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# The growth hormone axis and cognition: empirical results and integrated theory derived from giant transgenic mice

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## ABSTRACT

Sleep is required for the consolidation of memory for complex tasks, and elements of the growth-hormone (GH) axis may regulate sleep. The GH axis also up-regulates protein synthesis, which is required for memory consolidation. Transgenic rat GH mice (TRGHM) express plasma GH at levels 100-300 times normal and sleep 3.4 h longer (30%) than their normal siblings. Consequently, we hypothesized that they might show superior ability to learn a complex task (8-choice radial maze); 47% of the TRGHM learned the task before any normal mice. All 17 TRGHM learned the task, but 33% of the 18 normal mice learned little. TRGHM learned the task significantly faster than normal mice ($p < 0.05$) and made half as many errors in doing so, even when the normal nonlearners were excluded from the analysis. Whereas normal mice expressed a linear learning curve, TRGHM showed exponentially declining error rates. The contribution of the GH axis to cognition is conspicuously sparse in literature syntheses of knowledge concerning neuroendocrine mechanisms of learning and memory. This paper synthesizes the crucial role of major components of the GH axis in brain functioning into a holistic framework, integrating learning, sleep, free radicals, aging, and neurodegenerative diseases. TRGHM show both enhanced learning in youth and accelerated aging. Thus, they may provide a powerful new probe for use in gaining an understanding of aspects of central nervous system functioning, which is highly relevant to human health.

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