

The Study of Mind in Neurobehavioral Studies: A New Prospective

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ABSTRACT

Neurobehavioral studies are very important to infer any neurotoxicity in reference to neurotoxins. The studies are mainly related to the study of the central nervous system, i.e., study of the mind, because the mind is the living state of brain. The difference in mind and brain are not clearly defining, in any protocol, how to study the mind. It is a great time to prepare a protocol to study the outcome of brain completely with maximum area covering the brain live activities. The proposed studies, as part of neurobehavioral studies, the only difference is that all parameters as a protocol have not been reported in the literature. Therefore, a new definition of “mind” is coming into existence. The study of human behavior; is fully based on the study the outcome of the brain as both an academic and applied science discipline, Psychology is involving the scientific study of mental function/mental processes, such as perception, cognition, emotion, Psychology differs from the other social sciences, due to its focus on experimentation. Historically, psychology differed from biology and neuroscience in that it was primarily concerned with the mind rather than the brain. A new scientific initiative, the “Decade of the Mind”, seeks to advocate for the U.S. Government to invest \$4 billion over the next ten years in the science of the mind. However, the mind research has many ramifications. There is a possibility that the mind is an entity of a dynamic system that integrates its processes.

Keywords: Neurobehavioral, Neuroscience, Psychology, Neurology, neuropsychology, Brain, Mind

Exposure to environmental toxins is increasing every day at the workplace and home. Human behavior can be affected by such exposure and can give important clues that a person or population is in danger for behavioral alterations. If we can understand the mechanisms of these disturbances, then only the development of better testing and prevention programs will be possible. McDaniel, K.L (1993).

Neurobehavioral and neuropsychological studies are a part of neuroscience and a field devoted to the scientific description of the nervous system, and included, the structure, function, evolutionary history, development, genetics, biochemistry, physiology, pharmacology, neuroinformatic, computational neuroscience and pathology of the nervous system. As a branch of biological sciences. there has been a surge in the convergence of

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interest from many allied disciplines, including cognitive and neuro-psychology/neurobehavioral, and medicine. The scope of neuroscience has now broadened to include any systematic scientific experimental and theoretical investigation of the central and peripheral nervous system of biological organisms, Pettersen, R.B. (2005). The empirical methodologies employed by neuroscientists have been enormously expanded, from biochemical and genetic analysis of dynamics of individual nerve cells and their molecular constituents to imaging representations of perceptual and motor tasks in the brain.

The task of neural science is to explain behavior in terms of the activities of the working brain (mind). How does the brain regulate its millions of individual nerve cells to produce behavior, and how are these cells influenced by the environmental toxins. Bushnell, P.J, (1998), (1999). The leading edge of the behavioral scientists, their ultimate challenge is to understand the biological/psychological basis of consciousness of the mental processes, as outcome of brain by which we perceive, act, learn, and remember.

The term consciousness of the mental processes i.e., “psychology” was coined as a combination of two Greek words: “psyche” (soul of mind) and “logos” (study). Its original use suggested “the study of the mind”, Today psychology is explaining as science of behavior and mental processes. It is a broad discipline, essentially spanning subject matter from biology to psychology. Psychologists study the intersection of two critical relationships, one between brain function and behavior, and the other between the environment and behavior. Moser, V.C, (1990), (2000). The scientists follow the scientific methods, using careful observation, experimentation and analysis. Now psychologists also need to be creative in the way that they also apply scientific findings in studying behavior.

The recent advances in the area of neurosciences, the mapping of the brain by Piot-Grosjean (2001), opens a new field of exploration having the structures of the brain involved in complex forms of behavior Studies. Researchers have been defined, David J. (2007) The centers that are responsible for some elementary sensory functions such as seeing, hearing, learning and memory as cognitive and the control of the various muscular functions in motor system of the body.

The sensory and motor centers account for only a small part of the area for brain function. In order to proceed further with the mapping of the brain's functions we must investigate the systems responsible for the higher, more complex behavioral processes Hamm, R. J. (1994). Modern psychological investigations have made it clear that each behavioral process is a complex functional system which judges the result of every action of the brain. This mechanism is equally applicable to the outcome of the brain i.e., mind, including involuntary forms of behavior such as breathing and walking are voluntary behaviors such as reading, writing, decision-making and problem- solving are resulted as intelligence.

The role of intelligence is accepted as the innate ability of the learning process to invent partial or complete personal realms within the mind from elements derived from sense perceptions of the shared world. The term is technically used in psychology for the process of reviving in the mind percepts of objects formerly given in sense of learning through perception. Perceptual consciousness is a quality of the mind generally regarded to comprise qualities such as subjectivity, self-awareness and the ability to perceive the relationship between oneself and environment.

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Relation between brain and mind

The structural part of brain, or encephalon (Greek for "in the head"), is the control center of the central nervous system, responsible for thoughts. In most animals, the brain is in the head, protected by the skull and operates to the primary sensory orations, vision, hearing, taste and olfaction. While all vertebrates have a brain, most invertebrates have either a centralized brain or collections of individual ganglia.

Brains can be extremely complex, contain 100 billion neurons, each linked to as many as 10,000 others. The mind is defined as a function of working brain collectively refers to the aspects of intellect and consciousness manifested as combinations of thought, perception, memory, emotion, will and imagination and includes all the brain's conscious processes. These mental processes sometimes include the working of the unconscious or conscious and both combined thoughts of the individual. Mind is collectively used to refer especially to the thought processes and resulting as an outcome of brain.

Luria A.R. (1970). Every complex form of behavior depends on the joint operation of several faculties located in different zones of the brain. A disturbance of any one faculty will affect the behavior, in different ways. All neurobehavioral and neuropsychological disturbances will be included in their studies and are based on the activity of the brain i.e., mind.

PROPOSED DEFINITION OF MIND:

Mind may be explained as **M.I.N.D** where M denotes **memory**, I mean **intelligence**, and N represents all **neural activities** and lastly D represents, **drive/movements**. Here, we propose the protocol for neurobehavioral studies which includes all parameters representing the outcome/details of MIND.

M = Memory is an organism's ability to store, retain, and subsequently retrieve information; and has become one of the principal pillars of a branch of Science is called cognitive neuroscience, an interdisciplinary link between cognitive psychology and neuroscience. Immediate sensory memory corresponds approximately to the initial 200 - 500 milliseconds after an item is perceived. The information in sensory memory is then transferred to short-term memory which allows one to recall something from several seconds to as long as a minute without rehearsal. The storage capacity in sensory memory and short-term memory is generally limited which means that information is available for a certain period but is not retained indefinitely. Short- term memory is supported by transient patterns of neuronal communication, dependent on regions of the frontal lobe and the parietal lobe.

Long-term memory can store much larger quantities of information for unlimited duration, sometimes a whole life span, and maintained by more stable changes in neural connections spread throughout the brain. Memory is also sometimes specified as "working memory" which is the ability to retain and manipulate information in gaining the new knowledge Müller, N.G, (2006).In animal model to study the memory task, learning and conditioning are the main aspect of measurements, visual memory is also the part of memory preserving some characteristics of senses pertaining to visual clues and experience, which able to place in memory measurements in the animals.

I = Intelligence (also called intellect)

Intelligence is an umbrella term used to describe a property of the mind that encompasses many related abilities, such as the capacities to reason, to plan, to solve problems, to think

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abstractly, to comprehend ideas, to use language, and to learn. There are several ways to define intelligence, in some cases intelligence may include traits such as creativity, personality, character, knowledge, or wisdom and ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly with the help of separate or combined form of sensory systems from present and previous experience, and resulted in a intellect decision making.

The broader concept of intelligence is that which measured in IQ tests, especially in human being as higher brain functions with a strong argument that the psychometric approach measures only a part of what is commonly understood as intelligence. Moser, V.C. (2000) Furthermore, people still have unique strengths and weaknesses in specific areas; they are often able to solve problems, because they can quickly retrieve stored information which allows solving the problem successfully. Consequently, they argue that psychometric theories are based on stimulus and response, as a mental ability that is often taken as an indicator of intelligence level is working memory ability which reflects the intellect in humans at all. Müller, N.G (2006).

The primary focus of intelligence researchers, scientists have attempted to investigate animal intelligence, or more broadly, animal sensory activity as cognitive factor dominated learning and memory as a core intelligence. They try to correlate the core mental ability in a different species, and established a common ability amongst all the species Katarzyna Nosek (2008). They study various measures of problem solving, in different stressful situations, as well as mathematical and conditioning abilities. The present challenges in this area are defining intelligence as some common factor so that it means the same thing across all species.

N = Neurons

Neurotoxicity occurs when the exposure to natural or artificial toxic substances, which are called neurotoxins, alters the normal activity of the nervous system in such a way as to cause damage to nervous tissue. This can eventually disrupt or even kill neurons, key cells that transmit and process signals in the brain and other parts of the nervous system, Geller, A.M. (2000). Neurotoxicity can result from exposure to substances used in chemotherapy, radiation treatment, drug therapies, certain drug abuse, and organ transplants, as well as exposure to heavy metals such as lead and mercury, certain foods and food additives, pesticides, industrial and/or cleaning solvents, cosmetics, and some naturally occurring substances Bushnell,P.J.(1994),(1997). The symptoms may include limb weakness or numbness, loss of memory, vision, and/or intellect, headache, cognitive and behavioral problems and sexual dysfunction. The term neurotoxic is used to describe a substance, condition or state that damages the nervous system and/or brain, usually by killing neurons, Deborah A (2005). The term is generally used to describe a condition or substance that has been shown to result in observable physical damage. The presence of neurocognitive deficits alone is not usually considered sufficient evidence of neurotoxicity, as many substances exist which may impair neurocognitive performance without resulting in the death of neurons. This may be due to the direct action of the substance, with the impairment and neurocognitive deficits being temporary, and resolving when the substance is metabolized from the body. Padilla,S. (1992), (1994) In some cases the level or exposure-time may be critical, with some substances only becoming neurotoxic in certain doses or time periods.

At the molecular level of neurotoxicity, include the mechanisms by which neurons express and respond to molecular signals and how axons form complex connectivity patterns McGaughy, J. (1995). At this level, tools from molecular biology and genetics are used to

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understand how neurons develop and die, and how genetic changes affect biological functions. The morphology, molecular identity and physiological characteristics of neurons and how they relate to different types of behavior are also of considerable interest.

The behavioral can explained in Psychology and attempts to explain conscious behavior and its logical interaction with the nervous system, primarily devoted to describing human experience and behavior as it occurs and has begun to examine the relationship between consciousness and the brain or nervous system or vice versa. It is still not clear how these interact, does consciousness determine brain states or do brain states determine consciousness. Perhaps to understand this, it is necessary to define "consciousness" and "brain state, (mind) in living organisms. An understanding of brain function is increasingly being included in psychological theory and practice, particularly in areas such as artificial intelligence, Moser, V.C. (2000) neuropsychology, and cognitive neuroscience. Brain and behavior are closely related brain functions as working brain may be assessed by the Luria-Nebraska Neuropsychological Battery. Working Brain as defined by Luria, (1970) in "An Introduction to Neuropsychology", scientific interest in the study of the brain, as the organ of mental live activity. The mind as a cerebral organization of perception and action, of attention and memory, or speech and intellectual processes, and attempts to fit the facts obtained by neuropsychological studies of individual brain systems into their appropriate place in the grand design of psychological science. Tilson, and Moser, V.C., (1992), (1997) in neuropsychological studies molecular and Cellular techniques in Ezequiela Adrover, (2007) along with other like, neuro-receptors, behavioral genetics, cytology, synapse, action potential, neurotransmitters, neuroimmunology, biochemistry, patch clamp, voltage clamp, molecular cloning, gene knockout, linkage analysis, fluorescent in situ hybridization, Southern blots, DNA microarray, green fluorescent protein, calcium imaging, two-photon microscopy, HPLC, micro dialysis, and receptor activities are well documented. {Salamones, JD (1990) Moser, VC (1995)},

D = DRIVE/ MOVEMENT (Locomotor Activity)

Drive or locomotors activities are controlled by a complex of cortical and sub cortical zones, the classical theory was that spontaneous movement originated with the large pyramidal cells of the cortex; they have long axons that conduct impulses to the spinal cord. It is now known that other zones participating in spontaneous movement are the post central zone, which deals with sensory feedback from the muscles. The parieto-occipital zone, which is involved in the spatial orientation of movement; the premotor zone, which deals with the separate links of motor behavior, and the frontal zone, which programs movements, resulted in different studies of lesions in different zones give rise to different locomotors abnormalities. Bowen, S.E. (1998)

The mechanism of the formation of a voluntary movement or ataxia is much more complicated, {Crofton, K.M, (1991)} during the system of cortical zones participating in the creation of voluntary movements. Whereas the complex of sub cortical and cortical zones, each playing a highly specific role in the whole locomotors functional system. That is widely confirmed in many lesions of different parts of the brain resulting in disturbance in locomotors' activities. Weiler, (1994)

The brain must receive feedback from the muscles and joints to correct the program of impulses directed to the motor apparatus. One can recognize the nature of the problem by recalling how difficult it is to start a leg movement if the leg has become numb, Meyer, H.A., (1997), This sensory abnormality is provided by a special part of the brain, the post

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central sensory cortex. If this part of the cortex is destroyed by a wound or other injury, the patient not only loses sensation in the limb but also is unable to fulfill well-coordinated activities. Hmm, R J, (1994).

The sensory and spatial factors in the organization of a movement are basic but still insufficient to allow the completion of the movement, as voluntary movement is the result of a sequence of events. A skilled movement is really a kinetic melody of such interchangeable links in nervous system, and fulfilled part of the movement is blocked and the impulse is shifted to another link can an organized skilled movement is made.

Every movement has to be subordinated to a stable program or a stable intention and is provided in the prefrontal lobes of the brain.

COCLUSION

Neurosciences and psychology have put us on a vista of a new path in the investigation of the brain functions i.e., mind and we can suppose that it is likely to lead the way to substantial changes in the design of neurobehavioral research in the future. The behavior of an organism is an integrated and outcome of the sensory and motor components of central nervous system and requires the whole, intact organism, so it can be studied lively.

Behavioral changes often serve as early indicators of neurotoxicity, occurring much before more permanent damage to the CNS occurs Moser, V.C.(1991) Thus, behavioral parameter are widely employed the study of neurotoxicity due to environmental and industrial contaminants and pollutants, in animal model as well as in the exposed human populations. Hence the utility of behavioral test as broad-spectrum nervous system toxicity biomarker, is seriously considered in population exposed to different industrial / environmental toxins and may be use as tool of predictive toxicology.

Table:1- Proposed protocol for neurobehavioral Studies:

Parameters	Human	Animal (Rat/Mice)
MEMORY (Sensory /Cognitive)	Auditory/Visual memory	Active learning
	Immediate memory	Passive learning
	Delayed memory	
Tests	Digit Span (WAIS)	Jumping box
	Digit Symbol Substitution	Y maze
	Benton Visual Retention	Water maze
INTELLIGENCE (Higher brain function)		
Sensory + motor	Thinking/ reasoning	Thinking/ reasoning
	Visual accuracy	Visual accuracy
Tests	WAIS	Maze leaning, hole poke
	Progressive matrices	Puzzle, Y-maze
	Koh's block (WAIS)	
	Bordon wiserma vigilance	
NEURO-functions		
Neurology/ Structure of brain/ axon	EMG, NCV, FMRI, PET	FMRI, PET, receptor binding, D-2 and Ach estimation
Tests	Subjective neurological assessment, Q-16, Luria-Nebraska Neuropsychological Battery.	FOB, (Clinical- examination)
DRIVE (motor functions)	Movement disorders, Ataxia	Locomotor's-activity monitor(SLA)
Tests	Reaction time, Santa Ana dexterity, digit symbol(WAIS), mirror drawing	Ataxia and catalepsy Hind and Fore limb strength Test

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Conflict of Interest

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