

## **Comment:** **Importance of cognitive reserve in traumatic brain injury**

The expectation for moderate to severe traumatic brain injury (TBI) is permanent damage and lasting deficits. However, in a multicenter investigation, Schneider et al.<sup>1</sup> show that by 1 year postinjury, one-fourth of patients with TBI achieve disability-free recovery (DFR), defined as a score of zero on the Disability Rating Scale. Of importance, cognitive reserve (CR) in the form of educational attainment was related to DFR.

The neural basis for learning and memory depends on network integrity. Functional neuroimaging studies show the modifiability and strengthening of large-scale networks by educational training.<sup>2</sup> In this sense, educational attainment likely represents a proxy for neural processes that reflect network integrity.

Once injured, how networks mend or adapt determines TBI outcome. Does educational attainment function passively, whereby established networks provide the neural scaffolding for rerouting and adaptation? Or is there something more active that leads to DFR? If educational attainment implicates more efficient neural networks, established networks may be better able to respond to the treatment milieu associated with intervention and rehabilitation after TBI. Regardless, these findings provide intriguing hypotheses about the role of CR in brain structure and function as well as response to injury.

Sumowski et al.<sup>3</sup> have shown that educational attainment also attenuates the level of cognitive impairment in TBI. CR is a major factor related to resiliency in aging and the timing and expression of dementing illnesses. The investigations by Schneider et al.<sup>1</sup> and others<sup>3,4</sup> firmly establish a CR role in TBI outcome.

Of course, caution is needed so as not to overinterpret the role of educational attainment. The Disability Rating Scale is but a rating scale with low and overly broad thresholds that lead to DFR classification. Nonetheless, because the brain is an experience-dependent organ, educational attainment must reflect neural integrity at some level, which in turn represents an important factor for the clinician to consider in understanding TBI outcome.

1. Schneider EB, Sur S, Raymont V, et al. Functional recovery after moderate/severe traumatic brain injury: a role for cognitive reserve? *Neurology* 2014;82:1636–1642.
2. Mackey AP, Miller Singley AT, Bunge SA. Intensive reasoning training alters patterns of brain connectivity at rest. *J Neurosci* 2013;33:4796–4803.
3. Sumowski JF, Chiaravalloti N, Krch D, Paxton J, Deluca J. Education attenuates the negative impact of traumatic brain injury on cognitive status. *Arch Phys Med Rehabil* 2013;94:2562–2564.
4. Levi Y, Rassovsky Y, Agranov E, Sela-Kaufman M, Vakil E. Cognitive reserve components as expressed in traumatic brain injury. *J Int Neuropsychol Soc* 2013;19:664–671.

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