DEVELOPMENTAL ANTECEDENTS OF ACHIEVED EMINENCE

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Certain select individuals in any time and place exert an exceptional personal influence over their fellow human beings. These individuals achieve fame, or infamy, that may endure for generations, if not for the subsequent duration of human civilization. In general, there are two broad forms such phenomenal impact may take. On the one hand, a person may "make history" for unusual accomplishments in creative endeavors, like science, philosophy, literature, music, or the visual arts. Big names such as Copernicus, Descartes, Shakespeare, Beethoven, and Michelangelo leap immediately to mind as exemplars. On the other hand, others leave an impression upon the course of history through the exercise of extraordinary leadership, whether in the political, military, economic, or religious domain. In this category, we can place such notables as Lenin, Napoleon, Carnegie, and Luther. Francis Galton (1869), in his classic book *Hereditary Genius*, initiated the practice of using the generic label "genius" to cover all varieties of rare influence (also see Albert, 1975; Cox, 1926; Simonton, 1984d). It should be noted, nonetheless, given how value-loaded this term seems, that to be counted as a genius one need not be invariably right in

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a epistemological or ethical sense. Many creators have attained distinction for generating provocative remarks that contemporaries and posterity have felt compelled to denounce or qualify. Aristotle is well-known today mostly as a repository of incorrect, even funny ideas. Likewise, a character like Hitler or Genghis Khan can be styled a genius, albeit an "evil" one. The measure of genius is achieved eminence, but eminence may assume the guise of notoriety and universal condemnation.

Handed the raw fact that a small proportion of persons dominate the manifestation of creativity or leadership, an obvious next question is where these so-called geniuses come from. How true are Milton's oft-quoted lines "The childhood shows the man,/As morning shows the day"? Can we inventory those events occurring during the early formative years that directly contribute to the development of high-caliber genius? This issue is clearly of immense theoretical and practical importance. On the theoretical side, learning the developmental antecedents of achieved eminence may shed additional light on such perennial problems as the relative significance of genetic inheritance and external environment on personality and social development. And practically, knowledge of developmental antecedents may permit us to more directly intervene, to make recommendations on how to encourage or at least identify the truly gifted.

Therefore, in this literature review, I will summarize the chief empirical findings that have been collected in over a century of research. The review closes with a discussion of the principal theoretical interpretations that can be offered for the results.

EMPIRICAL FINDINGS

The Goertzels, in a pair of interesting books, have quite ambitiously undertaken to isolate the main childhood causes of adulthood achievement (Goertzel & Goertzel, 1962; Goertzel, Goertzel, & Goertzel, 1978). Concentrating on twentieth-century eminent leaders and creators, the Goertzels examined such potential factors as birth order, socioeconomic class, parental personality quirks and socialization practices, handicaps (emotional and physical), early school experiences, and role models. Although their methodology was more qualitative than quantitative, and more exploratory than hypothesis-testing (especially in the first volume), the Goertzels at least present something of the range of developmental possibilities (also see Albert, 1983; Dennis & Dennis, 1976; Simonton, 1984d; Walberg, Rasher & Parkerson, 1980). In this essay, I equally treat a wide array of possible influences, even though I focus on those that have received the most attention in empirical research. Specifically, we will look at intellec-

tual development, family position, motivation, parental loss, role models and mentors, education, and the overall sociocultural milieu or zeitgeist.

Intellectual Development

The connection between genius and intelligence is obvious. Hence, it should not surprise us that intellectual development has long been studied as a principal agent of achieved eminence. Such remains the focal point of much current research on the "gifted child." And scientific inquiries can be said to date all the way back to the aforementioned Galton, whose 1869 *Hereditary Genius* attempted to demonstrate three fundamental points. First, intellectual ability is distributed in such fashion (viz. the normal curve) that few persons in any population exhibit really potent intellects. Second, those favored with notable above-average minds will necessarily perform well in the competition for fame and fortune in any endeavor they pursue; intelligence is strongly correlated with a rich tally of adulthood accomplishments. Third, intelligence is subject to straightforward genetic inheritance. A logical consequence of these propositions is that achieved eminence will tend to run in families. Famous parents will have illustrious offspring. Most of Galton's book is devoted to documenting this inference. In chapter after chapter, he lists eminent personages in a variety of creativity and leadership fields, and then indicates that family lineages occur far above chance expectation. Galton himself, of course, can be said to illustrate this conclusion, related as he was to the Darwins—Erasmus, Charles, and George.

It goes without saying that Galton's aims were less than fully fulfilled. Subsequent research fails to endorse the main tenets of his eugenic doctrine. For one thing, in many fields of achievement, eminent personalities do not cluster conspicuously into family configurations (see, e.g., Bramwell, 1948). And in those domains where a fine family pedigree is of value, social advantage appears the best explanation. Thus, poets do not form dynasties, while English judges, who do, are probably exploiting political connections passed down like heirlooms. Another difficulty concerns the equivalence that Galton posits between intelligence and achieved eminence. Although there is some likelihood that a strong intellect contributes to eventual attainment, it is by no means self-evident that exceptional intelligence invariably mandates distinction in life. Even more critically, it is possible that some personal qualities that make for success are acquired in some other fashion than genetic. As an example, one inquiry into 342 hereditary monarchs found that even though intelligence did seem to have a prominent genetic component, and while intelligence correlated with distinction as a political leader, achieved eminence was primarily trans-

ferred from generation to generation via role modeling, a process that we will discuss later in this review (Simonton, 1983b).

In Galton's 1869 investigation, intelligence was not directly observed, only inferred. Galton's anthropometric laboratory did burgeon with devices that purported to assess human intellect (Galton, 1883), yet these gadgets gauged very little of what we now consider to define intelligence (cf. Johnson, McClearn, Yuen, Nagoshi, Ahern, & Cole, 1985). With the advent of Alfred Binet's IQ test, and particularly Louis Terman's adaptation known as the Stanford-Binet, the connection between intelligence and achievement could be more directly assessed. Indeed, the 1920s witnessed a profusion of empirical studies on the repercussions of high IQ, including such classics as Leta Hollingworth's (1926) *Gifted Children* and Catherine Cox's (1926) *The Early Mental Traits of Three Hundred Geniuses*. The latter is of special interest to us here. Cox's tome is the second volume of Terman's (1925) *Genetic Studies of Genius*, surely one of the monumental longitudinal inquiries in the history of developmental psychology. Terman's ambitious goal was to track a sample of intellectually gifted children all the way through to adulthood, to demonstrate that their accomplishments would rise far beyond the average. Follow-up work is being continued to this very day (see, e.g., Holahan, 1984–1985; Sears, 1977). Cox strove to demonstrate the same linkage, but in the reverse direction: Creators and leaders who have without doubt "made it big" were assessed retrospectively for intellectual capacity. Her sample of 301 "geniuses" was culled from James McKeen Cattell's (1903) rank-ordered list of a thousand eminent personalities, with restrictions regarding rank, realm of achievement, and birth dates. Because every one of these historical figures was deceased, she could not just administer the Stanford-Binet. Instead, she adapted a "historiometric" procedure originated by Terman (1917) to estimate the intelligence quotient of Francis Galton (cf. Woods, 1906, 1911, 1913). In a nutshell, the developmental definition of IQ as a ratio of mental to chronological age was transferred to biographical data on the precocious behaviors exhibited by geniuses. Mozart provides one of the most striking examples, for he began composing around 5 or 6 years of age, and by the time he was 15 he had already written sonatas, concerti, masses, symphonies, and an opera. The question to be answered for an IQ estimate is what age would an intellectually average person, even one with musical talents, perform such feats? Using this approach, Cox and her research assistants obtained reliable estimates for all 301 geniuses. These range from 115 (U. S. Grant) to 200 (J. S. Mill), with an average around 153 (Simonton, 1976a, based on the corrected estimates from the years 0 to 17). Cox had a collection of very bright men and women indeed.

She did not stop at calculating IQ scores, however, for she proceeded to determine the correlation between these scores and achieved eminence,

the latter measure based on Cattell's (1903) rankings. Cox found a modest correlation of .25, which shrank to .16 when she partialled out data reliability. Although these coefficients are statistically significant, a secondary analysis of her data revealed more subtle sources of methodological artifact, so that this correlation dips just below statistical significance in a more extensive multivariate test (Simonton, 1976a; cf. Walberg, Rasher & Parkerson, 1980). Naturally, that any correlation was found at all should have been astonishing. Since the 301 were pre-selected for "genius," the variation in intellectual ability was severely truncated; all 301 had at the minimum the mental power of the average American college student (Cronbach, 1960). Even so, the fact persists that the members of the Cox club form a potent intellectual elite. Moreover, subsequent historiometric studies have isolated additional evidence associating intelligence with exceptional achievement. In the first place, intelligence is strongly linked with versatility, or the possession of skills and talents in many domains, a factor which contributes to adulthood distinction (Simonton, 1976a; cf. White, 1931). Even more critically, a couple of inquiries into the achieved eminence of hereditary monarchs divulged a clear (albeit moderate) relation between assessed intelligence and distinction (Simonton, 1983b, 1984e). An intriguing aspect of these two investigations is the decision to deliberately sample leaders who attained power through hereditary rather than elective succession. Both Galton and Cox pointedly excluded those who they believed attained a place in history without necessarily proving themselves worthy. Yet this precise fact renders hereditary monarchs more, not less, useful as test cases. Kings and queens vary immensely in their standing with posterity, and they differ almost as much in their native intellectual gifts. Only in a hereditary monarchy can a mediocre, even feeble intellect assume the reins of government. In any case, by enhancing the variation in intellectual prowess, the correlation between intelligence and notable accomplishment becomes all the more pronounced.

The most secure conclusion to offer at this juncture is that intelligence is a necessary but not sufficient cause of adulthood success in careers that demand creativity or leadership. Those who leave the lasting impact on others are hardly likely to have been retarded as children, and almost all would be considered gifted children today. On the other hand, an extemely high IQ does not automatically guarantee fame. In Terman's longitudinal inquiry, not all of his exceptional children grew up to become impressive adults, for a significant proportion could be branded "underachievers" (Terman & Oden, 1959). In fact, the literature on both creativity and leadership frequently contains the speculation that an excessive intelligence might even militate against personal influence (e.g., Barron & Harrington, 1981; Bass, 1981). Simonton (1985a) has proposed a formal model that specifies the circumstances that will likely yield a curvilinear, concave-

downward function between intelligence and creativity or leadership. Under many common conditions, for example, the highest odds of exercising personal influence in a group is enjoyed by that individual with an IQ only around 1.2 standard deviations above the mean IQ of the group (cf. Hollingworth, 1926). It may perhaps illustrate the model's applicability to note that Galton, whose IQ stood as high as 200 (Terman, 1917), is not nearly so universally acclaimed as his cousin Charles Darwin, who could boast a mere 155 at most (Cox, 1926).

Family Position

The fundamental thesis of Galton's (1869) treatise seems contradicted by a single salient fact: Not all siblings from a distinguished family prove equally successful. Relatively few eminent personalities are only children, yet in an overwhelming majority of instances, one son or daughter stands out while their brothers and sisters remain in obscurity. If intelligence propels a person into fame and if intelligence is a gift of genetic endowment, we should be able to enumerate far more siblings in lists of the eminent. Curiously, Galton himself offered one possible route around this impasse in his 1874 book *English Men of Science:* The first-born son of any family enjoyed optimal opportunities to attain a high place in social acclaim. This announcement marks the onset of the vast and frequently confusing literature on birth-order effects (e.g., Adams, 1972; Albert, 1980; Altus, 1966; cf. Schooler, 1972). But why should first-born children be honored with superior chances of adulthood success? One potential explanation is Zajonc's (1976) "confluence model" of intellectual development. In the preceding section, we observed that achievement in part depends on intellect, and thus anything that contributes to intellectual growth may equally enhance ultimate accomplishment. Expressed in rather simple terms, the confluence model maintains that intellectual growth increases with the quality of mental stimulation available in the home environment. Parents dominate the environment of the first-born child, but as each child is added to the family, the average mental maturity to be found in the home is progressively degraded, such that the last born child suffers the most disadvantage. The confluence model leads to some provocative predictions about the consequences of single-parent homes, the spacing of children, and the like, but we need not delve into these implications and complications here. The model has come under considerable attack on both theoretical and empirical grounds (e.g., Brackbill & Nichols, 1982; Galbraith, 1982a, 1982b; cf. Bernbaum, Markus, & Zajonc, 1982; Zajonc, 1983). From our present standpoint, two reasons can be offered for rejecting the confluence model as an explanation for the primacy of the first born. First, the amount of variance explained is hardly sufficient to account

for the extreme within-family contrasts in adulthood distinction. Second, and most critically, the earlier-born child does not always come out on top of the heap. Long ago, Havelock Ellis (1904), for instance, observed that the last-born child in a family had more favorable odds of success than the middle child, a finding that runs counter to the monotonic decline predicted by the confluence model.

In fact, if we must evoke birth order as a developmental factor in achieved eminence, it appears that primogeniture does not invariably rule. In some domains of achievement, being the first born can even be a handicap. This reversal is especially apparent in political leadership. Revolutionary leaders provide the most dramatic case in point, for revolutionaries are more prone to be last or later-born children from large families (Matossian & Schafer, 1977; Stewart, 1977; Walberg, Rasher, & Parkerson, 1980). On the other hand, political leaders in more stable circumstances have a higher likelihood of being middle children (Goertzel, Goertzel, & Goertzel, 1978; Stewart, 1977). These results suggest that it is the impact of family ordinal position on personality and social development that marks the central causal link. Different locations in the family pecking order bring about contrasting interpersonal experiences that determine the course of personal development (cf. Albert, 1980; Howarth, 1982). Social skills and predilections acquired in childhood then affect what kinds of situations the person is likely to prove successful as an adult. First-born children, especially first sons, have ample opportunities to lord it over younger siblings, middle children get plenty of experience being the conciliators and mediators between older and younger siblings, while last borns may build up resentment toward elders in authority that can take the form of rebelliousness. All this is rather abstract, so I must illustrate this range of alternatives by sketching a theory of political leadership.

Louis Stewart (1977) has proposed that the best birth order for a leader depends quite directly on the political zeitgeist in which that leader hopes to assume power. Altogether, there are four distinguishable types of settings for political leadership, each with a corresponding ordinal position that maximizes the development of the requisite personality traits and social expertise: Times of international crises and warfare favor the first born; when civil conflicts break out or threaten to evolve due to the utter collapse of social function, the only child comes into the forefront; a nation at peace, engaged in the quiet reconciliation of diverse interest groups, seeks a middle child as leader; and, as mentioned already, when revolutionary movements prevail, it is the last-born child whose hour has come. Rather than merely speculate, Stewart subjected his theory to empirical tests, using both United States presidents and British prime ministers—and the upshot was favorable. Most remarkable was the finding that the leading presidential candidates in any given November tend to be of the same birth order.

Not only may the consequences of various ordinal positions in the family depend on the social context, but birth-order effects are swayed by other developmental variables as well. This complexity renders the interpretation of birth-order phenomena somewhat more complicated than is desirable. As an example, Barry (1979) has examined how naming the first-born son after the father may foster more intimate father-son affiliation, which later translates into an adult more prone to identify with authority. He showed that U.S. presidents who were first-born paternal namesakes were far more likely to have been affiliated with their predecessor in some way, such as in the subordinate capacity of the vice-president. In contrast, presidents who were later-born sons having an older brother named after their father displayed a far lower probability of some special connection with the predecessor in the White House. This result ties in with the tendency of later-born sons from large families to become rebels and revolutionaries, a domain of achievement in which an absence of strong identification with authority figures may be sine qua non (Matossian & Schafer, 1977; Walberg, Rasher, & Parkerson, 1980). Needless to say, many other family variables are likely to moderate the impact of birth order besides the assignment of the given name; sex, spacing, parental dominance and preference, social norms and prejudices all contribute as well. This complexity makes it extremely troublesome to tease out precisely what is happening when family position effects emerge in a study. All that we can conclude with any confidence now is that birth order does leave an impression on a child's chances of achieving recognition as an adult.

Motivation

Cox (1926) was obliged to explain the low correlation between assessed intelligence and eventual achievement. Just as Terman learned in his complementary longitudinal inquiry (Terman & Oden, 1959), the brightest were not always the best, nor were the best invariably the brightest. Fortunately, Cox devoted a considerable amount of effort to assessing a subsample of 100 geniuses on 67 personality traits so as to discern whether factors other than intelligence contribute to adulthood success. Her conclusion was that motivation plays an essential role, "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). Early in life, future geniuses had developed a desire to excel that propelled them past all obstacles, including any relative handicap in IQ. Subsequent researchers have corroborated this inference (Walberg, Rasher, & Parkerson, 1980). In Roe's (1952) psychological examination of 64 eminent scientists, for example, a driving absorption in work characterized them all (also see Busse & Mansfield, 1984).

There is even some data suggesting that those scientists who author frequently-cited papers exhibit the "workaholic" or Type A (coronary-prone) behavior pattern that has received so much attention of late in health psychology (Matthews, Helmreich, Beane, & Lucker, 1980).

Henry Murray's (1938) Thematic Apperception Test (TAT) has inspired a sizable amount of literature on the relation between motivation and distinguished achievement in diverse endeavors. The coding schemes for projective measures have been converted into content analytical procedures that can be applied to historical documents and artifacts. The best exemplars of this research tradition can perhaps be found in David C. McClelland's (1961) *The Achieving Society*. This book's fundamental thesis is that the achievement motive provides the psychological foundation of economic prosperity. This thesis is documented exploiting an unusual range of methodologies, including experimental, cross-cultural, and transhistorical. Thus, in laboratory experiments using a ring-toss game, subjects high in the need for achievement were shown to prefer tasks having a moderate risk of success, shying away from either sure-bets or missions-impossible (McClelland, 1961, chap. 6). Moreover, cross-cultural research indicates that the socialization practice of early independence training is linked with having folk tales loaded heavily with achievement imagery (McClelland & Friedman, 1952), a cultural trait that is itself associated with economic accomplishment (McClelland, 1961, chap. 3). Finally, transhistorical analyses have shown how the ups and downs in achievement imagery are correlated with the general rise and fall in economic well-being. In many of these latter studies, the classical literature of a nation is content analyzed to measure the level of achievement motivation (e.g., Bradburn & Berlew, 1961; Cortés, 1960), though a few studies took advantage of the distinctive relation between achievement drive and preferred doodle and drawing patterns (see Aronson, 1958). The paper by DeCharms and Moeller (1962) probably provides the best illustration of how transhistorical methods were employed to test McClelland's hypothesis. The authors scrutinized the United States from 1800 to 1950, using a per capita patent index as a gauge of economic prosperity. To evaluate American achievement imagery, DeCharms and Moeller subjected the most widely read children's readers for any given period to a content analysis. As predicted, the ups and downs in achievement motivation anticipate the historical trend for the indicator of economic success, in this case, technological creativity. Comparable results hold for pre-Incan Peru, ancient Greece, medieval and early modern Spain, and England prior to the Industrial Revolution.

As often happens with pioneering research, the work of McClelland and his colleagues has provoked some disagreement and controversy, and not all researchers have fully replicated the hypothesized correlation (e.g., Finison, 1976; Frey, 1984; Mazur & Rosa, 1977). Even so, the balance of

the evidence may endorse the conclusion that economic advancement requires an exceptional achievement drive, much of which is acquired in childhood via definite educational and socialization influences. This generalization is of value to us here for two reasons. First, the economic prosperity that results from economic and technological innovations may be conducive to the development of creativity of all varieties; while wealth may not guarantee the emergence of genius, extreme poverty is certainly detrimental (Simonton, 1984d, chap. 8). Second, entrepreneurship constitutes a form of both creativity and leadership, and in its extreme form, may entail outright genius. This last point, however, suggests a gap in the literature on the achieving society: It would be most intriguing to discover if the tycoons of history featured a drive to achieve far above the norm. A content analysis of the written correspondence might establish the motivational basis of those who display entrepreneurial genius, and biographical data might root this impetus in childhood experiences.

Provocative research on the power motive also sprang from the TAT, but from the outset, the stress was on the individual achiever rather than the achieving society. The germinal work in this field is David G. Winter's (1973) *The Power Motive.* As we might imagine, a fair portion of this book is devoted to determining how the need to control or dominate others affects the impact of political leaders. The style and effectiveness of the American chief executive has received particular attention. By content analyzing inaugural addresses, the need for power has been directly linked to various aspects of presidential performance (cf. Donley & Winter, 1970). Power-driven presidents are more prone to enter the United States into a war, are less likely to reach agreements on arms limitations, tend to select cabinet members more on the basis of expertise than friendship, and display a higher probability of becoming the target of an attempted assassination (Winter & Stewart, 1977). More critical, perhaps, is the fact that an exceptional need for power is associated with an active and positive presidency (cf. Barber, 1977) and with a higher overall greatness rating in polls of professional historians (e.g., Maranell, 1970; Winter & Stewart, 1977; cf. Simonton, 1981b, 1986b). Power motivation thus appears as essential to political success as achievement motivation is to economic accomplishment (also see Wendt & Light, 1976). Curiously, while the achievement and power drives are highly correlated for American presidents (but not for the general population), the former drive turns out to have relatively little impact on political leadership. On the other hand, a third personality trait derived from the projective TAT, the need for affiliation, has been proven in more recent research to affect the odds of attaining distinction in the White House. Chief executives who desire intimate and supportive relationships with others, on the average, are more flexible and display more likelihood of negotiating arms limitation agreements, but are also

more inclined to be passive, to appoint cronies to the cabinet, to have an administration scandal, and, finally, to go down in history as second-rate leaders (Winter & Stewart, 1977). For the most part, then, achieved eminence in the Oval Office requires the development of a potent power orientation, but a weak affiliation disposition (cf. Etheredge, 1978).

From a developmental perspective, the research on the power motive suffers from one crucial drawback: Whereas the literature on the achievement motive has attempted to pinpoint developmental antecedents, the work done on the power motive has been less successful in that regard (cf. Wendt & Light, 1976; Winter, 1973). We can speculate, nonetheless, that childhood experiences and parental child-rearing practices may instill a specific motivational emphasis in a developing personality. If the achievement motive emerges supreme, the chances of adulthood achievement become highest in occupations demanding entrepreneurial and technological innovation. Should the power motive grow into the dominant force, success is most assured in the political arena.

Parental Loss

Conceivably, truly phenomenal success in adulthood requires the development of exceptional personality attributes, characteristics that depend on the occurrence of rare but powerful events in childhood. One such dramatic occasion is parental loss, especially orphanhood. And, in fact, numerous investigators have noted the uncommonly high incidence of parental loss among the eminent. If we examine those geniuses that qualified for the Cox (1926) sample, between 21 and 31% lost a parent before attaining adulthood (Albert, 1971; also see Walberg, Rasher, & Parkerson, 1980). One study of famous English and French poets found that 30% came from father-absent homes (Martindale, 1972), and another investigation of creative writers found that 55 percent lost a parent prior to becoming 15 years of age (Brown, 1968). Even if we concentrate solely on twentieth-century personalities who lived when mortality rates were lower, the frequency of orphanhood remains high. In the Goertzels' second sample, 10% lost their mothers and 18% lost their fathers before becoming adults (Goertzel, Goertzel, & Goertzel, 1978). In Roe's (1952) investigation of eminent contemporary scientists, some 15% lost a parent by death before age 10, and such loss occurred to 26% before attaining adulthood. These proportions are well above the expected incidence in the general population (see, e.g., Gregory, 1965).

By far the most systematic and exhaustive empirical treatment of this phenomenon is the essay "Parental Loss and Genius" by J. Marvin Eisenstadt (1978). He began by developing a parental loss profile for 699 eminent creators and leaders. He found that over 34% lost a parent before

their 16th year, 45% before their 21st. As many as 21% lost both parents by age 30. Eisenstadt went on to compare these rates with various available base lines. Only two special populations exhibit incidences of orphanhood that rival those of historical geniuses, namely juvenile delinquents and severely depressed (or suicidal) patients (cf. Crook & Eliot, 1980). Eisenstadt concludes that the bereavement trauma associated with the death of a parent in childhood induces a coping process that, under the proper circumstances, leads to a strong achievement orientation, and thus a high probability of adulthood distinction. In a sense, parental loss throws the child into a disequilibrium which only extraordinary effort can set aright. Failure to adapt positively to orphanhood results in a more destructive personality, sometimes turned outward (delinquency) and other times, inward (depression and suicide).

Eisenstadt's findings and speculations have implications for other facets of achievement. Dryden's line "Great wits are sure to madness near allied" expresses a long-held and widespread belief in the mental instability of genius (Becker, 1978), and parental loss may provide the etiological nexus between creativity and psychopathology, as Eisenstadt suggested. The proportion of individuals with mental pathology is above-average among famous creators, especially those in the arts. In one sample of poets, 15% had psychotic symptoms, and nearly half exhibited some signs of mental disorder (Martindale, 1972). Moreover, the type of illness favored by creative geniuses is depression and suicidal tendencies. In the Goertzels' second sample of leaders and creators, 9% suffered serious emotional difficulties, 3% attempted suicide, and 2% committed suicide (Goertzel, Goertzel, & Goertzel, 1978). We can even conjecture that an affinity exists between juvenile delinquents and some types of leaders. Certain dictators, most notably Benito Mussolini, were in fact both notorious delinquents and distinguished (albeit misguided) leaders. Of course, we do not know exactly why some persons respond constructively to bereavement, others destructively. Perhaps exceptional intelligence is mandatory to channel the elicited emotional energy in the direction of outstanding creativity or leadership. Before we can provide a complete account of this issue, however, we must first understand exactly how parental loss affects personal development. One objection that may be raised to Eisenstadt's own theoretical interpretation is that it supposes that the child immediately experiences the trauma of partial or complete orphanhood. Yet in many instances this direct impact is most improbable. To offer a dramatic case, Newton could not have been adversely (or benefically) affected by his father's death, for Isaac was a posthumous child.

Newton's development still could have been deflected by parental loss if we assume that some other mechanism mediates the effect. In particular, it is conceivable that orphanhood disrupts the usual process of a child's

identification with the same-sex parent (cf. Martindale, 1972). For example, parental death or absence may oblige the son to become more closely identified with the mother, producing an androgynous male (and an analogous consequence would occur for a daughter whose mother had died). This androgyny may then facilitate the emergence of a more creative personality (but see Harrington & Anderson, 1981). In the case of male children, moreover, the absence of a strong male role model could produce an insecure son who overcompensates by taking on the airs of an exaggerated masculinity. Goertzel and Goertzel (1962) reported a high percentage of "smothering" (dominating and possessive) mothers for poets, dictators, and military heroes. Moreover, over half of notable male poets exhibited some cross-sexual identification, displaying traits usually deemed feminine in Western culture (Martindale, 1972). Despots and conquerors might possess the same core disposition as do poets, but hide it under a cloak of extreme machismo.

This alternative explanation leads to several verifiable predictions that empirically separate it from Eisenstadt's (1978) bereavement hypothesis. It is the loss of the same-sex parent that defines the key event, no matter whether this loss occurs by death, divorce, exile, or alcoholism. But should that parent be replaced by another same-sex model, such as a grandparent or stepparent, cross-sexual identification is minimized. Also, the loss of a close sibling or other relative should be sans effect, any bereavement notwithstanding. Finally, unlike Eisenstadt's theory, the offered alternative would permit a posthumous child like Newton to experience the developmental consequences of parental loss without undergoing bereavement. From a theoretical standpoint, this rival account is more consistent with the next factor that influences the rise of genius.

Models and Mentors

Alfred Kroeber (1944), an anthropologist, took exception to the essential tenet of Galton's (1869) *Hereditary Genius*. If achieved eminence derives from intelligence, and if intelligence is a genetic gift, then Galton must explain the distinctive transhistorical fluctuations in genius. Some periods in history are marked as "Golden Ages," others as "Dark Ages." Yet it is extremely unlikely that the traits in a population gene pool fluctuate so rapidly in frequency. Indeed, if genius is defined simply as the upper crust of the general population, the percentage of geniuses must remain constant across the ages, while the absolute count should vary solely with the population size. Galton himself was cognizant of this problem, but still subscribed to a genetic explanation. The decline in Greek civilization, for instance, which occurred despite the growth in the number of Greeks, was neatly ascribed to the miscegenation that followed in the wake of Alexander

the Great's armies, diluting the genetic superiority previously enjoyed by the people of Hellas. Even if this implausible (and racist) interpretation were accepted, how can Galton's theory account for the Greek's emergence out of obscurity to the glories of Athens and Alexandria? Did the Greeks after the Dorian invasions surreptitiously implement eugenic practices to deliberately produce a "master race"? Kroeber maintained that some other mechanism must underlie the characteristic time signature in the appearance of genius. In particular, he hypothesized that genius originates in the act of emulation. Each generation strives first to equal and then to surpass the generation that preceded it, driving the culture to ever greater heights of achievement. But because all creators operate within the same given cultural "pattern," or "paradigm" (cf. Kuhn, 1970), this process eventually leads to the exhaustion of the received tradition, and thus creativity of the highest order proves ever more scanty. The Golden Age gives way to a Silver Age of bland imitatiors, which ultimately peters out into a Dark Age in which the mere avoidance of retrogression is a grand accomplishment. Kroeber quotes an obscure Roman historian Velleius Paterculus: "Genius is fostered by emulation, and it is now envy, now admiration, which enkindles imitation, and, in the nature of things, that which is cultivated with the highest zeal advances to the highest perfection; but it is difficult to continue at the point of perfection, and naturally that which cannot advance must recede" (p. 18).

This interpretation of the transhistorical clustering of genius, needless to say, complies with several prominent theoretical perspectives. Such role-modeling effects may be subsumed under social learning theory (Bandura & Walters, 1963). Even closer, perhaps, is Erikson's (1951) psychosocial theory in which an adolescent's identity is established partly on the basis of models. But whatever the theoretical framework, an ample body of research indicates the importance of role-model availability as a developmental antecedent of achieved eminence. Thus, in one large sample of famous creators and leaders, about 63% had been exposed to eminent persons very early in life (Walberg, Rasher, & Parkerson, 1980). The current author, in a series of papers extending over nearly a decade, has tried to elucidate how role models contribute to the development of exceptional achievement (Simonton, 1975b, 1976c, 1977b, 1983b, 1984a). The first inquiry took advantage of a generational time-series design (Simonton, 1984c) to discern if the number of creators in a given generation is a positive function of the supply of creators in the previous generation. If we employ 20-year periods as the analytical unit, counting the number of eminent creators in the preceding period is tantamount to tabulating the availability of role models during an individual's adolescence. A time-series analysis of over five thousand geniuses spanning 127 generations of Western civilization revealed that the count of creators at generation *g* depends on the

count at generations $g-1$ and $g-2$, or the previous two generations (Simonton, 1975b). Thus, both the parental and the grandparental generations provide useful models of creativity. Another study of 342 hereditary monarchs showed that a parallel result holds for achieved eminence as a political leader (Simonton, 1983b). The distinction attained by a monarch was positively associated with that achieved by his or her parent and grandparent in the same royal position. Significantly, the transfer of leader expertise across generations requires role models of the same sex. A king's achievement is dependent on his father's accomplishments; a queen's, far less so. The superior efficacy of same-sex versus cross-sex models holds for creative development as well (Goldstein, 1979).

Given that the growth of personal achievement potential is tied to the prior two generations, the timewise distribution of genius is governed by a second-order autoregressive dynamic model (Simonton, 1975b). Accordingly, geniuses will necessarily cluster into the configurations that Kroeber (1944) so fully documented (Simonton, 1981a). Nonetheless, role-model availability is not invariably beneficial to the emergence of genius. While the emulation of distinguished predecessors is certainly advantageous, the impact of such models can be negative if it elicits mere imitation. Geniuses must learn to rise above their models. This adverse consequence has been well documented, too. One analysis of 2,012 Western philosophers discovered that even if thinkers do not emerge in an intellectual vacuum, the truly phenomenal philosophers tend to develop in a relative dry phase in the history of ideas (Simonton, 1976c). With too many thinkers, too many schools, the developing mind may be more likely to align with a particular school or master than to break new ground. Another example comes from an investigation into the differential eminence of 696 classical composers (Simonton, 1977b). The more role models were available during childhood and adolescence, the more prococity a composer was likely to display, and creative precocity is positively related to total lifetime productivity and hence, final eminence. At the same time, the abundance of potential models exerted a negative direct effect on productivity as well, a consequence that may reflect a detriment due to excessive imitation. The most successful composers begin by imitating their models, but quickly advance to emulation, advancing beyond rather than echoing their predecessors (Simonton, 1980d).

A study of 772 painters and sculptors divulged something of the complexity of this interplay between imitation and emulation (Simonton, 1984a). The differential eminence attained by these artists, who spanned from the Renaissance to the twentieth century, was related to potential role models in preceding generations. One finding was that those artists who actually served an apprenticeship under an eminent master had higher odds of achieving success. A similar positive association evidently holds

for scientists (cf. Zuckerman, 1977). Yet those who had more than one distinguished master were better off in ultimate acclaim than those who had merely one. Obviously, though one mentor can contribute to creative development, a student's potential may be stymied insofar as imitation alone is instilled in the would-be genius. The real asset of working under more than one master is that it becomes much harder to slide into mere imitation. On the contrary, an apprentice under more than one master will be under more urging to somehow synthesize the diversity of aesthetic values and techniques, and thereby oblige the young artist to rise above his or her mentors.

Another result of this study has even more provocative implications. Each artist in the sample may have claimed one or more "paragons," that is, notable predecessors who command admiration, and are seen as setting high standards of aesthetic excellence. Not only may we count the number of asserted paragons, but additionally we can measure the age gap between those paragons and the developing artist. Some artists admire predecessors who are "old masters," whereas other artists model themselves after predecessors who are near contemporaries. We accordingly have two gauges of paragon impact; the raw count and the average age gap. These two factors contribute to eventual artistic achievement in a complex fashion. To begin with, the connection between eminence and the artist-paragon age gap is described by a curvilinear, "inverted-U" function, indicating the existence of an optimal age difference between artist and paragon. Painters and sculptors who admired predecessors too proximate or too distant in history were less successful than those who chose as paragons predecessors at a more moderate separation. This nonmonotonic function suggests that the best models are neither too similar (for that would encourage straightforward imitation) nor too dissimilar (for that would offer little in the way of relevant guidelines for creativity). This suggestion is supported by the additional fact that the optimal artist-paragon gap is not constant, but rather depends directly on the number of paragons that an artist holds dear: The more paragons, the shorter the most advantageous time interval. An artist who admires but one predecessor is in manifest danger of succumbing to imitation, and therefore, that paragon must be much farther away in historical time, inserting dissimilarities that weaken the temptation. With the addition of more paragons, the threat of imitation diminishes, just as happens for masters, and hence the age gap can decrease for optimal effect. It is intriguing that the curvilinear function actually vanishes for artists who look up to only one paragon; in that case, the function becomes strictly linear, meaning that the bigger the historical separation, the better the prospects for creative development. The cost of imitation overrides any advantage that might accrue from historical proximity.

This analysis of 772 artists arrived at two additional conclusions that are worthy of notice. First, when determining the availability of role models, attention should focus on predecessors who belong to the same cultural tradition as the developing artist. While young creators can and do model themselves after previous masters in other nations, less benefit arises from doing so. Indeed, talented artists who grow up when other nations dominate the aesthetic scene are less prone to reach the heights of success as mature creators (cf. Simonton, 1977b). Second, for those artists whose parents were themselves famous artists, the transfer of success from one generation to the next is also contingent on the parent-child age gap. The optimum age hiatus is about 20 years, after which the positive association between parent's and child's eminence declines and even turns negative (making, in fact, the overall correlation negative). This finding implies that artistic parents provide the best models when they are near their peak productive age, this high point in creative output occurring around the 40th year (Simonton, 1975a, 1977a, 1980c, 1980d, 1984b). Parents past their prime can actually hamper the creative growth of their artistically-inclined children. Curiously, there is evidence that the same constraints hold for mentors generally; at least in the sciences (Simonton, 1984d). Scientists who are at the peak age of around forty also tend to be at their best as mentors for future notable reseachers (cf. Zuckerman, 1977).

It goes without saying that considerably more research is required before we can completely understand the repercussions of models and mentors for development. Nevertheless, we do know that admiration is a powerful force in the emergence of an achievement-oriented personality, albeit the consequences can just as well prove detrimental as advantageous. Predecessors must be emulated and surpassed, not just imitated; models must serve as stepping stones, not stumbling blocks, to creative advancement. A parallel ambivalence has been found for the closely related process of education, as we witness next.

Formal Education

Albert Einstein acquired an extreme distaste for formal education. From primary school through college, he was never a steady student, and his adulthood complaints have provided some familiar quotes condemning the instructional enterprise: "One had to cram all this stuff into one's mind for the examinations, whether one liked it or not. This coercion had such a deterring effect on me that, after I passed the final examination, I found the consideration of any scientific problems distasteful to me for an entire year" (quoted in Hoffman, 1972, p. 31). In more general terms, "It is, in fact, nothing short of a miracle that the modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry; for this delicate

little plant, aside from stimulation, stands mostly in need of freedom; without this it goes to wreck and ruin without fail. It is a very grave mistake to think that the enjoyment of seeing and searching can be promoted by means of coercion and a sense of duty" (quoted in Schlipp, 1951, p. 17). But does the empirical literature second Einstein's criticisms? Actually, this question can be usefully subdivided into two independent parts. First, is achievement as an adult correlated with being a high quality student in childhood and adolescence? Second, does increasing formal education raise or lower the odds of attaining exceptional success as an adult?

Concerning the first issue, a cornucopia of research on contemporary subject pools suggests that academic prowess, gauged by either grades or scholastic honors, is not necessarily correlated with extracurricular accomplishments in activities requiring creativity or leadership (e.g., Baird, 1968; Bednar & Parker, 1965; MacKinnon, 1960; Richards, Holland, & Lutz, 1967). Except where special programs are available for gifted children, the typical school system may be ill-equipped to handle budding geniuses, and in some ways, may discourage a genius from attaining scholastic success (e.g., Bently, 1966; Getzels & Jackson, 1962; Hasan & Butcher, 1966). Comparable results obtain when we look at historical populations of eminent personalities. In the Goertzels' samples, for instance, some 60% shared Einstein's dislike of schools and school teachers, secondary school provoking the most dissatisfaction (Goertzel & Goertzel, 1962; Goertzel, Goertzel, & Goertzel, 1978). While 20% attained academic honors of some kind, 8% failed in school (Goertzel, Goertzel, & Goertzel, 1978). Hudson (1958) scrutinized the undergraduate records of scientists who became Fellows of the Royal Society, and found them to be undistinguished scholars. Thus, the data imply that exceptional proficiency as a student is by no means a requirement for adulthood achievement. At the same time, no cause exists for concluding that high scholastic honors doom one to a life of obscurity. The correlation between honors and achieved eminence is simply zero, not negative. Furthermore, the relevance of being an excellent student varies according to the field of endeavor in which the individual seeks renown (cf. Hudson, 1966). Future scientists, as an example, are more favorably disposed toward school, and accordingly tend to perform better in classes, in comparison to those gifted children and adolescents whose hearts are bent on the arts or humanities (e.g., Goertzel, Goertzel, & Goertzel, 1978; Schaefer & Anastasi, 1968). Hence, a blanket condemnation of educational kudos hardly seems in order.

On the other hand, there is some justification, apropos of the second issue, for believing that too much formal education can prove detrimental to adulthood success. In the Goertzels collection of 300 eminent twentieth-century creators and leaders, 15% had an 8th grade education or less; 11%, some high school; 23%, a high school diploma; 4%, some college; 19%,

a college degree; 4%, some graduate work; and 19%, a graduate degree (Goertzel, Goertzel, & Goertzel, 1978). Those with higher degrees are outnumbered by dropouts from primary and secondary education! Einstein himself may have earned a Ph.D., but he did so only by sending a lesser paper to a university for consideration as a doctoral dissertation, and thus received a degree by correspondence, while working full time as a Swiss patent official. However, to precisely assess the association between formal educational level and achievement we must estimate the functional relation between these two variables. This estimation has been carried out in three separate studies, using distinct subject pools and variable operationalizations, yet converging on the same generalization (Simonton, 1983a, 1984d, chap. 4).

The first inquiry exploited the data that Cox (1926) had published on her 301 geniuses (Simonton, 1976a). This sample was subdivided into 109 leaders and 192 creators, and for each subsample, a curve was determined relating achieved eminence to the highest attained level of formal education. For the eminent leaders, the curve was strictly linear, and negative, indicating that formal education is inversely proportional to achieving eminence in leadership positions. The creative geniuses in her sample, in contrast, exhibited a curvilinear, roughly inverted-U function; increases in educational level first brought increases in creative potential, up to a certain peak, after which increasing formal education served only to decrease eminence as a creator. The turning point occurred somewhere in the final two years of undergraduate education. The specialization that attends selecting a "major" and pursuing a profession may not encourage the emergence of genius.

The second study adopted an entirely different approach (Simonton, 1981b). Rather than scrutinize all varieties of genius, solely political leaders were examined, and then just past presidents of the United States. Furthermore, the independent variable, formal education, was operationalized in another fashion, with a larger set of potential control variables introduced into the equation. The most significant change, however, concerned the dependent variable, for here Maranell's (1970) ratings were used to derive a measure of presidential dogmatism (i.e., idealistic inflexibility versus pragmatic flexibility). Because dogmatism has been consistently shown to be negatively correlated with creativity (Simonton, 1983a), we might expect that the function found in the first study would be inverted. Just such a mirror image is found: As formal education increases, dogmatism declines down to a minimum, beyond which additional formal education serves only to raise dogmatism. The optimum for reducing the idealistic-inflexibility displayed decades later in the White House is somewhere in the last two years of college.

One asset of this second investigation is that the mean birth year of the

subjects is about a century more recent than holds for the Cox geniuses, permitting us more confidence that the observed relation is transhistorically invariant. The third investigation reinforces this invariance still further, for this time the Goertzels' second sample was exploited, consisting of over 300 eminent creators and leaders all of whom established their reputations in this century (Simonton, 1984d, chap. 4). As in the first study, the dependent measure was again achieved eminence, though a more fine-grained indicator of educational attainment was devised. With only minor qualifications, the results replicated earlier findings. For those creators who achieved fame in either the arts (e.g., poetry, fiction, painting, sculpture, music, etc.) or the humanities (e.g., philosophy, history, etc.), a curvilinear inverted-U function was discovered, with the high point appearing once more in the last two years of undergraduate education. Yet for scientists, the optimal level of formal education has shifted upward to some graduate training, and the downturn occasioned by earning a graduate degree is comparatively minor. Moreover, the distinction achieved by twentieth-century leaders, unlike their predecessors in the Cox sample, is positively related to formal educational level, and in a linear manner. Governing a modern nation may demand more knowledge and sophistication than was the case in centuries past.

The main conclusions to be drawn from the above research are twofold: One, scholastic success per se is unrelated to adulthood achievement; two, creativity in the majority of endeavors is connected to educational level by an inverted–U curve with a peak in the last half of college (except in the sciences, where the peak is about four years later). This last function replicated across three investigations employing subjects spanning from the Renaissance to the present day, and thus enjoys noteworthy transhistorical invariance. But how can these results be interpeted? One possibility is to maintain that beyond a certain point, formal education works against creative development. In childhood and adolescence, education probably provides the requisite variety of knowledge and skills for notable accomplishment in any domain, but in the latter part of undergraduate education, as students enter early adulthood, such broad exposure may give way to an excessive specialization that is not conducive to exceptional success later in life (cf. Barnett, 1953; Koestler, 1964). A growing awareness of having to earn a living may also replace the intrinsic motivation so essential for creativity with a preoccupation with extrinsic rewards (cf. Amabile, 1983). Alternatively, we can suggest that the potential genius assumes an active role in deciding how much formal education contributes to personal creative development. Truly innovative minds may discover much earlier that formal education becomes simply irrelevant to their ambitions. So they then simply drop out when the impertinence of academic requirements becomes too irritating or boring. Presumably the emerging

genius would devote the extra time to self-education, pursuing subjects that dovetail more closely with personal fascinations and enthusiasms than can any arbitrary academic curriculum. Creative potential is in fact associated with a rich involvement in diverse activities, such as hobbies and voracious reading (Goertzel, Goertzel, & Goertzel, 1978; Schaefer & Anastasi, 1968; Simonton, 1984d, chap. 4).

Whatever the final interpretation, a comprehensive account of the role of education in producing genius-gauge achievers will likely have to incorporate several key factors (Simonton, 1984d, chap. 4). For one thing, the native intellectual power of the potential genius is probably crucial. The higher a student's intelligence, the faster information can be processed, providing more opportunities for developing extracurricular interests that contribute to eventual success. Exceedingly gifted pupils may have the wherewithal to earn high honors in school and college without sacrificing outside activities essential to creative growth. Nonetheless, even the brightest must face one discomfitting fact: The higher one goes in the educational system, the more demanding the academic requirements. Not only do the courses become increasingly more rigourous and sophisticated, but the competition from fellow students grows as the less able are weeded out and as the reality of forthcoming adulthood responsibilities settles in. Thus, a brilliant pupil who earned top grades in high school with ample time left over for additional intellectual pursuits may feel far more cramped in college. Under such pressure, a pupil with finite intellectual resources may have to choose whether to focus exclusively on school work so as to maintain a honorable scholastic performance or to forfeit the quest of academic excellence in order to nourish outside interests. The consequence of this choice depends on the student's aspirations. If the talents reside in the arts, for example, then becoming a college dropout will have scant repercussions, for then academics feature less positive value. Should the goal be that of becoming a Nobel laureate in physics, chemistry, or physiology, scholastic persistence is more beneficial, for academic training corresponds more directly with the acquisition of the information and techniques needed by any contributing scientist. Nevertheless, even in science, the trade-offs between formal instruction and self-education depend on the scope of one's plans. Should one wish to revolutionize the scientific enterprise, then leaving education sooner may be the wiser move, for no advantage accrues from total immersion in the prevalent paradigm. Yet should the desire be more modest, to advance science within the confines of a given paradigm, then that paradigm must be mastered, a mastery that is best acquired through extensive training under established advocates. Needless to say, to opt for the revolutionary route is to gamble at high risk; while in all likelihood, revolutionaries score more points with posterity than do practitioners of what Kuhn (1970) once styled "normal science," the scientific

zeitgeist must be ripe and ready for a paradigmatic shift. Again using Kuhnian terminology, sufficient anomalies in the existing framework must have accumulated so that the groundwork is laid for a new synthesis. To attempt a scientific revolution out of step with the times is to consign oneself to becoming, at best, a mere precursor or anticipator, a status perhaps rather below that of a paradigmatic advancer.

Even though a complete theory incorporating the above factors remains to be elaborated and tested, the empirical data are clear on one central point: There is no reason to doubt the worth of formal education for creative development so long as we limit attention to childhood and adolescence. All historiometric inquiries concur that any turnabout takes place when the developing genius is in his or her early twenties, assuming college entrance in the late teens. At least as concerns the production of the highest-caliber creators, primary and secondary school teachers can rejoice that they apparently make a positive contribution to growth, and even college professors are providing some additional impetus in lower-division courses. It is only instruction in the upper-division, graduate, and professional courses where some questions are raised, and then not in all fields and in every historical circumstance. Only when the proper moment has come can an ill-educated mind like Einstein's make a loud splash in the annals of history.

Zeitgeist

Creativity and leadership do not occur in isolation from the sociocultural milieu in which the genius acts. Achieved eminence is in part a group phenomenon, the individual serving as an agent for the "spirit of the times," or, to exploit the German term, the "zeitgeist" (Boring, 1963). The occurrence of scientific multiples—where two or more scientists arrive at the same discovery independently and often stimultaneously—has frequently been cited as proof that prevailing scientific traditions decide when the proper moment has come for a particular contribution (e.g., Merton, 1961; Ogburn & Thomas, 1922; but see also Simonton, 1978b, 1979, 1987). The political setting is not without import either, even in the exercise of creativity. War, for instance, has a definite detrimental consequence for scientific and technological innovation (Simonton, 1980b). But these are all instances of external factors affecting the adult who strives to attain distinction. For the purposes of the present review, it is even more significant that social, cultural, and political events impinge on the early development of a potential genius, shaping the course of maturation. The developmental function of the zeitgeist has been amply documented for creative endeavors in particular (see, e.g., Simonton, 1978a, 1984d). May a handful of ex-

amples suffice here to illustrate the diverse ways creative development is marked by the greater sociocultural world.

To begin with, the creative genius appears to be nurtured by political fragmentation, or the existence of a large number of sovereign nations in a civilization area. This effect has been shown to hold across four world civilizations (Naroll, Benjamin, Fohl, Fried, Hildreth, & Schaefer, 1971) and from the Ancient Greeks to modern times (Simonton, 1975b). Conversely, creative development is stifled by the presence of massive empire states. Evidently, all-encompassing empires tend to suppress cultural diversity in the quest for a homogeneous population most conducive to imperial stability (cf. Simonton, 1976b). As a result, nationalistic revolts against imperialistic rule contribute to growth of creative individuals (Simonton, 1975b). A disproportionate number of creative geniuses spring forth about a generation after such violent insistance on cultural uniqueness and hence diversity. Not all acts of political violence, nonetheless, facilitate the emergence of genius, for a negative repercussion has been observed for political instability, when the ruling elite of a nation succumbs to anarchy (Simonton, 1975b, 1976c). Military revolts, political assassinations, coups d'etat, and dynastic conflicts exemplify how governments may descend into chaos. Whatever the specifics, political instability decidedly inhibits creative development, especially of future scientists, philosophers, literary figures, and composers. The prospective genius needs to develop a sense that the world is an orderly place in which people can enjoy some personal control over their fates—a faith explosively undermined when the adulthood world is tossed about by utterly capricious, even cruel events.

This last example implies that the zeitgeist may affect not just the quantity of creativity, but the quality or content of that creativity as well. In childhood and adolescence, individuals are evolving a worldview, a set of beliefs and preferences that will guide the course of adulthood. Thus the milieu in which development occurs may determine the direction and disposition of adulthood achievement. Research has in fact demonstrated that political events taking place during the developmental period influence the ideological stance assumed by those creators who pursue a career in philosophy (Simonton, 1976d). Thinkers who grew up in times of political fragmentation, for example, tend to advocate such philosophical positions as empiricism, skepticism, materialism, nominalism, individualism, and hedonistic or utilitarian ethics. More fascinating is what happens to those creative intellects whose childhood and adolescence took place in the context of civil disturbances; these thinkers tend to adopt highly polarized beliefs on all major philosophical questions. Hence, one generation after a surfeit of revolts, rebellions, or riots, we witness an upsurge of both empiricists and rationalists, skeptics and fideists, materialists and idealists,

individualists and statists, determinists and proponents of free will, hedonists and ethical absolutists. It is as if the political conflict in one generation translates into ideological controversy in the next; yesteryear's contending political leaders inspire tomorrow's contending schools.

So, the political zeitgeist touches the philosophical zeitgeist after a generational delay, yet it is equally true that the ideas of one generation build upon or react to the ideas of the preceding generations. Earlier we discussed the impact of role models, and certainly such models can affect the content of achievement as well as its magnitude. Generational analysis of the history of ideas in Western civilization has indeed demonstrated that: (a) certain ideas tend to stimulate the emergence of extending ideas, as when a large crop of empiricists in generation g elicits a bumper crop of skeptics in generation $g+1$; (b) other ideas tend to provoke a reaction in the next generation, as when skeptics are followed by fideists (i.e., those who argue for blind faith); and (c) yet other ideas cause thought in the subsequent generation to polarize, as when both skeptics and fideists, clear opponents, emerge as a generational response to an earlier surge in empiricists, materialists, determinists, individualists, and hedonists (Simonton, 1978c).

The foregoing examples represent only a sampling, but they do serve to indicate how the development of genius is pushed and pulled by forces that originate well beyond the boundaries of home and school. Any genius is deeply rooted in the zeitgeist, whether political or cultural, which ultimately influences both the size and nature of achievement.

THEORETICAL INTERPRETATIONS

How can the above empirical findings be interpreted? Is there a common thread that links these facts into a unified picture of how genius emerges from youth to maturity? In discussing this issue, we are compelled to echo a debate that has permeated developmental psychology, indeed all of psychology, almost from its inception, namely, the nature-nurture problem. The two standard interpretations of the emergence of genius are, one, that achieved eminence is an upshot of environmental circumstances that nourish the development of potential creativity or leadership; and two, that phenomenal adulthood success can be best ascribed to superior genetic endowment. Let us examine each of these positions to see how well they can marshall pertinent data in support.

Environmental Effects

The environment can make two principal contributions to the development of creativity or leadership potential. First, and perhaps foremost,

the setting in which the child and adolescent grows may stimulate or encumber intellectual development. We have repeatedly mentioned that intelligence is a prerequisite for achievement, and it is clear that many of the developmental antecedents of achieved eminence entail exposure to manifest intellect-nurturing stimuli. For example, one study of the childhoods of historical figures found that the overwhelming majority were exposed to numerous adults early on, had a rich store of cultural stimuli available, and were allowed to freely explore these enriched surroundings (Walberg, Rasher, & Parkerson, 1980). Studies of contemporary gifted children reveal a comparable presence of a stimulating environment (e.g., Schaefer & Anastasi, 1968). The Zajonc (1976) confluence model illustrates yet another way that the developmental milieu might participate in the growth of exceptional intelligence.

Actually, the most critical function of the environment may not be to boost intellectual power per se, but rather to nourish the emergence of a special style of thinking that is most conducive to innovative behavior as an adult. The creative process evidently involves the ability to see overlap between widely separated ideas (Bartlett, 1958), or to "biosociate" hitherto disparate concepts (Koestler, 1964), and this ability depends on the capacity to generate "remote associations" (Mednick, 1962) or in some other manner exhibit "divergent" thinking (for theoretical framework, see Simonton, 1980a). Thus, many of the early developmental experiences that contribute to achieved distinction later in life may do so primarily via their impact on the growth of this particular cognitive style. No doubt many of these experiences—such as parental loss or disrupted education—would operate to undermine the inculcation of extremely convergent thinking habits. Individuals who grew up in more conventional settings, even if highly gifted in psychometric IQ scores, may fail to evolve the capacity for divergent thinking that feeds the creative process later in life.

The second environmental effect may be motivational. We have observed that intellectual prowess alone does not suffice to push a gifted child on the road to adulthood success. The potential genius must equally possess the drive, the will to convert potential to actual accomplishment. This internal impetus may presuppose a specific set of developmental antecedents. Hence, the achievement motive may depend on early independence training and exposure to narratives replete in achievement imagery (McClelland, 1961); orphanhood might induce a bereavement syndrome that supports the emergence of a compensatory drive to earn acclaim (Eisenstadt, 1978); or access to paragons could provoke an admiration that propels a quest to imitate, emulate, and surpass inspiring predecessors (Kroeber, 1944; Simonton 1984a)—just to cite a few cases where motivation may ensue from early developmental experiences. On a broader theoretical level, we can mention the extensive work of Amabile (1983)

on the social psychology of creativity, especially the repercussions of external rewards and evaluations on intrinsic motivation. If we accept her argument that achievement must be intrinsically motivated to prove successful, and if it is true that extrinsic motivation can be strengthened at the expense of intrinsic motivation through the application of social and material reinforcers, then some of the findings reviewed above might be interpreted as illustrations of how intrinsic drives can become enhanced or inhibited. The most obvious example is education; the institution of a formal grading system predicated on examinations is well designed, inadvertently or not, to weaken intrinsic interest in intellectual activities, just as Einstein protested in the quotes given earlier in this essay.

It must be emphasized that the two environmental effects just outlined are not mutually exclusive. If the environmental position is justified, then there is no reason why we cannot suppose that events and circumstances in childhood and adolescence contribute to both intellectual and motivational development. Indeed, some early experiences may nurture cognitive and affective growth simultaneously. Being a first born child or admiring a mentor may evoke developmental processes that can enlarge both the intellectual apparatus and the urgency to apply that apparatus. At the same time, other experiences may encourage beneficial growth in one direction while discouraging parallel growth in the other direction. For example, education may in some ways augment intellectual strengths, but concomitantly vitiate the necessary motivational basis for the exploitation of those strengths. Indeed, the curvilinear inverted-U relation between formal education and achievement may in part reflect the fact that beyond a specified point, formal training begins to do more harm than good, destroying intrinsic curiosity without a sufficient compensatory nurturing of intellect.

Genetic Effects

American psychology, as is well known, has a strong environmental bias, a bias betrayed in the preeminence of learning theory and behaviorism for so much of its history. The nurture position is rather democratic, for any inequalities in human beings can be easily remedied by a judicious manipulation of the environment. This view is quite optimistic as well: Do we need more talented creators and leaders? Well, change child-rearing practices, restructure the school system, and all will be rectified! If we know enough and can apply what we know with enough diligence and dedication, almost any parent can share the joys of having a gifted child. This environmental optimism is a far cry from what Galton (1869) maintained from his stalwart genetic stance. While it is true that even the most deprived childhood could not keep a genius down, in Galton's eyes, it is equally true that no amount of remedial intervention could improve the lot of the

overwhelming majority of sub-superior minds. The sole hope is that a comprehensive program of eugenics might be implemented to improve the gene pool over the long haul. It is ironic that Galton, the founder of eugenics, should have himself sired no progeny.

However repugnant the genetic theory of genius sounds to modern ears, nature has been making something of a comeback in recent years. The advent of sociobiology may have gotten this movement going full steam, but whatever the source of inspiration, it is evident that an increasing number of psychologists are willing to grant genetic endowment ever more say in the construction of human personality. Within developmental psychology, one of the most outspoken champions of a nature position is Sandra Scarr, albeit her theory is far less simplistic than Galton's (see Scarr & McCartney, 1983). She has argued that the environment does not affect personal development so much as the individual's genotype affects the environment. The environment accordingly becomes an effect rather than a cause of development, the actual cause originating in the genes. The genotype impinges upon the environment in three ways. First, parents, who bear an obvious genetic relation to their offspring, determine the environments in which their children grow, due to genetically provided parental preferences. This effect is passive, for the developing child is not immediately engaged in designing the environment. Second comes the evocative route, when a child with a given genotype elicits responses from others which then become part of the child's environment, without necessarily affecting the child in any way. The last approach is active: The child may, on the basis of his or her genotypic predisposition, deliberately select the environment in which he or she lives. Genes may determine interests, even values, which then guide the child's structuring of the external world, insofar as the child has some control. Whether passive, evocative, or active, it is the genotype that decides the environment, so that the environment is reduced to a virtual epiphenomenon. As a consequence, Scarr believes, like Galton before her, that the environment has little to say in personality development. Correlations observed between environmental and psychological variables are largely if not entirely due to their common dependence on the genotype, and thus are inherently spurious. Research on personality resemblances as a function of genetic relation appear to support this claim, especially when identical twins raised apart seem more similar than adoptive children raised in the same family (cf. Scarr, Webber, Weinberg, & Wittig, 1981).

Scarr's theory is provocative, especially when, as an intellectual exercise, we reinterpret many of the so-called developmental antecedents as mere exemplars of genotype-environment effects. For instance, parents well-gifted with native intelligence may (a) construct home environments rich in intellectual and cultural stimuli, such as books, art, and mentally chal-

lenging hobbies, and (b) have children of comparable brilliance, thereby yielding a spurious relation between an environmental variable and a developmental outcome (cf. Goertzel, Goertzel, & Goertzel, 1978; Schaefer & Anastasi, 1968). Moreover, truly gifted children may evoke responses from parents, teachers, and others that lead to the child having a "special family position" (cf. Albert, 1980) and becoming the protégé of distinguished mentors (cf. Zuckerman, 1977). Lastly, a genuine genius may consciously modify the world about him or her so as to make it comply more intimately with his or her genetically-provided disposition: The gifted may seek out models and mentors, for instance, and, as speculated earlier, decide on the proper level of formal education most germane to personal development. Hence, someone may have attained distinction not because they admired an eminent master early in life, but rather that very admiration is a quality that distinguishes potential genius. Even some supposed developmental antecedents that do not seem immediately to fit Scarr's model might be squeezed and stretched until they do. Parental loss provides an excellent case in point, for this "cause" might actually represent a genotype–environment effect of the passive kind. Parents carrying the genes that make for successful offspring might be disposed to die earlier (e.g., they possess and pass down a dangerous risk-taking inclination), or such parents might put off having children until later in life and thus die earlier in their children's lives (e.g., they have and hand down an ambitious orientation that places career before family).

Another asset of Scarr's theory of genotype-environment effects is that it helps explain why two siblings, though from the same family, may nonetheless exhibit rather distinct career paths in adulthood. A specific constellation of traits may be required for success in any endeavor, such as high intelligence, a divergent thinking style, and motivational persistence (cf. Bachtold, 1980). In addition, any given endeavor requiring creativity or leadership probably demands a subsidiary set of helpful traits (cf. Simonton, 1986a). The personality that makes a proficient scientist, for instance, may not make an accomplished artist (cf. Hudson, 1966). So let us suppose that dozens of character traits are required, each dependent on its own cluster of genes. Then if each child represents a random draw from the parental pool of genetically determined attributes, only in rare instances would the genotypes even be close, except in cases of identical twins. Consequently, one child may have the configuration of traits most appropriate for a scientist, another the cluster that brings success in the arts, while yet another child is predisposed to enter politics, the last child being perhaps content to become a mindless ditch digger. Each child will start off with similar family surroundings due to the passive genotype–environment effect, but as time goes on, each will evoke different responses

from others and actively seek out stimuli most compatible with his or her genotypic disposition.

Although Scarr's theory successfully explicates many key results, its explanatory utility is limited. Often it is awkward to recast an empirical relation as a genotype-environment effect—the parental loss effect defining one evident instance—and many times a genetic account, no matter how sophisticated, proves untenable. In fact, the objection that Kroeber (1944) raised against Galton's (1869) nature-position can just as well be thrown at Scarr's model: The fluctuations of genius in transhistorical time series cannot be plausibly discounted as random sampling variation from a stable gene pool, nor can the ups and downs be ascribed to shifts in the population due to selection pressures of marriage practices. Rather, the changes in the emergence of historical genius appear most readily explicable in terms of the impact of specific social, cultural, and political conditions on the development and realization of creativity and leadership. A child or adolescent disinclined to achieve does not chose a milieu plagued by political instability, no more than a youth with extraordinary achievement potential can acquire distinguished mentors when none are available. As a consequence, even if it holds that the genotype can actively shape the environment, it is equally just to assert that in many instances, the environment is an agent that affects how the genotype is actualized in historically significant behavior. One might have the right combination of traits that make for a scientific revolutionary, yet if the zeitgeist has not generated all the elements necessary for a grand synthesis, that would-be revolutionary may turn out no more than a crank.

From a completely predictive standpoint, the nature-nurture debate need not be resolved in order for the empirical findings reviewed here to have some value. If the environmental viewpoint is primarily correct, then the diverse events and circumstances that stem from familial, educational, and sociocultural settings represent outright developmental antecedents, that is, variables that affect, in the causal sense, the probability of genius emerging. On the other hand, should the genetic hypothesis capture the larger chunk of the phenomenon, the various facts convert to mere clues that allow us to predict whether a youth can claim exceptional genetic potential. To offer one illustration, whether outstanding mentors directly contribute to creative development or youths with high innate creative potential select distinguished mentors in the active construction of a compatible environment, the mentors remain signs that we have a gifted child or adolescent before us. The mentorship serves as a predictor independent of the theoretical interpretation even if the prediction is buttressed by causal determination solely in the environmental perspective. Only when the goal is to exploit our knowledge so as to control, not just identify the appearance

of genius does the proper explanation assume paramount importance. Should we advocate eugenic programs or educational reforms? Is it better to implement genetic counseling rather than instruct parents on optimal socialization techniques? Answers to these questions do mandate solution of the nature-nurture controversy, but such a solution remains far distant from our grasp.

CONCLUSION

Let us operate on the assumption that achieved eminence results from a combination of genetic and environmental factors. Biological inheritance may provide the baseline for intelligence and drive, while the environment shapes these givens into specific cognitive and motivational dispositions. An important question is how these diverse factors are integrated into the ultimate product; an exceptional creator or leader. To respond properly to this question, we must recognize a peculiar feature of adulthood achievement, namely that the distribution is highly skewed. In any given endeavor, a small proportion of the achievers account for a disproportionate amount of the total output. Wayne Dennis (1955), for instance, surveying the distribution of productivity in seven domains, found that fully half of all creative work tended to be contributed by a mere 10 percent of the workers; over 60% of the contributors made but one contribution each, whereas the single most prolific creator generated almost 10% of the total and is 57 times more productive than the least productive creators in the discipline (also see Dennis, 1954c). And these statistics understate the degree of elitism in achievement, for only those members of a profession who contributed at least one item are even counted, when utterly silent members may constitute the plurality.

Lotka (1926) and Price (1963) have put forth formal principles that describe the magnitude of productive elitism; though these principles were announced with respect to scientific creativity, they apply to any area of achievement, including leadership (Simonton, 1984d, chap. 5). According to Lotka's law, the number of researchers publishing no more or less than n papers is inversely proportional to n^2, a functional relation quite similar to Pareto's law of income distribution in which personal earnings are inversely proportional to $n^{1.5}$ (Price, 1963). Price's law is compatible with Lotka's (Allison, Price, Griffith, Moravcsik, & Stewart, 1976), but expresses the same idea more simply: Half of all scientific contributions are published by the square root of the total number of scientific contributors. For instance, if there are just 100 scientists in a given field, a mere 10 will be responsible for 50% of all productivity. To offer a more concrete application of this principle, 250 classical composers have created works that

are an active part of the repertoire, so Price's law would predict that 15.8 should account for half of the music performed—a prediction that corresponds well with the actual size of these elite 16 (Moles, 1968).

Because people are at times wary (or envious) of unusual productivity, thinking that it has either little or even a negative connection with actual impact (e.g., Rubin, 1978), it requires emphasis that the distribution for total productivity is identical to that for creative output. Those individuals who produce more works altogether tend to be precisely those who create the most highly acclaimed "masterworks" (see, e.g., Dennis, 1954a; Helmreich, Spence, Beane, Lucker, & Matthews, 1980; Rushton & Endler, 1979; Simonton, 1984d, chap. 5). To be sure, there are "perfectionists" who confine themselves to creating a handful of exquisite gems, just as there are indeed "mass producers" who spew forth volumes of worthless material, but these people mark the exceptions. Typically, the participants in any endeavor fall on the continuum linking, at one pole, the "silent" who generate very little, and none of that of value, so as to project virtually zero professional visibility, and, at the other pole, the "prolific" who produce a large supply of worthy contributions boasting a high impact value. In fact, the link between quality and quantity appears best delineated by what I have styled the "constant probability of success" model (Simonton, 1984d, chap. 5; cf. Dennis, 1954a). The ratio of hits to misses stays relatively constant across individuals so that the most eminent creators conceive more inferior works in the process of conceiving more superior works. So quality, or "creativity," is a sheer probabilistic function of quantity, or plain "productivity." Generate more ideas and the odds increase that some of those ideas will withstand tests of truth or beauty. Besides holding cross-sectionally, this model equally holds longitudinally, within creative careers (Simonton, 1977a, 1985b). Those periods in which a creative person produces the most total works tend to be the same as those in which the most notable creations appear. Moreover, this model seems to apply to leadership activities just as well (Simonton, 1984d, chap. 5). Hence, in many respects, it does not matter whether we are speaking of quantity or quality when trying to explicate the conspicuous elitism of the empirical distribution.

Now there are three ways that achieving individuals might yield an impressive lifetime volume of contributions, however defined. First, achievers can exhibit productive precocity, that is, they can begin their careers at uncommon ages. Second, achievers can display productive longevity, extending their careers until quite late in life. Third, achievers can display high productivity rates per unit of time. Even though precocity, longevity, and productivity rate are all mathematically independent components of the final score, the empirical data in fact show that these attributes are highly correlated (Dennis, 1954b; Simonton, 1977b; Zuckerman, 1977).

The most productive creators begin their careers early, and their careers rather late, and maintain high average rates of output throughout their careers. I have proposed an information-processing mathematical model which demonstrates that these three components originate in a single fundamental attribute: creative potential (Simonton, 1984b). The higher the creative potential, the more exceptional the precocity, longevity, and rate of contribution. Therefore, we may infer that creative potential is distributed in the population in a highly skewed, elitist fashion. By analogy, leadership potential, too, may possess a comparable distribution. But how can this come about? Many human characteristics, such as intelligence, are described by a normal curve, and thus we might anticipate that genius in whatever form should be defined by a similar bell-shaped function. Four explanations can be offered.

Dennis (1954c) conjectured, first of all, that the observed distribution may represent but the upper portion of the normal curve. Presumably, some sort of threshold is operating such that below a certain point in the distribution of requisite human abilities, the probability of exerting personal influence becomes nil. The problem with this explanation, as Herbert Simon (1954) pointed out, is that the upper tail of any individual-differences distribution drops off far more rapidly than that for achievement. As an example, the most productive psychologists dominate the field far in excess of what could be predicted by any increment they may enjoy in psychometric intelligence. Therefore, even if the normal curve underlies the final distribution of achieved eminence, some other mechanism must stretch this tail so as to render the result more elitist.

Alternatively, a number of researchers, including Simon (1955), have argued that social reinforcement offers just such a mechanism (Allison, 1980; Allison, Long, & Krauze, 1982; Price, 1976). The basic concept is that of the accumulation of advantage: Success breeds more success, while failure begets further failure (Merton, 1968). Mathematical models have been devised that demonstrate how even if everyone began with the same initial level of ability, over time a subset will be granted long winning streaks at the expense of the majority (Allison, 1980; Simon, 1955). The only requirement is that society be stingy in the dispersal of rewards, and thus fierce competition exists for social acclaim. This assumption, needless to say, is preeminently reasonable, for few honors are available to all takers. Although the principle of cumulative advantage can explicate how the distribution becomes so extreme, it does not provide a complete account. The evidence indicates that in the race for success, individuals do not all start out equal, and thus social reinforcement works to exaggerate initial inequalities that are probably already highly skewed (Allison & Stewart, 1974).

To appreciate the third explanation, we must recognize a significant

feature of many of the developmental influences inventoried earlier: Often these effects depend on the occurrence of rare events or conditions. Orphanhood is a prime example, for even among the eminent, those who have experienced parental loss are a minority. Likewise, distinguished mentors are scarce, and the chances of linking up with one are small, so that such an association represents a relatively improbable occasion. Insofar as the development of achievement is nurtured by such exceptional events, the resulting distribution of eminence must be necessarily quite skewed. This repercussion would be particularly prominent if the various factors that contribute to development do so in a multiplicative rather than additive manner—which brings us to the fourth and last explanation.

Shockley (1957) has observed that even if all the attributes that make for achievement were normally distributed in the population, achievement would not be so distributed should their impact enter as products rather than sums. To illustrate how this might work, let me use Bachtold's (1980) hypothesis that creative problem-solving ability is contingent on the four characteristics of intelligence, activity, emotionality, and introversion, all with a major physiological and hence genetic basis. Even if these three qualities were normally distributed in the population, creative ability would not be if it were the function of the product of all four attributes. In other words, if one must be highly intelligent and very active and highly emotional and extremely introverted to be creative, then creativity would be described by a skewed "lognormal" distribution. A person who shines in all four prerequisites would be most rare indeed. Applying Shockley's idea more generally, if any of the developmental factors that yield distinguished achievers are so tied to multiplicative functions, the outcome would be elitist.

Whatever the correct interpretation, the distinctive distribution of achieved eminence should not blind us to the salient fact that even the greatest geniuses in history differ only in degree from their far more numerous and obscure colleagues. The distribution may be asymmetrical, but the function is monotonically decreasing, not bimodal. Thus, while we may proclaim that the top performers in any endeavor are many times more influential than those at the bottom of the totem pole, everyone is still being contrasted along the same quantitative dimension. Accordingly, the developmental antecedents we have discussed in this essay may yet have pertinence for more everyday varieties of achievement, the kinds that do not lead to history-making breakthroughs in culture or politics. That historiometric and psychometric studies frequently arrive at the same lists of developmental inputs endorses this downward extrapolation (see, e.g., Amabile, 1983; Goertzel & Goertzel, 1962; Simonton, 1984d). This essay has therefore disclosed some guidelines for identifying promising achievers in a wide range of outcomes. Some truth may dwell in the words "Genius

does what it must, and Talent does what it can" (Owen Meredith, *Last Words of a Sensitive Second-Rate Poet)*, yet, even so, the etiology of talent, or giftedness, may be the same as genius, albeit on a more diminutive scale.

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