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Putting the Cognitive Mediation Networks Theory to the test: Evaluation of a framework for understanding the digital age

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ABSTRACT

The Cognitive Mediation Networks Theory (CMNT) is a novel approach to human intelligence that, among other things, attempts to understand the cognitive changes associated to the emergence and dissemination of information and communication technologies throughout the last few decades. The present paper aims to investigate a central claim of the model, which is that the greater interaction of individuals with the changes emanating from the Digital Revolution and its implications (Hyperculture) tends to, in and of itself, produce psychological changes that lead to enhanced Cognitive Performance. For that purpose, a total of 1291 Brazilian adults and adolescents were investigated by means of an especially prepared form and cognitive tests. The results obtained indicated that a greater degree of Hyperculture is positively associated to Cognitive Performance and Sociability, regardless of sex, age, income, and level of education. These findings, taken together with those from other studies, strongly support the predictions of the CMNT, which emerges in this paper as a valid model of human cognition, at least when applied to the impacts of the Digital Revolution.

1. Introduction

The phenomenon commonly referred to as the "Digital Revolution" is a set of advances in digital technology, telecommunications, and software with profound economic, social, and cultural implications. Its origins trace back to the early and mid XX Century or even earlier, but most of the crucial developments emerged between 1990 and 2000, with the development of powerful yet low-cost digital processors, easy-to-use graphic user interface operating systems, and powerful search engines (IN-STAT MDR; Julian, 1996; Keller & Kumar). This has led to substantial changes in society and culture as a whole, creating what is known as the Knowledge Society, where the economy runs mainly on information, knowledge, and innovation (Comin & Hobjin, 2008; Stehr, 1994), something which influences humans at both individual and collective levels (Gelernter & Brockman, 2010; NPD GROUP; Papadakis & Collins, 2001; Tapscott).

In spite of the obvious importance of studying the psychological impacts of the Digital Revolution, there is very little in terms of broad theories capable of adequately explaining the dynamics and mechanisms underlying such phenomena. Lévy (1992, 1999) proposes that the interactivity arising from digital networks and hypertextual communication, particularly the new forms of temporal organization and material involvement that it entails, are leading to the development of an online collective intelligence by means of "knowledge spaces" and "cosmopedias" (predicting the emergence of Wikipedia, anticipating "wikinomics", and foreshadowing the current notions of the efficacy of shared distributed knowledge systems). Carr (2010), on the other hand, proposes that, by providing automation of mental tasks and being a source of constant distraction, digital devices and the Internet have detrimental effects on cognition that diminish the capacity for concentration and contemplation, such author being a critic of technological utopianism and of the high value usually given to online social production. Van Dijck (2007), advocates the notion that digital technologies mediate mnemonic processes creating a *continuum* between what is individual and what is cultural, something that he believes should be studied from the perspective of an intersection between the fields of neuropsychology, media and technology studies, and critical cultural studies. Aboujaoude (2011) focuses on emotional and affective aspects, suggesting that Internet activities strongly promote various types of obsessive behavior and addictions, leading to psychopathologies. None of these authors, however, provide an encompassing vision that simultaneously

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describes the psychological mechanisms involved, produces specific falsifiable predictions, refers to major cognitive theories, and is supported by extensive objective data.

The Cognitive Mediation Networks Theory (CMNT) is a contextualist, constructivist, information processing approach to human intelligence that aims to provide a broad approach to cognition by drawing from concepts and research from various authors and schools of thought, such as Jean Piaget, Gérard Vergnaud, Lev Semenovich Vygotsky, David Chalmers, and Robert James Sternberg, as well as Charles Darwin and the Theory of Evolution. Its goal is to provide a coherent theoretical synthesis of psychological theories and frameworks that are usually seen as separate, or even in conflict with each other, in order to produce a unified model. One special application of the CMNT is the understanding of the collective and individual changes associated to the Digital Revolution, i.e., the many sociocultural and psychological changes related to the emergence and dissemination of information and communication technologies (ICTs) throughout the last few decades (Souza, 2004, 2006; Souza, De Lima e SIlva, & Roazzi, 2010; Souza & Roazzi, 2000, 2003, 2007, 2009).

The CMNT attempts to explain the impacts that digital technologies have on human thinking by presenting a view of cognition as an information-processing phenomenon where a good deal of the processing is done outside of the brain. The internal and external mechanisms involved in such a phenomenon are extremely complex, with the recent Digital Revolution representing the latest step in an evolutionary path that goes from psychophysics to social groups to culture and, finally, to Hyperculture. There is a fairly large body of evidence showing that crucial predictions of the model, that is to say, the emergence of a Hyperculture that is clearly discernible from what traditionally has been called culture, the occurrence of new forms of thinking associated to it, and its association to measurable gains in Cognitive Performance, all independent of sex, income, and level of education, have been observed (Raupp, Serrano Neto, Martins, & Souza, 2010; Souza & Roazzi, 2007, 2009; Souza, 2006; Souza et al., 2010). Indeed, it may well be good explanation for the Flynn Effect, that is, the gradual increase in the raw scores of IQ tests in developed countries throughout most of the 20th Century (Flynn, 2003).

The present paper attempts to provide new, broader, evidence for the predictions of the CMNT by means of a study that is more detailed and controlled than the previous ones, as well as including modes of analysis that allow for a stronger argument in favor of a causal explanation of the findings. It also includes a more varied sample in terms of socioeconomic status, education, and geographical location, which favors the robustness of the results. This was achieved by collecting sociodemographic, psychometric, and other data from 1291 individuals of both sexes and different ages in a total of 46 different municipalities in the state of Pernambuco, Brazil. The findings thus obtained have fully supported the expectations of the CMNT regarding the emergence and impacts of the Hyperculture, thereby corroborating that theory as a valid model for human cognition, particularly regarding the understanding of the psychological implications of the Digital Revolution. The possible ramifications of such findings and conclusions are discussed in the end.

2. The Cognitive Mediation Networks Theory

2.1. Basic tenets

The CMNT is founded upon a set of five basic assumptions regarding human cognition and data processing, them being:

I. The human species has as its most important evolutionary advantage the ability to generate, store, retrieve, manipulate, and apply knowledge in various ways (Gil, 2003).
II. Human cognition is effectively the result of some form of information-processing (Chalmers, 1999; Kail & Bisanz, 1992; Sternberg, 1988).
III. Alone, the human brain constitutes a finite and, ultimately, unsatisfactory, information-processing resource (Hannan, 2003; Kurtzweil, 2002; Merkle, 1988, 1989; Miller, 1956; Ward, 1997; White, 2003).
IV. Practically any organized physical system is capable of executing logical operations to some degree (Copeland & Sylvan, 1998; Minsky, 1967).
V. Human beings complement their cerebral information-processing by interacting with external organized physical systems (Lock, 2000; Phillips, 1989; Ward, 1997).

Combining all of the above, one has a picture of human cognition where individuals develop and use knowledge by means of the information-processing done by their brains and, being such information-processing capacity limited and unsatisfactory, they also engage in cognitive activity through the interaction with structures in the environment that supply additional information-processing capacity.

2.2. Extracerebral cognition and mediation

The process by which human beings rely on external structures in order to complement the information processing done by their organic brain (extracerebral cognition) is called by the CMNT "Mediation" and it can be described as having the following components:

- *Object*: The physical item, abstract concept, problem, situation, and/or relation regarding which the individual is attempting to construct knowledge;
- *Internal Processing*: The physiological (synaptic, neural, and endocrine) brain activity that executes and individual's basic logical operations;
- *Internal mechanisms*: Mental structure that manages algorithms, codes, and data that allow the connection, interaction and integration between the internal processing of the brain and the extracerebral processing done by the structures in the environment, working both as a "hardware driver" and a "network protocol";
- *External mechanisms*: Can be of various kinds and capacities, ranging from simple physical objects (fingers, stones), to individuals and to groups with complex social activities, symbolic systems, and tools/artifacts.

The key aspect of Cognitive Mediation is an individual's set of internal mechanisms, which make it possible to use external structures as auxiliary information-processing devices, but also work as internal "virtual machines" that provides new cognitive functionalities (logical tools, techniques and strategies), adding advantages that last beyond the duration of the "connection" to an External Mechanism, having an important role in shaping the way thinking occurs (Souza, 2004, 2006; Souza & Roazzi, 2000).

In order to integrate the information-processing done by the brain and the one executed by external mechanisms, it is necessary that there be some logical link between these computational devices, in other words, some way of translating inputs, outputs, and throughputs between them. This is very similar to having to install "device driver" software in a computer system so that it can recognize and deploy a specific piece of external hardware, such as a printer, a scanner or storage device. In humans, this may be achieved by means of a mental representation of a physical