

Neurological Substrates of Personal Identity: Implications for Neurorehabilitation

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Introduction

Survivors of traumatic brain injury often have difficulty regaining direction in their lives and participating in goal-directed rehabilitation programs. Cognitive and behavioral impairments often associated with psychological issues or frontal lobe injury have been identified as potential causes of this lack of initiation. Other neural substrates may be involved as well. This paper will examine the hypothesis that damage to the temporal lobes, can contribute to a persons struggle to regain direction in his/her life by impeding the neurological re-development of personal identity.

Traumatic brain injury often results in damage to the temporal lobes. Damage to the temporal lobes can affect functioning of the hippocampus and the amygdala. These structures work cooperatively on memory functioning and many aspects of daily life and independent functioning. The amygdala functions as an organ of appraisal for danger, safety, and familiarity in approach-avoidance situations (Sarter and Markouitsch, 1985). It is one of the key structures in affective memory (Ross, Homan, and Buck, 1994). The amygdala enhances hippocampal processing of emotional memory by stimulating the release of norepinephrine via other brain structures (McGaugh, 1993). Persons with amygdaloid nucleus damage often lose the gestalt of the "to-be-remembered" information, while their recall of the details remains relatively intact (Buchanan, Karafin, & Adolphs, 2003).

The hippocampus is an essential structure in the creation, integration, and storage of memories. It does this through the ongoing process of memory consolidation, which can take weeks or months to complete after information is first learned (Bremner, 2001). Memory integration is relevant to what we can recall about our lives, ourselves, and what we have been through. Research shows that memory integration can be impaired by disruption of the cortico-hippocampal tracts dedicated to integration of new memories into existing memory networks (Cozolino, 2002).

The hippocampus and amygdala: substrates of identity development

Developing an identity involves retaining and integrating life experiences. Neurologically, the hippocampus undergoes significant neurologic maturation during early and late adolescence (Benes, 1989) paralleling the beginning formation of

personal identity. As substrates of learning and memory, the hippocampus and amygdala are involved in the formation of personal identity. Functionally, the hippocampus has been described as placing the individual in the context of space and time. It participates in our ability to compare different memories and make inferences from previously learned experiences (Eichenbaum, 1992). It helps the individual predict the future and recall the past by relating present information to other memories and experiences (Nadel & Bohbot, 2001). As such, the hippocampus plays an integrative role in our experience (Zola-Morgan and Squire, 1990). It's also involved in the retention, integration, and recall of our life experiences and narratives. Perhaps it is for that reason that damage to the hippocampus increases symptoms of dissociation (Bremner, 2001).

Psychiatric conditions characterized by damaged or lost identity have been associated with disruptions in hippocampal and amygdala structure and functioning. For example, imaging studies show significantly decreased hippocampal (13.1%) and amygdala (21.9%) volumes in people with borderline personality disorder (Schmahl, Vermetten, Elzinga, & Bremner, 2003; Tebartz van Elst, Hesslinger, Thiel, Geiger, Haegle, Lemieux, Lieb, Bohus, Hennig, & Ebert, 2003), schizophrenia (Van Elst & Trimble, 2003), and Post Traumatic Stress Syndrome (Gilbertson, Shenton, Ciszewski, Kasai, Lasko, Orr, & Pitman, 2002).

Re-establishing the self in rehabilitation:

Survivors of brain injury often have trouble developing a direction in their lives and participating in goal directed rehabilitation. These difficulties can impede the rehabilitation process and are sometimes mistakenly interpreted by clinicians, families and friends as a lack of motivation or initiative. This can create a major obstacle for survivors needing cognitive, social and vocational retraining. Individuals whose identity was tied to their occupation or some skill that they no longer possess, may need assistance establishing social and neuronal connections to re-integrate a new identity. This process may be particularly difficult for persons who have had pre-injury cognitive or psychiatric difficulties that already compromised their ability to integrate experiences into a stable identity.

Arguably, healthy identity re-formation may be central to forming and pursuing goals, developing a life plan, and establishing and maintaining healthy relationships. The holistic rehabilitation process, which encompasses psychological adjustment, should facilitate the integration of one's experiences into an identity. Clinicians may be able to facilitate appropriate

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recall of life events, and develop healthy positive narratives with clients through use of memory notebooks, visual timelines and pictorials accounts of daily life events. During this process the clinician will benefit by understanding neural plasticity and the malleability of memory. For example, understanding that memories can be modified each time they are recalled can help the clinician assist the individual shape memories in a way which fosters improved adjustment and identity formation. When working with individuals who have memory impairments and perhaps emotional adjustment issues it may be helpful to understand that because memories are affected by emotions not just at time of encoding, but also at time of recall, the accuracy of memories (and thus the recall of what we've lived through) can vary greatly. False memories can be reliably implanted in experimental situations (Ceci & Bruch, 1993) and may be experienced by people during their lives.

More importantly however, may be the relationship and dialogue that a therapist is able to establish with a patient while performing these acts. The connections and conclusions they draw between remembered life experiences can help emotional adjustment, identity formation, and foster improved neural network integration (Cozolino, 2002) between these and other neural structures.

Conclusions

In summary, some individuals who suffer brain injuries or dysfunction involving the hippocampus and the amygdala may experience cognitive and emotional problems that can affect identity re-formation. Clinicians who are aware of the neurological basis underlying this dysfunction will be better suited to help survivors re-integrate and interpret their memories and facilitate the development of healthier identities.

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