Short Communication

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A brief review of connectionist models in contrast with modelling cognition

Abstract

The understanding of brain mechanisms is a fundamental topic to unravel the etiology of various disorders, ranging from sleep disturbances to language acquisition, providing evidence-based knowledge for more assertive treatments. Existing contrast between conventional and recent approaches to describe brain mechanisms became evident within the last decades. The importance of developing complex computer technology for the use with artificial neural network systems, makes advanced computational models (connectionist models) that simulate brain activities a particularly useful strategy in neuroscientific investigations. This paper covers a brief overview on the development and functioning of connectionist models, and contrasts this perspective with more traditional approaches to modelling cognition.

Keywords: connectionist models, modelling cognition, brain activity, neuroscientific investigations, human brain, cognitive functioning, dysfunctional performances, computational equations, mathematical equations, parallel distributed processing, backward propagation

Volume 3 Issue 1 - 2019

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Received: January 30, 2018 | **Published:** January 16, 2019

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Models of cognitive processes have recently been applied in neuropsychological investigations in order to provide more concrete evidences of human brain functioning. A model may be described as the several ways in which a theory might be represented, to increase the understanding of its underlying principal components.[1] It is worth noting there are positive characteristics about models, for instance, instead of abstract theories or symbolic figures proposed to explain mental mechanisms, modals actually represent complex brain mechanisms in terms of more accurate computational and mathematical equations. In that, the interpretation of cognitive functioning is empirically assessed, and outcomes analyses are less ambiguous.[2] Another important aspect of cognitive models is that they are usually able to predict and explain observable facts (functional or dysfunctional performances), in terms of generated probabilistic graphical models, with greater details of how brain processes actually occur.[1] The stages in the processing systems, also the nature of the input and output are analysed within the models' framework. Prior to concepts of cognitive models, however, assumptions were based on vague ideas and predictions of brains processes.

Connectionist models of neural networks suggest brain activity would operate likewise and resemble that of a computer system.[3] This pattern of function works according to a massive number of interconnected units or nodes. Each unit represents a neuron and respective activation values correspond to the action potential discharge in the human brain.[1] Within a connectionist network the nodes are arranged in layers, or structures, which are divided into the input, the intermediate or hidden, and the output units. The input units are associated with stimuli from the environment, while the hidden units connect to the output layers to promote the particular response and allow its manifestations to occur.[4] The simulated brain response is highly dependent on the previous input units, once every node has its own weight (input charge) which might send an inhibitory or excitatory message to the following unit. Following this initial trend of activation, inhibitory and excitatory model connections stress the likelihood of energy, or weight, to be passed from one unit to the next. Mostly important, the connections within the model operate in a sequence of parallel distributed processing (PDP). In other words, not only a single node weight is influencing a particular response, but also the sum of every weight related to each input unit associated with that particular response plays a role in the outcome response.[4] The outcome response, therefore, happens when the sum of all units' weights reach a threshold of activation in which excitatory impulse is sent to the outcome nodes.[5]

With regard to the functioning of the connectionist system itself, there is a remarkable adjustment process which takes place within the networks in order to provide learning output. That is best known as Backward Propagation.[5] This process consists of a computer representation of the human synaptic mechanisms in the brain, also simulating the differences of potentials of activation between brain cells (neurons). In order to function, the system relies on the analysis of incorrect results (output responses) produced by the output units. In this case, the system networks adjust different input units (which hold different weights) until they reach appropriate weight to achieve the desired response. An example of this computational process might be based on the NETtalk network, which counted on 50.000 trials to achieve the correct spelling of 1000 words. The results did support the assumption that the network managed to 'learn' (by adjusting input-output charge responses) the specific spelling of the words by itself.[5,6] The mentioned functioning is a fundamental distinction between the connectionist model and the traditional approaches to information processing, once the connectionist system is able to learn how to acquire a specific response without the need of further input other than the stimuli itself. The learning process happens by adjusting or altering connections between input nodes, according to their weights. This represents and is considered a breakthrough in contrast with previous models, when it was necessary to supply the program with all basic input and output information for the programmes operate accordingly. The prior principal (before connectionist models) relied on essential associative processes, in which every time a certain input was stimulated, it then trigged the equivalent response according to the stimuli characteristics (weight). That, again, depended on having to provide enough information to be stored in the system's memory, otherwise the main database would not be able to find sufficient characters (information) to produce the desired response.[5,7]

Additionally, in traditional models of cognitive processing the storage of information depended on the type of input stimuli to generate knowledge, all of which would be kept in separate places or departments (boxes) in the cognitive system.[5] However, in line with perspectives of connectionist models, input information is stored in a distributed and integrative way, which highlights the interconnection of processes involved to generate responses. That is similar to the human synaptic transmission course, a fact that was shown to be coherent with neuroscientific findings regarding the physiological basis of synaptic transmissions, directly linked to brain functioning and disorders of various types.[3] Past assumptions have not presented sufficient understanding of cognitive processes, and have been challenged by more recent types of analyses at the cognitive level involving complex computational models. The need of more advanced methods in Cognitive science increased along with the implementation of sophisticated computational models for the understanding of brain functions, aiming to aid more assertive approaches to treatments. These models provide an extensive interpretation of mental functions based on the simulation of human synaptic processes, to explain how the human brain actually works. The connectionist perspective is so far one of the most ambitious attempts to replicate brain activities through a huge number of units, in a parallel distributed network. Although criticism has challenged the reliability of connectionist models, this approach has become very influential and gained support in the neuropsychological fields of research as an attempt to further understand brains mechanisms and provide more accurate approaches to treatment of various conditions.

Acknowledgement

None.

Conflict of interest

The author declared that there are no conflicts of interest.

References

1. Testolin A, Zorzi M. Probabilistic Models and Generative Neural Networks: Towards an Unified Framework for Modeling Normal and Impaired Neurocognitive Functions. *Front Comput Neurosci*. 2016;10:73.
2. Robert C, Guilpin C, Limoge A. Review of neural network applications in sleep research. *J Neurosci Methods*. 1998;79(2):187–193.
3. Atkinson RL, Atkinson RC, Smith EE, et al. *Introduction to Psychology*. 11th ed. London: Harcourt Brace Jovanovich College Pusblishers. 1993.
4. Smith EE, Rosslyn SM. *Cognitive Psychology*. Mind and Brain. USA: Pearson Education Limited. 2007.
5. Eysenck MW, Keane MT. *Cognitive Psychology*. A Student's Handbook. Seventh Edition. New York: Psychology Press Taylor & Francis Group. 2015.
6. Thagard P. Mind. *Introduction to Cognitive Science*. USA: Massachusetts Institute of Technology. 2005.
7. Woollams AM. Connectionist neuropsychology: uncovering ultimate causes of acquired dyslexia. *Philos Trans R Soc Lond B Biol Sci*. 2014;369(1634):20120398.

Citation: Durgante H. A brief review of connectionist models in contrast with modelling cognition. *Sleep Med Dis Int J*. 2019;3(1):7–8. DOI: 10.15406/smdij.2019.03.00059