Intelligence xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Intelligence

journal homepage:

Nature, nurture, and expertise: Response to Ericsson

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ARTICLE INFO

Article history:
Received 7 January 2014
Accepted 8 January 2014
Available online xxxx

Keywords:
Twins
Reading
Genotype-environment interaction and correlation
Non-shared environment
Liability-threshold

ABSTRACT

Most scientists have moved beyond the nature vs. nurture debate to accept the importance of nature as well as nurture. However, in Ericsson's response to our research that shows the importance of genetic influences on the acquisition of expertise in reading, he does not address the implications of our research for his environmentalist hypothesis. Instead, he dismisses research on expertise at any other level than the "less than a handful of individuals with the very highest levels of performance," which limits research to case studies. In this brief reply, we argue that his intransigence obscures many interesting empirical questions about the nature and origins of expertise, and that genetically sensitive research offers many useful insights into the roles of both nature and nurture, and especially their interplay.

1. Introduction

Our paper – *Nature, Nurture, and Expertise* – used superior performance in reading as a novel example of genetic research on the acquisition of expertise. We showed that genetic factors account for more than half of the difference in performance between expert readers and normal readers. Moreover, we presented evidence supporting a far-reaching hypothesis that emerges from genetic research throughout the life sciences: The extremes of a trait are merely the quantitative extremes of the same genetic and environmental factors responsible for the rest of the normal distribution.

We used these results to discuss three important issues relevant to the synergism that could come from integrating research on genetics and on training:

- The distinction between research on 'what could be' versus 'what is';
- The fundamental point that what is inherited is DNA sequence variation;
- The usefulness of moving beyond a passive model, assuming one-size-fits-all training regimes that are imposed on people, to an active model in which people select, modify, and create environments that foster the acquisition of expertise, in part on the basis of their genetic propensities.

Ericsson's (2014) response to our paper does not address these findings and issues, but dismisses genetic research on the acquisition of expertise by defining the data away in two ways. First, although Ericsson defines expertise as "consistently superior performance", he limits the word *superior* to "a level of performance attained by less than a handful of individuals", then uses this definition to reject as irrelevant any research that does not pertain to this handful of individuals. Second, he ignores our data on superior performance in reading in adolescents by limiting 'expertise' to adults. Here, we discuss these two issues in greater detail and then highlight other issues raised in our paper that Ericsson does not discuss.

2. "A handful of individuals" versus "beginners"

We have no objection to Ericsson's interest in the "less than a handful of individuals" with "the very highest levels of performance" — even though such research would be limited to case studies, and in any case requires quantitative definition: just how small is a "handful"? We do object, however, to defining expertise solely in terms of this interest, rather than considering

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http://dx.doi.org/10.1016/j.intell.2014.01.003

research on those at other levels of expertise, whom Ericsson collectively calls “beginners.” For example, Ericsson dismisses the results of recent meta-analyses (Ma et al., 2013) showing significant associations between performance in endurance athletics and the angiotensin I-converting enzyme gene (ACE), and between performance in power athletics and the alpha-actinin-3 gene (ACTN3) because these studies “included competitors merely participating in national events.” How can athletes competing at a national level be considered “beginners”? (As an aside, anyone interested in the exciting findings emerging from genetic research on sports should read an excellent book that was published after the papers in this special issue were in proof: Epstein, 2013.)

Our interest is not limited to case studies of a handful of the world's top experts, but includes research on the acquisition of expertise in the much larger group of experts from whom the top experts eventually emerge. Further, Ericsson's assertion that “expert performance is qualitatively different from other types of human performance” cannot be taken on faith, especially since it goes against the general principle emerging from genetic research that the extremes of a trait are only quantitatively, not qualitatively, different from the rest of the distribution (see the penultimate section of our paper, *The Abnormal is Normal*).

3. Superior performance in reading as an example of the acquisition of expertise

Ericsson limits expertise to adults and argues that our genetic research on adolescents is therefore not relevant: “Based on our definition of expert performance Plomin, Shakeshaft, McMillan, and Trzaskowski's (2014) article does not report on a single estimate of heritability for expert performance.” Specifically, Ericsson states that our expert readers at age 12 are “only precocious and six years later the majority of all of the other students are able to match their performance,” a statement for which he cites no reference. On the contrary, by age 12, the annual rate of growth in reading performance has slowed to negligible levels (Hill, Bloom, Black, & Lipsey, 2007), and in our TEDS study we find that stability of individual differences in reading fluency from age 12 to 16 is greater than the stability for intelligence. We insist that the best readers at age 12 do indeed meet any sensible definition of expertise, just as would the top performers in games, arts, and athletics. In any of these domains, the top performers at age 12 might well differ from the top performers at age 22, 42, or 82. All performance is limited by context in some ways — for example, by gender and disability, as well as age.

We investigated superior performance in reading as a novel example of the application of genetic strategies to investigating the origins of expertise. We assessed reading using a broad battery of reading tests, which meets Ericsson's definition of expert performance as “consistently superior performance on a specified set of representative tasks for a domain”. We suggest that reading is a particularly good test case for environmentalist hypotheses of expertise because all children receive massive amounts of training in reading, especially in the UK where a national curriculum imposes specific literacy training. As a result, the acquisition of reading expertise attenuates the cause-and-effect problem of genotype–environment correlation that can cloud the interpretation of research on the acquisition of expertise in the real world (with the exception of randomized control trials): Correlations between deliberate practice and the acquisition of expertise cannot be safely interpreted as being caused by the effect of practice on expertise. In the real world (and even in the laboratory), people are not passive recipients of training in sports, arts, or reading; for example, people who read fluently are more likely to read for pleasure. These issues are discussed in the last section of our paper, *The Nature of Nurture: From a Passive Model of Imposed Environments to an Active Model of Shaped Experience*.

4. Other issues

We argue that Ericsson (2014) misrepresents genetic research into the acquisition of expertise. Here are three examples:

1. Ericsson dismisses twin studies showing genetic influence on superior performance by arguing that twins are underrepresented among superior performers. A person's twin status is often not known and there are no definitive surveys (but Ericsson is wrong to say that there are no twins among Nobel laureates in the sciences: Rita Levi-Montalcini, Physiology and Medicine, 1986, was a twin). Even if there were a difference in *mean* performance between twins and the general population, this would not warrant ignoring twin research, which concerns variance and not means (Plomin, DeFries, Knopik, & Neiderhiser, 2013).
2. Ericsson spends a quarter of his response to our paper discussing emergenesis, an extreme form of epistatic (non-additive) genetic variance, which we mentioned in just one sentence in our paper. However, the point of our research findings is that genetic effects are primarily additive.
3. Ericsson does not address our discussion of epigenetics as just another form of gene expression (transcription and translation of the DNA code) in response to the environment. We emphasized that what is inherited is DNA sequence variation. Instead, Ericsson discusses MZ twin discordance, which behavioral genetics has long used as a powerful tool for understanding non-shared environment (Plomin, 2011). However, this has nothing to do with the issues raised in the relevant section of our paper, *What is Inherited is DNA Sequence Variation*.

5. Conclusion

Finding genetic influence on expertise does not imply that practice is unnecessary, or that the environment is irrelevant; indeed, our paper emphasized that genetically sensitive research implicates nurture as well as nature. We agree with Ericsson's conclusion that “the nature–nurture dichotomy is no longer scientifically meaningful” — to us, however, this implies recognition rather than rejection of genetic influences on the acquisition of expert performance.

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Please cite this article as: Plomin, R., et al., Nature, nurture, and expertise: Response to Ericsson, *Intelligence* (2014), http://dx.doi.org/10.1016/j.intell.2014.01.003

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