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Bridging The Gap Between Education And Cognitive Neuropsychology

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Abstract

The human brain is a fascinating and enigmatic machine. It has the ability to monitor and control our basic life activities, to maintain our posture and direct our movements, to receive, store and interpret information about the world around us and likewise bears the capacity to produce this information accessible, whenever it is needed. In the domain of learning many students struggle to cope with the demands and requirements of the classroom learning, as a result being left behind by an educational system eventually. The field of cognitive neuropsychology has been flourishing in the late years, which studies how the brain and the nervous system affects cognition and the resultant behavior. The aim of contemporary cognitive neuropsychology is to articulate the functional architecture underlying normal human cognitive abilities, on the basis of patterns of performance over a variety of cognitive tasks involving subjects with varying degrees of brain-damage (Bub,1994). This article talks about the inevitable role of the brain in the learning procedure and also explicates the benefits of incorporating the findings from cognitive psychology into the educational sphere.

Keywords: Cognitive neuropsychology, brain and cognition.

Introduction

One of the most important fields of psychological research today deals with human behavior. Not only psychologists, but also philosophers, empiricists, and nativists have taken initiative to explore the human mental behavior. By virtue of this, different branches of psychology had emerged, some of them are, behavior psychology, cognitive psychology, comparative psychology, social psychology, and experimental psychology. Cognitive psychology is the study of how people perceive, learn, remember, and think about information (Sternberg, 1999). It is the scientific study of mind and mental function, including learning, memory, attention, perception, reasoning, language, conceptual development, and decision making. To put it differently, cognitive psychology deals with the study of internal mental processes or our mental life. Being a younger branch of psychology, this branch has several practical applications, which includes resolving learning disorders, improving memory, and enhancing the processes of learning.

The second half of the nineteenth century paved the way for cognitive neuropsychology when neurologists such as Lichtheim, Bastian, Wernicke, and others set about to make inferences about the cognitive architecture of the language processing system. This was accomplished by studying the various ways in which spoken or written language abilities broke down after brain damage. Cognitive neuropsychologists were not only interested in the functional architecture of cognition, but also discuss how the components of such an architecture were localized in the brain (Caramazza & Coltheart, pp. 3) because these cognitive neuropsychologists were also cognitive neuroscientists. A radical turn in the development of cognitive psychology came about in the first half of the twentieth century when behaviorists like B. F. Skinner asserted that mental internal operations such as attention, memory, thinking cannot be observed or proved.

Therefore, they claimed, mental processes are irrelevant and led to the demise of cognitive psychology. Consequent upon this, the twentieth century witnessed the emergence of behaviorism and gradually cognitive psychology vanished from the scientific scene until the first half of the twentieth century. In the 1950s, scientists reverted to explore the mental operations such as attention, memory, images, language processing, thinking, and consciousness. The failure of behaviorism foreshadowed a new chapter “Cognitive Revolution” the exploration of cognition.

Cognitive psychology is the scientific investigation of the mental processes which includes thinking and perception (cognition) and this branch of cognitive psychology presumes the modularity of mind (Fodor, 1983). The concept of modularity appeared in psychology during 1980s in Fodor's work "The Modularity of Mind (1983)". In Fodorian sense the concept modularity of mind views that the mind is modular, which means the degree to which cognitive domains can be thought of as separable (Elsabbagh & Karmiloff-Smith, 2004). To express it in another way, cognitive processing components are composed of relatively autonomous processing components or innate neural structures or modules. Subsequently, cognitive neuropsychology came into light by seminal papers from Marshall and Newcombe (1966,1973) on the cognitive neuropsychology of reading and from Shallice and Warringhton (1970) on the cognitive neuropsychology of memory.Cognitive neuropsychology, a branch of neuropsychology that studies how brain structure and function relate to specific psychological processes (Stirling and Elliot, 2008). In other words, it is the science of the relation between brain function and behavior (Kolbe, 2000). Even though, cognitive neuropsychologists study persons who have brain damage, they do not study the mechanism of the brain and only focuses on how it is connected with the cognitive process. There is another discipline which focuses on brain mechanisms, cognitive neuroscience, which is a branch of neuroscience. In brief, cognitive neuropsychology deals with the study of mind rather than brain and cognitive neuroscience study the brain mechanisms.

Why neuroscience matters to cognitive neuropsychology?

The subject of cognitive psychology is cognition and certainly, it would be convenient if we could understand "cognition" devoid of the nature of the brain. In order to construct and prove theories about our thinking processes, it is impossible to defy the neurobiological constraints. Neuroscience encompasses the study of neuroanatomy, neurophysiology, brain functions and related psychological and computer-based models. Cognitive neuroscience is the study of the neural systems of the brain that subserve cognition (Caramazza & Coltheart, 1992, pp. 4). This branch of neuroscience focuses specifically on understanding higher level cognitive processes through brain imaging techniques. For many years, neuroscientists had investigated the neuronal issues, which involves, different types of brain damage, lesions, and traumas affect the brain and the related mental functions, but the findings were isolated from cognitive and psychological

perspectives. Also, neurobiological data provide physical evidence which supplies a theoretical foundation for the processes of cognition. Earlier neuroscientists neglected the factors which perturbed the mental functions, later on, the rise of new technologies in due course of time provides evidence that supports the relation between brain pathology and behavior. As a result, neuroscientists turned to cognitive psychologists to explain the observations made in the laboratories and cognitive psychologists sought neurological explanations for their findings.

From this we can infer that both cognitive neuroscience and cognitive psychology, which are a part of the wider field called "cognitive science" overlaps each other, where the former concentrates on the neural substrates of the mental processes and their behavioral manifestations and the latter turned on the neurological basis for the occurrence of a behavior, resulted in "cognitive neuropsychology." Cognitive neuropsychology, a branch of neuropsychology that studies how brain structure and function relate to specific psychological processes (Stirling and Elliot, 2008). Neuroscience studies the structural aspect of the brain and find out the different functions of the brain parts. This branch of cognitive science also reveals the connection between different parts of the brain. To put in another way, neuroscience focuses on biological functioning of the brain. The two definitions alluded above indicates the distinction between cognitive neuropsychology and cognitive neuroscience. The domain of inquiry of cognitive neuropsychology looks out the functional organization of the brain, which includes language, cognition, perception, inhibition and motor processes. As such, cognitive neuropsychology is a branch of cognitive science, what differentiates cognitive neuropsychology from other branches of cognitive science rely on the type of the observation that it utilizes in developing and judging theories of normal cognition (Caramarzza & Coltheart, 2006, pp. 4). Cognitive neuropsychologists study how these biologically manipulated patterns of performance affect the functional organization of the brain in contradistinction to cognitive neuroscience.

The aim of contemporary cognitive neuropsychology is to articulate the functional architecture underlying normal human cognitive abilities, on the basis of patterns of performance over a variety of cognitive tasks involving subjects with varying degrees of brain-damage (Bub, 1994, pp. 417). In other words, the major objective of cognitive neuropsychology is the formulation and evaluation of cognitive theories based on the subjects' performance. On the contrary, neuroscience utilizes neuroscientific data to constrain cognitive as

well as psychological theories and modifying these theories to be more biologically plausible. To state it differently, cognitive neuroscience is the scientific investigation of the biological processes and aspects underpin cognition with special consideration of the neural connections in the brain. Furthermore, it explicates the role of neural correlates in controlling the cognitive activities. From this we can infer that cognitive neuroscience overlaps with various disciplines such as cognitive neuropsychology, cognitive psychology, neuroscience, and, psychology. Based on these statements we can assert that cognitive neuropsychology also derives materials from neuroscience, psychology, and cognitive neuroscience, hence cognitive neuroscience and cognitive neuropsychology are interdisciplinary fields.

Even though, these two branches of cognitive science show interdisciplinarity, there exist certain disagreement have been unnoticed or neglected sometimes. Some of the reasons are:

Begin with the first reason, cognitive neuropsychologists focus on people with brain disorders

(on the other hand not studying those disorders). Secondly, some cognitive neuropsychologist are also cognitive neuroscientists, but some others are not. In the case of persons who are only cognitive neuropsychologists, they have nothing to do with the neural systems of the brain that promote cognition. In contrast, persons who are not only cognitive neuropsychologists but also cognitive neuroscientists, study the cognitive deficits exhibit in person and comparing it with the nature of the normal cognitive mechanism and also the neural mechanisms associated with it. The next reason is, there often seem to be assumptions that conclusions about the functional architecture of cognition have implications for what the brain must be like, and conclusions about what the brain is like have implications for theories of the functional architecture of cognition (Caramarzza, 1992). If these are candid assumptions, then anyone doing cognitive neuropsychology would be doing cognitive neuroscience. From the arguments alluded to above, we can infer that learning whether sensory, motor, cognition, demands existing neural network to generate new neural patterns. However, the specific weight given by an investigator to the cognitive or the neural substrate of the brain relies on the investigator's inclination towards it. Supporting the above argument (Caramarzza, 1992), claimed that neuropsychological data are by their very nature, function-brain pairings, and therefore they offer a potential window into the neural organization of cognitive systems. So how cognitive neuropsychology is interconnected with cognitive neuroscience is still a matter of controversy. Taking

together, all these arguments, we can conclude that the major aim of both cognitive neuropsychology and cognitive neuroscience is to construct connections between mind and brain by formulating and evaluating cognitive theories and redesigning those theories to be more biologically reasonable. This paper takes the stand that the neuroscience as an indispensable source of knowledge to inform the process of learning. However, also concur that the findings from neuroscience studies cannot be directly consigned into the classroom. Of late, research in neuroscience has lured the attention of educationists thus whoever is inquisitive in education and learning wants to discern how the findings from neuroscience research could be utilized in the academic field. Taking this into account, this article enunciates why the brain cannot be ignored in the processes of learning and also centralizes on how the findings from cognitive neuroscience and cognitive neuropsychology can be used to inform classroom teaching methodologies and further learning.

Can the brain be ignored?

The way the human brain works is still poorly comprehended albeit neuroscientists have been examining it for several centuries to tackle how it works exactly. During a period stretching from the1960s to the 1980s, a number of noted scholars (Fodor, 1975; Marr, 1982; Neisser, 1967;) argued persuasively that it is perfectly acceptable to ignore the brain when one constructs a theoretical model of some cognitive process (Brynes & Fox, 1988). Several arguments have surfaced on educationally relevant-areas in relation to brain and cognition.

Some thinkers argued that it is feasible to advance the level of cognition, leaving out how it is allied to the brain. Another group of scholars conversed that neuronal constructs are exclusively designed for biologists, hence it is unlikely for a psychologist and also for an educationist to make use of neuronal construct to furnish a psychological explication of behavior. The third group of scholars suggested that appealing to neurology within a psychological account tends to make one a reductionist (Fodor, 1975). These arguments may lead the educationists to ask, “Why should I strive to understand the expansive and complex literature on brain functioning when I don’t have to?” The arguments alluded above, justify that brain can be ignored. In my opinion, there are two reasons why discovering the complex process of the brain is significant for educationists. Foremost reason, to frame an appropriate instructional intervention to ameliorate the students’ academic performance, research findings from cognitive neuroscience assist teachers, researchers as well as

educationists by contributing insight into the nature of cognition and school-related tasks. Furthermore, the findings usually advance researchers' knowledge regarding cognitive functions such as attention, memory, spatial perception and language processing. Secondly, in order to perceive the nature of cognition, appropriate understanding about the connection between brain and cognition is unavoidable because cognition emanates from neuronal activity. With regard to the argument concerning the elucidation of vocabularies of psychology and biology, the translation of psychological terms into biological terms (and vice versa) still remains unexplored. The final argument discusses reductionism which appears within the context of a hierarchically arranged dualism of mind and brain (Brynes & Fox, 1998, pp. 300). In general, components of the mind such as memory, concepts, etc. are usually interpreted as existing at a "higher" level in contrast to what the brain comprises of - synaptic connections, neuronal activity, etc. When neural constructs are exerted to delineate the components of both mind and brain, reductionist wants to renounce the psychological terms and use only neurological terms which is contradicting the theorists view, whose coveted goal is to replace dualism of mind and brain by considering cognition as a neural activity and offer equal status to psychological and neural terms. In lieu of suggesting the exclusion of one set of terms, Brain and Fox (1998) recommended that educational psychologists become "bilingual". In conclusion, it is difficult to tease apart brain and cognition because information about both brain and cognition are needful to formulate teaching instructions and also can act as a means for child development and learning.

Educational relevance of cognitive neuropsychology.

Since cognitive neuropsychology and cognitive neuroscience overlaps each other, findings from both of these fields can enrich the education field, therefore I am using both the terms interchangeably. In this section, I am explaining how the findings from both these fields enhance the process of learning. This paper promotes the notion that the research findings from both of these fields have a substantiate role in enhancing the academic performance of students, which will, in turn, improves the quality of education. This objective can be accomplished when neuropsychology and education work in close integration in order to create teaching methods underpinned by the knowledge of mind and brain.

Regarding the integration of neuroscience and education, educators directly take on the research findings from neuroscience and apply it in their teaching, hence there would be a persistent flow of findings from the

research lab to the classroom. Then this type of approach is questionable and we can call it as "recipes for practice" anchored on neuroscientific findings. I hold the opinion that this approach is unsubstantial and may diminish the attempt to build a bond between education and neuroscience. Additionally, educators would become mere recipients of information produced by neuroscientists, consequently the former becomes passive. Moreover, in my view, if education renounces control to neuroscience, it may not regain its independence. Indeed, there exists a growing industry of so-called 'brain-based learning' products that propose pedagogical approaches and introduce tools and teaching techniques that claim to be based on neuroscientific data (Ansari, et. al, 2011, pp. 38). However, to grasp the connection between brain-based tools and teaching techniques through close observation unveils the fact that the bonding between these two is factually unsound. Therefore, we can infer that teaching approaches stationed on brain-based tools are incapable to assemble education and neuroscience. As an alternative, the logical interaction between neuropsychologists and educators would assist them to derive a common solution to the problem rather than opting a direct route, from the laboratory to the classroom. Therefore, training in various aspects of cognitive psychology should become a fundamental part of teacher education, while at the same time graduate students in cognitive neuroscience and neuropsychology should be exposed to educational issues. These types of approaches provide teachers as well as teacher educators a comprehensive picture about the development of the child and the biological hindrances fixed on learning processes. Analogously, cognitive neuroscientists when opened to educational matters will be habituated with pedagogical problems, burning questions by the educators and the prevalent issues in the classroom learning environment. For instance, allow educators to converse with cognitive neuroscientists and discuss the various learning strategies students are employed to solve while confronting a problem. Likewise, cognitive neuroscientists should analyze various strategies in the classroom environment to examine children, thereby bringing the descriptions of learning environment into the realms of neuroscience and neuropsychology. This all will, in turn, result in the collaboration of cognitive neuroscience, cognitive neuropsychology and education. Consequently, new research questions will loom that would be closely aligned with the issues encountered by teachers as well as neuroscientists, which further results in the generation of new teaching techniques.

Connecting neuroscience to teacher education curricula delivers a fundamental understanding of structural and functional aspects of brain development and also discloses the brain mechanisms subserving the cognitive functions *such as the typical and atypical development of reading and mathematical skills.* The benefits obtained from collaborating neuroscience and teacher education curricula is not circumscribed to the above-alluded information, but also *discuss wider topics of relevance to education such as the effects of culture on brain function.* Indeed, this does not mean that the curriculum should be enclosed within the sphere of brain imaging studies, but should also recite the inevitable role of behavioral science. To put it in another way, the curriculum should be an amalgamation of evidence from both neuroscience and behavioral science.

The fundamental objective behind associating neuroscience and neuropsychology to education is to understand and promote learning and development amongst students. Teachers should need satisfactory knowledge concerning science and *what science has revealed about learning and development at multiple levels of analysis, from multiple perspectives.* Furthermore, teacher training courses should take initiative to introduce research methodologies, behavioral methods, including its strengths and shortcomings, methods for measuring brain activity and also discusses the uses and misapplications of scientific data in publications. Being able to critically evaluate scientific results (Goswami, 2004) and their portrayal in the popular media is crucial, especially because there already exists a great proliferation of so-called 'neuromyths' in publications aimed at teachers. As I discussed earlier, there is an emerging body of pedagogical techniques called 'brain-based tools" claimed to be based on neuroscientific evidence, hence teachers' should be competent to critically appraise the subject matter to which they are exposed to or in other words teachers should be capable to question the inaccurate data and pseudoscience.

Conclusion

There are several issues that need to be considered in the learning processes and should be sorted out in order to come up with suitable solutions. Most importantly, teachers' should be aware about the structural and functional aspects of the brain, which includes perception, language processing, memory, attention, and cognition. For that teacher education curriculum should incorporate courses on cognitive neuropsychology and cognitive neuroscience, or integrate the methods and findings of both of these fields into their present

courses. Thus, in order to collaborate the findings of both of these fields with education, these fields need to depart from their traditional methods and techniques to attain the common goal that is child development and learning. To achieve this coveted goal teachers as well a educationists need to be 'neuropsychology literate' and, in the same vein, cognitive neuroscientists and neuropsychologists need to become 'education literate'.

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