Primer

World-class expertise: a developmental model

Scott Barry Kaufman[1]* and Angela L. Duckworth[2]

The field of psychology has done a remarkable job discovering the ways people differ from one another in their abilities and talents, but has long neglected the diverse ways people can unleash those capacities. There is no plausible mechanism by which our genes directly encode skills like how to dribble a basketball, play the violin, or solve an algebraic equation. We are not born knowing how to write a sonnet or flip an omelet. On the contrary, all human expertise—even at the far-right tail of the distribution—depends on experience and training. A more accurate understanding of the development of high achievement should inspire people to push beyond their perceived and often self-imposed limits to reach heights they never would have imagined possible. © 2015 Wiley Periodicals, Inc.

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INTRODUCTION

Where do Olympic athletes, virtuoso musicians, and Nobel winners come from? Why are they so different from the rest of us? We watch, open-mouthed and wide-eyed, at what they can do that we cannot. Outliers in the distribution of human achievement, they are not just a bit better than most at their chosen vocation, but dramatically so.

One explanation is that experts were born special—with qualitatively different genetic endowments than the rest of us. Outliers have something we don't; we'll never be like they are, no matter our efforts or our circumstance. Anyone who has seen Usain Bolt run more than 300 feet in fewer than 10 seconds or Mikhail Baryshnikov hanging mid-air, his body frozen above the stage for what appears an eternity might be forgiven for thinking, 'They and I are different species.'

The language we use to refer to those who impress us most reveals our implicit theories of how they got that way: 'God given talent,' 'a born natural,' and 'gifted and talented' suggest that genius is revealed more than cultivated. But there is no plausible mechanism by which our genes directly encode skills like how to dribble a basketball, play the violin, solve an algebraic equation, sprint, or pirouette. We are not born knowing how to write a sonnet or flip an omelet. On the contrary, human expertise, at all points in the distribution—including the far-right tail—is acquired.

Certainly, differences in how we acquire skills may be influenced by the particular genes passed on to us by our parents. But behavioral genetics studies suggest that both talent and motivation—along with almost every other human characteristic that varies in the population—are influenced by both genetic and environmental factors.[1–3] In other words, it makes no sense to assume that talent is inborn but the inclination to develop that talent is learned. All talents are developed through a complex interaction of nature and nurture.

BEYOND INNATE TALENT

Over the past century, a number of researchers have attempted to uncover the determinants of greatness.[4–6] The topic received its first scientific treatment by Francis Galton, Charles Darwin's half cousin. Galton[7] collected biographical information on a wide range of eminent people, including judges, statesmen, military commanders, scientists, poets, musicians, painters, and wrestlers. While he believed that eminence ran through the bloodlines, he concluded that

*Correspondence to: scott.barry.kaufman@gmail.com

[1]The Imagination Institute, University of Pennsylvania, Philadelphia, PA, USA

[2]Department of Psychology, University of Pennsylvania, Philadelphia, PA, USA

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ability alone was not enough for success in any domain of expertise. Rather, he believed geniuses were triply blessed by 'ability combined with zeal and with capacity for hard labour' (p. 33).

In the 1920s, a Stanford psychology graduate student named Catharine Cox[8] studied the lives of 301 eminent men and women who had been born between 1450 and 1850. She and other raters read the biographies and estimated each individual's intelligence quotient (IQ) by considering how precociously they achieved intellectual milestones such as reading and writing. To her surprise, she found only a small relationship between estimated IQ scores and rank order of eminence.

So she dug deeper. Taking a subset of 100 of the geniuses, she had them rated on 67 personality traits. She found that the following childhood traits predicted lifetime achievement: 'persistence of motive and effort, confidence in their abilities, and great strength or force of character' (p. 218). Cox concluded that 'High but not the highest intelligence, combined with the greatest degree of persistence, will achieve greater eminence than the highest degree of intelligence with somewhat less persistence' (p. 187).

Cox's mentor, Lewis Terman, also investigated the determinants of high achievement. Hoping to demonstrate the validity of his IQ test, he administered the Stanford–Binet Intelligence Scales to students who were nominated by their teachers as the brightest in their classrooms. While most of Terman's group of high-IQ participants grew up to be healthy, accomplished individuals, he did not select any publicly recognized geniuses. By the fifth edition of *Genetic Studies of Genius*,[9] after 30 years of follow-up studies, he came to the following conclusion (which is remarkably similar to Cox's):

> Notable achievement calls for more than a high order of intelligence. . . . Personality factors are extremely important determiners of achievement. . . . [particularly] persistence in the accomplishment of ends, integration toward goals, self-confidence, and freedom from inferiority feelings. (p. 147)

In the late 1950s, the 'father of creativity,' E. Paul Torrance, conducted his own long-term study of creative achievement. He included every student attending two Minnesota elementary schools from 1958 to 1965. Torrance and his contemporaries have followed up this group of students for more than 50 years later. They found that a group of characteristics that Torrance referred to as the 'Beyonder' characteristics—which include a love of work, high energy, persistence, sense of mission, courage, delight in deep thinking, tolerance of mistakes, and feeling comfortable as a 'minority of one'—predicted publicly recognized creative achievement as well as personal achievement, often better than various indicators of scholastic promise in childhood, including school grades and IQ test performance.[10–13]

Certainly, precocious youth exist. But even very early abilities are influenced by experience. Further, early abilities rarely lead directly to extraordinary adult accomplishments. In her study of prodigies who went on to make important contributions to their field, Ellen Winner[14] concluded, 'Creators must be able to persist in the face of difficulty and overcome the many obstacles in the way of creative discovery…Drive and energy in childhood are more predictive of success, if not creativity, than is IQ or some other more domain-specific ability' (p. 293).

Similarly, in a qualitative study of world-class concert pianists, neuroscientists, swimmers, chess players, mathematicians, and sculptors, Benjamin Bloom[15] noted that 'only a few of [the 120 high-performing individuals in the sample] were regarded as prodigies by teachers, parents, or experts' (p. 533). Rather, Bloom observed that in every domain of expertise, the most accomplished individuals exhibited a strong interest in their particular field, a desire to reach 'a high level of attainment' in that field, and a 'willingness to put in great amounts of time and effort' (p. 544).

All of these findings point to an inescapable conclusion: talent alone is not enough to reach high levels of expertise and may not even be the most important predictor of ultimate levels of expert performance.

EXPERTISE = TALENT × EFFORT

Rather than asking whether expertise can be explained by nature or by nurture, we think it makes more sense to think about expertise acquisition as a function of the *rate* at which we learn separately from the cumulative, high-quality *effort* we spend learning.[16] In the equation above, therefore, *talent* is defined as the rate at which a person learns, not as any sort of innate, fixed quality. In other words, what it means to be talented in a given domain is to progress more quickly up the skill curve than others who have invested equal effort. This is what teachers and coaches mean when they refer to someone as a 'quick study' or 'fast learner.'

The notion that some people learn more facilely than others is the core conception of intelligence. Over the past 100 years, intelligence researchers have done a remarkable job mapping out the terrain of cognitive ability. Most contemporary IQ tests are based on the Cattell–Horn–Carroll (CHC) theory of cognitive abilities,[17] which include the following mental

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functions: quantitative knowledge, reading and writing, comprehension-knowledge, fluid reasoning, short-term memory, long-term storage and retrieval, visual processing, auditory processing, and processing speed. All of these cognitive capacities influence the rate of learning.

Of course, IQ tests don't capture the entire universe of talent-related traits that influence the rate of expertise acquisition. Other such traits include (but are not limited to) imagination, creativity, emotional intelligence, rationality, and bodily kinesthetic, musical, artistic, and practical life skills.[18–21]

Less well charted, in our view, is the terrain of traits that influence cumulative effort over time. This list includes (but is not limited to) characteristics such as optimism, passion, inspiration, curiosity, goal commitment, need for achievement, self-efficacy, growth mindset, self-regulation, self-discipline, self-control, conscientiousness, and grit.

For instance, grit—'working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress'—predicts a wide range of outcomes, from West Point military cadet retention to national spelling bee performance to academic school performance.[22,23] A related construct—self-control—has also been shown to predict the academic performance of adolescents, sometimes better than IQ[24] (Figure 1).

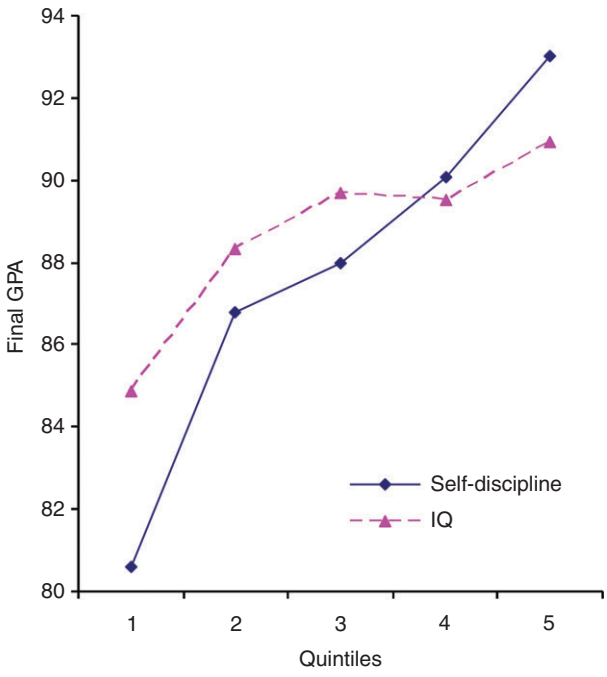

FIGURE 1 | Self-control outpredicts IQ in predicting grade point average (GPA). (Reprinted with permission from SAGE. Ref .24 Copyright 2005)

What can motivate grit and self-control? Robert Vallerand and colleagues found that passion—'a strong inclination or desire toward a self-defining activity that one likes (or even loves), that one finds important (high valuation), and in which one invests time and energy'—predicts amount of deliberate practice. As a consequence, passion predicts expert performance across a range of domains, from psychology to basketball to synchronized swimming to water-polo to classical music.[25–29] In particular, Vallerand and colleagues have found that *harmonious passion*—the flavor of passion that is in harmony with the rest of your identity and which you feel in control—demonstrated the most direct path to both well-being and high expert performance.

While these effort-related traits can be investigated at the individual differences level of analysis, we would like to emphasize that they interact with each other throughout the course of individual human development. All human beings are an integrated dynamic system of behavioral, emotional, cognitive, personality, and other psychological processes that change across time and situations.[30] Small changes in any part of the system can have a significant impact on the rest of the system. As Blair and Diamond[31] note, 'development is considered to be dynamic, nonlinear, and probabilistic, meaning that perturbation of the system at a given level at a given time can result in reorganization of processes at other levels and the emergence of novel behaviors and psychological functions' (p. 901).

In support of this view, recent research has demonstrated that factors such as anxiety, stress, fear of failure, stereotype threat, and low sense of belonging can substantially impact working memory, executive functioning, and intellectual performance.[31–37]

This research has important implications for cultivating world-class expertise in education and society.

CULTIVATING WORLD-CLASS EXPERTISE

> *Compared with what we ought to be, we are only half awake. Our fires are damped, our drafts are checked. We are making use of only a small part of our possible mental and physical resources… Of course there are limits: the trees don't grow into the sky. But the plain fact remains that men the world over possess amounts of resource, which only very exceptional individuals push to their extremes of use.—William James*[38]

In recent years, a number of 'wise psychological interventions' have produced significant benefits to

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performance and health over time.[39–41] These brief interventions target specific psychological processes that contribute to social problems or prevent people from flourishing, and are thought to cause lasting change because they target recursive processes that compound with time. For instance, increasing a sense of belonging among students who are under constant stereotype threat (e.g., minority students, women in science) has been found to change psychological and social processes that build over time, leading to higher performance.[42,43]

Other researchers have produced evidence that interventions that target the 'whole person' by increasing joy, physical fitness, and support, and which build effort-related traits—including confidence, pride, and self-efficacy—indirectly and directly improve academic outcomes and school success.[44–46] This suggests that educators need to address effort-related characteristics just as much, if not more so, than talent-related characteristics.

Based on the research, we would like to offer three specific recommendations to cultivate high levels of expertise in everyone.

First, we recommend that teachers reward effort in schools and instill in all students the notion that learning outcomes improve with effort. Research by Carol Dweck and colleagues has found that students who think intellectual ability is fixed find it more difficult to overcome obstacles and setbacks, and demonstrate lower performance, than those with equal levels of talent who think intellectual ability grows with effort and experience.[47,48] Critically, students who participate in interventions to increase their 'growth mindset' show greater enjoyment and engagement in learning, as well as higher GPAs.[41,49–51] Outside of the academic realm, research shows that expert performers put a high value on working hard and are less likely to let the costs of hard work outweigh the eventual long-term benefits of achievement.[52,53]

Second, we recommend that schools recognize the ineluctable trade-off between breadth and depth. Analysis of elite performers shows that they stay the course, remaining highly focused over an extended period of time.[52] They don't tend to worry constantly about what else they should be doing, or second-guess their commitment. In our culture of unrelenting standardized testing, we often overlook the importance of mastery and specialization, and the sense of competence and pride that come along with it. To paraphrase Benjamin Franklin, the goal of education is not just to learn a little about a lot but also a lot about a little.

Finally, we recommend that teachers help all students discover and cultivate their deep interests and provide them with resources, mentors, and coaches to cultivate expertise through sustained interest and effort over time.[54] Five particular factors that have been shown to increase engagement and interest are: (1) introducing a certain amount of autonomy into the process, giving people some freedom to choose how they learn, (2) making tasks meaningful by drawing connections to personally relevant values and goals in the students lives, (3) increasing a sense of purpose for learning that goes beyond self-serving concerns, (4) increasing a sense of competence and self-efficacy for the material, and (5) increasing positive social relationships. All five of these factors—autonomy, meaning, purpose, competence, and positive relationships—have been shown to lead to increased engagement, deeper learning and higher self-regulation.[5,55–66] Many after-school programs show high levels of engagement because of support of these factors.[55,58,59,63]

There are also implications of this research for the delivery of special services in schools. In the United States, the predominant selection criteria for entrance into 'gifted and talented' programs are performance on IQ tests and standardized tests of achievement.[5,67] Effort-related characteristics, such as motivation and task commitment, are rarely included in the selection process. This is unfortunate considering that these students would also benefit from enriched resources. Therefore, we recommend that children who demonstrate exceptional passion and commitment to a particular goal should receive just as many resources they require to flourish as those identified 'gifted and talented.'[4,23,68] In other words, our schools should encourage children to, as Torrance[69] argued in his *Manifesto for Children*: 'fall in love with something and pursue it with intensity.'

CONCLUSION

In 1907, the founder of the field of psychology, William James, proposed 'a program that might with proper care be made to cover the whole field of psychology, and might show us parts of it in a very fresh light.' (p. 332). The first part of his suggested program had to do with cataloguing our many 'powers' or different types of abilities that exist. The second part of his suggested program involved the 'means of unlocking them or getting at them.'

Based on our review of the literature, we estimate that the field of psychology has done a remarkable job discovering the ways people differ from one another in their abilities and talents, but has long neglected the diverse ways people can unleash those capacities. It is our hope that a more accurate understanding of the

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development of expertise and high achievement will inspire all people to push beyond their perceived and often self-imposed limits to reach heights they never would have imagined possible.

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