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## Impact of culture and history on operators future performance<sup>1</sup>

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### Introduction

To a certain extend, it is a bet to entitle this conference " Cognition, Culture and Design ", as this title joins three terms that could be considered as very distant. This bet could be considered as a challenge. How to connect these three concepts? It is easy for the ECCE community to bring together "Cognition" and "Design", as most of us agree that design is a cognitive process, as it is the case for problem solving, text writing or object modeling. Thus the more challenging aspect is to add "Culture" at this troika of concepts. As far as we are concerned, we consider this challenge as very relevant. We will explain why.

The traditional point of view is to consider human cognition as information processing. This is orthodoxy in our scientific community. In this view, the cognitive act is considered as "intracranial", taking place between sensory input and motor output.

In this view :

- the cognitive act is conceived as located in the central nervous system;
- it is considered as a symbolic treatment or as the building of a connective network of subsymbolic units;
- it is conceived primarily as a manipulation of internal representations corresponding to the external world.

This point of view is broadly shared in psychology and in cognitive ergonomics to explain how human beings produce and use knowledge in working activities and more generally in their relations with the world. When social, historical and cultural aspects are evoked it is most often a secondary feature. Up to now, with few exceptions (e.g. Kaptelinin, 1992), those dimensions are rarely considered as constituent elements of cognitive processes: they are not in the core of pieces of research. This

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<sup>1</sup> Communication proposed at the eleventh European Conference on Cognitive Ergonomics (ECCE 11) on " Cognition, Culture and Design"

conference that invites the notion of culture to join the notion of cognition will live up to this classical point of view. Some researchers have contributed to depict an externalist perspective to consider the way human beings use and produce knowledge. From Bruner to Vygotsky including Meyerson, it is possible to trace a clinical analysis of cognitive activity (Brassac, 2002) where social, historico-cultural and concrete aspects play jointly a role in the study of thinking.

We will then start this paper by evoking the work of these psychologists whose theses give a huge place to the concrete action of thinking subjects. Through their convergences, we will show how they can contribute to give a larger place to culture in our view on human cognition. After that, we will say some words on possible contribution to anticipate consequences of design choice from this culturally centered perspective. We will evoke some results of an empirical work analyzed through this paradigm. We will conclude on the added value of a clinical perspective of human activities at work, based on a culturalist epistemology.

## **1. Culture and cognition (Bruner, Meyerson, Vygotsky)**

### **1.1. Bruner position**

If there is one prominent author that has reconsidered his research practices in cognitive psychology, it is certainly J. Bruner. Writing about exchanges he has had with Jean Piaget in the middle of last century, he explains their shared goal : to describe the meaning built by the human being in his relation with the world :

"What meant for us this cognitive revolution during the fifties? It was an effort to put the meaning in the center of psychology. Neither the couple stimulus-response, neither observable behavior, neither biological determinants and their transformations: signification. [...] Our ambition was more radical: we wanted to discover and to describe formally the significations that human being build when in contact with his environment and to emit hypothesis on processes intervening in this building process. We wanted to study symbolic activities that human being uses to build and give sense to the world around him and to his own life." (Bruner, 1990/1991 : 18 translation by ourselves).

The message is clear. The human being, center of focus of psychology, is characterized as a *creator*. This creation is a *process* and this process is made of *semiotic activities*. These activities are *constructive* and they give sense to the world. This point of view will determine the way Bruner conceives his research activities, centered on the construction of meaning by the subject. In this perspective, the meaning is conceived as a dynamic construction where both the physical world and a man are going ahead through the semiotic activities of the human being. However, Bruner admits that he didn't [follow/keep up with] this program. He regrets that it is the case of nearly all the psychology. Bruner explains this in "Acts of meaning" in 1990 :

"When adopting the computer metaphor, the cognitive revolution turned aside of its initial goal. For me, it is useful to revivify, to brush up what was originally at the core of this revolution: the conviction that the fundamental concept of psychology is the *signification* and the processes and transactions that contribute to its construction" (ibid : 47).

To operate this about-face, the author fustigates the solipsism of the psychologists engaged in cognitive sciences, of which he regrets the negligence of the rooting of cognitive activities in the material, historical and cultural situation that however gives support to any human action. This negligence of intersubjective basement is linked to the underplay of intentional dimension of human agent.

What the man does is mold by his intentions and these intentions are determined by the symbolic systems of the surrounding culture. That is why, for Bruner, culture shapes the human mind. The path that will allow the psychologist to formalize the characteristics of human mind and of the underlying processes of its development must be those underneath the joint development of world and man. In this

difference of opinion with the information processing paradigm of main stream cognitive psychology, Bruner echoes Vygotsky and Meyerson positions.

## 1.2. Meyerson's point of view

Meyerson explains the leitmotiv of his works in the forewords of his thesis:

"Acts of man lead to institutions and creations<sup>2</sup>. [...] The psychologist knows that these creations are realized by the effort of mind, and exclusively by this effort, because hands were guided, the tools were built, the material was mold by the mind. So, the human mind is in his creations. [...] Action and thinking express themselves in the creations". (Meyerson, 1948/1995 : 9-10, translation by ourselves).

Using this word "creation" let think at pictorial, musical and other artistic productions, but in fact Meyerson uses this term in a broader way, including every human production, the result of every work or activity of a subject. So we can say that for him, the detailed study of these human productions is at the core of his research to build knowledge related to human inner mind (Parot, 1996 : 2). This idea is that trough the study of the effect of human activity on the surrounding world, namely the artifacts and institutions continuously transformed, we will reach psychological functions that are at the origin of their development. By this position, Meyerson adopts a constructivist and interactionist perspective. This interactionism is double-faced:

- Social interactionism: "[Acts of a man] are always linked to acts of other men with multiple connections". (Meyerson, 1948/1995 : 17).
- Interactionism between man and his physical surrounding : " Thinking is not possible without material medium. [...] The constraints of material is a permanent stimulant for mind : "as an obstacle to its path, it becomes the path." (Meyerson, 1987 : 107).

The human behavior is embedded in the environment in a dualistic way: "Man is continuously transformed by his action **on physical environment and on social environment**; it is not a simple transformation of his mind by the environment, but a continuous backward and forward motion [...]. Mind and environment are shaped together; so for a different environment corresponds a somehow different mind." (Meyerson, 1987 : 89).

This interactionist perspective puts at the center the notion of construction. Man is continuously building, constructing, says Meyerson. He becomes himself through his concrete creation, and this creation should take into consideration the resistance of the external world. This implicates so-called "active-experimental" activities, leading to construct material artifacts, works of art, institutions, ... "What is said with notions such as works, experience, creation, is the contribution of man to the physical and social environment, with all what this contribution supposes of reciprocal actions". (Meyerson, 1987 : 70).

So, for him, the human activity is always a projective activity, where characteristics of the human mind could be studied through the production of the human. When man creates an object, when he interacts with the external world, this informs us on what classical cognitive approaches would have considered as essentially intra-mind. He considers as central to his psychology the external productions of the subject. In this way, he is interactionnist and constructivist. The central point of his perspective is the object, the artefact, seen as an external and concrete products resulting of human behaviors. Theses products make sense and support the relation between man and objects, as well as between objects. On this point, we are close to the position of Vygotsky and his activity theory, recently revisited by the human computer interaction community.

## 1.3. The position of Vygotsky

Lev Vygotsky, the founder of cultural-historical psychology, puts also the concrete dimension of human behavior in the center of his conception.

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<sup>2</sup> The french word is "œuvre", describing what is produced by human work. There is no simple english translation, so we use creation in this sense.

"The primary form of intellectual activity is active and practical thinking, focused toward reality and presenting one of the fundamental form of adaptation to emerging problems and changing situations of the external environment". Vygotsky, 1934/1985 : 60, translation by ourselves).

His purpose is to focus his conception of psychology on concrete action. He plans to approach the human cognitive functions through the study of real activities with real objects. For him, this activity is mediated by two different media : tools and signs. The human being acts through the combination of tools and signs "that play a central role in the organization of human mental processes" (Wertsch, 1985 : 139). Tools and signs are created and transformed during the development of the activity itself and carry with them a particular culture. We can say that tools and signs play a double role in this theory; they shape and are shaped by human activity.

Technical tools are used to manipulate physical objects (e.g., a hammer) while psychological tools (signs) are used by human beings to influence other people (e.g., a concept, a publication, a graph). So they are used to transform and to act on the material environment, on the subject behavior and on the behavior of others. In his carrier, Vygotsky was more focused on the role of signs. That explains why, to approach an extended instrumental theory, Rabardel (1995, 1999) gives a central role to tools, between artifact and activity. According to him, "the tool bears, under a specific form, the whole relationship between the human being and the reality on which it allows to act, with himself and with others". This position is centered on two kinds of dialogs : dialog between human-beings, but also dialog between an human and the concrete reality. This position could be considered as being in the same line as the Vygotsky perspective.

The positions of the three authors above-mentioned agree in the role they give to concrete and socio-cultural dimensions of human behavior. This convergence gives support to conceive cognitive processes as embedded in the culture. This is also true for the specific cognitive activity we want to discuss here.

### **The future situation as included in history and culture**

When transforming a working situation through (re)conception, the two above mentioned paradigms could be considered, namely the classical cognitive one and the historico-cultural. The working situation is constrained by the concrete and conceptual tools used by the operators. Both these tools and the operators are embedded in an historical and cultural context, specific to the company where it takes place. This context has shaped the tools and the operators' reactions over the years. Then, when interested in the consequences – more particularly for what safety is concerned – of a concrete change through design of this situation, the ergonomist should take into account the way this culture and this history will affect the future behavior of operators facing the new designed situation. This could be of great help to accompany the choices in design. Indeed, the way the operators will face the new situation is not only determined by their cognitive capacities, but also by how in their enterprise, their practices in the previous situation has built for them a particular way of tackling similar problems. Then, to have an idea of how safe the future situation will be, the ergonomist could need this historico-cultural perspective to understand human response to the future situation.

In our speech, we will develop this framework in a concrete study using a simulation of the future situation. Due to a lack of space, we will only summarize here the key elements.

In this study, control room operators with contrasted level of experience (novices versus experts, corresponding also to two levels of cultural impregnation through the practice of the old situation) had to deal with a simulated future situation, selected for the difficulty it bears. The study brings two astonishing results:

- 1° confronted to this new problem, experts proved to be less efficient than novices, namely for what safety criterions are concerned ;
- 2° during the debriefing, these experts overvalued their performance, considering that their reactions were roughly adapted and under evaluated the consequences for the plant on safety.

An explanation in terms of cognitive process is not satisfactory, as this frame doesn't provide any clue to explain this lack of concern for goals related to safety. It seems that the way competing goals of production and safety is carried out in the culture of the company for years, so an historico-cultural perspective, is a better candidate to explain these two astonishing results.

### Conclusion

Classical cognitive ergonomics is, without doubt, a useful tool to study design problems. However, in some cases, the way people will apprehend the future situation (result of the design) is difficult to explain with models focused on information processing characteristics of the human brain. Besides this frame, some field data prompt us to take into account the historico-cultural context. This context, largely carried out by material and conceptual tools around the operator, has shaped, day after day and during years, the way he will consider the new reality that the designer is aimed to conceive for him.

In psychology, conceptual frameworks have been proposed by many authors to integrate this dimension, and we hope that this conference and our presentation will contribute to heighten our collective awareness of their potential contribution to our field.

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