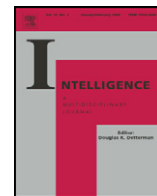


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## Creative performance, expertise acquisition, individual differences, and developmental antecedents: An integrative research agenda

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### ABSTRACT

This article sketches an integrative research agenda for creative achievement that combines the expertise-acquisition framework with individual differences in cognitive abilities and dispositional traits as well as the genetic and environmental factors underlying the development of those same individual-difference variables. The treatment begins with a discussion of domain-specific creative expertise and performance, a discussion that indicates the added complexities in assessing both variables. The analysis then shifts to substantial individual variation in both expertise acquisition and creative performance, variation that does not sit easily with a simple single-cause conception, particularly when performance appears inversely related to the amount of time taken to attain the requisite expertise. This leads to the question of whether individual-difference variables can account for otherwise inexplicable “faster better” and “more bang for the buck” effects. If so, then the obvious last inquiry concerns the developmental antecedents of those variables, where these antecedents can be both genetic and environmental. The upshot of the suggested analysis should be complex structural equation models that fully accommodate both nature and nurture in explaining exceptional creative performance.

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### 1. Introduction

Recently I was invited to write a comment for *Nature*, a knock on the door not heard often. I was specifically asked to discuss the place of scientific genius in the modern natural sciences. Having conducted research on the subject for more than three decades, and having followed current trends in the main disciplines of pure research—especially in physics and biology—I responded with a highly speculative “thought piece.” The editors did not like it. They wanted something more declarative than inquisitive. Accordingly, the essay went through several revisions, with increasingly more passages inserted by the editors. Even after the *fifth* version was accepted for publication, I received a galley with additional changes, including a rewritten title and summary—all in words not my own. I lodged a protest over the last-minute alterations,

but to no avail. Indeed, even after I received the “final” version of the comment during the embargo period, the editors decided to make another dramatic change in the title without seeking my permission: the insertion of “After Einstein” as the main title. The resulting comment has provoked more controversy than anything else associated with my name (Simonton, 2013). I have lost track of the number of times I had to inform irate scientists that I did *not* argue that Albert Einstein was the “last scientific genius.”

In retrospect, of course, the *Nature* editors knew exactly what they were doing. They wanted headlines that would draw attention to their journal. That goal was best attained by a provocative, even dogmatic thesis that would create a big splash in the media. The original version of the essay would not have done so: too many qualifications, conjectures, and complications. Indeed, my own historiometric research suggests that taking extremist stances is indeed a virtue. For instance, a study of more than two thousand Western philosophers showed that the most eminent among them were most likely to advocate the most radical and

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uncompromising beliefs (Simonton, 1976). Being a staunch determinist or indeterminist earns more points with posterity than proposing some conciliatory position (viz. compatibilism). The same general effect was found in another study of 54 eminent psychologists (Simonton, 2000b). With respect to the nature–nurture issue, for example, Francis Galton and John B. Watson likely gained considerable fame—or notoriety—for advocating one side or the other rather than the middle. The same long-term benefit even accrues to historic leaders (Simonton, 1984). The recent discovery of King Richard III's skeleton would have caused much less of a stir had he been as morally mediocre as other monarchs of his era. Getting rid of your young nephews may be reprehensible, but such evil acts can also secure you a permanent place not just in history but also in great literature.

Unfortunately, the same extremist advocacy is found in the research on the relation between expertise acquisition and domain-specific performance. In particular, some researchers have attained a high degree of professional and public visibility by taking doctrinaire positions claiming that exceptional achievement can be totally attributed to the amount of “deliberate practice” a person devoted to acquiring the requisite skills and knowledge (e.g., Howe, 1999; cf. Simonton, 2002). Work hard enough and long enough—about a decade minimum—and anybody can become an Albert Einstein. Einstein's former university professor, Hermann Minkowski, might have called his student a “lazy dog” (Hoffmann, 1972, p. 84), and his classmate Marcel Grossmann was clearly the better student by far, but perhaps Einstein was secretly burning the midnight oil when everyone else was fast asleep, enabling him to earn more fame and glory than either his teacher or friend managed to pull off with their seemingly superior expertise.

At great risk to my future impact on the field, I wish to sketch out a research agenda that is integrative rather than polarizing. This sketch will indicate how much we need to know before anyone can even dare to become more forthright in their opinions. The phenomenon of exceptional achievement is much too complicated to permit simplistic, one-sided explanations. In particular, a full understanding requires (a) the identification of all individual-difference variables that correlate with acquisition and performance and (b) the determination of the developmental antecedents, both genetic and environmental, of these identified correlates. In part because my own expertise concentrates on extraordinary creativity, my discussion will focus on examples from that area as well. Just as important, the application of the expertise framework to outstanding creativity is now more than 20 years old (Ericsson, 1999; Hayes, 1989) and has stimulated considerable debate for at least a dozen years (Simonton, 1996, 2000a). That said, the same broad principles should often (even if not always) apply to many other domains of human achievement, such as sports, chess, musical performance, and even various forms of leadership. The main differences in the applications mostly involve the complexity of the phenomena. Roughly put, exceptional leadership is probably the most complex, followed by creativity, and then musical performance, chess, and sports.

## 2. Domain-specific expertise and creative performance

The first item on the agenda is the most basic but perhaps also the most difficult, namely, the answer to two questions:

First, what does it mean to have expertise in a creative domain? Second, what does it mean to exhibit exceptional performance in a creative domain?

### 2.1. What is creative expertise?

Starting with the first question, too often advocates of “expertise acquisition is all you need” assume from the very start the existence of some precisely defined domain that can be mastered through sufficient training and practice. This assumption often makes perfect sense because those proponents tend to focus on well-established domains that have been around for decades if not centuries and that have not changed anything fundamental about the nature of the domain (Ericsson, 1996; Ericsson, Charness, Feltovich, & Hoffman, 2006). For example, the original research on expertise came from work on expertise in chess (e.g., Simon & Chase, 1973). Yet chess is a game that has a very long history and that has not changed any essential principles for centuries. Chess expertise is also so well established that computers have been programmed to play the game at the highest levels of performance, even beating the world chess champion (Hsu, 2002). It is conceivable that the situation might change when the domain-specific expertise is not so precisely defined. Consider the following two points:

First, sometimes the expertise does not exist until it is first created. An example is Galileo's creation of telescopic astronomy (Simonton, 2012a). After using trial-and-error to devise a new instrument suitable for observing the night sky, he carried out a series of observations that revolutionized astronomy, including the mountains on the moon, the moons of Jupiter, the stars of the Milky Way, the phases of Venus, the spots on the sun, and the striking abnormality in Saturn's image that was later resolved into its rings. Yet these discoveries had no basis in any existing scientific expertise. On the contrary, almost everything he observed conflicted with both Ptolemaic astronomy and Aristotelian cosmology, and his newfangled telescope had no justification in contemporary optics (a problem only later worked out by Kepler). As a result, many if not most “experts” of his day at first rejected his claims as mere optical illusions. Interestingly, the expertise that actually proved most useful to his observations was his prior training in the visual arts, such as chiaroscuro drawing, that enabled him to interpret correctly what other observers had completely missed, even after the discoveries were initially announced. Even so, nobody at the time could have anticipated that such artistic background would have proved useful. An analogous narrative is witnessed in Antonie van Leeuwenhoek's observations in microscopic biology, achievements that were based not on optics or biology but rather on the high-quality textile trade (Simonton, 2012a). Leeuwenhoek's discoveries were likewise rejected by the scientific “experts” who could not figure out how a simple tradesman, with no scientific education, made a one-lens microscope that multiplied objects hundreds of times, revealing spermatozoa, protozoa, bacteria, blood cells, and other basic life forms never known before.

Second, even when a domain-specific expertise is pretty much defined in advance, that expertise can be conceived multiple ways, making it difficult to determine precisely what optimal subset of that generalized expertise is most relevant to a particular performance criterion. A concrete example is the composition of an opera in the classical

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