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# Are Routines Reducible to Mere Cognitive Automatisms?

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By

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## Some contributions from cognitive science to help shed light on change in routines

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**Abstract:**
The aim of this article is to understand permanence and changes inside organizational routines. For this purpose, it seems important to explain how individual and collective memorisation occurs, so as to grasp how knowledge can be converted into routines. Although memorisation mechanisms imply a degree of durability, our procedural and declarative knowledge, and our memorisation processes, evolve so that individuals and organisations can project themselves into the future and innovate. Some authors highlight the necessity of dreaming and forgetting (Bergson 1896); others believe that emotions play a role in our memorisation processes (Damasio 1994). These dimensions are not only important at the individual level but also in an organisational context (Lazaric and Denis 2005; Reynaud 2005; Pentland and Feldman 2005).I review the individual dimension of these memorisation processes, with the Anderson's distinction between procedural knowledge and declarative knowledge. I discuss the notion of cognitive automatisms in order to show why routines should be investigated beyond their first literal assumption (Bargh, 1997). This leads to a clear understanding of the micro level that underpins organisational flexibility and adaptation (notably the motivational triggers). Within organisations, the memorisation mechanisms are at once similar and diverse. Indeed, organisations use their own filters and mechanisms to generate organisational coordination. Organizational memory has its own dimension as it does not merely consist of the sum of individual knowledge and must be able to survive when individuals leave. Routines depend on the organisational memory implemented and on the procedural knowledge and representations of it (individual and collective representations).

**Key words:** Knowledge; memorisation; organizations; individuals
**Jel codes:** D83; O31

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*"We are right when we say that habit is formed by the repetition of an effort; but what would be the use of repeating it, if the result were always to reproduce the same thing? The true effect of repetition is to decompose, and then to recompose, and thus appeal to the intelligence of the body. In this sense, a movement is learnt when the body has been made to understand it." (Bergson, 1896:137)*

*"The first records, in the form of memory-images, all the events of our daily life as they occur in time; it leaves to each fact, to each gesture, its place and date. Regardless of utility or of practical application, it stores up the past by the mere necessity of its own nature. But every perception is prolonged into a nascent action; and while the images are taking their place and order in this memory, the movements which continue them modify the organism, and create in the body new dispositions towards action"( Bergson, ibid: 92).*

**Introduction**

The literal meaning of the term « routine » can cause one to assume that this concept is mundane. Furthermore, in everyday language, the term « routine » has a negative connotation because it is seen as a form of cognitive automatism that relegates this process to a backdrop position, far from the league of « grand », carefully designed and implemented strategic plans. Routines are seen as unconscious whereas decision-making is thought to be deliberate and intentional. This point of view, shared by many researchers is unlikely to foster progress in the scientific debate.

A careful look at the empirical studies conducted in cognitive science is enough to see that major advances have been made on the question of memorization processes. Thus, the reflection (see quotation above) undertaken by Bergson (ibid), who introduced the notions of individual freedom, motivation and free will in the study of memorization processes, was for the most part validated by contemporary studies. Some researchers pay homage to this original thinker who formulated in a very precise way something which cognitive science was to prove much later (Squire 2004). If the debate on the forms of memorization and on cognitive automatisms has always been a delicate and controversial one because it lays bare, from the start, the potential limitations of our consciousness; it nonetheless constitutes a philosophical question, which may highly relevant to that of organizational routines.

Indeed, the conceptualization of organizational routines has evolved and now includes the notion of procedural knowledge (Cohen and Bacdayan 1994), or that of « recurrent interactions patterns » (Cohen *et al*., 1996) or even of change driven by individuals (Feldman 2000). One could think at first that these

definitions cannot be reconciled or even that they are antagonistic. But this would be ignoring the contributions of cognitive science, which has always emphasized that free will is essential to memorization (Bargh 1997). The example of the learning driver shows how cognitive automatisms do exist and are necessary, but it also shows that the latter are acquired through a long learning process in which motivation plays a far from negligible role in the formation and transformation of routines. Thus the debate on individual memorization processes is in many ways relevant to collective forms of memorization. The notion of « mindfulness » developed by Langer (1979) and reexamined recently (Weick and Sutcliffe, 2006 ; Levinthal and Rerup 2006) points to organizations' intentional efforts to avoid being lulled by the organizational routines they activate on a daily basis and to remain vigilant at all times in order to give sense to their daily work and to learn by questioning their existing practices. This debate enables us to truly understand the implications of the notion of organizational routines and to better explain enduring criticisms or misunderstandings (Becker 2004; Abel, Felin and Foss 2007).

In the first section of this article we get right into the cognitive science debate and explore the concepts of cognitive automatism, of procedural and declarative knowledge. I show that the studies conducted in this field have been strongly influenced by the mind-as-computer metaphor and that it has taken a great amount of work to refine and complete this representation. In the second section, I show why motivation and individual freedom are important mechanisms in the processes of collective memorization. We emphasize that this mechanism of intrinsic change co-evolves with other forms of changes, and particularly with change in the environment. I conclude on the new factors of change in routines and show to what extent they can help us better understand and interpret the co-evolution of individual and organizational levels.

## I) Inside the cognitive black box and beyond: routines and memorization processes

Cohen and Bacdayan (1994) define routines as procedural knowledge. In order to introduce this issue, the content of this knowledge and its opposite form has to be debated.

Anderson was one of the first authors to have made a distinction between declarative and procedural memory and to have popularized these notions. In this section, I shall talk about Anderson's distinction between procedural knowledge and declarative knowledge, and will show that "proceduralisation" processes are in no way automatic and that individuals can consciously choose the degree of stability inside their knowledge. Studies in cognitive science have discussed the notion of cognitive automatisms (Shiffrin and Schneider 1977) and have pointed to their temporal and contextual nature (Cohen 1991, Cohen and Bacdayan ibid). Emotions are also a determining factor in our memorization processes and it is therefore important to observe them closely if one is to grasp the difficulties of individual memorization and routinisation processes. They impact on the quality of the memorization process and on the setting up of potential cognitive automatisms.

**1.1) The origin of the concept of the procedural knowledge: Anderson's distinction between two forms of memories**

Many authors regard the distinction between procedural knowledge and declarative knowledge as fundamental to understanding the development of routines. For example M. Cohen (1991) who, based on Anderson's works, distinguishes two forms of memorization: the memorization of procedural knowledge and that of declarative knowledge.

Taking into account the studies on artificial intelligence (Winograd 1975) and a criticism of behaviorist analyses – which focused on the external manifestation of behavior and not its content – Anderson, following Simon's steps, observed the course of mental processes in order to understand their driving forces. Based on Simon's distinction between short-term memory and long-term memory, Anderson introduced a key notion: that of declarative memory, which plays a key role between "working memory" and "production memory" (Anderson (1976)). The graph below summarizes his argument (figure 1).

In 1976, Anderson developed the idea that one form of memory collected facts and that another stored and recorded them. This notion was refined and clarified in 1983, a time during which Anderson distanced himself from the Simonian approach, in order to concentrate on cognitive mechanisms per se.

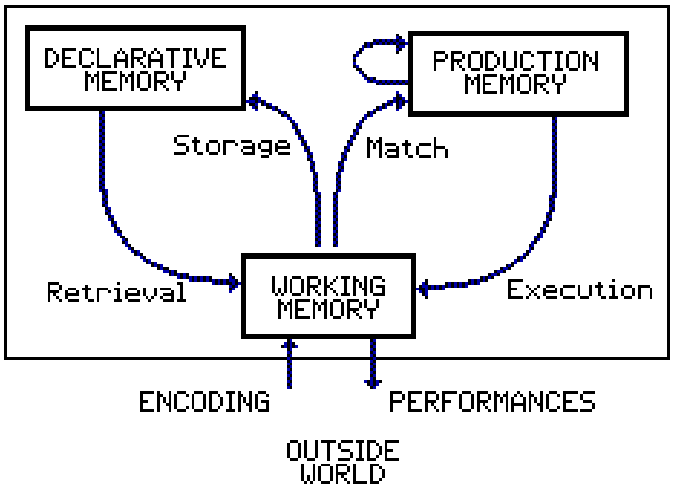


**Figure 1: The Declarative memory between production memory and working memory: Source Anderson 1976**.

Later on, Anderson's research used the criticisms of artificial intelligence to go beyond the metaphor of the mind as a simple computer and to explore new directions. Indeed, starting from the Ryle's distinction between "know that " and "know how", Winograd underlines why the expert system can only encode two representations of knowledge: the knowledge encoded independently from the programme and the knowledge mobilized when the programme is being used. In this context, declarative knowledge may exist independently of its use, whereas procedural knowledge translates into in a specific behavior. This makes it possible to operationally separate the knowledge that is easily accessible, communicable, and usable because it is independent and varied, from the knowledge that is used to solve a problem[1].

Declarative memory concerns more specifically the recollection of facts, events and propositions (Anderson 1983, Cohen 1991). It is not linked to a specific use and can be used for several purposes. In particular, it can be "re-organized" in order to find the solution to a problem. It therefore mobilizes facts and technical or scientific principles that are different from know-how. Procedural memory, on the other hand, concerns know-how, how things are done, the knowledge that is put to use. Part of this knowledge can be expressed through routines and rests on "patterned sequences of learned behavior involving multiple actors" (Cohen and Bacdayan 1994: 557).

Anderson focuses more particularly on the creation of procedural knowledge. Indeed, he believes that declarative knowledge is converted into procedural knowledge thanks to the processes through which declarative knowledge is interpreted and selected. Interpretation leaves a trace in the working memory and repetition converts this declarative knowledge into procedural knowledge thanks to a compilation mechanism. The creation of some 'production rules' and their successful repetition increases their efficiency and, thus, their probability of being selected again. Anderson explains that 'knowledge automatisation' occurs once knowledge has been used frequently over time for a specific purpose increasing consequently performance and speed. This observation was introduced for explaining several clinical studies that have shown that the two forms of memory may be dissociated. A patient suffering from amnesia, for example, might no longer memorize declarative knowledge but his memorization of procedural knowledge is not affected. The case of a patient who did not remember the daily visits of his doctor, but could still play chess with great precision (Cohen 1991) is but one of many cases that have made it possible to distinguish several types of memorization in individuals (Cohen 1984, Cohen and Eichenbaum 1993).

[1] Anderson distances himself from the artificial intelligence approach and bases his analysis on his "Adaptative Control of Thought" (or ACT) theory, to understand the transition from the status of declarative intelligence to that of procedural intelligence.

These two forms of memory do not have implications at the level of individual memorization alone. Indeed, as we shall see later, they generate specific representations of knowledge, creating different forms of organizational memory. Furthermore, they can promote the creation of cognitive automatisms that play a role in the individual and collective routinisation process. This is the reason why Anderson's distinction is based on two questions that have been fundamental to the study of routines: are there automatic procedures that make it possible to convert declarative knowledge into procedural knowledge? Are there cognitive automatisms that can govern the human spirit? These questions, which many in cognitive science have tried to answer, deserve to be examined here.

### 1.2. The latest works in cognitive science

*121 Squire's extension and refinement of Bergson's theory*

According to Squire two pioneers have had great influence in the field of cognitive science. William James (1890) with his work "*Principles of Psychology*" and Henri Bergson who was a French philosopher (1859-1941).

Bergson's works were pioneering in their conceptualization of memorization processes (Squire, 2004)[2] . Indeed, for this French philosopher, there are two forms of memorization: memorization in the form of representations, and memorization in action. Bergson distinguishes a memory that stores the facts of our daily life such as images, from a memory that materializes into motor mechanisms through the recollection of stored facts. Bergson takes the example of the lesson learnt by heart, and which, through repetition results in a form of automatism. He likens this form of memory to habit-memory, opposing it to image-memory that does not rely on pure repetition and maintains an important degree of imagination:

> "*To call up the past in the form of an image, we must be able to withdraw ourselves from the action of the moment, we must have the power to value the useless, we must have the will to dream*" (Bergson, ibid, 94)

[2] Henri Bergson wrote the first edition of "*Matter and Memory*" in 1896 and "*Creative evolution*" in 1907. He was highly influenced by Spencer's work. There are many similarities between Bergson's work and his book "*Matter and Memory*" and William James' approach to habits. Bergson grants great importance to the notion of perception initially developed by William James. Just as James did, he thought that perception and emotion play a key role in our cognitive faculties. Bergson was awarded the Nobel Prize for literature in 1927. Throughout his works, he strongly argued that intuition was deeper than pure reason and was also influenced by Spencer's evolutionist ideas. However, in "*Creative evolution*", Bergson argues that creative urge, not the Darwinian concept of natural selection, is at the heart of selection. It is also said that Bergson (who married Marcel Proust's cousin in 1881) gave Marcel Proust the idea for his great novel "*Remembrance of things past*" (1913-1927).

According to Bergson, there is permanent tension between the memory turned towards the present action and the memory that tends to distance itself from action. Hence the selection between motor habits and their representations:

> *"The nascent generality of the idea consists, then, in a certain activity of the mind, in a movement between action and representation" (Bergson, ibid:324).*

Moreover, Bergson goes further in his description of the memorization process in that he emphasizes how the body accompanies the memorization process. The body is involved in this cognitive effort in that together the body and spirit provide direction and meaning to the memorization process.

Squire's approach (2004) might initially be disconcerting because it seems to point to the existence of a multitude of memorization processes. But in fact, it is more a decomposition of the procedural memory into different facets and learning zones that it describes. Indeed, following Bergson, we could subdivide memory into a declarative form (where we build representations) and a non-declarative form (zone of reflex and automatisms). This recent concept makes it possible to locate the areas in the body where different types of knowledge are created and stabilized. Emotions are part of this configuration and correspond to a specific area that stores long-term memories.

Squire (2004) uses and extends Bergson's distinction to the principle of declarative and non-declarative knowledge. Like James, he underlines that there are many forms of memorization. Some are more able to collect facts whereas others are directly operational, while others still are related to more emotional forms of memorization located in other parts of the brain, particularly in the "amygdala" area. Each specific form of memorization is associated to a physiological area. This does not constitute a break from Anderson's work, but a diversification of the non-declarative form of memorization, which helps to gain a better understanding of the various learning processes where emotions and reflexes are included as specific types of functioning located in a particular area. According to Squire (2004):

> *"Declarative memory allows remembered material to be compared and contrasted. It supports the encoding of memories in terms of relationships among multiple items and events. The stored representations are flexible and can guide performance under a wide range of test conditions. Declarative memory is representational. It provides a way to model the external world and a model of the world it is either true or false. It is dispositional and expressed through performance rather than recollection. Non-declarative forms of memory occur as modifications within specialized performance systems. The memories are revealed through reactivation of the systems within the learning originally occurred" (Squire, 2004: 172-173).*

This representation of the various forms of memorization is illustrated in the graph below (figure 2)

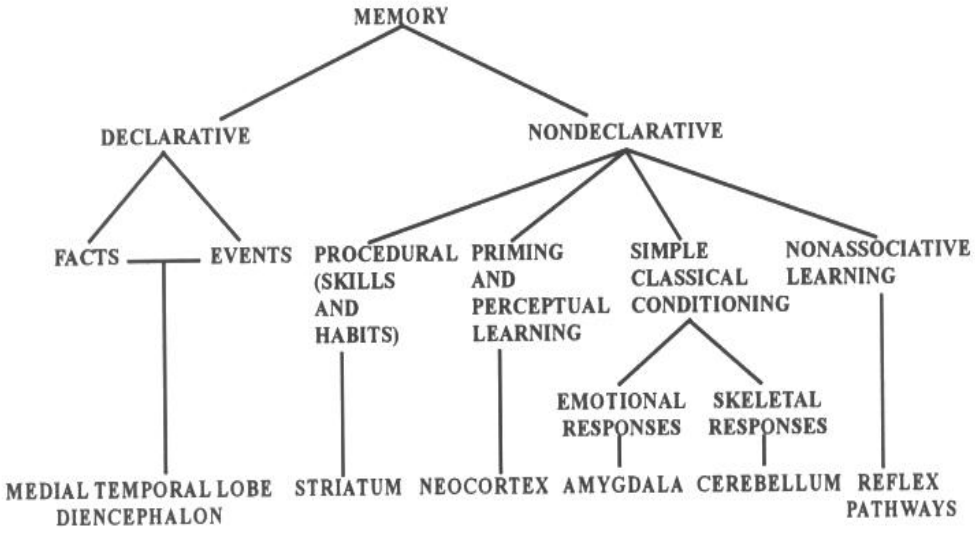


**Figure 2: Declarative and non-declarative forms of memories**
**(Source: Squire, ibid: 173).**

Squire's theory has now been largely accepted within the cognitive science community (Eichenbaum 1997; Eichenbaum, Cohen 2001; Milner, Squire and Kandel 1999; Schacter, Wagner, Buckner 2000). This argument is partly based on James' pioneering works, which underlined the flexibility of habits and showed that the various forms of memorization are found in different parts of the brain and are inter-connected (James 1890 in Thompson 1990).

In this vein, Eichenbaum argues that there is no unique circuit through which non-declarative knowledge is converted into declarative knowledge during the execution or modification of a task; different circuits ("brain circuits") are at play and have distinct functions in the "hippocampus". Declarative knowledge is essential here in that it makes it possible to avoid over-simplified behaviors characterized by some rigidity in a context of repetition. Declarative memory is characterized by "representational flexibility" enabling it to adapt to new situations, contrary to the non declarative forms of memorization that are thought to be more rigid (Eichenbaum, ibid, p. 554).

*1.2.2 Damasio's theory of emotions*

The question here is therefore to determine, in cognitive and social sciences, the degree of plasticity of both forms of memory. Indeed, although non-declarative memory involves an emotional zone that has an impact on motor sensory processes; it is highly probable that these forms of memorization are far

from inert. This is precisely what Damasio suggests when he argues that emotions play an important role in our cognitive faculties (Damasio, 1994).

Our memory does not merely consist of archiving or storing documents or images that enable us to observe the past. On the contrary, our memory rests on representations made of recollections that enable us to implement our potential representations and use them. This notion of images could also be found in Boulding's work (1956) for whom our knowledge base is built around our recollection of images that guide our future and present behavior, a "vision of the world" so to speak[3]. Representations serve to build the future, to create new knowledge and to stabilize the knowledge we use daily. They are made not only of images but also of emotions.

When an individual faces a difficult situation and needs to make a precise choice, or elaborate a strategy, the challenge is to be able to implement a solution that will not be the fruit of past learning only. The act of inventing then rests on analogies and action combined with intuition and reason. Damasio (ibid) shows that if a truly new situation emerges, intense emotions play a role in the resolution of this problem. Emotions then serve to project oneself into the future and to make decisions. Contrary to what one could think, they are not the enemy of the mind but accompany the latter; otherwise, there could be no true invention or creativity. This work is based on the somatic markers hypothesis which, based on clinical observations, has shed light on how the brain, when faced with a new situation, activates part of its resources in different ways. Indeed, the attention required to carry out a new task or face a new problem, mobilizes a certain somatic state that activates the biological regulation of the dorso-lateral area.

> *"The somatic marker mechanism stimulates those of the working memory and of the attention related to future scenarios. In short, we cannot form an appropriate theoretical representation of our own psychological state and that of others if we do not have a mechanism such as that of somatic markers" (Damasio, ibid: 278).*

The concept of somatic markers is particularly interesting here. Indeed, using the latest studies in cognitive science, Damasio has shown that every time a cognitive effort is made, there is a localized activation of our neurons. Neurologists have been able to visualize this cognitive effort that activates certain localized zones of our brains and bodies. This example tries to show why the creation of individual routines may be conceived beyond pure automaticity, but may imply intense attention and decision-making.

[3] For a survey on the theories of knowledge, see Lazaric and Lorenz (2003).

### 1.3. Theories on cognitive automatisms and their implication

The question of cognitive automatisms is not new and has been the object of much research. Bergson proposed, long ago, a philosophical answer to this question by emphasizing that the will was inalienable and that consciousness could not be reduced to mere repetition. Studies conducted in cognitive science have also shown that cognitive automatisms evolve in parallel with consciousness and deliberation processes. These studies deserve to be examined more closely because they are central to the questions of change in memorization forms.

*131 The classical debate on cognitive automatisms*

The question of cognitive automatisms was first addressed from the perspective of individuals' attention and their limited capacities. R. M Shiffrin, with Atkinson, started his works in 1968, focusing more particularly on memory control processes (Atkinson & Shiffrin 1968). A few years later, he and Schneider started their research on cognitive automatisms (Shiffrin and Schneider, 1977), distinguishing two types of information processing. The controlled process is performed more slowly and requires great attention. The automatic process, on the contrary, does not require attention in order to be performed; because it is anchored in long-term memory. The controlled processing, on the other hand, is maintained in the working memory, which requires conscious effort and sustained attention (Camus, 1988: 64). Furthermore, as Camus underlines, tha automatic process can be mobilized consciously.

> *"An automatic process can be prepared by a controlled process. That is to say that an individual can consciously decide to enact an automatic activity. Controlled processing can help improve automatic processing of information. Indeed, the information processed automatically is transient and labile and its storing in the working memory takes no longer than a few seconds. If automatic processing requires more time, controlled processing enables individuals to maintain active the information that is necessary for automatic processing" (Camus, ibid: 66).*

Schneider and Shiffrin's research has influenced the research protocol in cognitive science. Their work is based on the fact that visual automatism is different from motor-sensory automatism. Schmidt reckons that in the context of motor-skill development, automatism is comparable to a flexible and parametrizable pattern more than to a rigid process (Schmidt 1975: 83). In keeping with this line of research on visual capacities and their automatic encoding, Kahneman distinguishes several levels of automatism: a highly automatic type of information processing that does not require any particular attention; a partly automatic process which attention can influence, and finally information processing that is occasionally automatic and requires attention (Kahneman and Charzick 1983; Kahneman and Treisman 1984). This distinction has led cognitive science to put in perspective these forms of automatism:

*"There is widespread consensus around the notion that, notwithstanding exceptions, a behavior understood as an observable response to a given situation, cannot be considered as totally automatic: Only some components of the processing underlying this behavior can be considered totally automatic" (Perruchet, 1988: 9).*

These studies concur with and complement the work of Anderson. They explain and put in perspective the automatic process implemented by individuals. In the so-called proceduralisation phase, domain knowledge is directly incorporated into procedures for the execution of skills, which makes it possible to mobilize working memory less, but can also lead to errors or misses if the compilation phase is too short. In other words, the transition from declarative knowledge to procedural knowledge remains a delicate operation because the automatic process can lock some know-how into tight procedures. Human judgment is thus necessary to update these procedures.

*132. J. Bargh's contributions*

John Bargh has proposed a theory on cognitive automatisms. He nuances his approach by putting motivation at the center of his analysis and proposes a synthesis of several research studies in psychology to progressively integrate the principles of motivations such as they are described in the « self determination theory » or «SDT ». Bargh's theory could be considered in direct continuity to Anderson's works because he focuses on the procedural dimension of cognitive mechanisms.

*"An automatic mental phenomenon occurs reflexively whenever certain triggering conditions are in place; when those conditions are present, the process runs off autonomously, independently of conscious guidance (Anderson 1992; Bargh 1989, 1996). Thus research and theory in both domains, social psychology and automaticity, have, at the core, the specification of "if – then" relations between situational events and circumstances on the one hand, and cognitive, emotional and behavioural effects on the other" (Bargh, ibid:3).*

The aim is to observe to what extent the emotional, cognitive and motivational conditions that characterize an environment can constitute the basis of a preconscious psychological state that can generate an automatic response – automatic in that it escapes the individual's awareness and direct consciousness. This hypothesis is summarized in the graph below.

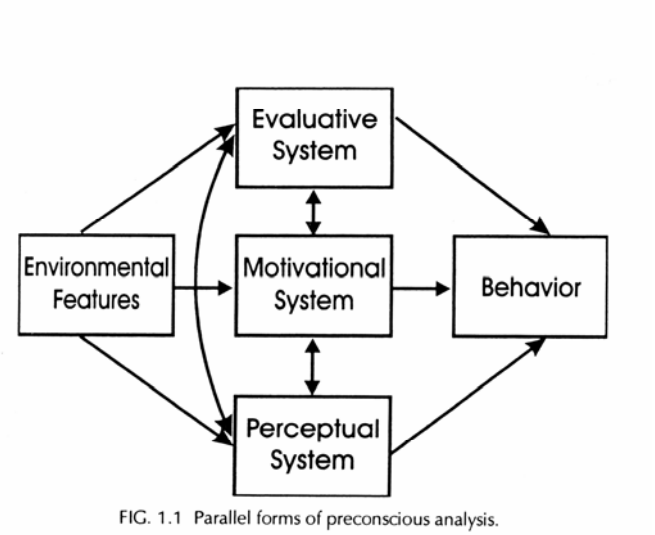

FIG. 1.1 Parallel forms of preconscious analysis.

**Figure 3: Bargh's auto-motive model**

This hypothesis shall be discussed further later. The underlying idea – which Bargh borrowed from Whitehead (1911) and Sriffin and Dumais (1981) – is that the routinisation of certain procedures helps an individual focus his/her attention on essential, new and creative tasks. This is an essential point in the analysis of routinisation and we shall examine it more closely later.

What is new compared to the traditional theory on cognitive automatisms is the manner in which Bargh analyses motivation. Indeed, nothing happens by accident. First of all, before walking can become an automatic process, we have learnt how to walk; and second of all we intend to walk (Bargh, ibid, 28). Bargh even talks of an « *auto-motive model* » to explain to what extent mental representations are essential to the development of cognitive mechanisms.

The motivation / free will hypothesis enables Bargh to free himself from the computer metaphor in which cognition is reduced to serial processing; and to envisage mental processes as processes that rely on parallel or connectionist mechanisms[4]. Mental processes evolve in parallel with various perceptual and motivational mechanisms. As highlighted by the Simonian approach, cognition is not the only driving force behind this dynamic, nor is it the only element of the decisional process. The interactions between cognition and motivation are therefore essential and must be taken into account. Consciousness is essential in that it initiates the process of skill acquisition and the process through which the

[4] This raises a number of problems. Indeed though mental processes can be considered as relying on simultaneous and/or parallel mechanisms, the body operates differently from the mind. The body is not capable of generating processes in a parallel manner. According to Bargh, consciousness can enable the subject to adjust what the mind and what the body can do. The serial aspect is reintroduced because it enables the individual to adjust what he/she wants to do and what he/she actually can do!!

individual modifies these skills; thus it can detect possible tensions arising during the acquisition of cognitive processes:

> *« But even in the case of these automatic motivations, it is possible for a person to become aware of his or her actions and, as in the case of bad habits, attempt to change those behavior patterns. This question of how automatic and conscious motivations interact when in conflict is one of practical as well theoretical importance, and we are now investigating parameters of this interaction" ( Bargh, ibid, 52).*

*133. Consciousness and free will in memorization process*

As Bargh & Chartrand (1999) acknowledge, the question of consciousness in mental processes has always been a thorny one, but current research tries to show why the co evolution of the potential automaticity and of free will is far form being a myth. The aim is to understand why and in what context a shift occurs from a so-called « more automatic » process to a so-called « more deliberate » and conscious phase[5].

Though the debate over the role of consciousness in memorization processes is not new, it was for a long time perceived as a philosophical issue rather than as a real question about a psychological process that deserved to be studied. Bergson had already answered this question in a literary manner by highlighting why repetition is not the contrary of free will. Indeed, in order to memorize something, one must make sense of it otherwise the body does not follow the process. Both forms of memory being closely interwoven, Bergson puts automatic memorization processes in perspective by highlighting the role played by individuals' free will and freedom in the process of memorization.

> *"We are right when we say that habit is formed by the repetition of an effort; but what would be the use of repeating it, if the result were always to reproduce the same thing? The true effect of repetition is to decompose, and then to recompose, and thus appeal to the intelligence of the body. In this sense, a movement is learnt when the body has been made to understand it." (Bergson, ibid:137)*

Furthermore, Bergson shows that although our memory is tuned to our body, "what is automatic in the evocation of remembrances" has been greatly exaggerated (Bergson, ibid: 117). And in this automatic *memorization tendency there are:*

[5] This synthesis is recent; indeed for many years psychology attempted to separate these processes instead of viewing them as working together, and empirical studies focused on one of the phases without managing to coordinate all the interacting cognitive processes.

> "*inner movements of repeating and recognizing that are like a prelude to voluntary attention. They mark the limit between the voluntary and the automatic*" (Bergson ibid: 145, my emphasize)

What Bergson highlighted, at the dawn of the 20th century, without being able to demonstrate it scientifically (that is experimentally with subjects in the process of learning) was that consciousness, freedom and free will were all involved in the same memorization process. Contemporary research has confirmed and refined Bergson's hypothesis but decades were necessary to reach to this conclusion because *« Free will has always been something of a problem for behavioral scientists »* (Carver, 1997, 98). And because the studies in biology and psychology were all based on the behaviorist paradigm, it took a long time to dismantle it and construct new hypotheses.

Recent studies converge on the fact that the consciousness vs. automaticity opposition is a dichotomy that is no longer valid because it has now become clear that consciousness accompanies, rather than replaces, the processes of automatisation (Baumeister & Sommer 1997; Tzelgov 1997; Bargh and Chartrand 1997; Carver ibid, Gardner and Cacioppo, 1997). Psychologists agree that both processes evolve together; which leaves unanswered the question of what context and environment cause this process to stop. Indeed:

> *"Consciousness is a state of relative indeterminacy. Consciousness creates a hole or gap in the deterministic web of causal relationships that shapes human behavior so to speak. Under familiar comfortable circumstances, certain causes lead smoothly to certain behavioral responses. Consciousness can disrupt and alter those connections, thereby disengaging behavior from its usual causes" (Baumeister & Sommer,ibid, 79).*

Furthermore, acknowledging the role of consciousness and free will in memorization processes implies recognizing that chance and the environment have a limited role. In terms of memorization, this boils down to no longer focusing all attention on the mechanisms of procedural knowledge learning, and to acknowledging the fact that declarative knowledge is an essential tool in the memorization process.

In other words the transition from representation to action is a mechanism that needs to be explained if we are to understand how our procedural knowledge evolves and why there is a gap between what an individual thinks he/she does and what he/she actually does (Tzelgov, 1997). In short, declarative and procedural knowledge appear to be indissociable and understanding the origin of their co-evolution is critical for perceiving the link between individual and organizational routines.

*134 Routines and cognitive automatisms : some potential semantic confusion*

The debate on organizational routines and automatisms has always had a more or less positive connotation because, even though contemporary research has intentionally distanced itself from the literal meaning of the term "routine", a good number of researchers seeking to observe organizational routines have always associated this research to processes that actually present little interest: « *It suggests the routine, mindless operation of thousands of people turned into mechanized pieces* » (D. Cohen, 1997:129). We shall see later in this article why this debate on consciousness (mindful *vs.* mindless) has been at the heart of the questions of organizational attention and routines.

From a wider point of view, it is interesting to note that the notion of "cognitive automatism" is not used in cognitive sciences only. Many economists have used it in their studies (Schumpeter, 1926 or more recently Kahneman, 2000) to explain decision-making processes and forms of individual rationality. This term -« *Automatismus eines ausbalancierten Kreislaufs*" (Schumpeter, 1926: 112)- used in 1926 by Schumpeter literally means "*Automatism of a balanced circular flow*" in English and was translated as "*The routines of the circular flow*" in the English version of 1934 (Becker, Knudsen March, 2006: 354). Many other terms were introduced in the English translation in which he was personally involved. Thus, there has for a long time been a confusion or analogy between both terms, in economic and cognitive science works alike. This source of misunderstanding must be emphasized as the actual notion of "routines" is faraway from the initial sense given by Schumpeter in 1926, because contemporary studies in cognitive, social and organizational sciences have provided new representations to address the question of organizational change, and therefore to gain a better understanding of organizational routines.

## II) Towards new micro foundations of organizational routines?

Approaching the individual dimension as a driving force behind the evolution and change in routines does not necessarily imply the mobilization of so-called "methodological individualism" as a framework of analysis. According to Abel, Felin and Foss (2007), change in routines, such as it is described by Nelson and Winter (idid) is only determined by external processes, that is, processes of competitive pressure that modify firms' characteristics. In other words, the sources of change are exogenous and not endogenous. Two questions arise from this: one related to the debate on the level of analysis (should one examine knowledge at individual or organizational level?) and another one related to the intentional or non-intentional nature of this change.

We shall address these issues in order to fully understand the organizational level. Moreover we shall integrate new complementary insights. Indeed the development of routines appears to require will and sustained effort so that new procedural memory can be created. The organizational dimension deserves careful observation because it is the *locus* where the individual and collective efforts are coordinated.

This debate is far form neutral to fully understand the evolution and stability of routines and their triggers such as the motivational dimension and the notion of effort raised by Leibenstein (1987).

### 2. 1. Does what we know about individuals' memorization processes apply to organizations?

Researchers often borrow references from cognitive science to explain individual memorization, but this can make it difficult for them to shift their analysis to the organizational level. This results in epistemological levels (if one does not refer to the same theories of memory [5]) and ontological approaches that differ according to the level of granularity and of analysis from which the question is examined (Lazaric, 2000). However, even if individuals do not memorize in the same way organizations do, it is important to recognize their memorization processes in order to understand how they can develop certain forms of memorization and how the later impact and foster collective memorization.

This debate, which has brought us into the heart of cognitive science, has raised the fundamental methodological question of how analyses of individual knowledge could be transposed to the level of organizational knowledge. Indeed, several authors consider that organizations do not "remember" in the literal sense of the term. Bartlett (1961), although he shared Bergson's point of view concerning the re-composition within individual learning processes, had his doubts concerning organizational memory. He favored the term "*memory within the group*" over the term "*memory of the group*" (Paoli and Prencipe 2003). Thus, it appears that the concept of "organizational memory" should not be understood literally but at metaphoric level (Divry and Lazaric 1998). Michael Cohen and Bacdayan are confronted with the same question in their observation of collective forms of memorization that go beyond individual forms of memorization.

The hypothesis that routines are distributed, was confirmed through a study on card games, helps to understand how routines form at individual level, and how they are transferred within a group, without the players having to consciously elaborate a strategy of knowledge exchange and transfer (Cohen and Bacdayan, 1994). Indeed, in their experiment, the card players do not speak to each other and yet develop common strategies and rules of action that are transferred within their group. The concept of "*transactive memory*" (Wegner 1987; Wegner *et al.* 1991) is in the same vein for explaining how individuals' memory lies within a social context. Indeed an experimental study was repeated in a laboratory in order to test how groups performed a task. Liang *et a*l (1995) identify three factors of performance that form the "*transactive memory*". The first effect is the specialization of certain aspects

[5] The Simonian approach differs from Polanyi's approach. And these are but two examples of the different cognitive theories used in the analysis of routines.

and the differences between the groups according to whether or not their members were trained together; the second is coordination, i.e. the individuals who know each other will cooperate more naturally and in a more flexible way; the third is knowing and being able to trust other individuals' skills. Liang et al's study shows that the groups whose members were trained together perform better than the groups whose members were trained individually, hence the importance of interactions between individuals and the development of a "transactive memory".

The literature on organizational memory provides an explanation of why organizations' memory is not the sum of individual knowledge, but part of the latter, which will be used and activated within organizational routines. Organizational memory is thus "*collective beliefs, behavioural routines, or physical artefacts that vary in their content, level, dispersion and accessibility*" (Moorman and Miner, 1997).

On the basis of this definition, several authors have attempted to determine the impact of the content of organizational memory. Indeed, the centralized or decentralized nature of an organization, as well as the level of memorization (intense or low) has an impact on the firm's creativity – for example on its economic performance and creativity during the launch of new products. Thus, Moorman and Miner (ibid) underline the difficulty of determining, in practice, the right dosage of procedural memory and of declarative memory. Too much procedural memory within organizations can hinder creativity because then, firms find it difficult to absorb new knowledge. This balance is also very sensitive to changes in the environment. If organizational memory is dispersed but contains a minimal level of procedural knowledge, firms can then innovate and create new products even in a turbulent environment. However, the dispersion of knowledge can have a negative impact on competitiveness in the case of a turbulent environment, and a positive impact on creativity and performance in the context of a relatively stable environment. The conclusions of the study show that a sufficient degree of procedural knowledge enables firms to absorb new knowledge, but that the nature of this knowledge (centralized or scattered) has a structuring impact in the ability to assimilate (Moorman and Miner, ibid)[6].

Thus, the debate on methodological individualism could be questioned here. Though memorization is done by individuals, organizations are characterized by a collective form of memorization that enables them to maintain internal coherence and their long-term viability. An organization must also coordinate the beliefs and subjective representations of its staff in order to exist as a coherent entity. An

[6] A complementary study was conducted in some firms of the food-processing industry; it shows that a high degree of procedural knowledge has a positive impact on efficiency but a negative impact on creativity, and that it is necessary for both forms of memory to evolve together in order to stabilise the organisation and promote its creativity. Indeed, food-processing firms tend to extensively codify their practice, which creates important amounts of procedural knowledge but reduces their innovation capacity. Indeed, the combination of large amounts of procedural knowledge with internal or external information flows does not allow for creativity; this is due to the fact that the high degree of existing procedural knowledge hinders the absorption and assimilation of new information (Kyariapoulos and Ruyter, ibid.). This result is in keeping with other studies concerning ISO standards that underline why the implementation of ISO standards has a positive impact on attention and detail at the expense of innovation capacities (Naveh and Erz, 2004).

organization that does not do so is bound to failure because it would then be incapable of developing a common organizational culture to which individuals can refer. Furthermore, the analysis of routines cannot focus exclusively on the organizational or macroeconomic level (with a holistic framework of analysis), but must envisage routines as the result of the interaction between the individual and collective dimensions. An analysis at organizational level therefore helps explain this apparent dichotomy. Thus:

> *"Organizational routines are a unit of analysis that allows capturing a level of granularity significant for organizational change. (An analysis that remains too much on a macro-level will be systematically incapable of capturing many interactions and their effects on actors and the environment). Considering routines enables the researcher to 'zoom in' on micro-level dynamics and identify driving forces of change on that level." (Becker et al . 2005: 776).*

**2.2 Endogenous or exogenous change**

The origin of change in routines is a question that deserves particular attention. In the first part of this article I have focused more specifically on the endogenous sources of change in routines and discussed the different forms of memorization (declarative and procedural) by putting emphasis on the internal driving force behind this transformation: the motivation and free will of individuals. This approach – particularly in terms of the forms of individual memorization and their evolutions – helps understand the debates that are specific to different disciplines and try to clarify the meaning of the concepts that are currently mobilized. Indeed few years ago change in routines was considered more likely to be determined by change in the environment (Cohen *et al* 1996: 683).

This criticism also applied, more widely, to the Evolutionary Theory of change (Andersen 1994). Indeed Nelson and Winter's works can, at first sight, be interpreted as meaning that the competitive environment and external forces are the only determinants of change in routines; but a more careful reading suggests otherwise.

A source of competitive advantage definitely lies in the firm's ability to copy routines that exist in other firms; but also and above in its ability to extend its own internal routines. This internal extension of existing organizational forms may indeed be imperfect and costly, but it can also be a precious source of evolution and change. Indeed, novelties are often produced through imperfect replication of internal elements ('*the combinatorics of routines*'). This is an element of reflection borrowed from Schumpeter and developed by Winter, to explain the extension and renewal of knowledge databases in a given competitive environment (Becker and Lazaric 2003; Becker, Knudsen and March, 2006).

Finally, it is important to note that existing analyses of change in routines concentrate on internal or external changes, but few of them examine the possible interactions between both sources of change. Indeed, organizations have the ability to interpret external signs in many different ways; as a result, the intentional or non-intentional nature of change is often difficult, for an outsider, to observe. More longitudinal observations will be necessary in order to answer this puzzling question, and particularly to better understand how external signals are interpreted and how they can lead to internal organizational change (Galunic & Weeks 2002; Miner 1994; Plunket 2002). This question of primary importance for future research should deserve full attention, for having a better understanding of the co-evolution of social and cognitive processes as a double source of change in routines.

**2,3 Free will at the heart of the debate on organizational routines**

A question that arises when studying routines is that of their changes and renewal. And as Feldman (2000) explicitly acknowledged, the fact that routines change is difficult to admit. One can legitimately ask why. What is more, admitting that routines change boils down to acknowledging that declarative and procedural memories co-evolve and that determination and consciousness also do; which means that routines are - as Langer suggested (Langer 1989 ; Langer and Modoveanu 2000) - activated in a *mindful* manner.

In fact, Langer recognizes that researchers in social sciences have tended to base their reflection on the mind-as-computer metaphor (Newell 1990). This metaphor proved useful to characterize many situations but over time it has become an analogy and a veritable « *epistemological obstacle* », in the sense meant by Bachelard (1938). Thus, many scholars have been misled by this analogy in that they ended up thinking that the mind truly behaved liked a computer instead of seeing that the mind could, in a metaphorical way, bear a resemblance to a computer. [7]

The mind-as-computer metaphor has made it possible to, often simplistically, envisage cognitive phenomena as algorithmic information processing, when in fact most cognitive processes are different (Lazaric and Mangolte 1999). Thus, for many years researchers approached routines from the angle of procedural knowledge only, forgetting about the significance of the meaning, origin and dynamic of that knowledge. The problem is not the metaphor itself but the way it is interpreted. For example Cohen and Bacdayan's (1994) definition of routines as procedural knowledge is still valid as long as it is understood that this definition does not consider routines as involving the processing of congealed information, but rather of knowledge that evolves in a given organizational, social and institutional environment.

[7] And metaphors are robust because they are difficult to invalidate empirically (Langer and Modoveanu 2000).

This is the reason why Langer rested on the notion of "*mindfulness*" to highlight individuals' attention inside cognitive automatisms. In this theoretical perspective, individuals should make sense of what they do and perceive, by increasing their acuity so as to be able to integrate new information, to continuously update and refine their mental categories. In short, and as Bergson highlighted, learning a lesson by heart is not enough to truly memorize it; in order to do so one must make sense of what one does and perceives (Bergson, ibid).

Indeed, the notion of "*mindfulness*" emphasizes the necessity of focusing not so much on simple quantitative questions of data storing, but on the quality of the memorization. Experimental studies show that working groups that apply this principle memorize what they learn better and are more creative (Langer, *ibid*). This principle has also been implemented in industrial work procedures and in complex technological environments so as to reduce the risk of accidents. Observing industrial environments has made it possible to see that organizational mindfulness and individual consciousness were vital in preventing major technological disasters (Weick and Sutcliffe, 2001, 2006). This implies that potential change in routines should not be seen as a fateful coincidence related to external and disruptive factors, but as a crucial ingredient to the revitalization of individuals and organizations. This leads us to reconsider the very meaning of the term "routine" and to focus on individual and collective memorization processes.

> *"Routines now appear to be more mindful and more variable and to consume more attention that was first thought. The continuum of mindful action that had previously been masked has now become more difficult to ignore" (Weick and Sutcliffe, 2006:522).*

Indeed, organizations that apply procedures in an automatic fashion and without understanding them and the context in which they were implemented can eventually face serious difficulties. At organizational level, this has significant implications as indeed the organizations that rely on routines might, in their daily mobilization, forget the context in which they were learned and their significance. This is the reason why in some organizational contexts and certain collective tasks, some groups may tend to rely on old procedural knowledge without questioning its adequacy. This can lead to organizational inertia, conservatism, and even to spectacular catastrophes. The best known is that analyzed by Gersick and Hackman (1990). These researchers have shown why certain groups of individuals tend to rely on old know-how without being able to call it into question when the situation requires such a change. This can lead to an individual and/or collective inability to recognize new information and to consciously encode it into procedural memory. For example, in the case of the air disaster of January 13th 1982, the crew proved incapable of questioning the usual procedures and to recognize that they were faced with a new situation in which heavy snow falls and the presence of ice in the engines called for the activation of the engine anti-ice system. The members of the crew seemed "locked" in traditional procedures and performed the usual tasks (check list) without modifying any.

This accident has led researchers to discuss the organizational problems that can arise within groups of individuals and the maintenance of certain automatic procedures that should have been eliminated. The failure of the aircraft crew to question their procedural knowledge could have been avoided if they had acted in a less routine-like fashion and had trusted their common sense. This shows the strength and weakness of procedural knowledge. Indeed, it is used to stabilize information but can also become a trap if its carriers do not call it into question on a regular basis. This is the reason why some authors recommend that attention be focused, not only on the accumulation of knowledge but also on the destruction of the latter. Indeed, there comes a time when individuals and organizations are incapable of absorbing new information. In this regard, Bergson ( ibid) thought it essential for individuals to dream in order to create new representations and to withdraw from the knowledge developed and destined for imminent use. Other authors suggest the importance, at organizational level, of forgetting in order to be able to carry on learning. This "organizational forgetting" must be managed consciously and carefully so that crucial technological and organizational know-how is not occulted (Holan and Philips, 2004).

In short we could say that "*mindfulness*" consists in the exploration of new frameworks or new mental representations whereas daily behavior tends to be "*less mindful*" as it consists in the exploitation of pre-existing information and knowledge (Levinthal and Rerup 2006). Naturally this dichotomy is not apparent because both types of behavior are interdependent. In all acts of creativeness, there are moments of regularity and in all regularity questions subsist.

Moreover, as we shall see below, the activation of this individual and collective consciousness has its costs for an organization. In the context of the implementation of an expert system (Sachem) designed to help the operators make decisions concerning the functioning of a blast furnace at Usinor (a firm that latter became the ARCELOR group), I was able to observe, this delicate process of creating new collective representations. Indeed various furnace operators differed in their representations of the technical processes and in some cases had opposite views on certain procedures: the fluidization process in particular. The dissection and articulation of existing knowledge forced the operators, through the creation of a common language, to examine and reconsider their pre-existing beliefs concerning the furnace and therefore their technical conceptions (Lazaric, Mangolte Massue, 2003).

This revision of beliefs and the elaboration of a language shared by the various communities of furnace operators was a very long and costly process. This ambitious project of knowledge articulation and codification also shows the limitations of such an operation in the long term. Indeed, the paradigm beliefs were dissected by calling into question the existing cognitive automatisms related to fluidization and by increasing "mindfulness" among operators so as to enable them to separate the so-called valid beliefs from the non-valid ones. Moreover '*mindfulness*' may be difficult to be permanently activated. In other words, the expert system - which was initially designed so as not to become a "cognitive

prosthesis", i.e. so that it would not become a substitute for individuals' decision making power but on the contrary encourage them to use their free will in their final decision making (by analyzing the raw data and suggesting a possible action without even imposing it) – became a few years after its implementation a comfort zone on which the new comers rested to make decisions.

The new furnace operators familiarized themselves with the expert system they helped put in place, but over time failed to call into question its architecture and the causal links between the various technical events. Thus, the operators' trust and familiarity with the system reduced their acuity particularly that of the new comers who had not taken part in its development and who then tended to consider this system as a quasi immovable technical state of the art. Over time the operators questioned the architecture of the expert system less and less frequently, which shows that it is difficult for organizations to ensure that their staff remain "*mindful*" at all times. This example also illustrates how and why social interactions foster cognitive dynamism. In this case, the organizational trust that was necessary became, in turn, a form of obstacle by causing a routinisation of the collective practices, and therefore by reducing the operators' ability to question what had taken them so much effort to develop.

This raises the question of the role of individuals' motivation and efforts in the various forms of memorization. Effort and motivation are essential for individuals to be able to call into question and objectively examine some of their practices and beliefs. As Langer recognized, there is a link between attention and motivation: "*such mindful attention also results in a greater liking for the task and improved memory*" (Langer and Moldoveanu, 2000: 3, underlined by us).

**2.4) Effort and motivation at the heart of routines**

Routines and routinisation processes should be understood not as processes that "freeze" procedural knowledge once and for all, but as processes through which knowledge evolves. Indeed, the procedural and declarative knowledge held by individuals is not inert but memorized in a certain social and political context, which leads individuals to reconfigure it actively in order to either question or modify it in the course of action according to their understanding of a situation. As Martha Feldman has highlighted in this regard:

> "*Routines are performed by people who think and feel and care. Their reactions are situated in institutional, organizational and personal contexts. Their actions are motivated by will and intention. They create, resist, engage in conflict, and acquiesce to domination. All these forces influence the enactment of organizational routines and create a tremendous potential for change" (Feldman, 2000: 614).*

*241) The possible modulation of an effort convention to face the hierarchy*

Several interpretations are possible for this resistance of individuals. The first interpretation, found in theoretical and empirical literature, is related to the implicit or explicit resistance to hierarchy. Indeed, individuals are not passive to the new organizational practices suggested by the hierarchy. In an organizational context, individuals can also display inertial behavior because organizational changes can disrupt the "organizational truce" (Nelson and Winter 1982) on the one hand, and reduce the discretionary power they obtained within the organization, on the other (by possibly reducing their local decision making power).

The resistance met during the setting up of codification procedures also indicates the difficulty for enterprises of maintaining a balance between sustained innovation and organizational stability. Indeed, codifying procedural knowledge, as in the context of ISO standards, responds to a need to articulate and memorize existing knowledge by giving less room for creativity. Nevertheless, behind managerial methods, there often are gaps between what individuals and organizations claim they do and what they actually put in practice. This gap can be analyzed as a form of resistance or as a certain amount of discretionary power or leeway enjoyed by the individuals. These evolutions are also observed at political level in organizations that claim to have implemented a certain level of organizational practices, but whose theoretical claims are not corroborated by reality. The discrepancy between "ostensive routines" and "performative" ones which has been studied theoretically and empirically (Feldman and Pentland, 2003) shows organizations' difficulty in controlling the routines developed and their lack of power in the face of individuals' free will.

Leibenstein (1987) reaches a similar conclusion and highlights that the individuals in an organization exert varying degrees of effort. Their effort convention is implemented in relation to local practices and the individuals exert more or less effort depending on a given social and historical context, in other words, depending on whether or not they like the conditions in the firm.

In the nuclear industry, this gap between existing routines and the routines that should be implemented has been well described by the concepts of "official memory" and "underground memory" (Girod-Seville, 1998). In this industrial sector, the level of prescriptive specificity is quite high, which sometimes causes individuals to deviate from the administrative rules and to invent and combine their own practices to solve problems. This leads to differences between the official level of memory such as the management team sees it and the reality of this organizational memory. The individuals' creativity and resistance generate knowledge and cognitive representations that differ from the level prescribed by the management team. The political and cognitive dimensions are therefore the two hidden sides of one same process through which routines develop, but whose content oscillates between repetition and creativity depending on circumstances and on individuals and organizations' dispositions.

*242) The necessary involvement of individuals in the creation of a new form of procedural knowledge: an illustration*

The second possible interpretation for individuals' resistance is that the new forms of knowledge cannot be implemented in a "mindful" manner if they do not make sense to the individuals. As Feldman (2000) suggests, routines are "*effortful accomplishments*" and "*emergent accomplishments*". Thus, until the individuals have accepted and made sense of them, they cannot be deployed as they should be (i.e. requiring minimal vigilance for their application). The example below illustrates the difficulty of the process.

Through a case study B. Denis and I conducted in the mid 1990s, I was able to observe this difficult memorization and routinisation of tasks (Lazaric and Denis, 2001, 2005). The firm we surveyed (Defial) was a food-processing enterprise that supplied meat to wholesalers and collective caterers. This company was in the process of implementing the ISO 9002 quality standard and for this purpose had to reconfigure its knowledge base (for a detailed analysis and an explanation of our empirical observations, see Lazaric and Denis 2005).

This resulted in a new memorization and routinisation of tasks, but involved great difficulties both socially and cognitively. In order to implement the ISO 9002 standard, the firm Defial needed to reconfigure its organizational memory. Before the implementation of this standard, the employees - technicians and employees - had important discretionary powers with regard to quality control in the workshop and during the different stages of meat cutting and processing[8]. The introduction of the ISO 9002 standard represented a break from the traditional routines existing in the firm. Indeed, change occurred at two levels. Firstly, new technological tools were introduced: scales, automatic measurement and tuning devices as well as computers for the follow up and compilation of all technical data. The goal was to ensure traceability of the meat, and this could only be achieved by using new control and measurement tools. Secondly, the data collecting tasks were redistributed and centralized with the introduction of a quality manual in which was centrally memorized all the data related to organizational practices, the follow up between the various groups and the different stages of production. Although this process of change does not, a priori, seem complex, it proved extremely difficult to implement. The reasons for this difficulty deserve careful examination.

In fact, one of the reasons was related to the high level of procedural knowledge. Defial was a traditional family enterprise well established in the region, and whose functioning and organization had

[8] However, the health safety crisis that affected the beef market in Europe led to the implementation of strict selective measures that forced meat suppliers to comply with new quality control procedures, or else face eviction from the market. Thus, Defial had to implement the ISO standard rapidly, for fear of losing its regular clients.

remained almost unchanged since the mid 1950s[9]. Practices were therefore transferred "on-the-job" by employees and the average productivity rate depended on the level of cooperation between the employees and their ability to reduce intra organizational conflicts. The management team spent very little time in the workshop and trusted their foremen. As a result, the knowledge was transferred empirically without the management team intervening to verify the content of the work. Quality control was the responsibility of the maintenance team who collected samples of meat to have them controlled externally. In this context, the volume of procedural knowledge evolved progressively and regularly.

The introduction of the ISO norm had a significant impact on both forms of knowledge memorization. Indeed, declarative memory was disrupted by a sudden inflow of new organizational and technical procedures.[10]. In short the new division of labor required that the employees remain vigilant at all times (i.e. mindful), and "unlearn" some of their old procedural knowledge. For most employees the new process of memorization was difficult, firstly because of the employees' resistance to the changes that were taking place, and secondly because the new declarative knowledge that was to generate new procedural knowledge was not introduced and assimilated in one day. The cognitive automatisms were acquired more or less easily during the training phase and the employees inevitably experienced the "information overload syndrome"[11].This is well illustrated by a remark made by a member of the management team:

> *"Employees played their role, but the compilation of documents caused a major upheaval. In an effort to increase awareness among employees, we, along with the quality manager, summoned each team in turn and explained the role of the new procedures, why they were implemented, and why it was important for employees to record their actions. Although initially the operators recorded how they operate the controls, they soon stopped focusing and forgot to write down what they were doing. We (the management) had to constantly be there in order to observe them. Now the practice of taking notes is carried out more automatically. It is becoming an automatism" (The management, Defial, in Lazaric and Denis, ibid)*

[9] The technical tools used evolved progressively but organizational practices had changed very little. With regard to the labor force for example, the firm recruited and then trained local people with low levels of qualifications.

[10] The workers had to familiarize themselves with the new technological tools and learn how they functioned. In parallel to this, a new system of information flow management was implemented to facilitate information processing within teams, select significant practices that could serve as references, write the main control procedures implemented and transfer them to the following stage of production, and finally compile descriptions of all stages of production and make them available to the quality manager who could, if need be, modify the way in which certain tasks were performed. The volume of technical and organizational information needing processing was vast, especially for employees who were not accustomed to using computers to compile lists of technical problems.

11 The process was gradually stabilized thanks to the implementation of a training course that increased the employees' empirical knowledge and taught them how to manage the various flows of information and synchronize it adequately even though the technical objects are highly dispersed. Moreover, the volumes of information, which had previously seemed unmanageable, were progressively processed and distributed more efficiently between the different actors. Learning to compile data efficiently was essential to the creation of procedural knowledge.

The difficulty of memorizing tasks observed in Defial also explains why the creation of new procedural knowledge was uneasy. Indeed, individuals are very sensitive to the content and meaning of their work and might not always accept a reconfiguration of their knowledge and the implementation of new representations of the latter. Furthermore, and this is a question that deserves examination, the individuals who resist change because they do not wish to shake their habits or work in an environment that demands great attention and energy, are not necessarily the least capable of changing their procedural knowledge. These individuals can derive great pleasure from learning foreign languages or from trying a new sport. Consequently, the evolution of procedural knowledge in an organizational context, and simultaneously in a context of private life, needs to be explored to better understand the sources and content of procedural knowledge. The recent studies have made important contributions, but more in-depth observations are necessary to understand how the organizational context affects individual procedural knowledge and its representations (for a longer discussion see Becker *et al.* 2005).

*243 Effort convention and motivation: a discussion*

Using Defial's example of task memorization, I have tried to show why the creation of new automatisms was a delicate exercise. Indeed, individuals demonstrate some resistance to unlearning. Furthermore, although the incentive system plays a fundamental role, it does not solve all the problems. Individual and collective involvement is also needed. This sustained effort is the keystone of the setting up of new organizational routines and implies genuine individual and collective motivation. We can clearly see here that the debate on cognitive science is relevant to the study of routines and that it helps understand the difficulty, for organizations, of changing routines. Motivation is a conscious act and a commitment of individuals to take part in a new learning process, and as Leibenstein noted (1987), authority and hierarchy cannot take the place of this deliberate effort.

According to Leibenstein, the hierarchical structure could not control the daily routines of its members because they are able to exercise their discretionary power (Leibenstein 1987). In this perspective, an exploration of the micro foundation of the firm is necessary in order to better understand the social context in which the individuals modify their efforts (Leibenstein 1979), and more specifically, in what conditions they can reconcile their personal interests and those of the organization[12]. This compromise, called the "effort convention", is a state where individuals have discretion in choosing the level of their

[12] In the Simonian framework, the individuals in the organization must accept the targets of the organization and must identify psychologically with these targets ( Simon 1991)

performance; *This effort convention could* be described as a "social habit" or "a routine that has an interpersonal component" (Leibenstein, 1982: 93).

The question of motivation is not new (Bargh, ibid) and has been at the center of many studies in the fields of social psychology and organization theory. Deci and Ryan (1985) have shown, through the "self determination theory", that there exist several forms of motivation: the motivation which is intrinsically linked to the individual's values (i.e. his internal and inalienable values) and the extrinsic motivation which is more dependent on the "external environment" and is related to a tangible or intangible form of reward (moral recognition or classic reward system such as that of bonuses) [13].

The literature on motivation has expanded dramatically in the past few years. It is therefore not my intention here to describe it in detail (also see Gottschalg & Zollo, 2007). However, the notion of motivation is seldom related to the notions of effort convention and of routines (for rare exceptions, see Mangolte & Guennif 2002, Lazaric & Raybaut 2005, Foss 2007). And yet motivation now appears to determine, firstly, the way in which individuals involve themselves and take part in the implementation of new procedural knowledge or new "performative routines" (Feldman 2000), secondly their ability to examine their own cognitive automatisms with a critical and vigilant eye (Langer and Moldoveanu, 2000) and finally how they make sense of their work (Weick 1979, Reynaud 2005).

The motivational dimension has never been completely ignored in the conceptualization of routines. Indeed, in their analysis of organizational routines, Nelson and Winter (1982) highlighted two dimensions: the necessity to sustain an "organizational truce" if the firm is to function with efficiency and regularity, on the one hand, and the organizational reality and the difficulty of avoiding conflict within the firm on the other: *" routine in operation is consistent with routinely occurring laxity, slippage, rule-breaking, defiance and even sabotage"* (Nelson and Winter, 1982; for a more detailed discussion also see Becker, Lazaric, Nelson and Winter, 2005, 779).

Motivation and the social and cognitive dimension therefore co-evolve with one another and it is the very nature of this co-evolution that needs to be understood. The aim is not so much to show that a political dimension is added to a more "cognitive" dimension, so much as to understand the interactions between the two. The effort convention does not imply that a new dimension is added to the theory of routines, but more modestly, that we must understand how certain cognitive automatisms can have a social and institutional origin, which can help us understand their possible evolution.

[13] The limitations of the incentive system, notably with only extrinsic and monetary compensation, have been very well documented in the literature showing the ambiguity of the bonus rule. Firstly, bonus rules are path dependant and entangled in a more global incentive system with potential myopic behaviours (Reynaud 2005). Secondly, incentives might not always be necessary to generate effort in the presence of complementary variables such as moral motivation of fairness.

Nevertheless, and as Leibenstein highlighted, human nature is largely unpredictable and how much effort individuals mobilize is unforeseeable. This is the reason why he proposed a micro-micro theory of the firm to observe the evolution of individuals' efforts in their organizations. Finally, it is interesting to note that Leibenstein's reflections concerning this dimension are very close to Feldman's thoughts on effort and individual freedom. In this respect Dopfer (2007) noted:

> *« Are humans thus identical to machines? The essential point is this: humans have cognition, autonomy and 'willed' behavior. They are subjective and their operation cannot be easily determined as they can for machines. This is the positive-theoretical aspect. Humans however are also different from machines because they are the ultimate orientation for any economic theory. A resources model that treats humans like objects misses exactly this negotiable normative point. This distinction has a significant bearing on the theory of the firm. Its component parts- subjects and objects- are organized by a social and technical organization respectively. A technical organization has positional and behavioural task rules that are more or less fixed. Technical perfection usually means a high degree of determination. Reliability is not measured in terms of willed behavior of the component parts, but as confidence in the instrumental perfection of the rules defining the construct. Agents, being subjects, are, essentially, different 'components parts' of an organization. The rules of a social organization must take on the form of norms that contain an 'ought to do'. The major contribution of Leibenstein's theory is to have made clear that there is a big gap between what agents in real firms ought to do and what they actually do " Dopfer ( 2007, 19, underlined by us).*

**Conclusion**

In order to understand what drives change in routines, I made an exploration inside the heart of cognitive mechanisms for observing the development and evolution of declarative and procedural knowledge. Some cognitive processes in human beings remain a mystery but cognitive science research is gradually shedding light on some of their aspects. Furthermore, new dimensions must be taken into account to understand the creation of procedural knowledge: individuals' emotions, free will and motivation. From this point of view, Bergson's contribution is invaluable and in keeping with many recent studies carried out in cognitive science. Bargh's contribution, by highlighting the importance of motivation, is symptomatic of this recent reconciliation between the forms of memorization considered « automatic » and the more controlled or deliberate processes. As Langer (ibid) as shown, there is also a causal relation, which should be examined more closely, between the concept of « mindfulness » and that of motivation. The debate in cognitive science concurs with the debate on organizations. Individual and organizational forms of memorization are distinct but they face the same difficulties:

how are representations made to change, how can a repertoire of knowledge used daily be changed and improved, and how can new knowledge be created?

More generally, the cognitive science debate is a detour that has enabled us to get to the heart of processes of individual memorization. This detour is essential if one is to include, in the study of organizational routines, new dimensions such as resistance and motivation. These dimensions must be taken account of when observing individuals' acquisition of new procedural knowledge (their resistance or their possible acceptance) and when trying to determine how organizations interfere on this process by « smoothing » this learning process.

Indeed, organizations use their own filters and mechanisms to generate organizational coordination. This memory feeds on individual knowledge but also has its own dimension as it does not merely consist of the sum of individual knowledge and must be able to survive when individuals leave. Memorization processes are distributed, i.e. they are impacted by the interactions of individuals with other people. The routines rest on the organizational memory implemented and on the procedural knowledge and representations of this knowledge (individual and collective representations). The organizational context where memorization processes and the creation of routines emerge can, in some measure, influence the creation of organizational procedural knowledge. However, as Leibenstein (1987) pointed out, a management team has limited control over the content of the work and the way in which it is performed and for this reason a sufficient amount of trust is necessary. An organization can create incentive measures, but is also faced with strong resistance.

Finally, change in routines is not purely intrinsic but is also caused by pressure from the environment. Nelson and Winter (1982) focused more on the changes caused by external conditions. Our contribution has been to show not only that there are also intra organizational factors that push organizations to modify their routines by recomposing and recombining them, but also that tensions between individuals and organizations arise in the face of these changes.

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