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ABSTRACT

This monograph reports on a study of six child prodigies whose talents are manifested in writing, music, and mathematics. The boys, aged 3.5-9 years, were observed in natural settings and while practicing their talent specialty, and interviews were conducted with the boys, their parents, and their teachers. The study concludes that prodigies focus on a single specialized talent, while otherwise possessing high, but not extreme, general intellectual ability. An enormous amount of work, practice, and study are needed to develop the prodigious talent, and prodigies need a great deal of assistance from parents and teachers. Only certain bodies of knowledge seem conducive to early prodigious mastery. The prodigy's arrival must come at a time when the culture values and supports development and recognition in the domain in which the prodigy is talented. It is concluded that: (1) by expressing such a specialized talent, the prodigy reflects a very specialized way of thinking and understanding, an evolutionary strategy that is an exception to the prevailing rule of human general adaptability; and (2) in several important ways, the process of mastery of a domain is the same for anyone seeking to learn it, whether or not they are exceptionally talented. Includes nine footnotes. (JDD)

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Nature's Gambit: Child Prodiges And The Development Of Talent

A Monograph Prepared for the
Leadership Accessing Program

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Introduction

Child prodigies are a puzzlement to all who encounter them, especially their parents and teachers. Very little research has been done on prodigies, yet they have amazing potential to help us understand how individual development interacts with cultural evolution to produce human ability. It is likely that a deeper understanding of the development of prodigious talent will help us to understand how talent develops in gifted children who are not prodigies. Feldman and Goldsmith present illustrations of prodigies whose talents are manifested in art, music, and mathematics. They also remind us of the extraordinary talent exhibited by Jesus Christ when, at age 12, he carried on learned philosophical discourses with elders in the temple in Jerusalem. All who heard the discourse were amazed, and his parents, when they found him, "understood not." Feldman and Goldsmith's major research focuses on six prodigies. The full results of their research are reported in their book, *Nature's Gambit*. They observed their subjects in a variety of natural settings, interviewed them, watched them practicing their talent specialty, talked to their parents, and interviewed their teachers. The children ranged in age from three-and-one-half to nine years. They conclude that the prodigy focuses on a single specialized talent, while otherwise possessing high, but not extreme, general intellectual ability. They also conclude that prodigious talent does not develop easily. An enormous amount of work, practice, and study are needed, and prodigies need a great deal of assistance from parents and teachers.

Feldman and Goldsmith also place major emphasis on the coincidence of the prodigies' arrival at a propitious moment in time. The culture must value and support development and recognition in the domain in which the prodigy is talented. For example, American children will get mild encouragement for talent in chess but very strong encouragement for talent in science and mathematics. There must also be a match between the prodigy, his or her talent, and the existing state of development in a field of study. Since such perfect "coincidences" are rare, only a very few individuals are destined to become prodigies, to master a field quickly, and possibly to push onward to creative achievement in that field. The processes of mastering a field and of developing new insights are the same for all who have talents or gifts, albeit at a lower level than those of the prodigy. The culture must value the potential areas of strength in the gifted; the child's talents must find focus; the child must work hard over a long period to develop his or her talent; and parents and teachers must provide guidance and encouragement.

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Brief Biographies of the Authors

David Henry Feldman is Professor of Developmental Psychology in the Eliot-Pearson Department of Child Study at Tufts University. He directs the Jessie Smith Noyes Fellows in Gifted Education at Tufts and is the 1988 Distinguished Scholar of the National Association for Gifted Education.

Lynn T. Goldsmith is Visiting Research Scientist at the Eliot-Pearson Department of Child Study and Co-Director of the Developmental Science Group, both at Tufts. She was trained at Yale and Minnesota (Institute of Child Development) and was collaborating author of David Henry Feldman's recent book, *Nature's Gambit* (1986).

Nature's Gambit: Child Prodigies and the Development of Talent

Imagine yourself the parent of an active, inquiring five-year-old girl—a girl who loves to swing on her swing set, play with her friends, and cuddle in your lap to hear bedtime stories. Now imagine that, being a parent who is dedicated to the idea of providing enriching experiences for your child, you enroll her in a "music and movement" class with several other neighborhood children. To your surprise, you find that she has little interest in joining the class while they pretend that they are raindrops falling to earth, but she is completely smitten with the teacher's piano. In the space of three or four weeks, she has begun to pick out complicated tunes by ear and is begging for a piano of her own. Within a year her progress has been so rapid that she is enrolled in weekly private piano lessons, and her teacher has already suggested that you begin looking for a more advanced instructor. By the time she is eight, you are driving her to several different lessons a week, one of which is with a teacher who lives 40 miles from your home. Your daughter practices an hour or two every day and is preparing to perform a short piece with the local symphony orchestra. To your continued amazement, your daughter has turned out to be a piano prodigy.

While this particular example is an imaginary one, it accurately reflects the experiences of parents who discover that their children display exceptional talents or abilities. The phenomenon of the child prodigy is a fascinating one for the general public to consider and a very real and demanding one for those families who find themselves living with such a child. Yet the phenomenon has been virtually neglected by the scientific community despite the fact that it illustrates one of the most distinctive and powerful forms of human capability. Even more than this, the phenomenon of the prodigy speaks in a unique voice about two central questions concerning the origins and development of human ability: (1) what kinds of evolutionary strategies have operated in the development of intellectual ability, and, (2) how can educators best develop individual potential?

In the last several centuries, scientists have, by and large, concentrated on three major areas of investigation: (1) understanding and, to some extent, harnessing the physical universe—achievements which have allowed us to explore our world and the spaces beyond in ways that few of our predecessors could have imagined even in their wildest dreams; (2) self-knowledge focused on exploring and mastering the potential of the human mind and body as reflected, for example, in the practice and teaching of ancient meditation traditions or the practice of self-regulatory behavior; and (3) efforts to understand fundamental processes underlying the behavior and functioning of the living world, as reflected by the advances of relatively new areas of scientific inquiry such as quantum physics, molecular biology, and neurophysiology.

We would propose that there is a fourth kind of knowledge yet to be explored: knowledge produced through the transactions between individuals and the culture they have created. The phenomenon of the child prodigy, we believe, can supply an initial route of access to that knowledge. The child prodigy is not just a fascinating, relatively isolated example of extreme talent but a key to the much larger puzzle of the development of individual and collective potential. This fourth area also involves understanding the nature of change, and, in particular, the kinds of changes that connect individual psychological development with the cultures in which people grow, learn, interact, and (perhaps most vitally) seek to change the world. To comprehend these processes of individual and cultural development involves taking a long-term, evolutionary perspective on the study of human ability. We wish to address questions about how and why we might find striking differences in the individual expression of talent. Why, for example, would a child occasionally appear whose achievements inspire awe and wonder and who is set apart from the rest of humanity by virtue of these achievements? This kind of question leads in turn to questions about the importance of optimizing the development of talent in others less naturally gifted — in each of us, in fact. Such questions are of central importance to the well-being of humanity and to the survival of the planet as a viable habitat.

Examples Of Early Prodigious Achievement

Though recognized for millennia, the phenomenon of the child prodigy seems to have engendered a combination of awe, jealousy, and ambivalence which has discouraged serious study. There is not even a consensual definition of the term "prodigy," although the phenomenon is always considered to involve producing unusually mature achievements at an unusually young age. For the purposes of our research, we have identified the *prodigy* as a *child who has mastered a cognitively demanding field at the level of an adult professional before the age of ten*. Such astounding and often unsettling children display the maturity and mastery of complex domains which rival or surpass those of adults who have dedicated many more years of study to the field. When confronted with such evidence of seemingly uncanny ability, people's reactions often run the gamut of extreme emotions. To understand this claim first hand, readers might wish to engage in a little armchair introspection, keeping track of their own reactions to the following examples of early prodigious achievement:

- A 13-year-old Chinese girl named Wang Yani has already distinguished herself as a painter of considerable stature. Her father is an oil painter, and Yani often visited him in his studio to watch him at work. One day when she was two years old she picked up a piece of charcoal and drew his "portrait" on the wall. Like the drawings of other children of this age, her picture was composed of scribbled lines, yet Yani insisted that she had drawn her father's likeness. Unlike other toddlers, Yani's graphic skills burgeoned over the next few months. Within the year she had begun a remarkable series of watercolors depicting monkeys engaged in a variety of activities, from riding friendly peacocks to exploring the contents of a wine jug. Her paintings could easily be mistaken for the work of a gifted

adolescent or even of a very talented adult. In a mere twelve months, Yani developed an extraordinary control over the medium, an appreciation for compositional features such as balance, line, and use of space, and a considerable flair for the dramatic as well. Her work is so extraordinary that the Nelson-Atkins Museum in Kansas City is sponsoring a retrospective of her work which will tour the country in 1989.¹

- Concert pianist Lorin Hollander, now in his 40's, remembers distinctly the day that his prodigious musical talents were first recognized. His father was the concertmaster of the NBC orchestra, so presumably young Lorin had been exposed to classical music from his earliest infancy. According to his own report, however, his first transcendent musical experience was stimulated by a visit to a live rehearsal. He has related:

When I was three and a half, I went with my father to a rehearsal and heard them play a violin quartet. I was profoundly moved by the music. When I came home, I wanted to somehow put down what I had heard. I found some drawing paper and began to draw spirals. My father asked me what I was doing, and I began to sing him back the piece which I remembered perfectly. I told him that I was trying to write it down. My father said, "No, you silly boy. We already have a way of writing music," and he brought out the score to show me. I fell into the music. That is the only way to describe it. Within four minutes I knew the notes, the clefs, everything. A car horn sounded outside and just for fun my father asked me what the note was. I immediately answered, "F sharp." He took a spoon and clinked a glass. "B flat," I told him. Then he and my mother realized they had a prodigy on their hands, and they started to run around to people, to find out what to do.²

- One of the children we have studied is a young boy we have called "Adam Konantovich." Adam is unusual even among the prodigies we have followed in that he seems to be gifted in a number of different specific areas as well as demonstrating unusually powerful general mental abilities. The following excerpts, reported by Adam's mother Fiona, illustrate his extraordinarily early interest in and grasp of the domains of mathematics and music.

When Adam was 10 months old, we were sitting in a tent in a Norwegian campground waiting, as one often does in Norway, for the rain to stop. Adam turned to us and said after a long pause, "Please teach me logarithms. I understand the characteristic, but I don't understand about the mantissa." Well, fortunately for us, you can't fall very far off the floor of a tent. When we recovered — it took a few minutes — one of us said, "We will, as soon as you learn arithmetic. Do you know what arithmetic is?" Adam, who was about two months away from reading, as far as we know, answered, "Yes — addition, subtraction, multiplication, division, and square root." My husband is a natural scientist: wherever his brilliance lies, he is competent in mathematics, but not brilliant. I am a

mathophobe. Where or how Adam acquired this information, I have no idea.

At age one, the PBS broadcast of the Boston Symphony would hold Adam spellbound for its entire length. He said that Seiji Ozawa was his favorite person in the whole world. Just about on his first birthday, he watched in rapture while a violinist played a prominent passage during one of those broadcasts. He said, "Oh, what was that?" I told him it was a violin, and he asked to play one. I said that his body was not ready yet. He asked when it would be and, thinking of the Suzuki method, I told him when he was three he would be able to play the violin. The matter was not mentioned again until a few days before his third birthday. He came into the kitchen and said, "Fiona, I'm ready!" I said, "That's nice, dear. What are you ready for?" Adam reminded me that I told him he could play the violin when he was three. We began a long and frustrating search for the right teacher for him. He was composing in his own hand (before the age of three-and-a-half), had perfect pitch, and was fascinated by the music to which he was exposed.³

- Finally, consider the description of a prodigy whose mature works are familiar to all of us:

Now his parents went to Jerusalem every year at the feast of the Passover, and when he was 12 years old they went up to Jerusalem after the custom of the feast And it came to pass that after three days they found him in the Temple sitting in the midst of the doctors, both hearing them and asking them questions, and all that heard him were astonished at his understanding and answers. And when they saw him they were amazed, and his mother said unto him, 'Son, why has thou thus dealt with us? Behold, thy father and I have sought thee sorrowing.' And he said unto them, 'How is it that you sought me? Know ye not that I must be about my father's business?' And they understood not the saying which he spake unto them (Luke, 2:41-50).

These cases should provide a feel for the phenomenon of early prodigious achievement. We have included them because there has been a tendency to deny the reality of a phenomenon that challenges some of our fundamental assumptions about children and ability. It is difficult for society to accept such striking accomplishments in children so young, for their talents and achievements seem to violate our implicit "rules" about the kind of journey that is required for mature mastery of a demanding field. But the fact of such extraordinary accomplishments must not be denied.

In past eras the phenomenon was explained by assuming that such children were blessed with a specific God-given talent. More recently, the tendency to deny special status to the prodigy has taken the form of asserting that such children simply represent a special use of general intellectual ability — that their talents or

achievements are no different in kind from the accomplishments of thousands of other children who score in the "gifted" range on IQ tests. As a result, there has been virtually no serious examination of the factors contributing to the phenomenon of the prodigy. Trying to explain how and why truly prodigious talent occurs and how the prodigy develops remains a neglected challenge. To answer such questions will require a much broader framework than is currently available for understanding ability and its development and will require that we do more than be dazzled by the prodigy's talent.

We began our own investigation of child prodigies to help remediate the lack of knowledge about the nature of prodigies, and also because we felt that understanding this phenomenon could lead to a greater understanding of the nature and development of all children's special gifts, be they extraordinary or more modest. Furthermore, we believe that the prodigy can tell us something deeper about the evolution of human abilities themselves, something new about the role of human cultures in the development and distillation of knowledge, and something useful about how better to enhance future growth and development.

A Study of Six Prodigies

In 1975 we⁴ began a study of child prodigies in an effort to answer some very specific questions about the relation between extreme talent and more general intellectual functioning. We undertook the study when it became clear that there was essentially no literature to consult about the phenomenon. Two books about child prodigies had been written — both originally in German — in the late 1920's, describing (in varying detail) nine cases of early prodigious achievement.⁵ Because so very little was known about child prodigies, we found we could not proceed to rigorous empirical investigations of prodigies' talents without first describing the phenomenon itself. We found ourselves engaged in something much like anthropological field work: we observed our subjects, their families, and their teachers; we watched the children as they took lessons, practiced, played in tournaments and competitions, went to school, rode their skateboards, ate dinner, and helped wash the dishes. We basically "hung around" with these families over a period of ten years, all the while trying to organize our observations into a meaningful structure.

Our final sample of children consisted of six boys⁶ who were between the ages of three-and-one-half and nine when we began our observations. Two of the boys were chess players; one seemed to be a mathematics prodigy when we met him at age six although he has subsequently turned more towards studies of natural science; one was a composer who is currently pursuing a career as a concert violinist. The fifth subject was a gifted writer who was already typing, without assistance, well-crafted short stories and plays when he was three years old. He has subsequently turned his attention to music as well and has developed into a gifted rock composer and guitarist. The sixth we studied was Adam, the child whose "adventures" were quoted earlier. Of all the children we studied, Adam most fit the

layperson's notions of the prodigy: he possessed an extraordinarily powerful mind and a seemingly limitless ability to comprehend complex areas of knowledge. When we first met Adam, he was three and a half years old and already conversant in several languages (French, Spanish, Hebrew, and a smattering of Russian), familiar with some of the principles of geometry, writing short compositions for the guitar and the violin, and interested in a wide range of scientific topics. Over the past ten years, he has begun to concentrate more exclusively on music composition and performance, displaying an unusual talent for the piano, violin, and flute.

Observing these children for the past decade, we have developed a framework which not only makes the phenomenon of early prodigious achievement itself more comprehensible, but which also speaks to broader issues of self-expression and talent development for all children. Two basic observations have guided this framework. The first is that, by and large, the child prodigy focuses on a single, specialized talent. Prodigies are not "all-around geniuses" who are able to excel in any field they choose. Even Adam, whose IQ has been estimated to lie somewhere in the range of 200, does not – and, more importantly, probably cannot – master any domain of knowledge at will.⁷ Instead, we found that the children displayed their extraordinary abilities in a relatively narrow area – chess, music, logical thinking, writing – which were balanced by strong but not extreme general intellectual capabilities.

The second observation was that, contrary to popular belief, prodigies' accomplishments are not produced effortlessly or instantaneously. Their talents, however extraordinary, develop only in the context of an enormous amount of personal effort and assistance from others. Although the contemporary scientific community would snicker at the idea that the prodigy has been blessed with a gift from the gods, the current explanation – that such children are blessed with a fortuitous shuffle of genes and hormones – smacks of the same kind of *deus ex machina*. The longstanding popular notion that prodigies are bestowed with the protean gift of an inborn and fully mature talent is simply untrue. A lot of very hard work goes into the seemingly magical emergence of a prodigy. The tendency in writing about prodigies has been to focus exclusively on the early emergence of the child's talent and therefore to equate prodigiousness with innate ability. This emphasis is understandable since what captures our attention is the fact of the uncanny accomplishments of a mere child, but it misses some critical parts of the process. Just as a magician dazzles us with a seamless performance, prodigies do not reveal the many hours of preparation required for the amazing feats that they perform.

To emphasize the preparation that must precede the appearance of prodigious talent, we have argued that the prodigy must be thought of as the instantiation of a complex system of interacting forces – the *co-incidence* of a number of different events which, working in concert, yield the child prodigy.⁸ Certainly a major factor in this equation is the child's talent, yet surprisingly little is known about the actual nature of such unusual talent. Sometimes prodigies appear

as isolated cases of ability in families which do not seem to have produced any other individuals of extraordinary talent; other times we hear of families in which the precocious appearance of talent has been a theme throughout several generations.⁹ What became clear to us from our own observations, however, is that none of the six children we studied had developed their talents singlehandedly. Between the initial indication of strong interest and ability and the subsequent exceptional achievements, there were literally thousands of hours of hard work and assistance from a number of other people. It has been taken for granted that the prodigy is in some sense nothing other than the exceptional talent he or she possesses. Yet even in this respect the phenomenon has been oversimplified. It seems that prodigies represent a particularly fortuitous blend of talent and personal characteristics — characteristics which strongly influence whether the talent ever gets exercised or stretched beyond its fledgling state.

We have found in our six subjects, and also in biographical accounts of historical cases, that child prodigies can be characterized by a passion for their field, a tenacious desire to master its secrets, and a supreme inner confidence about their ability to do so. They relish study and practice and often have to be dissuaded from spending every waking moment playing with problems and seeking to perfect their grasp of the field. Without these motivational and personality characteristics, the prodigy's considerable early talent would most likely fail to grow.

We have no doubt that there are children we never hear about who are born with raw talent equal to that of our subjects, but who do not have the interest or motivation to develop their gifts further. Similarly, there are children who are passionate about learning a domain despite the lack of any real gift for mastering it. It is the *combination* of extraordinary talent with strong commitment and confidence that provides the seeds for early prodigious achievement. Thus, even when considering the phenomenon of the prodigy in terms of the individual child, it should be clear that more than a natural gift is required for the expression of extreme talent at an early age. The "co-incidence equation," however, is even more complex: a number of other factors external to the child must co-incide if he or she is to develop an extraordinary talent into exceptional performance capability.

Parents play an incalculable role in the development of the child prodigy. Someone (in most cases it is the parents) must initially recognize that the child demonstrates unusual ability and decide that this ability merits further development. Parents are responsible for finding appropriate teachers, arranging and financing lessons and other enriching experiences, transporting and accompanying the child to these various activities, monitoring progress, offering support and encouragement, providing a range of "normal" childhood experiences, and also trying to keep the general household running smoothly. This is a difficult task, and one that was never taken lightly by the families in our study.

Teachers also play a critical role in the coincidence equation, for they are the sources for the child's continued involvement and progress in the chosen domain.

While the prodigy may demonstrate an impressive intuitive grasp of the domain, even the most astounding talent requires some form of guidance and instruction in order to mature. Teachers of prodigies must understand both the structure of the domain and the unique mix of mature and immature understanding that the prodigy brings to bear on mastering the field. No matter how talented they are, prodigies are still children, and the curricular content and teaching techniques most successful with adults may not be so with the prodigy. Teachers of prodigies are most often themselves extraordinary practitioners, possessing a dual sensitivity to the unusual requirements of exceptionally talented children and a deep understanding of the organization of the field of study.

Furthermore, only certain bodies of knowledge seem conducive to early prodigious mastery. Child prodigies can be found in chess, music composition and performance, writing, graphic arts, and (if one relaxes the criteria somewhat) mathematics and computer programming. Significant mastery of fields such as physics, medicine, molecular biology, the plastic arts, and choreography, however, do not seem to occur among even the most talented youngsters. We have suggested that several characteristics of the bodies of knowledge themselves make them more or less conducive to early prodigious achievement. The more structured the knowledge and the more established techniques there are for communicating this knowledge, the greater the possibility that the domain can be made comprehensible to a child who is already predisposed to think and learn about the field.

Finally, the culture at large must value and support the effort to pursue study of the child's special domain. Without some form of support at this level, the child will fight an uphill battle for the simple privilege of learning. In some very general, but nonetheless profound way, the culture provides or denies the opportunity to develop interests and talent. While American children displaying an interest in and aptitude for chess are generally only mildly encouraged to study and improve their game, children in Iceland — where chess is the national pastime — are heartily welcomed into an extensive and well-supported network of clubs, lessons, and tournaments. American children demonstrating strong interest in and unusual aptitude for mathematics or science will have less difficulty finding teachers and mentors to encourage, supervise, and even finance advanced study.

To take an even more extreme example of how important it is for the child's talent to conform to a culturally sanctioned domain, consider the following: several years ago we were told of a young boy who seemed to be a prodigious safecracker — left to play in his father's office one Saturday morning while his dad tried to clean up some paperwork on his desk, this eight-year-old boy amused himself by opening every combination safe in the office suite. His father was both proud of and perplexed by this sudden display of talent. Clearly he could not encourage the boy's talent as it presented itself since safecracking is not a skill generally considered desirable by the culture at large, yet he was unsure how he might go about channeling these apparently unusual perceptual and kinesthetic skills into a more productive realm of activity. (Unfortunately, we do not know what has

become of this child. We hope that he is on his way to becoming a surgeon, croupier, or magician rather than a gifted "second story man.") While this anecdote presents a rather absurd case, it nonetheless makes the general point that cultures try to circumscribe the talents that will be supported and encouraged.

Nature's Gambit

From the outset we have been amazed by the accomplishments we have witnessed. Our young friends have taught us much about the blessings—and the burdens—of extraordinary talent. The prodigy is not simply the mouthpiece for the spontaneous unfurling of a preformed ability but reflects the successful coincidence and careful orchestration of a number of critical contributing factors. Prodigies represent a fortuitous match between individual talent and an existing body of knowledge, but the existence of this match is not in and of itself sufficient to yield the marvelous achievements we have come to associate with prodigies. Prodigies work with passion, determination, and commitment to realize their gifts, assisted in this endeavor by dedicated parents, teachers, and mentors.

It was fairly obvious quite early in our research that prodigies, unlike the goddess Athena, did not arrive in this world with fully developed talents. What was far less clear to us was why such talent might emerge: was there a "message" the prodigy might carry for the rest of us? In Greek and Roman times the term "prodigy" referred not only to children of exceptional ability but to a whole host of portents and prophetic events. We began to wonder whether there might be some remaining portentousness to this phenomenon, something that might speak to all humankind rather than to the relatively few whose abilities take such an unusually powerful turn.

We would now suggest that the message of the prodigy is twofold. First, by expressing such a specialized talent, the prodigy reflects a human evolutionary strategy which has tended to be overlooked. Within an evolutionary framework, *homo sapiens* is a species which is strikingly adaptable to an extremely wide range of ecological niches. By virtue of our ability to communicate, cooperate, and change the environment, we have been able to create conditions which have allowed our species to spread over virtually the entire earth. This has been possible in large measure because as a species we are "cognitive generalists," possessing flexible intellectual skills. The prodigy, in contrast, represents an individual with a strong predisposition toward a very specialized way of thinking and understanding, an exception to the prevailing rule of general adaptability.

Were all of humanity as highly specialized as the prodigy, we doubt that human civilization would have the form it does today—in fact, we wonder whether anything as organized and sustained as a civilization would have developed without the general, flexible (and often more practical) intelligence of humanity. Yet some of the greatest advances in knowledge have been achieved by individuals working in highly specialized domains. We would suggest that human cultures grow and develop as a result of the joint activity of individuals who possess a more "generalist"

mentality and those whose talents and interests are quite highly specialized. We have considered the phenomenon of the prodigy as evidence that, against the background of a biological tendency toward general mental flexibility, there may be a second, counter tendency toward cognitive specialization of thinking and ability. This second tendency may be somewhat riskier, since extreme specialization may demand extremely specific conditions for its expression. We have come to view the prodigy as nature's gambit — the realization of an evolutionary shuffle of nature and nurture which, *under the right environmental conditions*, allows for the expression of extreme ability at an unusually early age.

Evolutionary biologists would blanch at the implication that "nature" is sapient or that evolution implies a directional process. We would, therefore, want to make it clear that we do not consider such a gambit to be a conscious, directed process. Rather, we mean to suggest that the occasional appearance of a child prodigy is as natural a phenomenon as any other, the by-product of the dual "strategies" for cognitive expression which are represented in the human gene pool. Some people are born with a tendency to master a wide range of domains; others are born with a more specialized set of interests and proclivities. These tendencies and proclivities do not fix the individual's subsequent course of learning and growing, but they do constrain them. They serve to direct and influence what any particular person finds most engaging, fulfilling, and worthy of sustained pursuit.

The second, practical lesson we have learned from our study of prodigies is that in several important ways the process of mastery of a domain is the same for anyone seeking to learn it, whether or not they are exceptionally talented. Prodigies are found when a near perfect co-incidence of those forces contributes to the realization of individual potential. This process is not limited to the development of extreme talent. The extent to which each of us is able to give voice to our own interests and special abilities is a function of how propitious the coordination of coincidence forces have been in our own lives. Although few are blessed with the raw ability of the prodigy, we each possess the capacity to master and enjoy certain kinds of challenges. Cultures recognize this fact with greater or lesser success, and direct attention toward the detection, nurturance, and fulfillment of potential.

Understanding the process of co-incidence helps us realize that, in order to begin to comprehend the prodigy (and, in fact, all development of expertise), we have to understand not only the talents and abilities of the child but also the highly evolved domains in which he or she comes to express those talents. Co-incidence involves the concordance of the child with the field, within a cultural content that values the child's capabilities at that particular point in history. It also involves a family willing to pour its emotional, financial, physical, and psychological resources into the development of those capabilities and the larger community's contribution of institutions, organizations, networks, competitions, teachers, and technologies which support and foster the realization of talent. When Yo-Yo Ma plays the Bach cello suites, his music is as much a culturally-based gift to him as it is his gift to us.

The development of an individual's talent and the development of resources within the culture involve the interplay of many forces combined in ways as complex as genetic codes themselves. And yet we know almost nothing about how this happens. The millennia-old traditions of self-knowledge and the centuries-old traditions of the arts and sciences will have to be brought to bear on our understanding of this process if, in Albert Einstein's words, we are to come to a fundamentally new way of thinking—a way of thinking that seems essential if humanity is to survive and flourish.

- 1 For more information about this extraordinary young artist, see Li, S. & Jiang, C. (1984). *Yani's monkeys*. Beijing, China: The Foreign Languages Press; *Wang Yani: Pictures by a young Chinese girl*. (1987). Munich: Prestel; and Goldsmith, L.T. & Feldman, D.H. (in press). *Wang Yani: Gifts well given*. In Ho, W.C. (Ed.), *The brush of innocence: Paintings by Wang Yani*. Kansas City, MO: The Nelson-Atkins Museum.
- 2 This quote appears in Winn, M. (1979, December 23). The pleasures and perils of being a child prodigy. *The New York Times Magazine*, p. 39.
- 3 "Fiona Konantovich" (pseudonym), personal communication.
- 4 The research was actually conceived and started by Feldman alone with an initial sample of three children. Three other boys and a collaborator (LTG) were acquired over the next three years. For a detailed report of our work, see Feldman, D.H., with Goldsmith, L.T. (1986). *Nature's gambit: Child prodigies and the development of the human potential*. New York: Basic Books.
- 5 See Baumgarten, F. (1930). *Wunderkinder psychologische untersuchungen*. Leipzig: Johann Ambrosius Barth; and Revesz, G. (1970, originally published in 1925). *The psychology of a music prodigy*. New York: Books for Libraries Press. The Baumgarten work has not been translated into English.
- 6 At the time we were gathering subjects for the study we were unable to find girls who met our criteria for early prodigious achievement, although we searched quite seriously for them. Since that time, we have heard of a number of girl prodigies; we expect to begin systematic study of a sample of girls in the future. For a discussion of the little that is known about young girls displaying extraordinary talent, see Goldsmith, L.T. (1987). *Girl Prodigies: Some Evidence and Some Speculations*. *Roeper Review*, 10, 74-82.

- 7 Some of Adam's teachers might dispute this claim, and it is true that he is able to grasp many complex concepts in a wide range of domains with seemingly little effort. Our own observations, however, would suggest that there are areas in which Adam shows no interest, or even downright aversion, and that these areas remain relatively uncharted territory for him. Yet other children and adults find these fields brimming with fascinating problems and complexities and are delighted to explore them in depth. We once asked Adam to draw us a map of a model landscape when he was about five years old. He chose instead to redefine the task, drawing a map of an imaginary land, complete with a carefully detailed key drawn in ornate calligraphy. In contrast, one of the children studied by Franziska Baumgarten was a cartographic prodigy whose greatest joy was to figure out topographical relationships among places and represent them in maps.
- 8 For a more detailed treatment of the concept of co-incidence, see *Nature's Gambit*.
- 9 In our own sample, with the possible exception of Nils, none of the boys seemed to come from families in which there had been other children demonstrating exceptional ability or even adults who had been brilliant practitioners of a related domain. In contrast, the Mozarts, Mendelssohns, and Menuhins all produced several musical prodigies; Wang Yani has a younger brother who is reputed to be an unusually gifted painter; and Michael Deakin has described, in his book *Children on the Hill* (1972), a family which seems to have produced four child prodigies, each in a different domain.