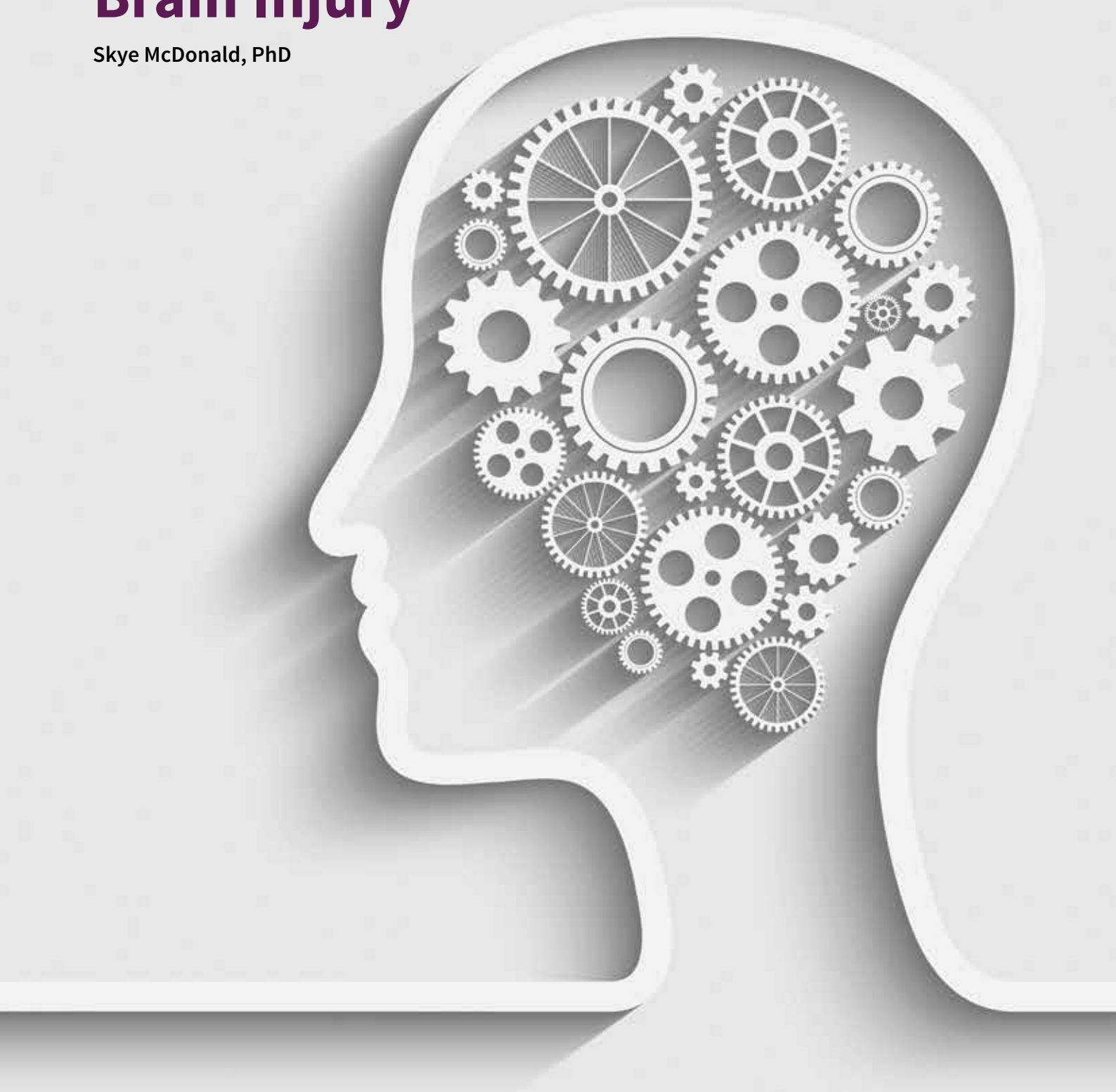
Understanding Psychological **Consequences of Traumatic Brain Injury**

Skye McDonald, PhD



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Understanding Psychological Consequences of Traumatic Brain Injury

Skye McDonald, PhD is a Professor of clinical neuropsychology, who has been interested in studying the social, emotional and communication disorders occurring following traumatic brain injury. Here we discuss her background, motivation and the outlines of her research and community service activities.

To start, what is your academic background and how did you pursue the early steps of your career in medical research?

I have a Bachelor's degree in science, with honours, and a Masters degree in clinical neuropsychology. Following my master studies, I worked as a clinician working with patients who suffer brain damage from a range of causes including stroke, dementia, and traumatic accidents. After several years, I became eager to understand the complex and subtle problems arising from brain injury, especially because of their immense impact on the ability of these patients to communicate. I enrolled in a PhD program, where I combined my research on patients with brain injury in the rehabilitation hospital with my clinical duties. After obtaining my PhD, I took up an academic position, through which I continued to perform research on the assessment and remediation of social and emotional difficulties arising from brain damage.

And what has been your motivation to choose neuropsychology as a field of specialization?

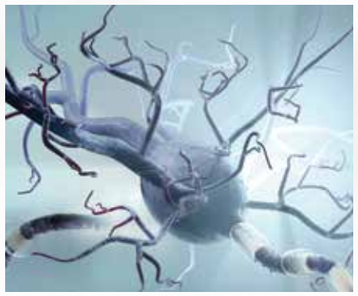
Understanding brain damage and its effects is a fascinating topic. Brain research has become a 'hot' topic in recent years, especially with the advent of modern brain imaging techniques that show the structures of the brain in detail, and indicate their activity during specific tasks. However, many facets of brain function remain difficult to reveal by these technologies. For example, there is a phenomenon known as unilateral neglect, whereby people suffering damage on the right side of their brain no longer notice anything to their left, despite having normal sensation. Why would this happen? What does it tell us about how the brain processes incoming information? We would not know the brain works in this way except by observing people with brain damage. So our understanding of the function and organization of the brain is extended by observing people with brain damage. It is also exciting to be able to pinpoint specific areas of brain damage or a particular neurological disorder, just from observing behaviour.

You are interested in studying the social and emotional disorders following brain injury. Can you explain to the readers the scope of these disorders and how do they influence the life of patients and their relatives?

Social and emotional processes can be affected by brain damage. For example, patients may lose their ability to recognize emotions in others, which can be problematic socially. If you are conversing with someone but you are unable to recognize expressions of boredom, irritation or even fascination, you will fail to guide your behaviour accordingly. This can be crippling socially when meeting new people, and can cause a huge strain on family members who find themselves unable to get the message across as to how they are feeling.

A second problem is the inability of these patients to put themselves "in another's shoes". We need to be able to see things from other people's perspective in order to understand conversational meaning. For example, when a person is being sarcastic they may say the opposite to what they mean. The only way we can understand their true meaning is to guess what is on their mind. Hinting, making small white lies, joking, using hyperbole are all instances where we need to guesstimate what the speaker intended.

A third major problem is related to disorders of emotional regulation. At one end of the scale is a disorder known as apathy, whereby the patient with brain damage cannot motivate



him/herself. Without external prompts the affected person may do nothing all day, every day. Another kind of disorder is losing control, where the patient may be over-talkative or tell bawdy jokes during job interviews for example.

All these social and emotional disorders have the sum effect of decreasing successful social interaction and increasing isolation and family strain.

Throughout your career, have you also collaborated or worked along with NGOs or patient support groups?

I am on the executive board of ASSBI, or the Australasian Society for the Study of Brain Impairment. ASSBI is a non-profit organization, and a vibrant society that offers clinicians and researchers the opportunity to come together in a cross-disciplinary forum to learn about the latest research concerned with people with brain disorders. Its cross-disciplinary nature is the key to its success. ASSBI holds an annual conference, offers a continuing education program, publishes a scientific journal, and operates a student forum. In addition, I developed a publishing arm 'ASSBI Resources', through which we sell evidence based resources for the assessment and treatment of conditions arising from brain disorders such as memory, language, communication, emotion perception, social skills, and anxiety.

Socio-emotional deficits in patients with Traumatic Brain Injury

Survivors of traumatic brain injury (TBI) suffer a multitude of social and emotional impairments, which negatively affects the quality of life of the patients and their families. Here we discuss the research conducted by Professor McDonald to unravel the nature and the underlying mechanisms of these disorders, and to develop diagnostic and treatment techniques.

Severe traumatic brain injury (TBI) arising from motor vehicle accidents, warfare and assaults is a leading cause of death and neuropsychological impairment worldwide. In the United States, it is estimated that around 5.3 million people are living with a TBI-related disability, while in the European Union the number is approximately 7.7 million. Survivors of TBI usually suffer physical, psychological and emotional deficits that prevent them returning to their former lifestyle. Relatives of these patients report lasting behavioural and personality changes such as childishness, self-centeredness, disinterest or dislike of others, quarrelsome, unreasonable or socially inappropriate behaviour, unhappiness and excitation. 'Such changes predict poor social adjustment and participation for the patients, and cause immense stress to their families and caregivers', said Professor McDonald.

A MATTER OF COGNITION

In 1978, an American neuropsychologist, Dr. Muriel Lezak, described impaired capacity for social perceptiveness as a key feature of the behavioural changes seen post injury. However, it is only recently that the research into the mechanisms underpinning poor social perceptiveness has commenced, fuelled by advances in the field of social neurosciences. A central element is social cognition— i.e. our ability to understand and predict the behaviour of others, share experiences and communicate effectively. As the human species relies upon cooperation and competition within groups to survive, social cognition is argued to be an evolutionary imperative that is modularly developed, independent of non-social information processing abilities (e.g. attention and memory).

THE BRAIN AND COGNITION

'The extent to which social cognition is mediated by unique brain processes, is hotly debated', says Professor McDonald. It does appear that the evaluation and interpretation of emotional and mental states represents a unique set of brain processes. Research involving the use of brain scanning technologies and behavioural assessment in patients with brain injury point to a system of interconnected networks within specific anatomical regions of the brain that mediate the automatic, often implicit, appraisal of emotionally salient information and mental states.

The brain structures thought to underlie social cognition are vulnerable to severe traumatic brain injury. TBI results in typical patterns of injury because of the way that acceleration/deceleration forces scrape the soft brain tissue across the bony floor of the skull. The frontal and temporal lobes of the brain are the most commonly affected regions. The brain structures in these regions are immediately affected by the contusions and bleeding, while more long-term effects can result from microscopic injury to the brain cells which disrupts the nerve connections. It is important to stress, however, that a TBI is highly variable in its effects depending on both severity the nature of the injury.

UNDERSTANDING COGNITIVE DEFICITS IN TBI

The research of Professor McDonald and her team focuses on understanding how social cognition is disrupted following TBI. Although the aforementioned changes in the personality and behaviour of the TBI survivors are not subtle, the early research has only described them in vague terms with no reference to the underlying mechanisms. Furthermore, no tools were available to pinpoint these disorders or to assess their severity. The early work of Professor McDonald focused on communication as a base to develop tests for the identification of social cognitive deficits. For example, in 2003 she developed a sensitive test to assess social perception in TBI patients. 'The Awareness of Social Inference Test', better known as TASIT. TASIT is currently used on an international scale to not only pinpoint social perception deficit in TBI patients, but also in other neuropsychological disorders such as dementia, schizophrenia, autism, stroke. Even more, it constituted an important basis for the development of social cognition research. Additionally, Professor McDonald has developed theories to explain aspects of

social cognition deficits in TBI and worked on methods to help the patient and their families circumvent misunderstandings. The following sections particularly discuss the research efforts of Professor McDonald in unraveling aspects of emotional and social impairment in TBI patients and their impacts.

Understanding the mechanisms underpinning social and emotional impairment in patients with TBI is a key element for developing techniques and treatments to improve the social interaction and life quality of these patients and their families

EMOTIONAL PERCEPTION

Emotional perception refers to our ability to recognize and identify emotions in others. During the last 15 years, Professor McDonald and her research group have proven that people with severe TBI have difficulties recognizing emotional facial expressions, especially negative expressions such as anger, sadness and disgust. In addition, they have established that people with TBI have significant difficulty recognizing emotion in audio and audiovisual displays. The reasons behind this impaired emotional perception have been explored by Professor McDonald in several studies. These supported the premise that people recognize emotions in others by simulating the same emotions in themselves. It appears that patients with severe TBI have problems with simulation but only for negative emotions. In several studies, these patients were able to mimic happy, but not angry faces of others and could express positive, but not negative emotions spontaneously and upon request. Similarly, they felt positive emotional changes when they were asked to assume happy postures, while no emotional changes were felt by assuming negative postures.

Based on their understanding of emotional perception deficits, Professor McDonald and her research team have recently developed treatments to improve emotional recognition, communication and social skills. These treatments can provide TBI patients with more positive opportunities for social interaction, leading ultimately to a better quality of life for them and their families.

THE THEORY OF MIND (TOM)

Another scope of the research done by Professor McDonald and her team is concerned with whether TBI patients are able to impute the thoughts and intentions of other people (an inability known as having a Theory of Mind, ToM). The ability to judge the motives of others is critical for understanding their behaviour and the meaning behind what they say. Professor McDonald has shown that some people with TBI have difficulty with this kind of judgement. 'This makes it very difficult for them to understand conversations. We have repeatedly demonstrated they can have a pronounced inability to understand sarcasm and, to a lesser extent, lies', said Professor McDonald. Noteworthy, the team of Professor McDonald is in the process of developing treatments for ToM and broadly social cognition disorders.

THE CURRENT FOCUS

The current research of Professor McDonald is focused on two main thrusts; emotional regulation and empathy. Many people with TBI experience loss of emotional control. They may be under-aroused and fail to engage with the world, or, alternatively, over excited, for example, being quick to anger. Professor McDonald has recently received funding to explore three potential techniques for improving emotion regulation. Her first research project concerns the use of biofeedback to improve heart rate variability (HRV), which is reduced in cases of pain, anxiety and depression. Biofeedback refers to the concept of training an individual to change physiological activity for the purposes of improving physical and psychological health. Professor McDonald is testing whether improving breathing techniques can improve HRV and emotional control in people with TBI. The two other techniques are direct brain stimulation with a gentle electrical current, and self-control training, which involves doing tasks in a non-routine manner.

The second project involves the examination of the mechanisms underpinning empathy, including whether facial mimicry (i.e. mimicking other's facial expressions) and identification (i.e. identifying with others) influences empathy and how these processes are affected by TBI.

Researcher Profile

Professor Skye McDonald
Professor of Clinical Neuropsychology at the University of NSW

Professor McDonald is interested in studying social, emotional, and communication disorders as well as neuropsychological rehabilitation, more generally. She has developed novel approaches to assess and remediate emotion perception, social skills and communication in patients suffering traumatic brain injury. Her work extends to other neurological disorders such as dementia and developmental disorders such as Autism Spectrum Disorders. Skye leads a national Centre of Research Excellence "Moving Ahead" to address psychosocial rehabilitation after traumatic brain injury. With colleagues, she has also developed PsycBITE, a database freely available on the internet that indexes all research ever published in English that provides empirical evidence attesting to the efficacy of treatment for neuropsychological disorders arising from acquired brain disorders.

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