deshpande, 1982) with the marketing function that process information, analyzes knowledge source from the outside and from the inside of the organization, to produce a shared outcome, that is its prerogative.

The television marketing gives a possible empirical context to study the effect of feedback loops on group learning, and on the contingent use of heuristics by the group. A cognitive agent can learn at distinct levels (Argyris and Schon, 1978). A first learning is adaptive, or single-loop, and is measured in a marketing context (Sinkula et al. 1997) by the dynamics of the marketing mix. Than a deeper learning can occur if it can be shown a modification into the decision rules or norms used by the learning agent. This latter kind of learning is called double-loop learning. In a television marketing context, the marketing mix of the firm is represented by the programs scheduling, called palimpsest, of the network or the group of networks. The palimpsest is projected in order to sell rooms for advertisements. The price of the space is determined by indexes that evaluate the audience. The audience, and indeed the share of the network, depends on several factors like characteristics of the network, time, duration of the program, typology of the program, and so forth (Casetti and Di Chio, 1998). Implicitly I presented some dimensions of the problem, and a causal relation -the one between share or audience, and the other variables- that are used by marketing managers to decide on the price of time rooms. The recombination of these values measures the dynamic of the marketing mix, that is it represents the adaptive learning of the management. More in deep if a variable is changed -for example due to the introduction or deletion of a program typology, the set of possible value of the variable changes-, or is added -for example a particular effect like the massive sport programming that appeared in the nineties in the Italian television market- or is deleted -for example cartoons are no more able to compete with news- than a generative learning can be observed.

3 The model

Argyris and Schon (1978) say that organizational learning occurs recognizing a gap between desired and measured outcome, that disconfirms the theory in use. To the perception of that gap it follows an answer from the management that activates again the feedback from the market. The perceived gap activates a learning process for the organization, both adaptive to the contingence and acting on norms and decision rules. The outcome feedback is a necessary condition (Ross et al. 2000) for learning, and when the source of the feedback is the market, it is favourable to consider a local context for the analysis of the organizational learning process. Even in a local context, the reaction of the group, made of individuals, must happen under a limited amount of time and resources, so its cognitive behaviour must reflect the interaction of its base cognitive capabilities, the structure of the environment and tasks, and the knowledge body (Newell, 1990). Following this way, considering that individuals don't have a precise, stable, and hedonically correct system of ordering for preferences, they aren't foolproof information processors, not ever they maximize personal utility, and they are not always moved by personal interest (Motterlini, 2003), one can suppose that the group will show a behaviour not completely rational and limited by its cognitive capabilities. Moreover human beings and hence groups, never look for the best solution but look for the best solution with respect to some criterion (Magnani, 2003; Tversky and Kahneman, 1974) deliberately choosing between accuracy and cognitive effort (Payne et al. 1993). To understand how this choice can be done, one must consider Simon's *memo paradox*. This paradox starts from Polanyi's thesis (1962) that sounds like we know much more than we can say (i.e. we can articulate). This may be extended to group cognition, especially when thinking (Hutchins in Meindl et al. 1996) about group learning behaviours in which individuals are not aware. However in the execution of a cognitive activity human beings, rationally limited, don't need to have a complete and explicit representation of the problem space, or the possibility to explore exhaustively the memory. Simon claims -and actually proves (Magnani, 2003)- that if it is possible to find an effective procedure to test and a procedure to generate possible solutions for a problem, than the agent faces a problem not yet solved but in which we know what we are looking for without disposing about it.

Consider now a group within an organization. The group receives a feedback from the outside of the organization (Ross et al. 2000; Shultz, 2001) and records the difference between the desired outcome and the measured one (see figure 1).

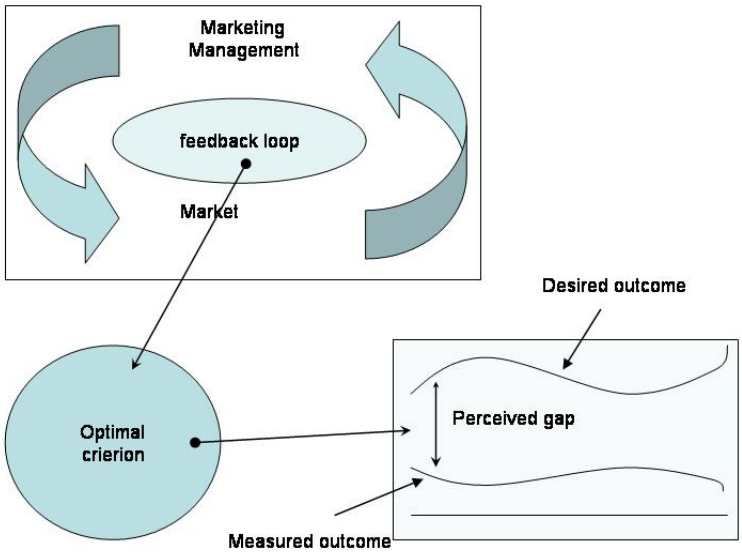

Fig. 1: gap perception

It should be noted that for the purposes of the present work is not necessary to consider the dynamic within the group that produces the final outcome. The point here is to show the structure of the final decision, that is the learning process dynamic. Now (Titus, 2000) the group reacts, and tries to explain the gap (Baker and Sinkula (1997) and Moriarty (1985) say that learning is function of the gap).

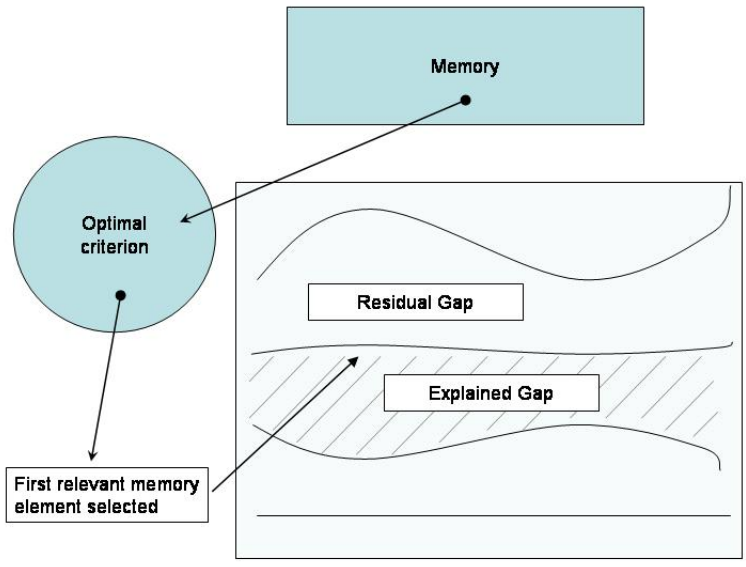

Fig. 2: first step

Presumably it will search information or causal relations or rules that explain the difference between measured and desired outcome. The group will perform this task under rationality and time limitation, deliberately choosing between accuracy and

cognitive effort (Payne et al. 1993). First the group will find the information or the rule, and more generally the knowledge element that better explains the perceived gap like in figure 2. If this knowledge block is not enough to explain the gap, the group will try to explain the residual gap in the same way (figure 3).

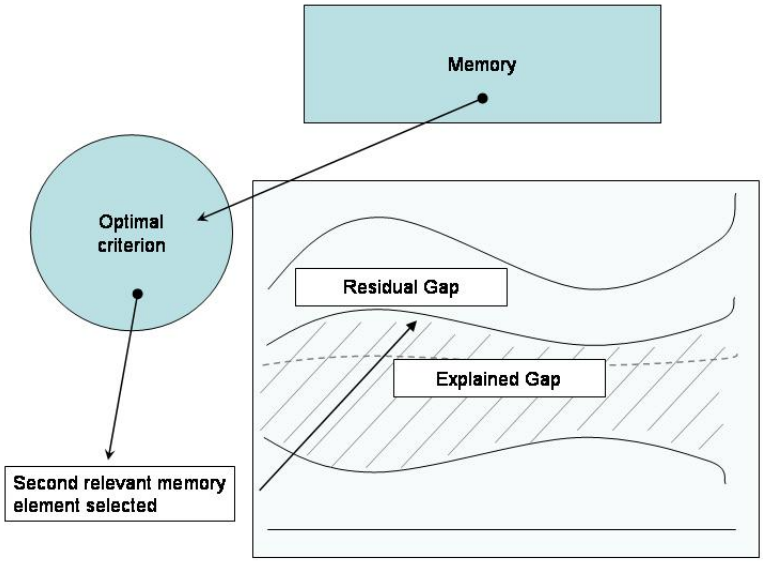

Fig. 3: generic step

The process in figure 3 will go on recursively covering the residual gap, until an acceptable level is reached as in figure 4.

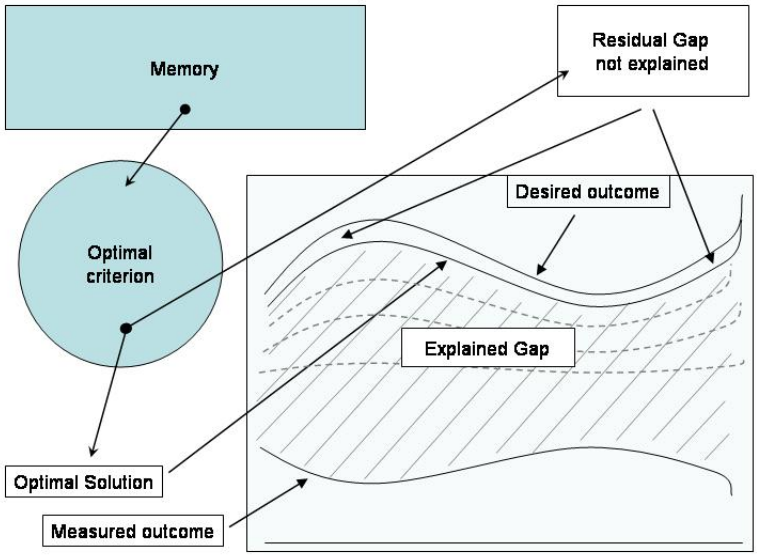

Fig. 4: the final solution

Taking the television marketing as an example it make everything easer. If the marketing group (I mean the function that is responsible to act on the mix of attributes

of the palimpsest) records a freakish audience, it will try to react explaining the gap. The first knowledge block, that is the first information or decision rule, can be supposed to explain most of the gap: for example an extraordinary performance can be explained by the nature of sport match of the program. This can be not enough to explain the gap. To articulate the explanation of the gap the group need to extract another block of knowledge: the program run at Wednesday that traditionally doesn't present a strong competition by other networks. The process goes on until a satisfactory level of explanation of the gap is reached. If knowledge base is inadequate to explain the gap, the group generates new rules or norms. It is important to note that the point here is not about to explicit exhibition of the used knowledge. Learning is not related to the exploitation of knowledge, but manifests into the modification of potential behaviours of the learning agent, due to experience. If the perceived gap induce just a recalibration of attributes into the marketing mix, the process shows to produce adaptive, single-loop, learning. If new rules will be used after this feedback, than the process induced generative, double-loop, learning.

3.1 The heuristic

It is possible to find a parallel between the model outlined and heuristics in AI called greedy heuristics (Friedman, 1999). These heuristics are based on an information space and on a choice criterion. A simplified version of the heuristic is outlined in figure 5, and it is immediate to link figure 1-4 to instructions in the greedy heuristic.

$(\rho_1, h_1) = Arg_{\{h \in H, \rho \in R\}} F(\rho \cdot h, f)$

$F_1 \leftarrow \rho_1 \cdot h_1$

for $m = 2...M$ and $F(F_m, f) > \delta$

$\tilde{f}_m = f - F_{m-1}$

$(\rho_m, h_m) = Arg_{\{h \in H, \rho \in R\}} F(\rho \cdot h, \tilde{f}_m)$

$F_m \leftarrow F_{m-1} + \rho_m \cdot h_m$

end for

Fig. 5: the greedy heuristic

Suppose that it is possible to represent with a space *H* of information *h* the problem space of an agent. Each information has a weight ρ, that is, its importance relatively to the gap to explain. Let f be the difference between the measured and desired

outcome of some action, due to the feedback (figure 1) and let F the criterion that the agent uses to select information. When the group reacts (figure 2, corresponding to the first two lines in figure 5) it search the first most important knowledge block. Then, recursively, (figures 3 and 4 , corresponding to the for cycle in figure 5) the learning agent explains the residual gap $\tilde{f}_m$ until it is small enough, say less than δ.

4 Further Research

This section outlines the main issues in group learning theory coming from the heuristic model previously presented. Furthermore the model and the architecture itself of the heuristic have to be proved. This starts the discussion on methodology and validation.

4.1 The impact on learning

In order to show that feedback impacts on learning it is convenient to think in terms of process. This means that it is better for the purposes of this research to look for a correlation between the frequency of feedback loops in place of a point to point correlation among feedback and learning occurrences. This approach is coherent with Skinner (1938; 1953) study on human behaviour, and in this perspective the feedback experience may raise the frequency of learning responses. In their learning model Argyris and Schon (1978) claim that learning at a first stage can involve a simple adaptive activity, calling this mode as *single-loop* (or *adaptive*) learning. At a second stage individuals may modify norms and rules following a deeper kind of learning, namely a *double-loop* (or *generative*) learning. The two authors specify a third mode of learning, the *deutero* learning that consists in a social sharing of knowledge after individual learning. In the present work the focus is on the group learning process, and so we will discuss only single- and double-loop learning activities.

Learning can be viewed as an interested behaviour that on the stimulus of a feedback generates o modifies rules and norms. In a computational perspective this observations sets out the validation procedure: to learn means to acquire new programs or to modify existing ones from a body of knowledge available in some way to the agent (Di Pace and Fabroncini, 1990). At a social level (Gherardi, 2003) adaptation corresponds to problem solution and learning in a strict sense corresponds to the generation or to the modification of norms and rules. For Sinkula, Baker and Noordewier (1997) in a marketing context the dynamics of marketing programs may be considered an appropriate measure for short-term organizational learning. This means that the recombination of the marketing mix variable can be used as a measure for single-loop

learning. When the organization modifies the set of variables (both adding or deleting variables and adding or deleting admissible values for a variable) it can be observed the modification of *old decisions rules and obsolete norms* (Baker and Sinkula, 1999; Slater and Narver, 1995) manifesting generative learning activities. Therefore it can be supposed that the feedback loop may act on the frequency of group cognitive activities, and hence it can be supposed that there is a positive correlation between the frequency of the feedback loop and the frequency of the single-loop learning.

If the intelligent agent (Skinner, 1938; Skinner, 1953) is interested into the consequences of its behaviour, the feedback can originate a reward (positive reinforcement) or a situation that is not desired (negative reinforcement). Baker and Sinkula (1999) note that there is the possibility for the routinization of adaptation activities, while an excess of attention to the feedback may limit intuition or generative learning capabilities for the organization. However intuition is an advanced and autonomous stadium of knowledge (Melone in Meindl et al. 1996) and feedback frequency does not correspond to information overload problems (Payne et al. 1993). In this sense it can be supposed that there is not a negative correlation between the frequency of the feedback loop and creativity and generation or modification of rules and norms and that there is not a negative correlation between the frequency of adaptive and generative learning. Furthermore it must been considered that learning (Baker and Sinkula, 1997; Moriarty, 1985) is function of the sensed gap between measured and desired outcome, so it can be supposed that the magnitude of the gap addresses learning to single-loop or double-loop. In other words, it can be supposed that there is a threshold for the magnitude of the perceived gap, below which the learning is adaptive, and generative otherwise. In the managerial literature about learning the manifestation of learning activity is considered in terms of *success* of learning and is measured in terms of performance (Sinkula et al. 1997; Prahalad and Hamel, 1990; Narver and Slater, 1990). If group learning implies organizational learning it can be supposed a relation between learning (manifesting herein as the modification of potential behaviours based on experience) and performance, coherently with Levinthal and Warglien (1999). In a marketing context a good measure of long-term performance is given by the performance relative to the major competitor and so it can be supposed that the frequency of the feedback-loop is correlated with the performance.

4.2 Validation

The starting point to discuss methodological issues on validity and validation of AI simulation is to be found in the early approach of Simon to simulation in cognitive science (Reed, 1994; Newell 1972; Bara 2000; Ruminati and Bonini, 2003; Motterlini, 2003; Cordeschi, 2003). In the literature (Bara, 2000; Reed, 1994; Gasperoni and Marradi, 1996) computer simulation is indicated as a valid technique to verify psychological theories. The basic idea is that a numeric algorithm may represent a mental process, and can be useful to study the impact that this representation has on related constructs.

Simon's work into AI simulation followed an incremental approach rather different from the unifying Newell's one. In social science the investigated properties are a part of a complex network of relations in which the active roles of individuals are of central importance. At an individual level it must be taken into consideration the great complexity of human brain, and it is difficult to accept the analogy between human mind and computer, human memory and formal structures, and a problem solving paradigm based on the search within the problem space. However the approach here is not architectural as in Newell perspective, but tends to acquire knowledge about the operational and mutational characteristics of the imitated system relatively to specific aspects. In a simulation the interest in not into the final outcome of the simulated interactions among the actors but rather into the shape and dynamics of the process involved in the situation. The success criterion for a simulation is based on the level of similarity with the real way agents use to process and elaborate data (Bara, 2000; Reed, 1994; Gasperoni and Marradi, 2003; Motterlini, 2003; Terna, 2003).

Modelling and simulating means simplify and represent phenomena. It is difficult to find the *correct method* in social science, if ever one could be found (Gasperoni and Marradi, 1996), and from this viewpoint a common logical base will be taken as the ground for the acceptance or the refusal of hypotheses and theories (Rudner, 1968; Popper, 1944). Following this direction, logics validate the passages in previous sections extending the individual cognition to group cognition and the formulation of structural aspects of the model. This represents the first step in validation: the passage from the real system to the theoretical model. The second step is the implementation of the simulator. This means the implementation of a program. Note that the simulator here may not be a standing alone procedure that eats some input and produces some output possibly tracking the process. Agents learn on the basis of their knowledge body (Simon, 1972; Newell, 1990). For this reason the simulator must have a base of

knowledge and must act coherently with it and with possibly breaking-points coming from the outside of the processual dynamics simulated by the model. This can be done by a supervised perspective to simulation that involves bayesian information approach (Allenby et al. 1995; Ripley, 1996; Friedmann, 1999). The link between theoretical model and simulator is called verification and consists into the adhesion of the implemented model to the theoretical one. Once a simulator has been implemented and verified, the simulation must be performed. This means that the simulator has to be run over the same conditions of the real system. The simulation will produce some result: these are the very data to be analyzed for the experiment. The validation process will terminate by assessing the degree of accuracy of the simulator with respect to the observation of the real system: in this framework the proof is constructivist in the sense that a given theoretical model can be considered to explain a given cognitive activity of the agent if the correspondent artefact is able to exhibit the expected behaviour, under procedural assumptions (e.g.: Bara, 2000). If a simulator is verified but not validate it means that the model well implements unfair assumptions, that is the theoretical model doesn't work. If the simulator is validate but not verified it means that it doesn't implement realistic assumption of the theoretical model. If the simulator is both verified and validate it means that it faithfully implement realistic assumptions about the real world.

Conclusions

In this paper I proposed a model to represent the organizational learning process at a group level. The research started from epistemological premises necessary to accept a group learning model acting within cognitive processes characterized by group outcomes, group decisions and problem solving, and group feedback. In this framework a group uses heuristics while performing learning activities activated from a feedback that is different from what expected. Coherently with the literature, it is possible to find a strong parallel between the heuristic and recursive greedy heuristics coming from Artificial Intelligence. The basic idea is that the dynamic of the learning process is reflected by the structure of a group decision, and the decision is recursively built from knowledge block used by the group to explain the gap between desired and measures outcome. Learning manifests into the modification of potential behaviours, due to experience, so next research is to prove that this architecture explains single-loop and double-loop learning frequency. Finally some methodological issue is discussed to present the validation paradigm to perform and accept the validation procedure to assess simulation results.

References

Allenby, Greg M., Arora, Neeraj and Ginter, James L. (1995), *Incorporating Prior Knowledge into the Analysis of Conjoint Studies*, Journal of Marketing Research, 32 (May), 152-162

Argyris, Chris and Schon, Donald A. (1978): *Organizational Learning: A Theory of Action Perspective*, Reading MA: Addison-Wesley

Argote, Linda, Insko, Chester A., Yovetich, Nancy A. and Romero, Anna A. (1995): *Group Learning Curves: The Effects of Turnover and Task Complexity on Group Performance*, Journal of Applied Social Psychology, 25, 512-529

Argote, Linda, McEvily Bill and Reagans, Ray (2003): *Managing Knowledge in Organizations: An Integrative Framework and Review of Emerging Themes*, Management Science, 49, 4, 571-582

Arora, Neeraj and Allenby, Greg M. (1999): *Measuring the Influence of Individual Preference Structure in Group Decision Making*, Journal of Marketing Research, 26 (November), 476-487

Baker, William E. and Sinkula James M. (1999): *The Synergistic Effect of Market Orientation and Learning Orientation on Organizational Performance*, Journal of the Academy of Marketing Science, 27, 4, 411-427

Bara, Bruno G. (2000): *Il Metodo della Scienza Cognitiva*, Bollati Boringhieri

Casetti, Francesco and Di Chio, Federico (1998): *Analisi della Televisione: strumenti, metodi e pratiche di ricerca*, Bompiani, Milano

Cook, Scott D. N. and Brown, John S (1999): *Brinding Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing*, Organizational Science, 10, 4 (July-August), 381-400

Cooper, Lee G. and Giuffrida, Giovanni (2000): *Turning Data mining into a Management Science Tool: New Algorithms and Empirical Results*, Management Science, 46, 2, 249-264

Cordeschi, Roberto (2003): *Una lezione per la scienza cognitiva*, Sistemi Intelligenti, a. XV, n. 1 (aprile)

Cyert, Richard and March, James (1963): *A Behavioral Theory of the Firm*, Prentice Hall, Englewood Cliffs, NJ

Day, George S. (1994): *Continuous Learning about Markets*, California Management Review, 36 (Summer), 9-31

Day, George S. (1999): *Creating a Market-Driven Organization*, Sloan Management Review, (Fall), 11-22

Day, George S. and Montgomery, David B. (1999): *Charting New Directions for Marketing*, Journal of Marketing, 63 (Special Issue), 3-13

Day, George S. and Nedungadi, Prakash (1994): *Managerial Representation of Competitive Advantage*, Journal of Marketing, 58 (April), 31-44

Day, George S. and Wensley, Robin (1983): *Marketing Theory with a Strategic Orientation*, Journal of Marketing, 47, (Fall), 79-89

Deshpande, Rohit (1982): *The Organizational Context of Market Research Use*, Journal of Marketing, 48, (Fall), 91-101

Deshpande, Rohit and Webster, Frederick E. Jr. (1982): *Organizational Culture and Marketing: Defining the Research Agenda*, Journal of Marketing, 53, (January), 3-15

Denrell, Jerker (2003): *Vicarious Learning, Undersampling of Failure, and the Myths of Management*, Organization Science, 14, 3 (May-June), 227-243

Dierkes, Meinolf, Bertholan Antal, Ariane, Child John, and Nonaka, Ikujiro (eds, 2001): *Handbook of Organizational Learning and Knowledge*, Oxford

Di Pace, Luigi and Fabrocini, Filippo (1990): *Tecnologia dell'apprendimento*, Franco Angeli

Feigenbaum, Edward A. and Feldman, Julian (eds, 1963): *Computers and Thought*, McGraw-Hill

Friedman, Jerome H. (preprint 1999): *Greedy Function Approximation: A Gradient Boosting Machine*

Gasperoni, Giancarlo and Marradi, Alberto (1996): *Metodo e tecniche nelle scienze sociali*, Enciclopedia delle scienze Sociali, vol. V, 625-643

Gherardi, Silvia (2003): *L'onda lunga della razionalità limitata nella sociologia dell'organizzazione*, a. XV, n. 1 (aprile)

Gibson Faison P. (2002): *Is It Better to Forget? Stimulus-Response, Prediction, and the Weight of Past Experience in a Fast-Paced Bargaining Task*, Computational and Mathematical Organization Theory, 8, 31-47

Glazer, Rashi (1991): *Marketing in an Information – Intensive Environment: Strategic Implications of Knowledge as an asset*, Journal of Marketing, 55, (October), 1-19

Grant, Robert M. (1996a): *Prospering in Dynamically-competitive Environments : Organizational Capability as Knowledge Integration*, Organizational Science, 7, 4, 375-386

Grant, Robert M. (1996b): *Toward a knowledge-based theory of the firm*, Strategic Management Journal, 17, 109-122

Holmqvist, Mikael (2003): *A Dynamic Model of Intra- and Interorganizational Learning*, Organization Studies, 24, 1, 95-123

Jaworski, Bernard J and Kohli, Ajay K. (1993): *Market Orientation: Antecedentents and Consequences*, Journal of Marketing Research, 57 (July), 53-70

Kohli, Ajay K. and Jaworski, Bernard J. (1990): *Market Orientation: The Construct, Research Propositions, And Managerial Implications*, Journal of Marketing, 54, 2; 1-18

Levinthal, Daniel A. and Warglien, Massimo (1999): *Landscape Design: Designing for Local Action in Complex Worlds*, Organizational Science, 10, 3, 342-357

Magnani, Lorenzo (2003): *Euristiche abduttive per la scoperta*, Sistemi Intelligenti, a. XV, n. 1 (aprile)

March, James and Simon, Herbert A. (1958): *Organizations*, John Wiley, New York

Meindl, James R., Stubbart, Charles and Porac Joseph F. (eds, 1996): *Cognition Within and Between Organizations*, SAGE Publications

Moriarty, Mark M. (1985): *Design Features of Forecasting Systems Involving Management Judgments*, Journal of Marketing Research, 22, (November), 353-64

Motterlini, Massimo (2003): *Note epistemologiche e mitologiche sulla relazione tra economia e psicologia*, Sistemi Intelligenti, a. XV, n. 1 (aprile)

Narver, John C. and Slater, Stanley F. (1990): *The Effect of Market Orientation on Business Profitability,* Journal of Marketing, 54, 4, 20-35

Nelson, Richard R. and Winter, Sidney G. (1982): *An evolutionary Theory of Economic Change*, Belknap Harward Press

Newell, Allen (1990): *Unified Theories of Cognition*, Harward University Press

Newell, Allen and Simon, Herbert (1972): *Human Problem Solving*, Prentice Hall

Noble, Charles H., Sinha, Rajiv K. and Kumar, Ajith (2002): *Market Orientation and Alternative Strategic Orientations: A Longitudinal Assessment of Performance Implications*, Journal of Marketing, 66 (October), 25-39

Nonaka, Ikujiro (1994): *A Dynamic Theory of Organizational Knowledge Creation*, Organization Science, 5, 1, 14-37

Nonaka, Ikujiro and Takeuchi, Hirotaka (1995): *The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York

Payne, John W., Bettman, James R. and Johnson, Eric J. (1993): *The Adaptive Decision Maker*, Cambridge University Press

Polanyi, Michael (1962): *Personal Knowledge: Towards a Post-Critical Philosophy*, University of Chicago Press, Chicago IL

Reed, Stephen K. (1994): *Psicologia Cognitiva*, Il Mulino

Ripley, Brian D. (1996): *Pattern Recognition and Neural Networks*, Cambridge University Press

Ross, William T. Jr, Chapman Moore, Marian and Staelin, Richard (2000): *Recurrent Marketing Decision: Decision Complexity, Decision Focus, and Firm Performance*, Marketing Letters, 11, 4, 283-297

Ruminati, Rino and Bovini, Nicolao (2003): *Razionalità limitata, intuizioni e decisioni*, Sistemi Intelligenti, a. XV, n. 1 (aprile)

Schulz, Martin (2001): *The Uncertain Relevance of Newness: Organizational Learning and Knowledge Flows*, Academy of Management Journal, 44, 4 (August), 661-681

Schulz, Martin (2003): *Pathways of Relevance: Exploring Inflows of Knowledge into Subunits of Multinational Corporations*, Organization Science, 14, 4 (July-August), 440-459

Shoemaker, Mary E. (2003): *Leadership Behaviours in Sales Managers: A Level Analysis*, Journal of Marketing Theory and Practice, (Spring), 17-29

Schendel, Dan (ed., 1996): *Special Issue: Knowledge and the Firm*, Strategic Management Journal, 17 (Winter)

Schoonhoven, Claudia Bird (1999): *Special Issue: Application of Complexity Theory to Organization Science*, Organizational Science, 10, 3 (My-June)

Simon, Herbert A. (1947): *Il comportamento amministrativo*, Il Mulino

Simon, Herbert A. (1955): *A Behaviour Model of Rational Choice*, The Quarterly Journal of Economics, LXIX (February), 99-118

Simon, Herbert A. (1972): *Theories of Bounded Rationality*, in Radner and Radner, eds., *Decision and Organisation*

Simon, Herbert A. (1991): *Bounded Rationality and Organizational Learning*, Organization Science, 2/1, 125-134

Sinkula, James M. (1994): *Market Information Processing and Organizational Learning,* Journal of Marketing, 58, 1, 35-45

Sinkula, James M., Baker, William E. and Noordewier, Thomas (1997): *A Framework for Market-Based Organizational Learning: Linking Values, Knowledge, and Behaviour*, Journal of the Academy of Marketing Science, 25, 4, 305-318

Skinner, Burrus, F. (1938): The Behaviour of Organism: An Experimental Analysis, New York, Appleton century crofts,

Skinner, Burrus, F. (1953): Scientific Human Behaviour, New York, Macmillan

Slater, Stanley F. and Narver, John C. (1995): *Market Orientation and the Learning Organization*, Journal of Marketing, 59, 2, 63-64

Slater, Stanley F. and Narver, John C. (2000): *Intelligence Generation and Superior Customer Value*, Journal of the Academy of Marketing Science, 28, 1, 120-127

Teece, David, Pisano, Gary and Shuen, Amy (1997): *Dynamic Capabilities and Strategic Management*, Strategic Management Journal, 18, 7, 509-533

Terna P. (2003): Esperimenti, scelte ed organizzazioni , Sistemi Intelligenti, a. XV, n. 1 (aprile)

Thieme, Jeffrey R., Song, Michael and Calantone, Roger J. (2000): *Artificial Neural Network Decision Support Systems for New Product Development Project System*, Journal of Marketing Research, 37 (November)

Titus, Philip A. (2000): *Marketing and the Creative Problem-Solving Process*, Journal of Marketing Education, 22, 3, 225-235

Thompson, James D. (1967): *Organization in Action*, MacGraw –Hill, New York

Tversky, Amos and Kahneman, Daniel (1974): *Judgment under uncertainty: Heuristics and biases*, Science, 185

Walsh, James P. and Rivera Ungson, Gerardo (1991): *Organizational Memory*, Academy of Management Review, 16, 1, 57-91