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The Neuropsychology of Sport and Performance

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Editorial

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Background

Neuropsychological theory has been a mainstay for understanding pathology within the brain-behavior context. However, our theories for predicting superior behavior are not as well developed. Sport neuropsychology was developed on the presumption that athletes represent a population in a relatively well-controlled environment for studying brain pathology due to injury. This study of pathology within a high-performance environment has been responsible for identifying the effects of mild traumatic brain injury (mTBI) on individual functioning. Far less attention has been paid to the other end of the performance continuum, and yet, viable brain-behavior hypotheses should hold true across the spectrum of function from neuropathology to exceptional performance. While sport continues to be a good model for study, other high performance activities are relevant as well, such as enhanced memory required of chess-masters, methods for enhancing learning in all environments, etc. The distinction for this journal would be the neurological processes that relate to behavioral function.

This is not a brand new concept. Obler and Fein (1988) provided an initial framework in their book, *The Exceptional Brian: The Neuropsychology of Exceptional Behavior*. This volume attempted characteristics and possible mechanisms for explaining giftedness in various activities, primarily in children.

In 2009 Ericsson, Nandagopal, and Roring attempted to define a theory of exceptional performance. These authors asserted that the development of expert performance is primarily constrained by individuals' engagement in deliberate practice and the quality of the available training resources. Furthermore, the distinctive characteristics of exceptional performers are the result of adaptations to extended and intense practice activities that selectively activate dormant genes that are contained within all healthy individuals' DNA.

The next year, Koziol, Budding, and Chikadel (2010) wrote an influential article titled: "Adaptation, Expertise, and Giftedness: Towards an Understanding of Cortical, Subcortical and Cerebellar Network Contributions." They proposed a theoretical framework that considered overlapping levels of function, from "pathological" through "normal" to "gifted" or exceptional ability. Their comprehensive review proposed a framework that included the brain's vertical organization as a means for understanding and considers "giftedness" from an evolutionary and neurodevelopmental vantage point.

Articles by Grabner, Neubauer, and Stern (2006) have attempted to identify neurological contributions to creativity, expertise, and intelligence, adding to the body of knowledge in this domain.

On the pathological side, the original sports laboratory assessment model (SLAM) as first proposed by Jeffrey Barth in 1983 has served to help understand mild traumatic brain injury in the sports context. While the implications for brain injury research and treatment are now well-known, the unique differences of sports participants provides an anchor for understanding high performance requirements in low-performance situations. Indeed, individual differences are significant contributors to both negative and positive brain-behavior relationships. The hope of this series is to expand the theoretical continuum of brain function to accommodate the full spectrum of function. It is our belief that only in this manner can neuropsychology mature and meet its scientific obligation.

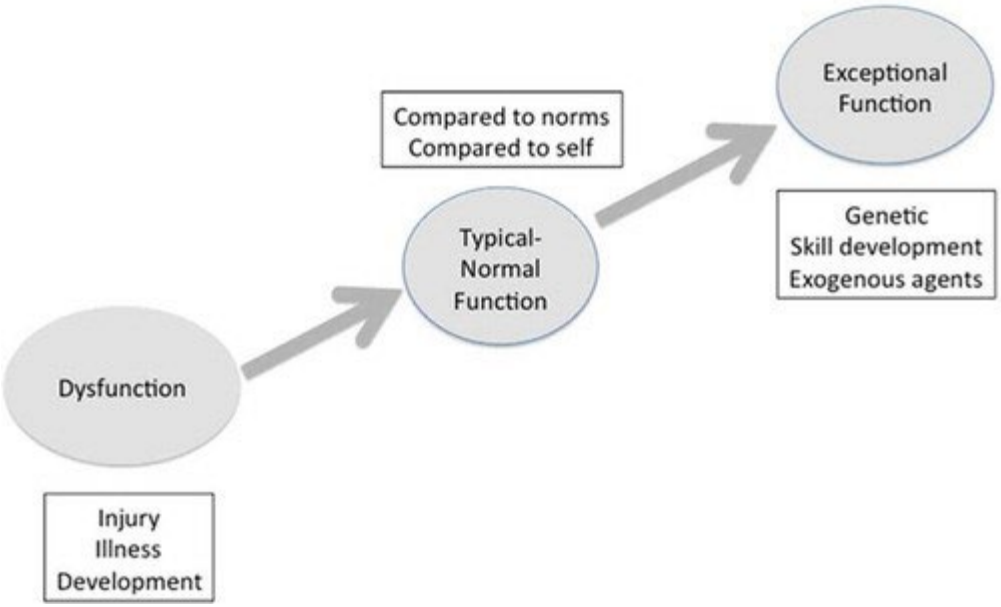

Figure 1. A continuum of performance.

The theoretical base for enhanced neuropsychological performance is barely developed; thus, new models and tools may be required. The neuropsychological aspects of both enhanced or exceptional learning and motor performance are serious and relevant topics of interest. Figure 1 describes a putative continuum of performance with "typical" or "normal" performance as the mean or median condition. Dysfunction can occur due to illness, injury (particularly traumatic brain), or developmental conditions affecting cognition. Exceptional performance is typically a function of genetics, specific training and skill development, or exogenous activities such as chemicals. Newer applications may include genetic manipulation or devices such as transcranial direct stimulation. Clearly, the ethics and potential unintended consequences of such activities are of great importance and need explication.

Aims and scope

The aim of this special series is to provide a venue for high-quality research that aims to describe and answer critical questions about the interface of neuropsychology and performance, from impaired neurocognitive performance to superior performance. The scope is more difficult to define and is bounded only by creativity in considering how neuropsychological function interfaces with behavior and performance.

In this issue we have papers that represent a variety of aspects of performance as it relates to neuropsychological functioning. López-Vicente et al. provide an interesting look at differences in cortical structures between those who play sports and those who do not. Brett et al. report on neuropsychological outcomes of a large sample of concussed athletes' test scores to noncontact athletes' test scores over a two-year period. Salazar provides validation data for a performance validity tool for use in concussion assessment. Walter et al. assess the effects of a nutritional supplement on executive and vestibular functions in the chronic postconcussive athletes. Masaki et al. examine the effects of anxiety on performance through electrophysiology and the Stroop test. LeMonda et al. surveyed neuropsychologists who do concussion assessment and management work and reflect the assessment trends in sports neuropsychology. It is a diverse set that we hope begins to expand our view of sports neuropsychology and its role in understanding performance across the continuum.

References

Barth, J. T., Macciocchi, S. N., Giordani, B., Rimeli, R. N., Jane, J. A., and Boll, T. J. (1983). Neuropsychological sequelae of minor head injury. *Neurosurgery*, 13(5), 529–533.

Ericsson, A. K., Nandagopal, K., & Roring, R. W. (2009). Toward a science of exceptional achievement: Attaining superior performance through deliberate practice. *Annals of the New York Academy of Sciences*, 1172, 199–217. doi:10.1196/annals.1393.001

Grabner, R. H., Neubauer, A. C., & Stern, E. (2006). Superior performance and neural efficiency: The impact of intelligence and expertise. *Brain Research Bulletin*, 69(4), 422–439. doi:10.1016/j.brainresbull.2006.02.009

Jung, R. E., Segall, J. M., Bockholt, H., Flores, R. A., Smith, S. M., Chavez, R. S., and Haier, R. J. (2010). White matter integrity, creativity, and psychopathology: Disentangling constructs with diffusion tensor imaging. 2010. *Plos ONE*, 5(3). doi:10.1371/journal.pone.009818

Jung, S., Bockholt,, et al. (2010). Neuroanatomy of creativity. *Human Brain Mapping*, 31(3), 398–409.

Koziol, L., Budding, D., & Chikadel, D. (2010). Adaptation, expertise, and giftedness: Towards an understanding of cortical, subcortical, and cerebellar network contributions. *Cerebellum*, 9(4), 499–529. doi:10.1007/s12311-010-0192-7

Obler, L., & Fein, D. (Eds). (1988). *The exceptional brain: The neuropsychology of exceptional behavior*. New York, NY: Guilford.