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Theoretical Analyses

Discussion on the Claim That the Human Mind is a Computational Process Device

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Abstract

In this theoretical paper, there will be offered a short introduction to the various discussions around the claim that the human mind operates in terms of computational processes. A number of proponents who have discussed such a theory feature this assignment. Their ideas are presented, discussed and interrelated to the general discipline of cognitive psychology, where much of that claim has been and is being put under scrutiny. The main objective of this paper is to provide a concise understanding on the above thesis, which by the use of an extensive literature could be further explored both by students of human cognition as well as researchers who would like a presentation to the topic on the basis of some foundational elements regarding the mind's ability to operate as a computing metaphor.

Keywords: mind, computational process, computational modeling networks and systems

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Introduction

The mind is a physical system implemented by the brain (Churchland & Grush, 1999). Cooper and Shallice (1995) posit that, it is a function and organization of switches which multi-disciplinarily approach the various aspects of cognition, such as perception, memory, attention, language, thinking and reasoning or motor control. They also stress that, in mind are operating afferent and efferent representational units that relate to sensory and motor molds of the brain.

The way that mind functions has raised the claim (Gazzaniga, Irvy, & Magnum, 1998; McLeod, Plunkett, & Rolls, 1998) that it is related to various computational processes taking place in brain. The aspect of computational process is not a new one. Shannon (1948a,b) discussed this idea by examining it under the speculation of information. He posits that the mind is a system of particular representations which activate elements of arrangements, in order to make up messages able to convey information processes to the brain.

Eysenck and Keane (2003) argue that the claim about the computational processing of mind is connected to computational modeling. Computational modeling reflects the attempt to simulating psychological theories and

cognitive processes, in view to present the operation of mind meaningfully and understandably. They consider that the mind in cognitive psychology is approached as analogous to a digital computer. According to Kuhn (1970), this approach is dominant and is considered to be the theoretical orientation upon which the computational understanding of mind is based. After 1970, several cognitive psychologists, like Lachman, Lachman, and Butterfield (1979), thought that the best way to approach mind and human cognition would be that of the information-paradigm processing.

Simon and Kaplan (1989) argued that ideas such as the mind is a symbol-processing system or, as Eysenck (1990) and Eysenck and Keane (2003) contend, it is a limited capacity processor having structural and resource limitations, these ideas had led to the view that human mind likens the formulation of computer functioning. Simon (1995) considers that the central understanding of human mind is the brain as a computing processor, where the various topics of cognition are registered. In this perspective, Rumelhart, Smolensky, McClelland, and Hinton (1986) postulate that, as computers seem to be developed without reaching technological barriers, cognitive theory, and in particular cognitive psychology, attempt to discuss the features of mind, by taking into account the claim that it is processed computationally, developing and enhancing the capabilities of brain in general.

Reflections on Human Mind as a Computational Process Device

Eysenck and Keane (2003) assume that, in the past, cognitive psychologists used to apply flowcharts, in order to justify the results in their experiments or to support their hypotheses. However, Eysenck and Keane argue these flowcharts were proven as much as inaccurate and inconceivable as to the point of questioning what sort of information was conveyed through them. They posit that questions such as 'What is really going in those boxes?', 'Under what process the arrows lead to other boxes?', 'What else is included in those arrows?' or 'What is the meaning of encoding results through flowcharts?' raised the issue of investigating and interpreting the mind as a vast system of representations and interactions which, in order to be accurately examined, should be decomposed to a number of different levels of cognitive modeling aspects. Cooper and Shallice (1995) argue that there should be suggested methods, able to supply such decomposition. Thus, there were proposed computational techniques which could describe psychological theories of the human mind, without using natural language, but formal specification patterns of logistics, directly executable as programs.

According to Eysenck and Keane (2003), there were suggested three computational modeling techniques, in order to discuss the aspect of mind in a computational way:

1. *Semantic networks*: In regard to Eysenck and Keane (2003), these networks are characterized by contiguity (two things are associated when occurred together), similarity (two things liken one another), and contrast (two things operate as opposites). Semantic networks discuss in detail the aspects of association, likeness and opposition of things as operational concepts.
2. *Production systems*: These systems, according to Eysenck and Keane (2003), are governed by the 'if-then' rules. They refer to an information working memory which at a given time can be accurately processed. They relate to the aspects of short-term memory (stored information for a limited period of time) and long-term memory (stored information for a considerable amount of time).
3. *Connectionist networks*: Ellis and Humphreys (1999) argue that these networks have a different structure or layers where they store information, i.e. hidden units. Representations of concepts can be stored in different parts of the neural-like network, without interfering one another. The method employed in these networks is called backward propagation of errors. This method implies that imperfect patterns of errors are noted, underlined and activated through propagation, in order to produce the required pattern.

Simon (1980) considers that cognitive psychology aims to understand mind not just as an input-output regulator, but in association with the internal causation its data are analyzed. Marr (1982) considers that cognitive psychology is being dominated by the so-called 'computational metaphor of mind' which discusses the functional operations of mind by constraining hypotheses about its causal mechanisms. However, once the functional analysis is not explanatory, it has been constructed a theory known as 'computational theory of mind' which attempts to interpret the systemic patterns of human mind. Fodor, Fodor, and Garrett (1975) state that, according to the computational theory of mind, neural systems appear to have innate representations that refer to one property of thinking. Marr (1982) posits that manipulation is the processing element of mind in this direction which means that attention is paid not to the content of processing, but to the formal property of it, i.e. not to what is included in those representations, but how are they arranged towards processing.

Roediger (1980) claims that the evaluation of mind as a computational process is related to an interdisciplinary grouping of cognitive psychology, artificial intelligence, linguistics, philosophy, neuroscience, and anthropology. All these scientific fields are unified by the aspect that mind is information processing system. Eysenck and Keane (2003) argue that these disciplines work towards presenting the mind in respect to a computational synthesis of the insights emerging from all the above approaches. Eysenck and Keane stress that the computational organization of mind appears also in short-memory which is argued as akin to the central processing unit (CPU), whereas long-memory as akin to the hard drive of a modern PC.

McGhee (2001) maintains that the understanding of mind as a computer comes through the aspect of computationalism. Eysenck (1990) and Gregory (1998) emphasize that computationalism means that, in human mind, there are manipulated cognitive structures, symbols, interactions and representations which relate to the idea of the computational metaphor which was mentioned above and is employed by some of the most notable cognitive psychologists. Gregory (1998) and Ellis and Humphreys (1999) claim that, in cognitive psychology, there is not only the aspect of computationalism which is associated with the mind, but also the aspect of connectionism which through the various neuronal networks of the brain (hardware) is mimicking cognitive informational processes (software) in a parallel description of computing functions. Gregory argues that, in this context, computationalism gives weight to the similarities between mind and computer programs, whereas connectionism draws attention on more neural network systems linked to information processing. Computationalism and connectionism, according to Gregory (1998), work on information processing programs, whilst experimental research underlines the importance of cause and effect, in order to understand and discuss the various operations of mind.

McGhee (2001) claims that there is an immense effort to understand that human mind and information processing work side by side. Lachman, Lachman, and Butterfield (1979) argue that this idea comes through the theories of human cognition, meaning that cognitive science, and in particular cognitive psychology, examines the mind and attempts to build up computing programs which would be able to represent the mind as a working model and a visual component of the contemporary science. Although, the former does not imply that computers can replace the functioning of mind, or that they are able to investigate it thoroughly, McGhee (2001) argues that there is a considerable need to apply theoretical models of computing on human internal representations, in order to check whether these can be turned to programs.

For McGhee (2001), the speculation that the mind is like a computer is an idea which is also related to the aspect of thinking. This speculation comes since middle 1960s (Bruner, 1957; Bruner, Goodnow, & Austin, 1956), when the question was in association whether computers can think or not. Some scientists have argued that computers

are not able of thinking because they cannot demonstrate imagination. According to these scientists, imagination is an understanding and characteristic of human thought, therefore creative and productive and these aspects computers do not have or acquire (Richardson, 1999; Turing, 1950). Eysenck (1990) underlines that the claim of those scientists does not imply that computers cannot demonstrate imagination in relation to their hardware and software, or a lack of thought when programs are pursued and executed, but that they demonstrate lack of human thought, lack of creativeness and productivity concerned with cognitive features and patterns that are situated in human mind. Eysenck (1990) also argues that computers and computational systems have evolved because of the need of representing human mind in an environment outside the human brain. The need to execute representations of human mind in computing environment gave birth to the aspect of artificial intelligence. Eysenck (1990) stresses that, nowadays, computers communicate with their users, ask questions, demonstrate opinions, follow orders, suggest changes in the information processing and execute decisions given to them by their users. However, the question beyond is, in what extent would computers be considered as original, creative, innovative and above all helpful, when they lack the very basics of human cognition? Or, is it artificial intelligence, or just an interactive intelligence which relates to the data one puts, so to represent already existing ideas of human cognitive processing? Should one talk of artificial or superficial intelligence? Eysenck (1990) concludes that these are some of the problems placed by cognitive psychologists, in view to find understandings that will be able to support the aforementioned statement, according to which the mind is like a computer which could well be understood both in terms of a "content-dependent machinery as well as a general-purpose system" (Varvatsoulias, 2010, p. 209).

Roediger (1980) argues that, as a form of computational process, the mind carries out operations and inputs which produce outputs in relation to understanding. The aspect of understanding does not refer to operations relating to computer processing, but to deduction of outputs into inputs, so these to be applied as programs relevant to computational modeling networks. The meaning of understanding is associated with mind. According to Searle (1980), programs which refer to applications of mind, such as understanding, are not processing in the same way as in humans. Computers cannot understand what they are processing; in other words, programs cannot demonstrate how understanding is taking place, or under which cognitive elements, it appears to operate in human mind.

Insights That Could Invoke Further Discussions From Researchers as to the Claim That the Human Mind Resembles Computational Processes

From what has been argued before, it does not mean that the claim about the mind as a form of computational process is rejected. On the contrary, cognitive psychologists (see, for example, Cooper & Shallice, 1995) place it in a framework which is useful to be further examined and investigated. This framework is related to the aspect of information which is a term that lies in the heart of cognitive science and cognitive psychology. The mind is a set of computational processes operating in the brain. Each process delivers a specific function which refers to multi-disciplinary patterns of associations (Marr, 1982). The mind is covered by the aspect that the brain is an information processor – a computer – which forms computational features processed by the mind (Eysenck & Keane, 2003).

To understand better the claim regarding the computational process of mind, cognitive psychologists consider the idea that the mind is simulated through computer programs and information processing (Cooper & Shallice, 1995). That means simulations in cognitive psychology generally mimics the human mind and are designed to

demonstrate internal consistency, because they are based on theories and models relevant to functions they are entitled to do, without necessarily meaning that such programs *describe* how humans perform, or would perform the same task (Gregory, 1998).

McGhee (2001) posits that computer simulations in cognitive psychology are generally designed to investigate the mind in relation to understandings provided through cognition. The rapid increase in the processing power of computers provides cognitive psychology with a valuable tool towards investigating human mind (McGhee, 2001). In this way, its various theories are implemented in order the human cognitive abilities to be examined thoroughly. McGhee claims that the same applies to the investigation of mind as well: "The assumption that the mind is a form of computational process refers to the relationship between predefined terms and the real-world referents of the terms themselves. This means that computers work out the features related to one another, rather than the reason they are related to the real world or the particular experience which humans acquire from it" (McGhee, 2001, p. 58). Chomsky (1957) maintains that information-processing refers rather to a syntactical understanding of human mind and its cognitions, than to a semantic one. In other words, the understanding of night and day or the passing of the hours during the day underlines that human mind operates in the real-world environment, instead of handling operationally input and data introduced to 'machinery-like' systems which reproduce what is being entered to them from users (McGhee, 2001).

Eysenck and Keane (2003) argue that originality and creativity relate to human mind, whereas the aspect of demonstrating them applies to computing systems. Experimental and real-world environments cannot be interconnected to the assumption of a cause-and-effect relationship, because they investigate human mind from a different point of view. In this way, computers and mind, although they can be interrelated to the aspect of demonstration, they cannot share originality and creativity like the mind itself is concerned (Eysenck & Keane, 2003). The human mind though can be considered as an information-processing system it cannot be replaced or reproduced through an information technique which is more likely to represent a computational system. In this context the aspect of computational process is relevant to the idea of a 'form feature' of mind which is more likely to grant an evaluation of issues in discussion of thinking, reasoning, mental representations and information-processing, that under the aforementioned perspective, anticipate the evaluation of mind as a computational process. Eysenck and Keane (2003) illustrate that those issues of discussion evaluate the mind as a computational process, in connection, however, to 'meanings' and 'implications of information receiving and processing', upon which the claim referring to the computing-processing of mind can be maintained.

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