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ERGONOMICS AND WORK MEMORY – ANALYSIS IN THE LIGHT OF COGNITIVE SCIENCES

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Abstract: Ergonomics is the study of adapting work to man. Work has a very broad meaning, covering not only those machines and equipment used to transform materials, but also the whole situation in which the relationship between man and his work takes place. This involves, in addition to the physical environment, the organizational aspects of how that work is scheduled and controlled to produce the desired results. Ergonomics, based on the ergonomic analysis of work and mobilizing knowledge in different scientific domains, is therefore able to propose, in existing situations, ergonomic arrangements in socio-technical systems and, in future situations, ergonomic design recommendations. Thus, cognitive science increasingly recovers robotics, as the perception grows that the replication of embodied minds, that is, intelligences endowed with a body that acts in a real environment. Most researched working memory models emphasize a high level of control and regulation of cognitive and perceptual-motor processing. Such studies tend to take the view that attentional control functions are an essential part or a subset of a larger working memory system.
Keywords: Ergonomics. Work Memory. Cognition Sciences.

INTRODUCTION

As time goes by, ergonomics becomes relevant all over the planet and, particularly, in Brazil. Its application, in addition to responding to this type of demand, contributes to increasing productivity and improving workers' health.

Highest productivity and quality possible with minimum cost; new technologies and production processes constantly emerging; and continuous overcoming of goals are some of the characteristics of hypercompetitiveness in the globalized market.

The demands on organizations and workers increase dramatically.

In addition, the successful memorization process is fundamental for the person to carry out learning and adapt to the environment in which he is inserted.

The study of ergonomics can also contribute to the understanding and development of cognitive systems.

A person with memory problems may have difficulty performing simple tasks.

Thus, the relevance of the interaction of ergonomics with work memory, analyzed in the light of Cognitive Sciences, increases.

ERGONOMICS

Ergonomics is pretty comprehensive. It studies complex systems, where dozens or even hundreds of elements interact with each other. Ergonomics has also expanded horizontally, encompassing almost all types of human activities. Currently, this expansion takes place mainly in the service sector and even in the study of domestic work.

Thus, it can be said that ergonomics is the study of adapting work to man. Work has a very broad meaning, covering not only those machines and equipment used to transform materials, but also the whole situation in which the relationship between man and his work takes place. This involves not only the physical environment, but also the organizational aspects of how that work is scheduled and controlled to produce the desired results.

The term ergonomics designates a domain of intervention constituted from several scientific disciplines, whose objective is to study work in order to adapt it to the physiological and psychological characteristics of man. Understanding work to adapt it to man requires a multidisciplinary effort.

According to Guimarães, ergonomics is a new science that transcends the orthodox approach focused on the individual, with the co-participation of psychology, industrial

engineering, industrial design, administration, etc., conceiving, transforming or adapting work to human characteristics (RIO; PIRES, 2001).

Adaptation always takes place from work to man. The reciprocal is not always true. That is, it is much more difficult to adapt a man to work. This means that ergonomics starts from human knowledge to design the work, adjusting it to human capabilities and limitations.

By definition, it can be said that ergonomics is the study of the relationship between man and his work, equipment and environment, and particularly, the application of knowledge of anatomy, physiology and psychology in solving problems arising from this relationship (IIDA, 2003) .

To accomplish its goal, ergonomics studies various aspects of human behavior at work and other important factors for the design of work systems, which are: man, machine, environment, information, organization and the consequences of work.

In the light of the magisterium of FIALHO, BRAVIANO; SANTOS, 2005), the goals achieved by ergonomics are the safety, satisfaction and well-being of workers in their relationship with production systems.

Efficiency comes as a result. In general, it is not accepted to place efficiency as the main objective of ergonomics, as it, alone, could mean sacrifice and suffering for workers and this is unacceptable, since ergonomics aims, in the first place, at the well-being of the worker .

Probably, these objectives are already part of the normal concern of designers such as engineers and industrial designers, managers and administrators of companies. The difference is that ergonomics deals with these issues scientifically, having accumulated knowledge and methodologies to interfere, both during the design and during the operation of production systems, with reasonable certainty of producing satisfactory results.

According to Iida (2003), the problem of adapting work to man does not always have a trivial solution that can be solved in the first attempt. On the contrary, it is usually a complex problem, with several comings and goings for which there is no ready answer.

Surveys provide a body of knowledge, general principles, basic measures of man's physical abilities and techniques for evaluating the effects, on human performance, of factors related to the design and operation of machines and the work environment. All this knowledge must be applied in each case or adapted to a given situation, in order to produce the desired result.

In an ideal situation, ergonomics needs to be applied from the initial stages of designing a machine, environment or workplace. These must always include human beings as one of their components. Thus, the characteristics of this human operator must be considered together with the characteristics or constraints of the mechanical or environmental parts to mutually adjust to each other.

Ergonomic practice consists of issuing value judgments regarding the overall performance of certain man-task systems.

As such systems are usually complex, involving relatively varied expectations, an attempt is made to facilitate the assessment of global performance based on the principle of global analysis/synthesis. This principle is based on the decomposition of the global judgment into partial judgments and their consequent recomposition (FIALHO, BRAVIANO; SANTOS, 2005).

Ergonomics, based on the ergonomic analysis of work and mobilizing knowledge in different scientific domains, is therefore able to propose, in existing situations, ergonomic arrangements in socio-technical systems and, in future situations, ergonomic design

recommendations.

Such high demands have a very big impact on the agents of the work: the people. This impact can be positive, providing greater motivation and disposition for life, improvement of self-esteem and quality of life. However, it can also be negative, imposing stimulation in quantity and quality above people's psychic and physical assimilation capacity.

The consequences of this negative impact can be disastrous for people and organizations, leading to high absenteeism, errors and accidents at work, damage to equipment and people, and reduced competitive capacity. All this reduces the possibility of successfully entering the market. The most serious thing is that these negative consequences are usually perceived only when some sign of exhaustion occurs.

With this, ergonomics comes to offer practical information of the highest importance for work to be a source of health, quality of life and productive efficiency.

It provides the representation of jobs appropriate to the psychophysiological characteristics of people; allows the organization of work to be structured in a healthy and productive way; it assists in the construction of work environments that are adequate and pleasant to the sensory, physical and emotional needs of workers and people in general.

Working comfortably is important to avoid physical and visual fatigue and prevent health disorders. Besides, to improve efficiency and quality of work (BRANDIMILLER, 2002).

The study of adaptation to work encompasses the transformations that occur when an organism passes from the state of rest to activity and even those more lasting character transformations due to training.

This way, monotony, fatigue and motivation are three very important aspects that must be of interest to all those who carry out analysis and design of human work. Monotony and fatigue are present in all jobs and, if they cannot be totally eliminated, they can be controlled and replaced by more interesting and motivating environments.

SCIENCES OF COGNITION

Science is an open way to choose facts or phenomena that may challenge or disturb human understanding.

Cognitive science is one of the most dynamic areas of research in the world today. It draws on the combined resources of Computer Science, Artificial Intelligence, Cognitive Psychology, Developmental and Evolutionary Linguistics, and Sociobiology.

As a cognitive domain, science is no exception to this form of constitution and is called an acceptability criterion, which defines and constitutes science as a cognitive domain and which simultaneously constitutes the person who applies it as a scientist, criteria for validating explanations science, it is this criterion of acceptability that constitutes science as a cognitive domain (MATURANA, 2001).

However, in recent years, cognitive science increasingly recovers robotics, as the perception of the replication of embodied minds grows, that is, intelligences endowed with a body that acts in a real environment.

This way, cognitive science understood as simulation science has as its starting point the construction of computational systems that instantiate the conditions of possibility of a certain type of mental life that is similar to that of human beings. In this sense, cognitive science is an a priori investigation and, at the same time, an enormous engineering task that presupposes and demands the experimentation of its models, thus approaching the empirical-formal disciplines.

The great difficulty faced by cognitive

science is to identify the organizational invariants of what is called mind.

The end of artificial intelligence or the so-called symbolic paradigm determines that cognitive science makes new theoretical alliances, abandoning, in part, its close relationship with analytical philosophy.

From the point of view of constituting a science of cognition, this new perspective puts people in an advantageous position, in which representation can now be treated as a cognitive phenomenon.

Thus, the main motivation of contemporary neuroscience seems to be the possibility of reducing mental phenomena to a neurological substrate, and, in so doing, assimilating cognitive science and philosophy of mind to a general science of the brain.

The notion that cognitive science and the explanation of human behavior are closely linked was ably expressed by Jerry Fodor [1], who noted that cognitive theories attempt to relate the *intensional properties* of mental states to their *causal capacities* to affect behavior. While it may take some time to recognize the significance of this position, it hints at a close link between the theory of cognition and the explanation of behavior.

Cognition cannot be described as an intrinsic phenomenon between the brain and the environment, a relationship that occurs as the organism acts in an environment.

Cognitive science can be characterized as a multidisciplinary area of studies where, as its central objective, the elaboration of scientific models and theories of human cognitive processes (ABRANTES, 1994).

The peculiarities of cognitive science arise from its form of constitution by applying the criterion of validation of scientific explanations.

Furthermore, the term cognitive sciences signals a multidisciplinary approach in the domain of the study of cognitive processes. This has, therefore, as its main scope the study of intelligence, be it present in human, animal or artificial systems.

Science is the domain of scientific claims and explanations that scientists generate by applying the validation criteria used in scientific explanations.

Scientists deal in science with understanding and explaining their human experience and not with understanding and explaining nature or reality as if these were objective domains of existence regardless of what they do.

Scientists working on a cognitive science project believe that the methods and knowledge produced within the various sciences can shed some light on issues that have been debated for millennia, namely: the nature of the mind and its relationship with the body; that of the epistemic status of beliefs about the world and oneself; the nature of the internal processes that are responsible for such beliefs, for learning and their causal role in behavior (ABRANTES, 1994).

The overtly mentalistic character of cognitive science is considered by many to be in conflict with a truly scientific approach to the study of human behavior and processes such as learning.

The dominant orientation in cognitive science postulates a level of analysis related to internal or mental processes, which would be, in principle, irreducible to the level of analysis of physical processes. This orientation has been, however, internally contested by the so-called connectionists in cognitive science, who propose a closer approximation between explanations of cognition involving mental states and those involving physical processes.

Cognitive science has adopted functionalism as an approach to the mind/body problem. This position in philosophy of mind is characterized by the thesis that it is possible to abstract, in the study of cognitive processes,

1 Contemporary cognitive psychologist, known for his proposals for the modularity of the mind and the language of thought.

from a particular material instantiation of mental processes. These processes could be described exclusively in terms of a functional organization of the mind, where, for example, modules would perform functions specified by processing relations between input and output.

For Moura and Correa (1997), the term cognitive science designates a multidisciplinary approach within the scope of the study of cognitive processes. Among the disciplines involved in this project are cognitive psychology, neurosciences, linguistics, logic and computer sciences. It is not difficult, therefore, to conclude that this area is permeated by a diversity of approaches and methods. It is possible, however, to establish a common point in the midst of all this diversity: the interest in the study of intelligence.

It can be said that the cognitive science project is not a unitary project, neither from the point of view of the disciplines that comprise it, nor from the theoretical framework adopted. In common, one can point out the internal process of elaborating a theory about cognition, or, more specifically, a theory regarding intelligent systems. Although it is not a consensus among researchers in the area, a significant number of investigations emphasize the use of computer simulation and the concepts derived from the use of the computational model in the construction of theories.

Thus, cognitive science is guided by a combative relationship between its two main paradigms: representationalism, which sees the mind as a symbol manipulator, and connectionism, which sees the mind as a pattern matcher.

JOB MEMORY

Memory comprises the human ability to store information, searching or retrieving it whenever necessary. The storage of information takes place through codification and absorption of the same, and storage can take place for a short or long period of time.

Sternberg (2000) explains that the information temporarily stored in the working memory (WM) is encoded basically in acoustic form. Therefore, when a person makes errors in retrieving words from short-term memory, these errors tend to reflect sound confusions. Long-term stored information is basically semantically encoded, that is, encoded through the meanings of words.

Working memory has limited capacity. It is characterized by performing not only the processing of information, but its storage.

Experimental and laboratory studies of human cognition have influenced the European conceptualization of working memory more than any other studies and, as such, have been the focus of many preceding discussions. However, other sources of research have supported and modified the working memory model.

Studies of individual differences in working memory function have been a prominent feature of working memory research in North America and studies of working memory in Europe.

As the evaluation of the working memory can only be observed through the evaluation of the performance, then it is necessary to address, particularly, the characteristics of the tasks of amplitude of the working memory. Range tasks are designed to mimic the demands on working memory during the performance of complex cognitive tasks.

Working memory breadth is a good predictor of comprehension because individuals who have less ability to simultaneously process and store verbal information in working memory are at a disadvantage when it comes to successively integrating ideas found in a text, as they have less ability to keep the

earliest reading information still active in working memory. Working memory breadth tasks require participants to simultaneously perform both the storage and processing that the tasks entail.

The name working memory is only part of the problem. Memory is emphasized, but memory storage is only one part of working memory, and indeed the smallest part.

Working memory span correlates strongly with reading comprehension, where a simple memory span measures, for example, immediate serial recall of words.

Studies of memory functions following brain injury have strongly influenced theorizing about working memory. Finding someone with a deficit in one aspect of working memory can help test predictions about the function of that part of working memory and about these rules in general cognition.

The nature of individual differences in constructed working memory broadly encompasses age-related variations as well as intra -individual variations due to various transient factors.

The processing and storage requirements within the working memory breadth task do not simulate the nature of the simultaneous processing and storage required in a more naturalistic task. In the sense of exactly what a person needs to process and store in a range task they are often unrelated to each other whereas they are related in everyday cognitive tasks.

The finding that people differ in working memory scores shows that systematic differences in other measures of controlled attention can be found in studies of both perceptual interference and memory interference.

The amplitude of the TM is considered a good measure of its limit because it requires a shift in attention between reading or solving math problems and maintaining words. This is an attention-altering feature that is an important component of TM amplitude.

Working memory tasks have been shown to be the best predictors of performance on complex cognitive tasks. A recent approach is the development of computational models that simulate the effects of individual differences and/or working memory load on participants' performance on various cognitive tasks. This model was more specifically addressed when commenting on the different types of working memory model processes.

Working memory and attention are related because both are about the control of information and are assumed to have limits on how much information can be controlled. It is important to point out that the concept of attention itself is not unitary.

Most researched working memory models emphasize a high level of control and regulation of cognitive and perceptual-motor processing. Such studies tend to take the view that attentional control functions are an essential part or a subset of a larger working memory system.

However, attention is a concept that has many facets. Most theories that are intended to study working memory and end up raising relationships with attention tend to choose a specific aspect. These aspects can be classified into two general categories: selective control and mental energy or resources. These two categories of models are not necessarily incompatible with each other. They can even be found in the same theory.

Working memory is a system consisting of active long-term memory traces of the principles, procedures, and skills necessary to achieve and maintain activation, limited capacity, and controlled attention.

In a cognitive view, all models approach working memory from only one or two interrelated perspectives, namely a functional one and a content-based perspective. That

is, some models characterize TM from a functional perspective in terms of its functions, processes or mechanisms that help in complex cognitive activities. Other models consider TM from a content-oriented perspective, arguing that activating elements in long-term memory constitute working memory, at least in part.

FINAL CONSIDERATIONS

Ergonomics is dematerialized, ceases to be physical, and starts to investigate the mind, cognitive functioning, adapting work not only as a set of gestures and movements, but contemplating it as a process of transformation where work and worker constantly create and interact. recreate.

Cognitive science is committed, indeed, to the construction of a scientific theory of mind. Such a methodological decision may seem paradoxical or problematically circular to those who regard mental processes as essentially inaccessible to scientific methods.

The Sciences consist of the domain of explanations and experimental inferences generated through the application of the epistemic criterion of validation. As such, scientists deal with clarifying and understanding their human experience and not with clarifying and understanding Nature or reality as if these were objective realms of experience regardless of what they do.

Thus, the focus on working memory has been seen with great success as a measure of the combined processing and storage capacity of working memory.

Working memory differs among people, and this difference manifests itself in a wide range of important cognitive tasks. Reasoning, problem solving, reading comprehension, acquiring new vocabulary words, learning to speak correctly, taking notes in a lecture are all influenced through individual differences in working memory.

Work, the essential foundation of the truculent environment, must present increasingly extraordinary results. It is he, the work, that, ultimately, puts into action productive processes, technologies, machinery. It is he who has the creative ability to develop new solutions that provide the competitive edge for people and organizations.

Developing simulations of human mental activities is the primary task of cognitive science. In this sense, it is basically a science of the artificial, that is, of the behavior of simulations understood as great mental experiments.

REFERENCES

ABRANTES, Paulo. **Epistemologia e cognição**. Brasília: Universidade de Brasília, 1994.

BRANDIMILLER, Primo A. **O corpo no trabalho**: guia de conforto e saúde para quem trabalha em microcomputadores. 2 ed. São Paulo: SENAC, 2002.

FIALHO, Francisco Antônio Pereira; BRAVIANO, Gilson; SANTOS, Néri dos. **Métodos e técnicas em ergonomia**. Florianópolis, 2005.

IIDA, Itiro. **Ergonomia**: projeto e produção. São Paulo: Edgard Blücher, 2003.

MATURANA, Humberto. **Cognição, ciência e vida cotidiana**. Belo Horizonte: UFMG, 2001.

MOURA, Maria Lucia Seidl de; CORREA, Jane. **Estudo psicológico do pensamento***:* de W. Wundt a uma ciência da cognição. Rio de Janeiro: EdUERJ, 1997.

RIO, Rodrigo Pires do; PIRES, Licínia. **Ergonomia**: fundamentos da prática ergonômica. 3 ed. São Paulo: LTr, 2001.

STERNBERG, Roberto J. **Psicologia cognitiva**. Porto Alegre: Artes Médicas Sul, 2000.