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COMMENTARY ON ERICSSON *ET AL.*

# Investigating the role of domain general mechanisms in the acquisition of domain specific expertise

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The expert performance approach championed by Ericsson *et al.* provides a scientific way forward for research on giftedness, and offers exciting new ways to further our understanding of the determinants of high ability within a particular domain of expertise. While the methods the authors use are commendable and are likely to further our understanding of the nature of expertise, I question whether they offer the most complete way to investigate the role of domain-general mechanisms (whether or not they are innate) in the acquisition of domain-specific expertise.

First of all, not all domains of expertise are alike. Domains differ to the extent which they rely on physical and mental abilities. Most of Ericsson *et al.*'s examples focus on domains where the main determinant of expertise-acquisition is the development of motor functions, not mental functions. It is an open question whether executive functions are just as malleable as motor functions.[1] One cannot collect data on the malleability of physical abilities, and claim that the same holds in equal measure to mental abilities. Whether anyone (regardless of general cognitive ability) can be trained to be an expert physicist to the same degree that they can be trained to be an expert dart thrower is an interesting and open question.

Secondly, Ericsson *et al.* are quite right in questioning the extent to which general cognitive ability constrains the ability to acquire expertise. It is true that a person's IQ score says very little as to their eventual capacity to learn a complex skill. The only way to assess an individual's capacity for intelligent functioning is to actively test that person's limits. This can be achieved through studies that further our understanding of learning processes, and sources of individual differences in these processes. Individual differences researchers have indeed attempted to understand the role of domain-general ability in skill acquisition. When humans with a wide range of general cognitive ability encounter a novel task, the critical components of performance in the initial stages are general reasoning ability and working memory

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capacity (Ackerman, 1988; Kyllonen & Christal, 1989; Anderson, 1993). It is only after this bottleneck is overcome that initial working memory resources play less of a role, and perceptual speed and psychomotor abilities take over in importance. Comparing world-class *experts* to novice *experts* to investigate the role of innate ability in expertise acquisition will not get at this important bottleneck, as only individuals who have already passed this important bottleneck will be studied.

Thirdly, Ericcson *et al.*'s methods don't allow for a complete understanding of the domain-general learning mechanisms that support skill acquisition. By focusing on a *specific* domain of expertise, important domain general learning mechanisms may not be identified simply because they aren't sought. To more fully understand the role of domain-general learning mechanisms, researchers must study individual differences in the ability to acquire knowledge that is independent of any particular domain of expertise. Recent research suggests interesting new avenues for the study of individual differences in domain-general learning mechanisms. The study of implicit learning, traditionally studied using experimental methods, is starting to be looked at from an individual differences perspective. Recent results suggest that individual differences in implicit learning may not be related to the central executive functions of working memory, or even fluid intelligence (Reber *et al.*, 1991; McGeorge *et al.*, 1997; Gebauer, 2002; Unsworth & Engle, 2005). If this research continues to replicate, it would suggest that humans may have multiple domain-general learning mechanisms (Mackintosh, 1998). Since implicit processes play a large role in skill acquisition, a further understanding of the source of individual differences in these domain-general learning mechanisms may be able to inform the expert performance approach.

Hopefully by investigating a wide range of domains of expertise (that differ in the constellation of mental and physical abilities they rely on), a wide range of individuals (with differing levels of general cognitive ability, personality traits, and domain-specific abilities), and a wide range of psychological approaches (experimental, individual differences) within every stage in the expertise acquisition process will we come to a deeper and more complete understanding of the mechanisms mediating expert performance and the role of domain-general cognitive abilities.

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## Note

1. Fascinating recent research does indeed suggest that central executive functions are quite malleable, as are the brain structures underlying these functions. In one study (Klingberg *et al.*, 2002), children with ADHD received an intensive training program to increase their working memory capacity. Not only was working memory capacity increased through training, but so was their performance on a test of general fluid intelligence. As a result of training, the children also showed a reduction in symptoms traditionally associated with AHD. Similar

improvements were also found for those without ADHD. In another study (Olesen *et al.*, 2004), healthy adults received working memory training for 5 weeks. As a result of training, brain activity related to working memory increased.

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