Giftedness and Expertise: The Case for Genetic Potential

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Ellen Winner[1] and Jennifer E. Drake[2,3]
[1]Boston College, [2]Brooklyn College, [3]Graduate Center of the City University of New York

Correspondence: Ellen Winner, winner@bc.edu

Abstract

We focus here on child prodigies to make the case that all high-level achievement—whether we call this giftedness or expertise—depends in part on genetic potential. Of course, high achievement also requires hard work (some call this "deliberate practice"), but hard work depends on two factors: the inborn ability to make progress (without this, children are likely to be frustrated and give up) and strong intrinsic motivation, which we call a *rage to master*. High ability is typically (but not always) coupled with a rage to master, and this combination leads to the extraordinary achievements of child prodigies. We provide examples from the domains of reading, number, drawing, and music to support our position that high ability makes itself known prior to any deliberate practice. We conclude by considering the vexed relationship between being a child prodigy and becoming a domain creator in adulthood.

Keywords

prodigy, art, talent, innate, rage to master

Introduction

The term gifted suggests innate potential without any reference to the end-state, whereas the term expertise suggests a high level of achievement without any reference to the cause. The view that expertise is sufficiently explained by deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993), with the exception made that height and body size may play a role in expertise in certain sports, might lead some to think that we can reject the concept of innate talent, and hence reject the concept of giftedness. It might also lead some to think that anyone can achieve greatness. We argue here that all high-level achievement depends on genetic potential, whether we want to call that achievement "expertise" or "giftedness." Of course, giftedness does not emerge fully formed, and hard work (whether we call this deliberate practice or something else) is needed for children with innate potential to reach high levels of achievement. In other words, expertise cannot be present at birth. However, deliberate practice itself requires intense intrinsic motivation—we refer to this as a rage to master. This kind of motivation, which is critical for mastery, is very likely a part of the child's genetic potential. We conclude by considering why so many child prodigies with clear genetic potential fail to achieve adult eminence as major creators in their domains.

The Case for Innate Differences in Domain-Specific Potential

The claim that expertise in a domain can be accounted for entirely (or even mostly) by amount of deliberate practice has thus far been refuted in two domains: chess and music. Three kinds of evidence undermine the argument that deliberate practice is all one needs for the attainment of expertise. First, the amount of practice is not sufficient to account for level of attainment. In the case of music, half of the variance in piano sight-reading skill is accounted for by working memory, which remains unaffected by increases in hours of practice (Meinz & Hambrick, 2010). In the case of chess, there is wide variability in hours of practice associated with becoming a chess master, and even 20,000 hours of deliberate practice does not guarantee becoming a chess master (Campitelli & Gobet, 2011). Second, high (if not world-class) levels of performance can be reached with no deliberate practice, at least according to one report: a six-year-old child was described by Ruthsatz and Detterman (2003) as a piano prodigy who had not engaged in any activity that could be considered deliberate practice. And third, the disposition to practice itself is under genetic control, as shown in Mosing, Madison, Pedersen, Kuja-Halkola, and Ullén's (2014) behavioral genetics study of music. These researchers reported that the predisposition to practice (what we would call rage to master) was 40 to 70 percent heritable.

In our work, we have examined child prodigies (children who before age 13 show extremely high levels of performance sometimes even surpassing what we see in a typical adult) to make the case that deliberate practice cannot account for the phenomenon of the prodigy. We rely primarily on the second type of evidence above: high levels of performance prior to any plausible case for engagement in deliberate practice. We use examples of prodigies in the domains of reading, number, music, and drawing. We focus here on what we believe are the three most typical features of prodigies: precocious achievement prior to practice (true by definition), intense drive (rage to master), and marching to their own drummer in the sense of needing little or no adult scaffolding.

Precocity Prior to Practice

Prodigies master the first steps in their domain at an earlier than average age and learn more rapidly in that domain than do typical children. Winner (1996) reported a child who figured out the sounds that letters make by age two, as revealed to his parents when he announced that the word *cheers* started with a G. When told that this was wrong, he suggested that it started with a J. He also announced that *daddy* and *dive* both started with a D. This child learned to read at age three by first asking his mother to repeatedly read him the same book while pointing to the words. Soon the child was doing the pointing. After one week, he asked for this to be repeated with a second book. That was all it took for him to crack the code of reading and he went on to read to himself—voraciously. Compare this to the typical course of learning to read in first grade! And note that this learning was self-initiated. This child went on to become a computer scientist as an adult, cracking another kind of code!

Another child reported by Winner (1996) showed a fascination with numbers. When he was brought to his mother's office for the first time at two and a half, he quickly learned to pair the office number with the occupant of each person along his mother's hallway. At age three, when a park ranger asked his parents for their license number, neither parent remembered, but the child spit it out accurately. This child also went on to become a computer scientist as an adult.

The earliest sign of precocity in the visual arts is typically the ability to draw recognizable graphic representations of three-dimensional objects one to two years in advance of the normal age timetable of three to four years of age. Figure 1 contrasts a precocious and age-typical attempt at drawing apples, both by two-year-olds. The age-typical child drew a slash for each apple (Figure 1a). For him, a slash stood for anything. The precocious child drew each apple's shape, along with the stem (Figure 1b). For him, the representation had to capture the apple's contour in order to represent an apple (Winner, 1996). One cannot teach a typical two-year-old to draw representationally; one has to wait for this to emerge. Children who make their first representational drawing of a human figure at age two progress rapidly over the next few years in the direction of increasing realism

(a)

(b)

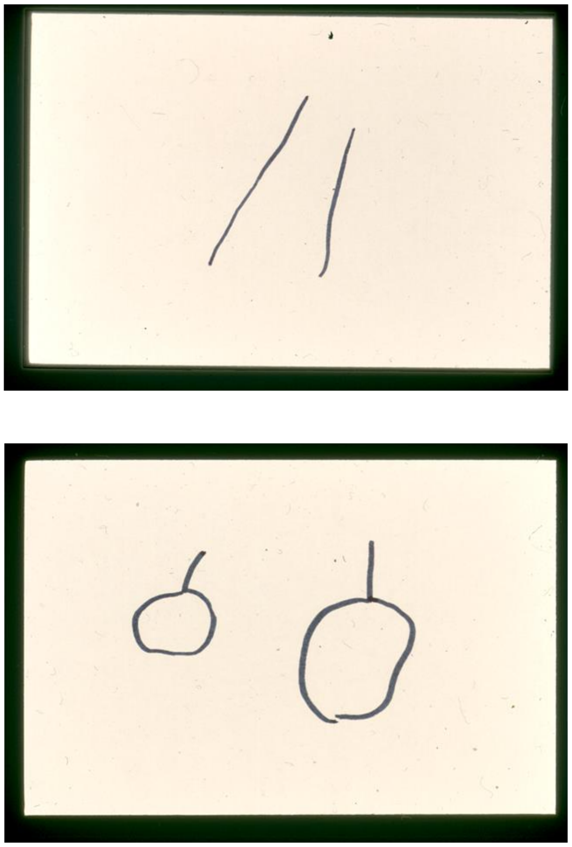

Figure 1. Apples drawn by typical 2-year-old (a) and by a precocious 2-year-old (b). From the collection of Ellen Winner.

Figure 2 shows an age-typical human figure drawing and one by a precocious child, both at age three. The age-typical child has drawn the familiar tadpole rendition of the human body; the precocious one has mastered a human form that is highly differentiated as well as in motion. [For the many other reports of children who show very early signs of talent in drawing, see Drake and Winner (2011-2012, 2012); Goldsmith and Feldman (1989); Golomb (1992); Milbrath (1998); Paine (1981); Selfe (1983); Winner (1996); Winner and Martino (1993); and Zhensun and Low (1991).]

(a)

(b)

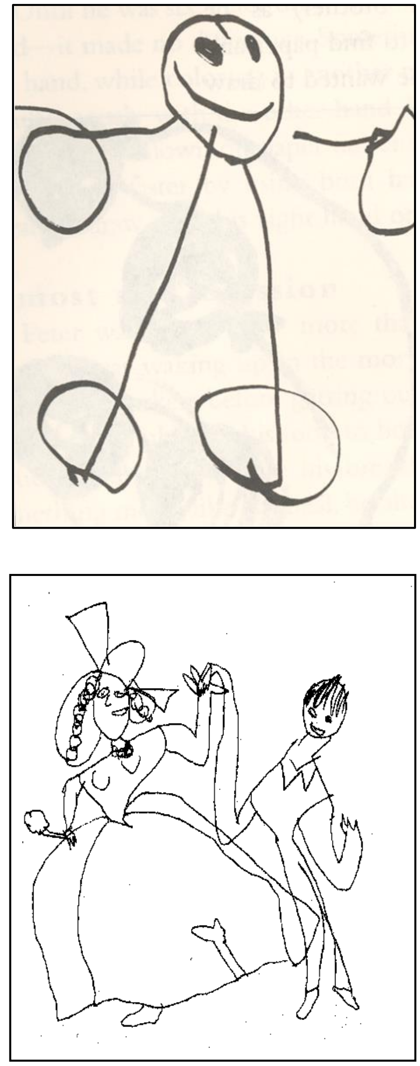

Figure 2. Typical tadpole human (a) by 3-year-old; from the collection of Ellen Winner. Drawing (b) by Gracie Pekrul, a precocious drawer, at age 3; reprinted with permission of her mother, Jennifer Krumm.

Musical giftedness reveals itself as young as age one or two, which is perhaps earlier than giftedness in any other domain of skill (Scott & Moffett, 1977; Shuter-Dyson, 1986). One of the earliest signs of musical giftedness is the ability to sing back a heard song with a high degree of accuracy. This ability is made possible by exceptional musical memory, a skill that has been said to be the ability most central to musical talent (Judd, 1988). While children ordinarily begin to sing at the same time as they begin to speak (18 months; Sloboda, 1985), musically gifted children have been reported to begin to sing at a younger age, and often before they can speak (Revesz, 1925; Shuter-Dyson, 1986). A child studied by Richet (1900) could play twenty pieces from memory by the age of three-and-a-half. At age three, the pianist Arthur Rubinstein listened to his older sister playing the piano and surprised his family by faultlessly playing the pieces she had been practicing (Winn, 1979).

Because large-scale studies of prodigies in specific domains have not been carried out, the argument we make here is a logical one based on numerous examples that we have encountered in our studies of prodigies (e.g., Drake & Winner, 2012; Winner, 1996). Our point is that it is implausible to hold that these very early behaviors could be due to prior deliberate practice. Why? There are three major reasons. First, parents report these behaviors appearing suddenly (and shockingly) rather than emerging gradually through practice. Second, parents tell us how surprised they were to see what their children could do. These were not parents who had tried to teach their children to read, to remember numbers, to draw contours, to sing back melodies. Finally, once these children do start practicing these skills, they progress far more rapidly than typical children (recall the example of the child who cracked the code of reading in two weeks). While it is also true that the prodigies we know about tend to come from families that provide them with enriched environments (Winner, 1996), there is no evidence that such enriched environments are always predictive of raising a prodigy. Many families provide their children with enriched environments but exceedingly few end up with prodigies.

Rage to Master

Children who exhibit precocity in a domain typically show a rage to master in that domain. These children "self-select" into engagement in reading, number, drawing, or music. Drawing obsessed children draw constantly; mathematically obsessed children think about numbers constantly; early readers bury their heads in books for hours on end with rapt attention. Parents that Winner (1996) studied reported that it was difficult to get their children to stop these activities in order to go to school, come to the dinner table, or go to sleep.

Where does this intense motivation come from? What keeps a child drawing or playing number games or playing the piano for hours every day? It is not the whip. Children persist in domains where learning is rewarding—that is, when it comes easily. One could never compel a child without innate potential in music or drawing or number or language to spend hours in painful, effortful daily drill. Children who work at something for hundreds of hours are a highly select breed.

The child prodigies who come to light are children with both precocious behavior and high rage to master. If there are children with high ability and low rage to master, we probably do not hear about them because they do not develop their abilities: without a voracious desire to master their domain, their abilities are likely to go unrecognized. When precocity and drive co-occur, it is difficult to determine their relative contributions. However, evidence from a behavioral genetics twin study of music indicates that common genes influence both ability and amount of practice, an instance of *genetic pleiotropy* (Mosing et al., 2014). This strongly suggests that there is a genetic basis to the rage to master seen in child prodigies. If this is the case, then the fact that precocity and drive so often co-occur is not simply a natural confound that befuddles our research efforts. Rather, precocity and drive are part of the same phenomenon. This co-occurrence also tells us something of critical importance, namely that drive (or rage to master) is *a part of* talent.

March to Their Own Drummer

Reports of prodigies show that these children often seem to "march to their own drummer," meaning that they do not just learn faster than ordinary children, but also learn differently. What's different, as reported by Winner (1996), is that they learn virtually on their own, requiring minimum adult scaffolding. Because these children figure so much out by themselves, they are creative. But we distinguish between little-c and big-C creativity (Gardner, 1993). Gifted children are creative in the little-c sense, meaning they make discoveries about their domain on their own. They figure out how to show depth in a drawing, how to sing back a melody they just heard, or how to find patterns in numbers—all without adult instruction. Big-C creativity, by contrast, involves changing a domain: Picasso and Braque's invention of cubism, Balanchine's choreography, Einstein's theory of relativity, etc. There is considerable evidence that creators do not make domain-altering changes until they have worked for at least ten years in their area (Gardner, 1993; Simonton, 1994). Hence, hard work (or deliberate practice) is certainly necessary for major creative discoveries that shake up a domain.

Relationship between Childhood Giftedness and Adult Eminence

Bamberger (1982) reported that music prodigies typically experience a crisis during adolescence, when they become increasingly self-critical of their playing. This crisis often results in dropping out of music. A recent *New York Times* profile of a violin prodigy, Saul Lipshutz, makes this same point (Vadukul, 2018). Quoted in this article is Ann Hulbert, author of *Off the Charts* (2018), a recent book about the difficult path that child prodigies follow. Hulbert commented, "A gift that once nurtured them suddenly becomes a big struggle. Their crisis comes down to autonomy: what am I?" Lipshutz felt he had been turned into a "trained monkey." The same crisis may affect other prodigies who are pushed to be on the public stage at an early age—whether in the form of giving concerts, entering sports contests, engaging in spelling bees, quiz shows, and math contests, or showing and selling art works in galleries (and examples of prodigy burn out can be found in Hulbert, 2018). Adolescence is the time when prodigies either do or do not make the transition from technical perfection to innovation and big-C, domain-transforming creativity. Only those who have the vision, desire, and chutzpah to do something in a new and original way will make the leap between child prodigy and adult creator (Gardner, 1993). The lives of prodigies often end sadly rather than in glory (Hulbert, 2018).

It is extremely difficult to predict which prodigies will successfully make the transition to adult creator, and which will not (Simonton, 1994). It is tempting to predict that those who are the most precocious (and thus show the most skill early on) will be those who achieve eminence as adults. But precocity is a very different skill from domain-altering creativity. Will the six-year-old who can draw as realistically as a skilled adult grow up to be the next Picasso? If at twenty she is still just drawing with technical precision, and not doing anything innovative, she will not be recognized as an important new artist.

The situation is the same in music. A child who plays Mozart just like her teacher, or even just like a Heifetz recording, amazes us. But by twenty, if this prodigy does not play in a way that is new, with some deep understanding, and a new interpretation, serious musicians and critics will lose interest. Technical perfection will win a child adoration, but it will win the prodigy grown into adulthood little or nothing. Clearly, while high ability is necessary to achieve adult eminence, it is not sufficient. The degree of skill in childhood cannot by itself predict later creative eminence.

In short, the skill that underlies prodigious achievement is not the same as the skill that underlies big-C creativity. A prodigy is someone who can easily and rapidly master a domain with expertise. A creator is someone who changes a domain. It is likely that personality factors play a major role in becoming a domain creator. Creators are restless, rebellious, and dissatisfied with the status quo (Simonton, 1994; Sulloway, 1996), and they have something new to "say." These are not factors that can be predicted by amount of deliberate practice. We find it difficult to imagine how deliberate practice could predict those prodigies who become creators versus those who either go on to become experts rather than creators, or who drop out, like the violin prodigy Saul Lipshutz (and so many others).

Of course, some individuals, such as Mozart, start out as prodigies and go on to become adults who transform their domains. As a prodigy, Mozart pleased the establishment. But it is only because of his later behavior, when he began to write music that broke with established convention, that we now consider him to be a creative genius. The creative artist/musician takes risks and breaks with conventions. The gifted child, or child prodigy, does not. As Hurwitz (1983) points out, gifted children have invested a great deal of energy in mastering a set of adult skills, and are often unwilling, or even unable, to experiment in the way that one must in order to be creative.

In sum, adults who achieve eminence and are considered to be major creators were often prodigies as children. However, the reverse is not the case: Most prodigies do not become domain-altering creators. Many drop out and turn to other pursuits; of those who do not drop out, most do not become known as creative geniuses. There is no direct route from precocity to challenging the status quo. Science has not yet determined how to predict the route that will be taken by a prodigy, but there is no reason to believe that the answer will be as simple as hours of deliberate practice.

Conclusion

We have tried to disentangle innate talent from deliberate practice in order to make the case that the talent *precedes* practice. If practice comes after talent has revealed itself, then practice alone cannot account for high achievement in a domain. Practice needs the raw material of talent to work with. Both talent and practice are necessary; neither is sufficient. Our argument is consistent with quantitative evidence from Hambrick et al. (2014) and Campitelli and Gobet (2011) showing that deliberate practice is not sufficient to explain individual differences in music and chess and that highly differential levels of achievement are reached despite the same amount of work. Our argument is also consistent with evidence from Mosing et al. (2014) that genetic factors influence how hard children are willing to work at music playing. Thus, even when hours of practice predict level of achievement, we cannot rule out an innate basis to the level of achievement attained. While not denying the importance of hard work and deliberate practice, it is time to close the book on the position that individual differences in achievement are due only to effort.

Authors' Declarations

The authors declare that there are no personal or financial conflicts of interest regarding the research in this article.

The authors declare that they conducted the research reported in this article in accordance with the Ethical Principles of the Journal of Expertise.

References

Bamberger, J. (1982). Growing up prodigies: The midlife crisis. In D. H. Feldman (Ed.), *Developmental approaches to giftedness and creativity* (pp. 61–77). San Francisco, CA: Jossey-Bass, Inc.

Campitelli, G., & Gobet, R. (2011). Deliberate practice: Necessary but not sufficient. *Psychological Science, 20*(5), 280–285.

Drake, J. E., & Winner, E. (2011-2012). Superior visual analysis and imagery in an autistic child with drawing talent. *Imagination, Cognition, and Personality, 31*, 9-29.

Drake, J. E., & Winner, E. (2012). Predicting artistic brilliance. *Scientific American Mind, 23*(5), 42–48.

Ericsson, K. A., Krampe, R. T., & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*(3), 363–406

Gardner, H. (1993). *Creating minds: An anatomy of creativity seen through the lives Freud, Einstein, Picasso, Stravinsky, Eliot, Graham and Gandhi.* New York, NY: Basic Books.

Goldsmith, L., & Feldman, D. (1989). Wang Yani: Gifts well given. In W. C. Ho (Ed.), *Wang Yani: The brush of innocence* (pp. 59–62). New York, NY: Hudson Hills.

Golomb, C. (1992). *The development of gifted child artists: Selected case studies*. Hillsdale, NJ: Erlbaum.

Hambrick, D. Z., Oswald, F. L., Altmann, E. M., Meinz, E. J., Gobet, F., & Campitalli, G. (2014). Deliberate practice: Is that all it takes to become an expert? *Intelligence, 45*, 34–45.

Hulbert, A. (2018). *Off the charts: The hidden lives*

and lessons of American child prodigies. New York, NY: Knopf.
Hurwitz, A. (1983). *The gifted and talented in art: A guide to program planning.* Worcester, MA: Davis Publications.
Judd, T. (1988). The varieties of musical talent. In L. K. Obler & D. Fein (Eds.), *The exceptional brain: Neuropsychology of talent and special abilities* (pp. 127–155). New York, NY: Guilford Press.
Milbrath, C. (1998). *Patterns of artistic development.* New York, NY: Cambridge University Press.
Mosing, M. A., Madison, G., Pedersen, N. L., Kuja-Halkola, R., & Ullén, F. (2014). Practice does not make perfect: no causal effect of music practice on music ability. *Psychological Science*, *25*, 1795–1803.
Paine, S. (1981). *Six children draw.* London, England: Academic Press.
Revesz, G. (1925). *The psychology of a musical prodigy*. Freeport, NY: Books for Libraries Press. Reprinted in 1970.
Richardson, J. (1991). *A life of Picasso*. New York, NY: Random House.
Richet, G. (1900). Note sur un cas remarquable de precocité musicale. IV Congrés Internationale de Psychologie. *Compte Rendu des Sciences*, 93–99.
Ruthsatz, J., & Detterman, D. K. (2003). An extraordinary memory: The case study of a musical prodigy. Intelligence, 31, 509–518.
Scott, D., & Moffett, A. (1977). The development of early musical talent in famous composers: A biographical review. In M. Critchley & R. Henson (Eds.). *Music and the brain: Studies in the neurology of music* (pp. 174–201). London, England: William Heinemann Medical Books Limited.
Selfe, L. (1983). *Normal and anomalous representational drawing ability in children*. London. England: Academic Press.
Shuter-Dyson, R. (1986). Musical giftedness. In J. Freeman (Ed.), *The psychology of gifted children* (pp. 159–183). Chichester, England: Wiley.
Simonton, D. (1994). *Greatness: Who makes history and why.* New York, NY: Guilford Press.
Sloboda, J. (1985). *The musical mind: The cognitive psychology of music*. Oxford, England: Clarendon Press.
Sulloway, F. (1996). *Born to rebel: Birth order, family dynamics, and creative lives*. New York, NY: Pantheon.
Vadukul, A. (2018). The redemption of a violin prodigy. *New York Times*, April 1, p. 24.
Winner, E. (1996). *Gifted children: Myths and realities.* New York, NY: Basic Books.
Winner, E., & Martino, G. (1993). Giftedness in the visual arts and music. In K. Heller, F. Monks, & A. H. Passow (Eds.), *International handbook of research and development of giftedness and talent* (pp. 253–281). New York, NY: Pergamon.
Winn, M. (1979, December 23). The pleasures and perils of being a child prodigy. *New York Times Magazine*, 12–17, 38-45.
Winner, E. (1997). Giftedness vs. creativity in the visual arts. *Poetics, 24*(6), 349–377.
Zhensun, A., & Low, A. (1991). *A young painter: The life and paintings of Wang Yani – China"s extraordinary young artist*. New York, NY: Scholastic, Inc.

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