
The Origins and Ends of Giftedness

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Five issues about giftedness are discussed. First, the origins of giftedness are explored. The view that giftedness is entirely a product of training is critiqued. There is indirect evidence for atypical brain organization and innate talent in gifted children: Many gifted children and savants have enhanced right-hemisphere development, language-related difficulties, and autoimmune disorders. Second, the intense motivation of gifted children is discussed. Third, it is argued that gifted children have social and emotional difficulties that set them apart. Fourth, evidence for the often uneven cognitive profiles of such children is presented. Finally, the relationship between childhood giftedness and "domain" creativity in adulthood is discussed. Few gifted children go on to become adult creators because the skills and personality factors required to be a creator are very different from those typical of even the most highly gifted children.

Gifted children and prodigies display near-adult level skills and interests. They may begin to read fluently at the age of three or four, without any extended instruction; they may play a musical instrument as skillfully as a highly trained adult; they may turn everyday experiences into mathematical problems to play with, moving from arithmetic to algebra before their peers have learned to carry numbers in addition (cf. Feldman, 1991; Radford, 1990; Winner, 1996a).

Psychologists have always been interested in the deviant. As a result we know much more about deviance at the negative than at the positive end of the spectrum. Just as we know more about depression and fear than we do about happiness and courage, we also know far more about retardation and learning problems than we do about giftedness. Research on retardation is more advanced and more integrated into the field of psychology than is research on giftedness. Research on retardation is more likely to find its way into mainstream developmental journals than is research on giftedness, which is often to be found in specialized and hence less widely read journals. This phenomenon is part of the wider phenomenon of psychology's focus on the pathological rather than the healthy. It also surely reflects the view that retardation is a problem researchers may eventually learn to alleviate, whereas gifts are privileges to be admired or envied rather than problems in need of solutions.

In previous work I have examined the myths and misconceptions held by laypeople and psychologists alike about the gifted (Winner, 1996a). Here I consider the

current state of knowledge about giftedness, focusing on five issues. The first and major focus of this article concerns what is known about the origins and causes of giftedness. I discuss and critique the view that giftedness is entirely a product of training and practice and argue that there is indirect evidence for atypical brain organization and innate talent in gifted children. The same claim is made as well for savants, autistic and retarded individuals with extremely high levels of ability, usually in only one area. I argue that the indirect evidence suggests that many gifted children and savants have enhanced right-hemisphere development, concomitant language-related difficulties, and autoimmune disorders.

In the second section, I briefly discuss the motivational characteristics of gifted children, showing that these children are far more intrinsically driven than are average children. Third, I discuss the particular social and emotional difficulties of gifted children that set them apart from others. Fourth, I describe what is known about the often uneven cognitive profiles of gifted children.

I conclude by proposing three ways to think about the "ends" of giftedness. The end of giftedness has a deliberately triple meaning. I use this term in a positive sense to refer to the adult endpoint of the development of a gifted child. I use it in a negative sense to refer to the potential disappearance of giftedness after childhood. Finally, I use it to refer to the goals I believe we should expect gifted children in particular to fulfill if we are to give them extra societal resources.

Origins and Causes of Giftedness

The Disputed Role of Training

The topic of giftedness inevitably awakens the nature-nurture debate. Most people in our culture subscribe to the nativist view of giftedness, in which giftedness is believed to be a product of inborn high ability. However, this folk psychology view of the origins of giftedness has recently come under sharp attack by psychologists who argue that giftedness (in any domain) is entirely a product of what is referred to as goal-directed hard work, or *deliberate prac-*

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tice (Ericsson, Krampe, & Tesch-Romer, 1993; Ericsson & Lehman, 1996; Howe, Davidson, & Sloboda, 1998; Howe, Davidson, Moore, & Sloboda, 1995; Sloboda, Davidson, & Howe, 1994). Ericsson et al. (1993) showed that levels of expertise in piano, violin, chess, bridge, and athletics correlate directly with the amount of deliberate practice. They also argued that there is no systematic and verifiable evidence for high abilities emerging prior to extensive periods of deliberate practice. They discounted as unreliable anecdotal reports about the childhood feats of prodigies such as Mozart, Gauss, and Menuhin.

Ericsson and Faivre (1988) have also sought to account for savant gifts in terms of deliberate practice. Savants are individuals who are retarded (with IQs between 40 and 70) and also either are autistic or show autistic symptoms. Savants are typically found in the domains of arithmetic calculation, music, and realistic drawing, and they often surpass child prodigies in their level of achievement. For instance, at ages three and four, the drawing prodigy Nadia drew more realistically than any known "normal" child prodigy at the same age (Selfe, 1977). Savants work obsessively in their area of ability, and it is the countless hours they spend drawing, doing mental calculation, or playing an instrument that have led to the suggestion that the savant's skills are the product of deliberate practice.

Consistent with this contemporary nurture view of giftedness are several other earlier findings. First, case studies of creative people such as those by Csikszentmihalyi (1996), Gardner (1993a), and Gruber (1981) show that all great achievement is associated with years of deep and prolonged work. For example, Gruber (1986) pointed out that it took Newton 20 years to go from his preliminary ideas to his magnum opus, *Principia Mathematica*. How-

ever, does this mean that hard work is all that is needed or that anyone can engage in the kind of hard work that will lead to Newton's creative breakthroughs?

Second, Roe (1951, 1953a, 1953b) found that outstanding achievement in science was predicted by the participants' capacity for endurance, concentration, and commitment rather than their level of intellectual ability. However, Roe's scientists were all high in intellectual ability to begin with. Her studies thus show that high ability is not sufficient for exceptional achievement; rather, one needs both high ability and perseverance.

Third, Bloom (1985) showed that eminent adults in a variety of domains did not achieve high levels of performance without a long and intensive period of training. Their training began in early childhood with warm and loving teachers, who were then supplanted by more demanding and rigorous master teachers. Bloom's study might be taken as evidence that the high levels of achievement attained were entirely the result of the rigorous training. However, a careful look at the descriptions of these eminent individuals as children shows that at a very young age, prior to any regimen of training or deliberate practice, signs of unusual ability were present. The musicians were described as quick to learn the piano, and both their parents and their teachers recognized they were special. The sculptors said that they drew constantly as children, usually realistically. The mathematicians recalled being obsessed with gears, valves, gauges, and dials and were considered "brilliant" as children. Thus, Bloom's work, like that of Roe (1951, 1953a, 1953b), allows us to conclude only that intensive training is necessary for the acquisition of expertise; it does not sufficiently explain children's high level of achievement.

The same criticism can be leveled at the work of Ericsson and his colleagues (Ericsson et al., 1993). Hard work and innate ability have not been unconfounded. Those children who have the most ability are also likely to be those who are most interested in a particular activity, who begin to work at that activity at an early age, and who work the hardest at it. Ericsson's research demonstrated the importance of hard work but did not rule out the role of innate ability.

Although Ericsson and his colleagues (Ericsson et al., 1993) consider the stories of early (pretraining) achievements of child prodigies to be unreliable, there are simply too many such reports that are too consistent with one another for them to be easily discounted. In addition, these reports come not only from potentially biased parents but also from careful case studies of young prodigies (cf. Feldman, 1991; Milbrath, 1998; Winner, 1996a). If exceptional abilities emerge prior to intensive instruction and training, then these abilities are likely to reflect atypical, innate potential.

The claim that savants achieve their astonishing level of performance because they have practiced their skill for countless hours leaves unexplained the fact that, like gifted children, savants show extremely high abilities right from the start, before they have spent much time working at their gift. In addition, this claim cannot explain why savants are

found only in domains that are highly rule governed and structured rather than in looser domains such as higher mathematics, abstract painting, philosophy, or creative writing. Thus, it seems more likely that savants and gifted children owe their gifts at least in part to innate abilities that in turn reflect atypical brain organization. Recently, Miller (1999) has made the same point: The motivation of savants may be the result rather than the cause of high ability.

Indirect evidence indicates that gifted children and savants have atypical brain organization (whether as a result of genetics, the in utero environment, or after-birth trauma). First, giftedness in mathematics, visual arts, and music is associated with superior visual-spatial abilities, and children with mathematical gifts show enhanced brain activity in their right hemisphere when asked to recognize faces, a task known to involve the right hemisphere (O'Boyle, Alexander, & Benbow, 1991; O'Boyle & Benbow, 1990). Thus, giftedness in these domains may involve enhanced right-hemisphere development. Second, individuals with gifts in mathematics, visual arts, and music are disproportionately nonright-handed. Again, this finding suggests atypical brain organization, because nonright-handedness is a rough index of anomalous brain dominance (Annett, 1985; Geschwind & Galaburda, 1987). Third, studies have shown that mathematically and musically gifted individuals have a more bilateral, symmetrical brain organization than is usual, with the right hemisphere participating in tasks ordinarily reserved for the left hemisphere (Gordon, 1970, 1978, 1980; Hassler & Birbaumer, 1988; O'Boyle, Gill, Benbow, & Alexander, 1994). Fourth, giftedness in spatial areas is accompanied by a disproportionate incidence of language-related learning disorders such as dyslexia, a finding reported for artists (Winner & Casey, 1993; Winner, Casey, DaSilva, & Hayes, 1991), inventors (Colangelo, Assouline, Kerr, Huesman, & Johnson, 1993), and musicians (Hassler, 1990). Finally, youths with very high IQs have an increased incidence of autoimmune problems (Benbow, 1986; Hildreth, 1966; Kolata, 1983; Temple, 1990); a link between immune disorders and giftedness in music has been suggested but not firmly established (Hassler & Birbaumer, 1988; McNamara, Flannery, Obler, & Schachter, 1994; but see Hassler & Gupta, 1993). In summary, giftedness in abilities that involve the right hemisphere may be associated with enhanced right-hemisphere development and hence with anomalous brain dominance. Individuals with such gifts are more likely to be nonright-handed, to have language represented bilaterally, and to have language-related and immune system disorders.

These disparate signs and symptoms are accounted for by Geschwind and Galaburda's (1987) theory of the *pathology of superiority*, in which an association between spatial (right-hemisphere) gifts, linguistic (left-hemisphere) deficits, nonright-handedness, and immune disorders is argued to be a consequence of testosterone-induced alterations of the fetal brain. Testosterone is argued to inhibit some areas of the brain while stimulating other areas. This theory has come under sharp attack (cf. Bryden, McManus, & Bulman-Fleming, 1994), and the evidence in support of

the model is inconsistent. However, whether or not the Geschwind and Galaburda model best accounts for the associations just described, we cannot discount the existence of these associations, which suggest gifted children, child prodigies, and savants are not made from scratch but are born with unusual brains that enable rapid learning in a particular domain.

The Role of Families

The notion that giftedness is a product of intensive training reflects an overly optimistic view of the power of nurture. A more negative view of the power of nurture is reflected in another common claim: that gifted children are created by driving, overambitious parents. There is concern that the end result of such extreme pushing will be disengagement, bitterness, and depression. Parents of gifted children are advised to let their children have a normal childhood.

However, most gifted children do not become bitter and disaffected. Moreover, it is impossible to drive an ordinary child to the kinds of high achievements seen in gifted children. In addition, gifted children typically report that their family played a positive, not a negative, role in their development (Van Tassel-Baska, 1989). Today we know quite a bit about the family characteristics of gifted children, at least of those in our society. These characteristics are positive ones, as described below, but the research does not allow us to conclude that particular family characteristics play a causal role in the development of giftedness. There are two reasons why no causal conclusions can be drawn from the existing data. First, there is the lack of relevant control groups. Second, if causality exists, its direction could be either from parent to child or from child to parent.

The families of gifted children are child centered, meaning that family life is often totally focused on the child's needs (e.g., Freeman, 1979; Winner, 1996a). However, the fact that parents spend a great deal of time with their gifted children does not mean that they create the gift. It is likely that parents first notice signs of exceptionality and then respond by devoting themselves to the development of their child's extraordinary ability. Of course, we have no information on the number of child-centered families that do not produce gifted children (i.e., the control-group problem).

Gifted children typically grow up in enriched family environments with a high level of intellectual or artistic stimulation (e.g., Csikszentmihalyi, Rathunde, & Whalen, 1993; Freeman, 1979; Gottfried, Gottfried, Bathurst, & Guerin, 1994; Moss, 1990). Of course, these findings are correlational. We cannot conclude that stimulation and enrichment lead to the development of giftedness. First, gifted children may need an unusual amount of stimulation and may demand enriched environments, a demand to which their parents respond. Thus, the child's inborn ability could be the driving force, leading the child to select enriched environments (cf. Scarr & McCartney, 1983). Again, how many children of enriched environments display no signs of giftedness?

Parents of gifted children typically have high expectations and also model hard work and high achievement themselves (Bloom, 1985; Csikszentmihalyi et al., 1993; Gardner, 1993a). It is logically possible that gifted children have simply inherited their gift from their parents, who also happen to be hardworking achievers. Parents of children in performance domains like music and athletics are the most directive; parents of children in the visual arts are the least directive; parents of children gifted in an academic domain fall somewhere in between (Bloom, 1985). To achieve in a performance domain, one must submit to rigorous and early training; even the most gifted children might not stick to such a rigorous schedule without a directive parent who insists that time be spent on practice. Families of children gifted in the visual arts may be the least directive because of the low value our culture places on being an artist.

Parents of gifted children grant their children more than the usual amount of independence (Colangelo & Dettman, 1983; Karnes, Schwedel, & Steinberg, 1984; Terman & Oden, 1947). However, we do not know whether granting independence leads to high achievement, or whether it is the recognition of the child's gift that leads to the granting of independence. It is also possible that gifted children are particularly strong willed and single-minded and thus demand independence.

Gifted children who grow up in "complex" families—those that combine both stimulation and nurturance—are happier, more alert, more engaged, and more goal directed than are gifted children who grow up in families with only one or neither of these traits (Csikszentmihalyi et al., 1993). Gifted children from complex families report more states of flow and high energy and were rated by teachers as original, independent, and working up to their potential. Youths who dropped out of their domains of talent reported having parents who were either too directive or too uninvolved. However, we do not know whether a combination of stimulation and nurturance causes gifted children to remain engaged, because we do not know whether the parents are reacting to the child, or the child to the parents.

Implications for Education and Child Rearing

Research on the nurture hypothesis has failed to demonstrate that giftedness is a product of hard work and intensive training or that any particular kind of family environment causes giftedness. Nonetheless, the research just reviewed has implications for the nurturance of giftedness. To be sure, no research has demonstrated that hard work, perseverance, and practice is sufficient to explain the existence of giftedness. Yet, these qualities have been shown to be necessary for high achievement, because we have no documented cases of high achievement reached in the absence of long training and many cases showing the association of high achievement with training.

Thus, parents and schools ought to hold and model high expectations if gifted children are to reach their potential. All too often, American schools do not sufficiently challenge their students. International comparisons show that American children, no matter what their ability level, perform below the levels of comparably aged students in

most European and East Asian nations (Mullis et al., 1998). The gap between American students and others is greatest for those at the highest levels of ability. According to a widely cited government report, about half of the top one percent of our students are underachieving (Ross, 1993).

Any educational solution for the gifted should be made in the context of educational reform for all students (Winner, 1996a, 1996b, 1997a). Standards and expectations are not only too low for the gifted, they are also far too low for the rest of our students. If our schools were as rigorous as those in Western Europe and East Asia, then many of our moderately gifted students, who are currently bored, tuning out, and underachieving, would be appropriately challenged. Those still not challenged enough ought to be able to take advanced classes in their domain of gift. Such advanced classes exist in high schools (e.g., advanced placement courses), but they should be available at all levels.

Schools are not the only agents that should hold gifted children to high standards. Parents also play a critical role. Too often parents fear pushing their children too hard. They fear they may rob their children of a normal childhood if they make them work too much and instead allow their children unlimited access to television, video games, malls, and such (Damon, 1995). To be sure, many gifted children are so driven that they focus on work in the area of their ability or talent whether or not their parents push them to do so. However, we do not know how many more high-potential children never develop their ability because they are not challenged but are instead captured by the potent messages from their peer culture to avoid work and be like everyone else.

Similarly, although we cannot conclude that any particular kind of family can create a gifted child, the correlational findings reported by Csikszentmihalyi et al. (1993) certainly suggest that given a high-potential child, certain kinds of family constellations are most likely to succeed in maintaining and nurturing the gift. Although it is not proven that complex families, which combine nurturance and stimulation, are causally implicated in maintaining and developing a gift, it is also not proven that they are *not* causally implicated. Unless we have evidence to show that family environment plays no causal role, it seems prudent to urge families to strive to combine the two qualities most typically associated with gifted youths who remain engaged in their area of ability.

Motivational Aspects of Giftedness

Gifted children have a deep intrinsic motivation to master the domain in which they have high ability and are almost manic in their energy level (Winner, 1996a, 1997b). Often one cannot tear these children away from activities in their area of giftedness, whether they involve an instrument, a computer, a sketch pad, or a math book. These children have a powerful interest in the domain in which they have high ability, and they can focus so intently on work in this domain that they lose sense of the outside world. They combine an obsessive interest with an ability to learn easily in a given domain. Unless social and emotional factors

interfere, this combination leads to high achievement. This intrinsic drive is part and parcel of an exceptional, inborn giftedness.

This “rage to master” characterizes children we have traditionally labeled *gifted*: children with high IQs who excel in school. It also characterizes children we have traditionally classified as *talented*, children who excel in art, music, or athletics.

The distinction in terminology between gifted and talented suggests two different subtypes of children, but this is a distinction with no basis. No matter what the domain, gifted or talented children show a rage to master: Musically gifted children spend hours voluntarily working at their instrument, artistically gifted children draw whenever they are allowed, just as mathematically gifted children willingly spend their time solving existing math problems and discovering new ones (Winner, 1996a, 1997b).

The intense drive characterizing gifted children should be recognized, celebrated, and cultivated, not destroyed. When children are not sufficiently challenged in school, as so often happens to gifted children, they sometimes lose their motivation and become underachievers. When parents and schools try to force single-minded, driven children to be well-rounded by curtailing activity in the children’s domain of giftedness and having the children spend time on more “normal” activities, they may end up stifling the children’s drive. All children, not only the gifted, would be better educated if teachers sought to find out what motivates and excites individual students and then harnessed this drive toward learning.

The Social and Emotional Lives of Gifted Children

The study of giftedness began in earnest in the early part of this century, when Lewis Terman initiated a large-scale longitudinal study of over 1,500 high-IQ children. The first volume about this group appeared in 1925 (Terman, 1925), a 40-year follow-up appeared in 1968 (Oden, 1968), and a volume describing the survivors in their 80s appeared in 1995 (Holahan & Sears, 1995). Terman’s goal was to dispel the myth that gifted children are maladjusted and emotionally troubled. Terman tried to use his evidence to show that the participants in his study were, in his words, “superior to unselected children in physique, health and social adjustment; [and] marked by superior moral attitudes as measured by character tests of trait ratings” (Subotnik & Arnold, 1994, pp. 17–18).

To understand how Terman came to this conclusion, it is necessary to understand how the children were selected for the study. The first cut came from teacher nominations of the brightest children and also the youngest children in their classes. Nominated students who scored in the top one percent of the school population on an intelligence test were then admitted to the study. For students under high school age, this meant a score of at least 140 on the Stanford-Binet IQ test; for high school students, this meant a score within the top one percent on the Terman Group Test of Mental Ability. Personality and social and emotional adjustment were assessed by asking teachers to rate

students on a variety of scales. Teachers may well have been subject to a halo effect, perceiving the students they had nominated as gifted as being generally better on all dimensions. In addition, because almost a third of the Terman children were drawn from professional, middle-class families, giftedness was confounded with social class.

Another early researcher of gifted children, Leta Stetter Hollingworth, argued that children with profoundly high IQs (over 180) had special social and emotional problems (Hollingworth, 1942). In a more recent report it was estimated that the rate of social and emotional difficulties experienced by profoundly academically gifted children is about twice the rate found among the nongifted, with almost a quarter of such children having such difficulties (Janos & Robinson, 1985). Extreme levels of giftedness lead to isolation. Hence, in middle childhood profoundly gifted children may try to hide their abilities in the hopes of becoming more popular. Academically gifted girls are more apt to do this than boys, and such girls report more depression, lower self-esteem, and more psychosomatic symptoms than do academically gifted boys (Gross, 1993).

Teenagers with gifts in the visual arts, music, and athletics have as many difficulties with their peers as do those gifted in academic areas (Csikszentmihalyi et al., 1993). These teenagers have been shown to be atypical socially and emotionally in a number of respects: They are highly driven, nonconforming, and independent thinkers.

Gifted children in all domains also tend to be introverted. They spend more time alone than do ordinary adolescents. They gain stimulation from themselves more than from others and report liking solitude far more than do most other people (Csikszentmihalyi et al., 1993). Gifted children are not only solitary because of their rich inner lives, but also because solitude is requisite for the development of their talent. Whereas ordinary children come home after school to play, gifted children come home after school eager to paint, play music, work on math problems, read, or write.

Despite liking solitude more than do ordinary children, gifted adolescents also report a preference to be with others rather than alone (Csikszentmihalyi et al., 1993). Thus, although they gain more from solitude than do others, they still yearn for peer contact. It is difficult for these atypical children to find like-minded peers.

The desire for like-minded peers is one of the strongest arguments for placing gifted children in advanced classes. Advanced classes for gifted students are almost nonexistent at the elementary level, infrequent at the middle school level, and common at the secondary level. Such opportunities come in the form of honors classes, advanced placement classes, and college-level courses. Because meta-analyses of research show that ability grouping helps students academically and does not harm them socially (Kulik & Kulik, 1997), schools should be increasing their offerings of advanced coursework and allowing such courses even at the elementary school level. Yet, all too often today schools are disbanding such offerings in the name of egalitarianism.

Advanced courses also exist in summer or weekend programs at many universities around the country (Stanley, 1988). Since 1979, over 100,000 students have participated in programs across the country now run by the Institute for the Academic Advancement of Youth at the Johns Hopkins University (Johns Hopkins University, 1999). Students are selected on the basis of a high Scholastic Aptitude Test (SAT) or American College Testing (ACT) score earned as early as late elementary school. (Students also participate in various annual regional talent searches based on the same model. In some of these talent searches students all the way down to the second grade are tested using downward extensions of the SAT and the ACT.) Students take courses in their area of high ability, and they find the experience to be very positive, particularly because meeting like-minded peers means they feel less isolated (Benbow & Lubinski, 1997; Enersen, 1993). There are now about a dozen residential state-supported high schools for the gifted, as well as an equal number of residential early-entrance-to-college programs; these make it possible for highly gifted children to mix with equally gifted peers (Boothe, Sethna, & Stanley, in press).

Cognitive Profiles of Gifted and Prodigious Children

Psychologists typically assess academic giftedness with an IQ test that yields subtest scores as well as an overall, global number. Children are usually defined as gifted if their global IQ score rises above some arbitrary cutoff point (often 130). The assumption underlying the use of a global score is that academically gifted children are generally gifted in all academic subjects. Some children justify this assumption perfectly by demonstrating giftedness in reading, math, and logical analytic thinking. These kind of children are *notationally gifted*, able to master rapidly the two kinds of notational symbol systems valued in school: language and numbers.

Although globally gifted children certainly exist, many other academically gifted children present a much less balanced picture; unevenness between verbal and mathematical abilities may be the rule, not the exception. Many of Terman's participants had greater strengths and interests in either reading or math. Terman, however, argued that the unevenness in ability among the gifted was no more marked than the unevenness found in the general population: "The 'one-sidedness' of precocious children is mythical" (Terman, 1925, p. 339).

More recent research suggests Terman was wrong. When assessed with difficult tests without low ceilings, academically gifted children often reveal jagged profiles, and a gift in one scholastic area does not imply a gift in another area. For example, Detterman and Daniel (1989) have found that the higher the IQ, the lower the correlation among subtests of the IQ test. Thus, it is more common to find mathematical ability far higher than verbal ability in a high-IQ individual than in a low-IQ individual. Wilkinson (1993) reported sharp discrepancies between verbal and performance IQ scores in children with IQs of 120 or higher. In a large-scale study of gifted adolescents, Achter,

Lubinski, and Benbow (1996) found that 42% of students scoring in the top 0.5% on the SATs had math and verbal SAT scores over one standard deviation apart, whereas 72% of students scoring in the top .01% had such a differentiated profile. When the personal interests of the individual children were added into the same equation, 82% and 94%, respectively, had differentiated profiles. Some mathematically gifted children identified by the Study of Mathematically Precocious Youth (SMPY; Stanley, 1988) are more gifted in math than verbal ability, although extreme cases of such discrepancies are not typical (J. C. Stanley, personal communication, January 7, 1999). For further evidence of unevenness of abilities associated with gifted IQs, see Benbow and Minor (1990); Lewis (1985); Mueller, Dash, Matheson, and Short (1984); and Silver and Clampit (1990).

It is not surprising that unevenness exists, because the abilities that underlie mathematical giftedness differ sharply from those that underlie verbal giftedness. Underlying mathematical but not verbal giftedness are spatial abilities (Benbow & Minor, 1990; Benbow, Stanley, Kirk, & Zonderman, 1983; Casey & Brabeck, 1989; Gardner, 1983; Hermelin & O'Connor, 1986; Krutetskii, 1976). Mathematically gifted children show stronger recall for numerical and spatial information than for linguistic information, whereas verbally gifted children show the reverse pattern (Dark & Benbow, 1991).

Jagged profiles also characterize children gifted in music and art. A gift in music or art can exist alongside an average or even a subnormal IQ. Correlations between musical ability and IQ are positive but low: Above an average IQ, intelligence is not particularly predictive of musical ability. In the same vein, high musical ability is not predictive of a high IQ (Shuter-Dyson, 1982). Further, the existence of musical savants, individuals who are retarded and autistic but who have exceptional musical ability, shows decisively that a high IQ is not a necessary component of giftedness in music (Miller, 1999; Treffert, 1989).

Yet, musically gifted children typically do very well academically (Csikszentmihalyi et al., 1993). One possible explanation for this conflicting set of findings is that all that our knowledge of the relation between music, IQ, and academic skills comes from studies of children taking classical music lessons. These children are likely to come from educated parents who provide enriched family environments. In addition, such children learn to read music and practice regularly, two activities that might transfer to school performance. Whether children who perform rebellious antiauthority music (rock, rap, etc.) and who do not read music also do well academically has not been investigated, but I speculate that such children would not excel in school-related activities.

Children gifted in the visual arts and in athletics typically show a lack of interest in academic achievement, with those gifted in the visual arts even less committed academically than those in athletics (Csikszentmihalyi et al., 1993). Savants who excel in drawing provide clear evidence for the possible dissociation between giftedness in the visual arts and IQ (Miller, 1999; Treffert, 1989).

A gift in the visual-spatial area may bring with it a language-based learning disability. Gifted children may perform at an average level in some academic domain. Others are gifted in one domain and learning disabled in another. Davis and Rimm (1985) estimated that there are between 120,000 and 180,000 American schoolchildren who are both gifted and learning disabled. A recent study by Reis, Neu, and McGuire (1995) found that all of the academically gifted students in a University of Connecticut program for learning disabled students had a language-based learning disability. It is certainly not uncommon to encounter high-IQ children who are also dyslexic.

It has also been argued that dyslexia is often accompanied by gifts in the visual-spatial arena, a view consistent with Geschwind and Galaburda's (1987) pathology of superiority theory, and anecdotal reports on this association abound (Galaburda & Kemper, 1979; Rimland & Fein, 1988; Sano, 1918; West, 1991). Consistent with this claim of association is the finding that there are disproportionately more dyslexics in populations of artists than in the population at large (Winner & Casey, 1993; Winner et al., 1991). Also consistent is Bloom's (1985) report that none of the 20 world-class mathematicians he studied had learned to read before attending school (even though most academically gifted children do read by that time) and that 6 had had trouble learning to read. A retrospective study of inventors (who are presumably individuals with high mechanical and spatial aptitude) showed that as children these individuals struggled with reading and writing (Colangelo et al., 1993). Also, late-talking children have been found to have high spatial abilities and to have relatives in spatial professions such as engineering (Sowell, 1998).

Despite these intriguing findings, however, systematic studies of the spatial abilities in dyslexic populations have revealed mixed and inconsistent findings (for a review, see von Karolyi, 1998a). Individuals with dyslexia show no spatial advantage on a wide variety of spatial tasks, including spatial visualization, mental rotation, spatial memory, visual scanning, and spatial orientation (Malinsky & Winner, 1999; Winner et al., 1999; for an exception, see von Karolyi, 1998b, 1999).

Educational programs for the academically gifted that rely on global IQ scores as an entrance criterion are likely to miss children who are unevenly gifted. Of course, admission by overall IQ means that children with mathematical gifts are treated identically to those with verbal gifts. It would make far more sense to admit children to special programs that are tailored to the domain in which they are gifted (Stanley & Benbow, 1986).

Although our schools do little for the academically gifted, with those choosing the curriculum often insisting that all children are gifted and hence none need special classes, our schools do even less for the musically or artistically gifted child. It is assumed that schools nurture academic but not artistic or musical abilities. Children with gifts in an art form are expected to get extracurricular training. This is particularly true in the case of music, whereas children gifted in the visual arts are likely to experiment on their own time in their field of talent, not

receiving formal training outside of school until or unless they elect to attend an art school. Schools ought to offer rigorous and advanced training in the arts as well as in academics so that gifted children can advance in an art form and have their gift taken as seriously as is academic ability.

The Ends of Giftedness

There are at least three senses in which to consider the ends of giftedness: (a) the most positive endpoint of childhood giftedness, (b) the end or loss of giftedness in adulthood, and (c) the end or goals that we should expect gifted children to fulfill. In the following paragraphs I consider each of these in turn.

When Giftedness Ends in Big-C Creativity

The highest possible endpoint of childhood giftedness is certainly creativity in the sense of domain-altering innovation (which I refer to here as *big-C creativity*). Terman's children typically became experts in a well-established domain (e.g., medicine, law, business, the academy). Although they may have been creative in the little-c sense (e.g., coming up with innovative approaches to problems), they did not become major creators. That is, they neither created a new domain nor revolutionized an old domain. Yet, expertise as an endpoint should not be lightly dismissed. Society needs experts, and we can neither expect nor hope that all prodigies will become creators. Many gifted children grow up to become happy and well-adjusted experts in their fields.

However, only a fraction of gifted children eventually become revolutionary adult creators. Those who do so must make a painful transition from a child prodigy (a child who learns rapidly and effortlessly in an established domain) to an adult creator (a person who disrupts and ultimately remakes a domain; Gardner, 1993a, 1993b; Simonton, 1977).

It is not surprising that most gifted children, even most child prodigies, do not go on to become adult creators. All young children, whether typical or gifted, think divergently and engage in fantasy play (cf. Richards, 1996, for a discussion of divergent thinking in ordinary children). However, this kind of universal creative thinking is quite different from the kind of big-C creativity that is involved in reshaping a domain. Individuals who are creative in this big-C sense have a personality structure different from that of the typical gifted (and nongifted) child: They are rebellious, they have a desire to alter the status quo, and they have often suffered childhoods of stress and trauma (Gardner, 1993a; M. G. Goertzel, Goertzel, & Goertzel, 1978; V. Goertzel & Goertzel, 1962; Sulloway, 1996). Their families are often a far cry from the complex families of engaged gifted adolescents (Csikszentmihalyi et al., 1993). The disproportionate incidence of manic depression in creative individuals also suggests a link (although not a necessary one) between creativity and psychopathology (Jami-son, 1993; Ludwig, 1995).

The biggest issue for profoundly gifted children is making the transition from precocity and technical exper-

tise to the innovation of the big-C creator. Consider the very different situation of a prodigy in an academic or artistic domain as compared with an athletic prodigy. An athlete's career is over relatively early in life because physical strength and agility are so important. Also, in sports, creativity plays far less of a role than it does in an art form or in a scholastic area such as mathematics. In sports there is no transition to be made from technical perfection to creative interpretation. For the athlete, technical perfection is most, if not all, of the story. In contrast, in music, mathematics, writing, or the visual arts, the situation is much more difficult for the prodigy. For example, a high-IQ six-year-old who can multiply three-digit numbers in her head or solve algebraic equations wins acclaim. However, as a young adult she must come up with a new way to solve some unsolved mathematical problem or discover some new problems or areas to investigate to make her mark in the domain of mathematics. Although she may remain in the domain of mathematics for her whole life as an excellent teacher, an accountant, an engineer, or a math professor, she will not have become a creator in the domain. Although she may not drop out of the field entirely, she will not fulfill the highest level of potential that a gifted child may reach, big-C creativity. The situation is the same in art or music. Technical perfection wins the prodigy adoration, but if the prodigy does not eventually go beyond technical perfection into originality, he or she sinks into oblivion.

There are a number of reasons for prodigies' failure to remake themselves into big-C creators. Two are inevitable, but two are within our control and hence challenge us to change how prodigies are nurtured so we may help them make this transition.

One inevitable reason is that the funnel is small. There is simply not enough room at the top for all prodigies to become creators. Therefore, there is an inevitable weeding out of those who do not make the cut, so to speak. Any domain would be in chaos if there were as many creative adult innovators as there are child prodigies.

A second inevitable reason is that the skill of being a prodigy is not the same as the skill of being a big-C creator. A prodigy is someone who can easily and rapidly master an already-established domain with expertise. A creator is someone who changes a domain. Personality and will are crucial factors in becoming an innovator or revolutionizer of a domain. Creators have a desire to shake things up. They are restless, rebellious, and dissatisfied with the status quo (Csikszentmihalyi, 1996; Gardner, 1993a; Simonton, 1994; Sulloway, 1996). They are courageous (cf. Gruber's, 1981, discussion of Darwin's courage) and independent (Albert & Runco, 1986). They are able to manage multiple related projects at the same time, engaging in what Gruber (1981) calls a "network of enterprise" (p. 105).

For these two reasons, we should never expect a prodigy to go on to become a creator. The ones who do make this transition are the exception, not the rule.

When Giftedness Ends

One nonevitable reason that prodigies may fail to make the transition is that they have become frozen into expertise. This is particularly a problem for those whose work has become public and has won them acclaim, such as musical performers, painters, or children who have been publicized as "whiz kids." Expertise won them fame and adoration as child prodigies. It is then difficult to break away from expertise and take the kinds of risks required to be creative.

A second nonevitable reason is that some with the potential to make the transition do not do so because they have been pushed so hard by their parents, teachers, and managers that they lose their intrinsic motivation (Elkind, 1981; Winner, 1996a). At adolescence they begin to ask, "Who am I doing this for?" If the answer is that they are pursuing their gift for a parent or a teacher but not for themselves, they may decide that they do not want to do it anymore and drop out (cf. Bamberger, 1986). The case of William James Sidis, a math prodigy pushed relentlessly by his father, is one such case among many (Montour, 1977).

These last two reasons show us what can happen when culture and greed overtake nature and stamp it out. Parents, teachers, and psychologists all have an obligation to nurture prodigies through the potential transition from expertise to creative innovation and to help them avoid four dangers:

1. The danger of pushing so hard that the intrinsic motivation and rage to master these children start out with become a craving for the extrinsic rewards of fame.

2. The danger of pushing so hard that these children later feel they missed out on having a normal childhood.

3. The danger of freezing a prodigy into a safe, technically perfect but noninnovative way of performing because this is what he or she has been rewarded for doing so well.

4. The danger of the psychological wound caused by the fall from being a famous prodigy who can perform perfectly to a forgotten adult who can do no more than perform perfectly.

The Ends, or Goals, That Gifted Children Should Be Held To

I have argued here and elsewhere (Winner, 1996a, 1996b, 1997a) that we should provide extra resources for the education of our most able students. The traditional argument for this has been a utilitarian one. These children are our national resources, and we should cultivate them so they can become our future leaders and innovators. However, there is also a nonutilitarian reason for intervention: We need to intervene for the happiness and mental health of gifted students. For their emotional well-being, students need an appropriate level of challenge. Otherwise, they are not only bored (which can lead to underachievement) but also socially isolated, and they feel different from everyone else. Schools can meet the needs of gifted students without violating egalitarianism. Schools cannot be truly egalitarian unless they acknowledge learning differences, including those differences possessed by students of high ability.

However, if our schools are to provide specialized education for the most able, then the most able must also learn to give back to the society that grants them extra resources. Thus, one of the ends of giftedness might be argued to be service. Today there is a one-sided emphasis on the self-actualization of the gifted child. All of the educational research on the outcomes of ability grouping, acceleration, pull-out programs, and so on focuses on one primary issue: whether the gifted do better on some cognitive or emotional measure when given such education. An altogether different emphasis can be found at the Israel Academy of Art and Science, a school for gifted adolescents in which students not only develop their abilities but also participate in community service, making use of the kinds of abilities in which they are gifted (Gardner, 1998). The moral value of service, of giving back to a society that has devoted extra resources to the gifted, ought to be considered as important as the value of self-actualization of the gifted. All children should be taught the value of service, and gifted children are no exception.

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