Does Creativity Decline With Age?

We shall not cease exploring
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

T. S. Eliot, The Four Quartets

The view that people become less creative as they grow older is widely shared. Albert Einstein won a Nobel prize for his contribution to quantum theory, a creative breakthrough that appeared in published form when he was only 26 years old. He later remarked that "a person who has not made his great contribution to science before the age of 30 will never do so." Was Einstein right?

The question of age and creativity is an important one for individuals who worry about becoming irrelevant in a fast-paced world. The question is also important for society. The French demographer Alfred Sauvy feared that an aging society would result in a "population of old people ruminating over old ideas in old houses" (Sauvy, 1976). In coming decades, the U.S. population will become older. The workforce will be aging in a period when companies are being pushed to adopt new methods to improve competitive performance. Can we expect middle-aged and older workers to exercise creativity and initiative, or can we expect them to resist new ideas? What will happen to American inventiveness and scientific creativity as the average age of scientists goes up (Stephan and Levin, 1992)? These questions are disturbing for those who see in an aging America the "specter of decline" (Pifer and Bronte, 1986; Moody, 1988a).

Some of these fears a have foundation in fact. For instance, there is a common stereotype that older people take longer to learn new things, and this is a stereotype that turns out to be true. Compared to younger people, older people *do* tend to proceed more slowly in new learning situations, but slower

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speed is partly explained by lack of practice, differences in learning style, or motivation. In addition, reaction time itself tends to slow down with age: probably the result of "hardware" limits in the nervous system. By itself, chronological age doesn't explain much about learning ability. In any case, slower speed or reaction time usually isn't a factor in everyday performance.

Along with the stereotype of low creativity, there is a common assumption that older people overall are just plain bored, yet the Duke Longitudinal Study of Aging found that nearly 9 out of 10 respondents said they had never been bored in the previous week (Palmore, 1981). Another stereotype suggests that the elderly cannot adapt to change, yet a little reflection shows this stereotype to be wrong. Consider only the enormous changes that most people are likely to face in their later years, changes such as retirement, widowhood, adapting to chronic illnesses, and so on.

The debate about age, intelligence, and creativity is important for America's future. A number of gerontologists, perhaps with one eye on their own advancing years and the other on a changing society, have tried to determine whether creativity declines with age. They have faced a number of practical obstacles in their research, the most basic being an acceptable definition of "creativity." Other types of cognitive function, notably intelligence, have proved easier to pinpoint, although not without debate.

Elements of Cognitive Function

Creativity has been related to intelligence, specifically, **fluid intelligence,** which is intelligence applied to new tasks or the ability to come up with novel or creative solutions to unforeseen problems (Horn, 1982). Some believe the key to fluid intelligence is divergent thinking, which is the ability to come up with lots of different ideas in response to a problem-solving challenge.

The other side of the coin is **crystallized intelligence,** which reflects accumulated past experience and socialization (Horn, 1982). Whereas fluid intelligence denotes a capacity for abstract creativity, crystallized intelligence may signify the acquisition of practical expertise in everyday life—in short, wisdom. Some components of wisdom have long been familiar. Philosophers going back to Socrates have argued that wisdom lies in a balanced attitude toward what we think we know: knowing what one does not know but, at the same time, refusing to be paralyzed by doubt (Meacham, 1990). Another key feature of wisdom would seem to be the ability to transcend bias or personal needs that may distort one's perception of a given situation (Orwoll and Perlmutter, 1990). Wisdom, then, involves more than cognitive development alone; it requires a degree of detachment and freedom from self-centeredness that has been described as "ego transcendence" (Peck, 1968).

Older people, if they develop a degree of detachment, might be in a position to achieve such wisdom. But, of course, no one has suggested that

wisdom is a universal or inevitable result of chronological age alone. Something more is required than merely living a certain number of years, but psychologists do not agree about what that "something more" might be.

Some psychologists have wondered if there is a trade-off between creativity and wisdom, with one declining while the other increases with advancing age. In this review, wisdom and creativity are seen in opposition to one another. Other psychologists argue that the cognitive processes involved in wisdom, intelligence, and creativity are all basically the same but are put to different uses by different kinds of people. Wise people, we might say, have a high tolerance for ambiguity because they appreciate how difficult it is to make reliable judgments. They see the world "in depth." By contrast, the creative person seeks to go beyond whatever is given in the immediate environment to create something new.

Yet genuine creativity need not be identified with novelty for its own sake, as contemporary Western societies often do. In some societies of the East—for example, India, China, or Japan—old age is viewed as an appropriate time for spiritual exploration and artistic development. Late-life disengagement is balanced by opportunities for personal growth and creativity. "A Confucian in office, a Taoist in retirement," went the Chinese proverb, so retirement roles might include meditation or traditional landscape painting. In the Hindu doctrine of life stages as well, later life was a period culminating in spiritual insight and wisdom.

What happens when a creative artist grows older and also develops a measure of wisdom applied to the creative process itself? Part of the answer may be found by looking at those creative artists who continued to be productive in old age. One of the greatest examples was the Dutch painter Rembrandt, whose style changed and deepened as he grew older. The aged Rembrandt practiced looser brushwork and became more preoccupied with the inner world of the people he painted. Another example is the impressionist Monet, who continued to paint his famous water lilies even after he was confined to his home in his 70s. Frail health also plagued the aging Matisse, who was forced to give up painting in favor of creating colored cardboard "cutouts" that distilled a lifetime of artistic experience into simple, powerful designs. It is as if the older artist is able to discard mere technical achievement in favor of some essential and elemental quality of art. We see a similar development of "late style" among poets such as Goethe and W. B. Yeats. All these examples suggest that in the last stage of life many of the greatest creative minds experience a change or a deepening of their creative style that could be attributed to an accumulation of wisdom.

The sources of creativity and productivity in later life are complex and result from many different factors. For example, most productive individuals produce both successes and failures; they have more successes than less productive individuals partly because they have more failures as well. There is no law of fate that decrees that creativity must decline with age. Late-life creativity is unquestionably real, but it is far from universal and it takes unpredictable forms. For example, it is well known that so-called "late bloomers"—like the painter Grandma Moses—may attain the peak of their

career much later in life than others. What is known about creativity in later life suggests that individual differences in creative potential are so substantial that they largely go beyond the effect of aging itself (Simonton, 1998).

The Classic Aging Pattern

Creativity in itself is difficult to define or measure, but psychologists have had long experience in measuring human intelligence. The **Wechsler Adult Intelligence Scale** (WAIS) is the most influential measure of global or general intelligence in use today. The WAIS includes a verbal scale and a performance scale, which are combined to assess IQ. The verbal part focuses on learned knowledge including comprehension, arithmetic, and vocabulary; the performance part measures ability to solve puzzles involving blocks or pictures. As people grow older, their verbal scores on the WAIS tend to remain stable, but their performance scores tend to decline (Sattler, 1982). This persistent difference between the two components has been found so often that it is called the **classic aging pattern.**

Some leading researchers have cautioned against taking the classic aging pattern too seriously. They question what is actually being measured by IQ tests. In other words, they challenge the very validity of IQ tests as a measure of the "real" intelligence of older adults. Perhaps test performance should not be equated with real differences in intelligence at all, they say. This controversy has a familiar ring. It is the same kind of challenge that has been heard about the use of IQ tests and Scholastic Aptitude Tests when those tests show poorer scores for some minority groups. Critics argue that "intelligence" is a more complex, multidimensional capacity than the tests measure (Gardner, 1985).

The evidence certainly indicates that age and intelligence have a complex relationship. In a test of basic memory skills of young and older adults, the average 70-year-old will take 3 or 4 times longer than a 20-year-old to identify a mental picture linking a word and a location and will tend to make more mistakes. Things are completely different when we test people for knowledge transmitted across generations through culture, however. Older people do well on language skills as well as knowledge about how to handle life's ups and downs. For example, when presented with a difficult hypothetical dilemma, older adults score much better than younger adults. How, then, do we develop a valid measure of late-life intellectual ability?

Measures of Late-Life Intelligence

Interest in the validity problem, or the problem of measuring "real" intelligence, has helped stimulate psychologists to ask whether any positive cognitive developments come with age. The long debate has at least confirmed that conventional methods of measuring intellectual abilities have not

always acknowledged the skills used by adults in coping with the demands of everyday life. As a result, some psychologists have become interested in devising new approaches and methods, such as an age-relevant intelligence test.

Tests to measure the relation of wisdom or creativity to age are seeking to capture something very elusive. Everyday intelligence is a multidimensional capacity involving more than logic or information processing alone. Everyday intelligence—what we sometimes call "common sense"—involves pragmatic or social judgment, which is more than abstract reasoning (Cornelius, 1990). What is involved is something akin to "everyday problem solving" (Cornelius and Caspi, 1987) or "expertise in life planning." Some of these same cognitive capacities are evident in what we call wisdom. The wisdom of later life probably includes several distinct attributes—reflective judgment in the face of uncertainty, "problem finding" (as opposed to solving an already given problem), integrated thought about one's life, and intuition, or the empathic ability to understand a concrete situation. These qualities are obviously difficult to measure on a test.

Paul Baltes, perhaps the leading psychologist investigating wisdom today, has tried to develop a psychological test to measure wisdom. Baltes and his associates presented adult test subjects with questions such as this one: "A fourteen-year-old girl is pregnant. What should she, what should one, consider and do?" In scoring the test, Baltes was not looking for any specific answer but instead was trying to measure how wise people go about dealing with difficult questions. Not all older people are wise, but more than half of the top responses on Baltes's "wisdom test" came from people beyond 60 years of age (Baltes, 1992).

Baltes went on to define wisdom as an expert knowledge system derived from experience and capable of dealing with pragmatic problems. That definition is similar to the commonsense understanding of wisdom as consisting of good judgment in response to uncertain problems of living. If we follow this approach, we can understand why wisdom, potentially at least, might increase with age. The reason goes back to the distinction between fluid intelligence, which operates by the mechanics of information processing, as opposed to the content-rich, pragmatic knowledge of crystallized intelligence.

Steps toward defining or measuring wisdom are still in the early stages, but the effort holds promise. Research on the aging mind has moved from a simple view of growth versus decline to a more complex assessment of potential and limits. The cognitive mechanics of the computer—information processing—can be compared with fluid intelligence, which is biology-based and tends to decline with age. On the other hand, cognitive pragmatics—factual knowledge and problem solving—can grow with age and can compensate for losses in processing power. We could say that with advancing age hardware declines, while software becomes enriched (Baltes, 1993).

Studies of Age and Cognitive Function

Different methodologies have been used to measure changes associated with aging. Cross-sectional studies look at groups of young and old people at a single point in time, and longitudinal studies follow subjects over many years. Optimists on the subject of creativity and age point out that cross-sectional studies of intelligence may be revealing differences that do not come from age itself but from characteristics of different cohorts.

For instance, young people taking IQ tests tend to be quite familiar with test taking from recent experience in school. As a group, they show far less test anxiety than do older people (Whitbourne, 1976). Furthermore, many older people accept the prejudices of ageism and believe that, with advancing age, intelligence inevitably declines. Older people also tend to be more cautious than younger people, and thus they may be more reluctant to guess at the right answers on an IQ test (Birkhill and Schaie, 1975). Finally, current cohorts of older people, on average, lack the formal schooling enjoyed by younger age groups.

Given the tendency of cross-sectional studies to overestimate the impact of chronological age, longitudinal studies make sense. One of the most extensive sources of knowledge about intelligence and aging comes from the Seattle Longitudinal Study, which followed individuals ranging from age 25 to age 81 over two decades (Schaie, 1996). That investigation and others have found that the steepest average intellectual declines come after age 60. Averages conceal large differences among individuals, but even on longitudinal studies the classic aging pattern emerges. Still, research findings do challenge the idea of inevitable, global intellectual decline for all individuals. Even more important, intellectual decline in older people may be halted or reversed by specific interventions, such as training and education. These findings suggest that intellectual decline in later life is by no means irreversible or inevitable.

Indeed, longitudinal studies show that successive cohorts of older people are in fact improving their performance on intelligence tests, perhaps reflecting higher educational attainment. In addition, anywhere from 60% to 85% of those tested maintain their scores over time or even improve specific abilities. Among those over age 80, only between 30% and 40% of participants in the Seattle study had declining scores.

These studies indicate that very few people show any global decline in intelligence as they age, suggesting that people can optimize their cognitive functioning by drawing on their strengths or compensating for losses. Perhaps most important, even in their 80s and 90s, people tend to remain quite competent in familiar everyday situations. Both cross-sectional and longitudinal studies, however, do show the classic aging pattern, with uniform decline among subjects beyond their seventies.

Studies of creativity, as opposed to cognitive function in general, have been more difficult to conduct. Again, the problem is defining creativity.

Both cross-sectional and longitudinal studies, using many different kinds of tests, have shown that divergent thinking does decline with advancing age, and the decline is not attributable simply to reductions in speed of response (McCrae, Arenberg, and Costa, 1987). These tests are not a completely satisfactory measure of creativity, however. Harvey Lehman in his classic study of creativity and aging used a public consensus approach instead. First, he recognized public consensus about products that clearly demonstrate superior creativity—for example, Mozart's symphonies, Newton's theory of gravity, or Thomas Edison's invention of new electrical devices. Lehman found that the curves of publicly acknowledged creativity followed exactly the curves of fluid intelligence: They both peaked after age 30 and declined with each subsequent decade (Lehman, 1962).

Wayne Dennis, a critic of Lehman's work, looked at different data and found that for most people the decades of the 40s and 50s were the most productive period (Dennis, 1966). Dennis's conclusions were based on quantitative measures of productivity, however (for example, how many publications), not on qualitative measures (how important the contribution was). Therefore, Dennis's results do not actually refute Lehman's findings.

Still other investigators measuring scientific creativity found that productivity among scientists peaked in the early 40s—later than Lehman said—and then declined slowly after age 50 (Cole, 1979; Diamond, 1986). A longitudinal study of creativity among mathematicians found that those who published a great deal when young did continue to publish as they became older, at least through middle age.

The evidence thus shows that age does not necessarily mean loss of cognitive function. Nevertheless, performance on intelligence tests does decline. Psychologists speculating about the reasons cite strong evidence that declining speed with advancing age does have a negative effect on performance on intelligence tests, but the precise reasons remain unclear (Salthouse, 1985a). Aging is, in fact, accompanied by a clear loss in **cognitive reserve capacity**—that is, the degree of unused potential for learning that exists at any given time. Studies of reaction time in training also show that the speed of information processing definitely declines with age. Older adults, for instance, do not reach the same peak of performance in reaction time as younger adults (Salthouse, 1985b), nor do older people achieve comparable performance when trained in memory skills (Baltes and Baltes, 1990).

Optimists counter that, although fluid intelligence abilities decline with age, crystallized abilities tend to increase. In addition, declines in cognitive ability among older people can often be compensated for by the expertise acquired with aging, a phenomenon that has been called *decrement with compensation*. In other words, wisdom and pragmatic knowledge compensate for declines in speed or fluid intelligence. For instance, despite declines in typing speed, some older typists demonstrate superior typing productivity. They apparently compensate for loss of speed by reading farther ahead in the manuscript they are typing, which is a pragmatic response demonstrating knowledge of how to type more effectively (Salthouse, 1984).

Correlates of Cognitive Stability

The debate about the causes and meaning of the measurable decline in IQ scores with age comes down to a difference between those who think of themselves as "realists" and those who take a more optimistic view. On the optimistic side, some psychologists speak of the "myth of the twilight years." They suggest that intelligence actually need not decline in later life at all (Baltes and Schaie, 1974). But other, equally expert psychologists bitterly reject this conclusion (Horn and Donaldson, 1977). These realists contend that declines in fluid intelligence in the classic aging pattern are empirical facts to be accepted, no matter how unpleasant. Although we might find individuals who do not exhibit the pattern, the realists insist, such cases do not refute an overall decline in average performance.

Taking another tack, the optimists have explanations other than chronological age for the classic aging pattern. One possible factor could be ill health, which does become more frequent with aging, though not universally so. Studies reveal consistent differences in IQ test performance depending on even modest declines in health status. Poor health and disability also tend to cause retirement and therefore probably weaken learning opportunities. Note, then, that both biological changes, such as health status, and social changes, such as retirement, may be responsible for changing cognitive abilities. It may be possible to change these biosocial factors to such a degree that the classic aging pattern no longer holds true.

The ability to adapt or compensate for decrements in cognitive function is probably related to cognitive style or personality. Basic personality dispositions include traits such as being neurotic, extroverted, open to experience, and conscientious. These dispositions predict how people adapt to changing life circumstances. Surprisingly, basic personality changes vary little after the age of 30 (Costa and McCrae, 1980; McCrae and Costa, 1990). Longitudinal studies show that personality is stable throughout adulthood, even in response to health problems, economic setbacks, and bereavement (Costa, Metter, and McCrae, 1994).

However, psychological characteristics over the life span do not emerge entirely from the isolated individual. Behavior often reflects social conditions and socially structured transitions in the life course (Schooler and Schaie, 1987). For example, retirement may boost the cognitive performance of people who retire from very routine or boring jobs, but accelerate cognitive decline for those who have held complex jobs. In addition, some psychological traits can be intensified by life course transitions. For instance, middle-aged people with flexible attitudes are less likely to experience a decline in psychological competence as they grow older than are those who could be described as cognitively rigid (Schaie, 1984).

We should thus be skeptical of any broad generalizations or unqualified claims about either the decline or the stability of intelligence with aging. Experiments in training have shown that declines in intellectual functioning among older people can be reversed. In the Seattle Longitudinal Study,

investigators found that 40% of participants showed a decline in mental abilities benefited from training; following training, they achieved intelligence scores at least as high as those measured at the beginning of the 14-year study (Cunningham and Torner, 1990). Critics question, however, whether the reversal reflects practice or a genuine reversal of changes induced by aging.

Despite the criticism, psychological studies with older people have demonstrated that intelligence, defined as the ability to think and learn new things, has a great measure of plasticity, or potential for growth even at advanced ages. Data from groups of healthy people between ages 60 and 80 show that they benefit from practice and show performance gains just as younger people do. One series of studies showed that elderly people could even be trained to become memory experts (Baltes and Baltes, 1990). When older people are stimulated and intellectually challenged, this capacity for learning is impressive.

Creativity in an Aging Population

These experiments suggest that the debate about the effect of aging on creativity and intelligence is by no means settled. The readings that follow represent the classic positions in this debate. The selection by Harvey Lehman gives some of the data from his public consensus studies and provides Lehman's major conclusions. Wayne Dennis, one of Lehman's strongest critics, attacks the claim that creativity declines with age. Dean Simonton's article provides an up-to-date summary of scientific studies of age and creativity since Lehman. Simonton shows that some of Lehman's points have been supported, but the issue turns out to be more complicated than earlier imagined. Finally, Gene Cohen argues that personal and public dimensions of late-life creativity must be carefully distinguished.

These discussions of wisdom and aging should remind us of how little we too know about what is possible in old age. It is during the 20th century that we have first seen gains in longevity on a massive scale. Only in recent decades have substantial numbers of people experienced old age in relatively good health and with high levels of education. Therefore, studies of older people in previous decades may not be a good basis for judging what older people are capable of today or in the future.

We are left to take hope from examples of individual achievement in the past. A number of creative artists made outstanding contributions in their old age. At age 71, Michelangelo was named chief architect of St. Peter's in Rome. Titian painted some of his greatest works in his 80s, and Picasso produced drawings and paintings into his 90s. Martha Graham continued her choreography into her 80s, and Jessica Tandy won an Oscar at age 80.

With improving opportunities to practice the arts and to pursue lifelong learning, tomorrow's elders could take up the challenge of creativity in the later years in ways unimagined today. The creative old age once reserved for an elite could become an opportunity for all. As art critic Ananda

Coomaraswamy put it, it is not that the artist is a special kind of person, it is that each person is a special kind of artist. Viewed in those terms, the real debate about age and creativity has barely begun.

Reading 37

Age and Achievement

Harvey Lehman

What are man's most creative years? At what ages are men likely to do their most outstanding work? In 1921, Professor Robert S. Woodworth, of Columbia University, published this statement in his book, *Psychology: A Study of Mental Life*: "Seldom does a very old person get outside the limits of his previous habits. Few great inventions, artistic or practical, have emanated from really old persons, and comparatively few even from the middle-aged. . . . The period from twenty years up to forty seems to be the most favorable for inventiveness" (p. 519). . . .

Assuming that the method by which one arrives at a conclusion is no less important than is the conclusion itself, let us see what is found when the inductive method is employed in the study of man's most creative years. Let us first examine the field of creative chemistry and attempt to answer the question whether chemists display more creative thinking at some chronological age levels than at others.

In his book, *A Concise History of Chemistry*. . . , Professor T. P. Hilditch, of the University of Liverpool, presents the names of several hundred noted chemists and the dates on which these chemists made their outstanding contributions to the science of chemistry. . . .

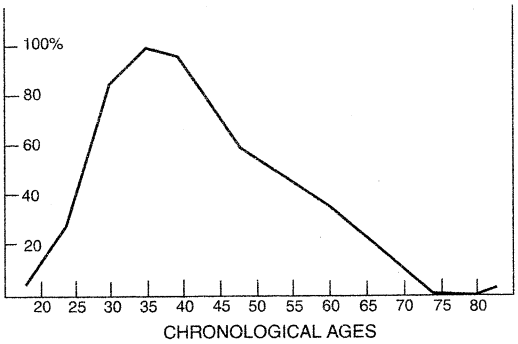
When the birth dates of the chemists listed by Hilditch were ascertained, insofar as data were available, it was possible to determine the ages at which the world's most renowned chemists made their most significant contributions, both theoretical and experimental, to the science of chemistry. A sample of the findings is set forth graphically in Figure 1.

Figure 1 presents, by five-year intervals, the chronological ages at which 244 chemists (now deceased) made 993 significant contributions to the science of chemistry. In studying Figure 1 it should be borne in mind that it sets forth the average number of chemical contributions per five-year intervals. Full and adequate allowance is thus made for the larger number of youthful workers. . . .

Figure 2 presents the ages at which 554 notable inventions were made by 402 well-known inventors. . . . When Figure 2 was displayed to interested friends and colleagues, several persons immediately said, "What about Edison?" It is, of course, well-known that Thomas A. Edison was very active as an inventor throughout his entire life. Figure 3 reveals, however, that 35 was Mr. Edison's most productive age. Moreover, during the four-year interval from 33 to 36, Edison took out a total of 312 United States patents. This was more than a fourth (28 per cent) of all the

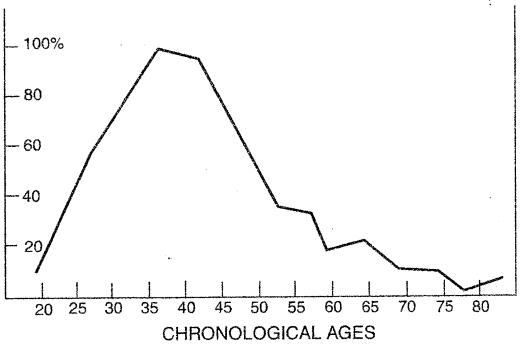
Source: Excerpted from *Age and Achievement*, by Harvey Lehman. Princeton, NJ: Princeton University Press, 1953. Reprinted by permission of the American Philosophical Society.

Figure 1. Average Number of Contributions by Chemists During Each Five-Year Interval of Their Lives



Based on 993 significant contributions by 244 chemists now deceased.

Figure 2. Average Number of Practical Inventions During Each Five-Year Interval of the Inventors' Lives



Based on 554 inventions from 402 inventors now deceased.

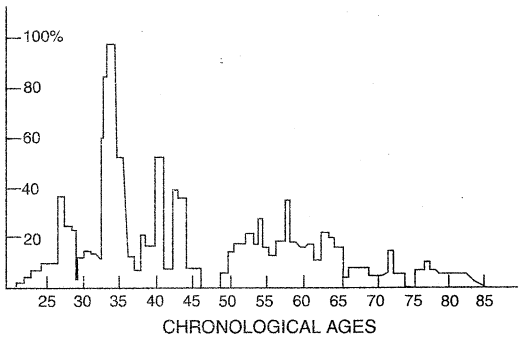
United States patents taken out by him during an inventive career that lasted for more than 60 years. . . .

The shape of a performance age-curve varies with a number of things: (1) the type of performance, (2) the excellence of the performance, and (3) the kind of measurement employed. This last fact can perhaps best be illustrated by use of an analogy. Thus, one might construct an age-curve setting forth the average ability of individuals within each of the several age-groups to do the ordinary high jump. At almost every age level some persons would be found who are more or less able to perform this feat. One might, therefore, test out large numbers at each age level and with the resultant data it would be quite possible to construct age-curves disclosing the *average* height that could be attained by the members of each age group.

But there are several other possible procedures which might be employed for comparing the several age groups. Thus, within each of the age groups, one might ascertain the per cent of individuals able to high-jump six feet, the per cent able to high-jump five feet, etc. With the obtained data it would then be possible to construct one curve that would show for each age group the per cent of individuals able to do six feet, another curve showing the per cent able to do five feet, and so on. If a number of these curves were to be constructed, it seems obvious that that curve which set forth age differences in the ability to do six feet would start its rise later and would fall off both earlier and much more rapidly than would another curve showing age differences in the ability to do, say, two feet. It is evident that very superior high jumping is likely to occur during a narrower age-range than would be found for a much lower degree of ability.

If we think in terms of actual performance, the foregoing situation seems to exist in such diverse fields of endeavor as athletics, mathematics, invention, science, chess, the composition of enduring music, and the writing of great books. For each of these types of behavior, very superior achievement seems most likely to occur during a relatively narrow age-range, and the more noteworthy the performance, the more rapidly does the resultant age-curve descend after it has attained its peak. The findings with . . . reference to sculptured works, oil paintings, and etchings suggest similarly that there is an optimal chrono-

Figure 3. Age Versus Inventions Patented in the U.S.A.



Based on a total of 1,086 patents.

Figure 4. Age Versus Famous Sculpture

Based on 262 works by 63 sculptors.

logical age level for superlatively great success within these particular fields also. . . .

The work of the genius in his old age may still be far superior to the best work that the average man is able to do in his prime. Therefore, for the study of age differences in creativity, it is not valid merely to compare the achievements of the aged genius with the more youthful accomplishments of the average person. If one wishes to ascertain when men of genius have done their very best work, it is necessary to compare the earlier works of men of genius with their own later works. . . .

Sculpture. Effort was made to ascertain the ages at which the most noted sculptors of early Greece executed their most famous works, but this information could not be obtained. Data for Figure 4 were found in Lorado Taft's *The History of American Sculpture*. . . , which attempts to list the best works of the most famous American sculptors. It seems safe to assume that Taft's list contains no age bias. From his book the dates of execution were found for 262 sculptured works by 63 sculptors now deceased. For these 262 works Figure 4 sets forth the average number executed during each five-year interval of the artists' lives. . . .

By means of statistical distributions and graphs [we] show the ages (1) at which outstanding thinkers have most frequently made (or first published) their momentous creative contributions, [and] (2) at which leaders have most often attained important positions of leadership. . . .

The most notable creative works of scientists and mathematicians were identified by experts in the various specialized fields of endeavor. For such fields as oil painting, education, philosophy, and literature, a consensus of the experts was obtained by a study of their published writings. In each field listed below the maximum average rate of highly superior production was found to occur not later than during the specified range of ages. For example, item 1 of this list, chemistry, 26-30, is to be interpreted as follows: in proportion to the number of chemists that were alive at each successive age level, very superior contributions to the field of chemistry were made at the greatest average rate when the chemists were not more than 26-30. The remaining items here and those in the tabular lists that follow are to be interpreted in similar manner.

Physical Sciences, Mathematics, and Inventions:

1. Chemistry, 26-30
2. Mathematics, 30-34
3. Physics, 30-34

4. Electronics, 30-34
5. Practical Inventions, 30-34
6. Surgical Techniques, 30-39
7. Geology, 35-39
8. Astronomy, 35-39

Biological Sciences:

9. Botany, 30-34
10. Classical Descriptions of Disease, 30-34
11. Genetics, 30-39
12. Entomology, 30-39
13. Psychology, 30-39
14. Bacteriology, 35-39
15. Physiology, 35-39
16. Pathology, 35-39
17. Medical Discoveries, 35-39 . . .

For most types of superior music, the maximum average rate of good production is likely to occur in the thirties. Here are the maxima.

18. Instrumental Selections, 25-29
19. Vocal Solos, 30-34
20. Symphonies, 30-34
21. Chamber Music, 35-39
22. Orchestral Music, 35-39
23. Grand Opera, 35-39
24. Cantatas, 40-44
25. Light Opera and Musical Comedy, 40-44

For the study of literary creativity, fifty well-known histories of English literature were canvassed. The works most often cited by the fifty literary historians were assumed to be superior to those cited infrequently. Best-liked short stories were identified similarly by use of 102 source books, and "best books" were ascertained by study of a collation of fifty "best book" lists. As is revealed by the following tabulation, literary works that are good and permanently great are produced at the highest average rate by persons who are not over 45 years old. It is clear also that most types of poetry show maxima 10 to 15 years earlier than most prose writings other than short stories.

26. German Composers of Noteworthy Lyrics and Ballads, 22-26
27. Odes, 24-28
28. Elegies, 25-29
29. Pastoral Poetry, 25-29
30. Narrative Poetry, 25-29
31. Sonnets, 26-31
32. Lyric Poetry, 26-31
33. Satiric Poetry, 30-34
34. Short Stories, 30-34
35. Religious Poetry (Hymns), 32-36
36. Comedies, 32-36
37. Tragedies, 34-38
38. "Most Influential Books," 35-39
39. Hymns by Women, 36-38
40. Novels, 40-44
41. "Best Books," 40-44
42. Best Sellers, 40-44
43. Miscellaneous Prose Writings, 41-45 . . .

Although the maximum average rate of output of the most important philosophical books occurred at 35-39, the total range for best production extended from 22 [to] 80, and for mere quantity of output—good, bad, and indifferent—the production rate was almost constant from 30 [to] 70. . . .

A very large proportion of the most renowned men of science and the humanities did their first important work before 25, and . . . in general the earlier starters contributed better work and were more prolific than were the slow starters. . . .

For most types of creative work the following generalizations have been derived. Within any given field of creative endeavor: (1) the maximum production rate for output of highest quality usually occurs at an earlier age than the maximum rate for less distinguished works by the same individuals; (2) the rate of good production usually does not change much in the middle years

and the decline, when it comes, is gradual at all the older ages—much more gradual than its onset in the late teens or early twenties; (3) production of highest quality tends to fall off not only at an earlier age but also at a more rapid rate than does output of lesser merit. . . .

Item 62 in the following tabulation shows that, in proportion to the number of men who were still alive at each successive age level, presidents of American colleges and universities have served most often at 50-54. The other items in this tabulation are to be interpreted similarly.

62. Presidents of American Colleges and Universities, 50-54
63. Presidents of the U.S. Prior to Truman, 55-59
64. U.S. Ambassadors to Foreign Countries From 1875 to 1900, 60-64
65. U.S. Senators in 1925, 60-64
66. Men in Charge of the U.S. Army From 1925 to 1945, 60-64
67. Justices of the U.S. Supreme Court From 1900 to 1925, 70-74
68. Speakers of the U.S. House of Representatives From 1900 to 1940, 70-74
69. Popes, 82-92

An analysis of age data for the most highly successful athletes reveals that their modal ages differ less from the norms for intellectual proficiency than is commonly supposed. The following comparisons are illustrative.

70. Professional Football Players, 22-26
71. Professional Prizefighters, 25-26
72. Professional Ice Hockey Players, 26
73. Professional Baseball Players, 27-28
74. Professional Tennis Players, 25-29
75. Automobile Racers, 26-30
76. Leading Contestants at Chess, 29-33
77. Professional Golfers, 31-36
78. Breakers of World Billiards Records, 31-36
79. Winners at Rifle and Pistol Shooting, 31-36
80. Winners of Important Bowling Championships, 31-36 . . .

When seven groups of earlier-born athletic champions were compared with seven groups of those more recently born, the field of sport being kept constant in each comparison, the later-born were found to be older than the earlier-born. The changes that have taken place in the modal ages of creative thinkers, leaders, and athletes all evidence the fact that these modal ages are not due solely to genetic factors. Whether the modal ages will continue to change and whether they can be subjected to some kind of human control are quite different questions.

A mere increase in man's longevity should not change greatly the modal ages at which man exhibits his greatest creative proficiency since, both for long-lived and for short-lived groups, the modal age occurs in the thirties. . . .

Possible Causes for the Early Maxima in Creativity

At present we are in no position to explain these curves of creativity that rise rapidly in early maturity and then decline slowly after attaining an earlier maximum. Undoubtedly multiple causation operates in these complex behaviors and no discovered contributing condition is likely to be of itself a sufficient or necessary cause. Nevertheless, it is profitable here to list sixteen of the factors which have been suggested as contributing to these representative functions with their early maxima, for such factors indicate possible lines for further research. Here is the list.

(1) A decline occurs prior to 40 in physical vigor, energy, and resistance to fatigue. This decline is probably far more important than such normal age changes as may occur in adult intelligence prior to outright senility.

(2) A diminution in sensory capacity and motor precision also takes place with advance in age. For example, impaired vision and hearing handicap the older individual in many cumulative ways, and writing by hand also becomes more difficult with advance in age.

(3) Serious illness, poor health, and various bodily infirmities more often influence adversely the production rates of older than of younger age groups.

(4) Glandular changes continue throughout life. It is conceivable that hormone research may some day reveal a partial explanation for the changes and especially for the early maxima.

(5) In some instances unhappy marriages and maladjustment in the sex life, growing worse with advance in age, may have interfered with creative work.

(6) The older age groups, more often than the younger, may have become indifferent toward creativity because of the death of a child, a mate, or some other dear one.

(7) As compared with younger persons, older ones are apt to be more preoccupied with the practical concerns of life, with earning a living, and with getting ahead.

(8) Less favorable conditions for concentrated work sometimes come with success, promotion, enhanced prestige, and responsibility.

(9) In some cases the youthful worker's primary ambition may not have been to discover the unknown or to create something new but to get renown. Having acquired prestige and recognition, such workers may try less hard for achievement.

(10) Too easy, too great, or too early fame may conceivably breed complacency and induce one to rest on his previously won laurels before he has done his best possible creative work.

(11) Some older persons may have become apathetic because they have experienced more often the deadening effect of non-recognition and of destructive criticism.

(12) As a result of negative transfer, the old generally are more inflexible than the young. This inflexibility may be a handicap to creative thinking, even though it is dependent on erudition.

(13) Perhaps in part because of the foregoing factors, some older persons experience a decrease in motivation which leads to a weaker intellectual interest and curiosity.

(14) Younger persons tend to have had a better formal education than their elders, they have grown to maturity in a more stimulating social and cultural milieu, and they have had less time to forget what they have learned.

(15) In some few cases outright psychosis has clouded what was previously a brilliant mind. Psychoses occur more often in the latter half of the normal life span.

(16) In other extreme cases, the individual's normal productive powers may have been sapped by alcohol, narcotics, and other kinds of dissipation. Here, as elsewhere, it is difficult to separate cause from effect. . . .

Upon the basis of all these statistics what is one to conclude? Whatever the causes of growth and decline, it remains clear that the genius does not function equally well throughout the years of adulthood. Superior creativity rises relatively rapidly to a maximum which occurs usually in the thirties and then falls off slowly. Almost as soon as he becomes fully mature, man is confronted with a gerontic paradox that may be expressed in terms of positive and negative transfer. Old people probably have more transfer, both positive and negative, than do young ones. As a result of positive transfer the old usually possess greater wisdom and erudition. These are invaluable assets. But when a situation requires a new way of looking at things, the acquisition of new techniques or even new vocabularies, the old seem stereotyped and rigid. To learn the new they often have to unlearn the old and that is twice as hard as learning without unlearning. But when a situation requires a store of past knowledge then the old find their advantage over the young.

Possibly every human behavior has its period of prime. No behavior can develop before the groundwork for it has been prepared, but in general it appears that the conditions essential for creativity and originality, which can be displayed in private achievement, come earlier than those social skills which contribute to leadership and eminence and which inevitably must wait, not upon the insight of the leader himself, but upon the insight of society about him.

Reading 38

Age and Achievement
A Critique

Wayne Dennis

The recent book by Lehman (1), *Age and Achievement*, seems to indicate that in many fields relatively little creative work of importance is done persons past 45 or 50 years of age. This generalization does not hold in all fields of creativity, but the preceding sentence expresses Lehman's most striking finding.

That the production of first-rate work in poetry, art, science, and other creative areas decreases markedly with age is a matter of prime importance. If correct, it suggests that the creative worker in many fields should plan for early superannuation. If the conclusion drawn by Lehman is erroneous, the impression which it has created should be corrected with dispatch, for a conviction that early deterioration is inevitable may itself have deleterious consequences. Clearly the relationship of age to achievement is a topic in regard to which conclusions should be drawn with extreme care.

It is the thesis of this [essay] that much of the apparent decline in creative achievement revealed by Lehman's tables and graphs is due to factors other than age. We believe Lehman's data give a spurious appearance of age decrement in creativity.

Let us note first that the studies presented by Lehman are so numerous and so varied that it is difficult to do justice to them in a brief recapitulation. However, it is not incorrect to say that Lehman has been interested primarily in determining the 5 or 10 year age-period in which important creative works have most often been produced. The first step in this procedure, typically, consists in identifying important works in some field. To avoid introducing a bias of his own, he always uses a list of works drawn up by some other person. Lehman then determines the age at which each item was produced. He has done this for many creative fields, including mathematical discoveries, contributions to chemistry, lyric poems, and operas, to mention only a few. The first six chapters of his book are devoted to presenting the results of these analyses.

The graphs in these chapters almost all indicate that the production of outstanding works rises to a peak relatively early in the adult years and then declines. The age at which the peak of productivity is reached varies from field to field. It is as early as ages 22-26 for lyrics, ballads, and odes, and as late as 40-45 for novels, metaphysics, and miscellaneous prose writings. However, for a considerable number of fields the top rates for the production of outstanding works occur between ages 30 and 39.

Many aspects of these curves are worthy of attention, but we are concerned chiefly with the decrements which follow the peaks. In most instances, as presented by Lehman, the decrements are very striking. For example,. . . at ages 40-45 chemists produce, per man [*sic*], only one half as many significant contributions as they produce between ages 30-35. By ages 60-65 their rate of

Source: "Age and Achievement: A Critique," by Wayne Dennis, *Journal of Gerontology*, 2(3): 331-333, 1956. Publication of this article was supported by a grant from the Forest Park Foundation to the *Journal of Gerontology*.

production is only 20 per cent of their peak rate. Other graphs give very similar data for other sciences. The fine arts also show a severe decrement. For example, . . . by ages 45-50 the production of orchestral music judged to be of highest merit is only about 10 per cent as great as it was 10 years earlier. By ages 55-60 the composition of orchestral music of high quality decreases to 20 per cent of the maximum rate.

Examination of such findings, page after page, creates an impression of inevitable decline. If these charts are taken at their face value, we must conclude that in most kinds of creative work the output of work of first-rate quality is greatly reduced after the thirties.

But should these charts be taken at their face value? Let us consider this question.

A major methodologic weakness in Lehman's treatment of data lies in the fact that in most instances a table or graph combines information pertaining to men of different degrees of longevity. Thus a table usually presents data for men nearly all of whom reached age 30, but only part of whom attained age 40, and still fewer of whom completed half a century of life. To equate for differences in numbers of subjects at different ages, Lehman found the mean number of important contributions per person for persons surviving each decade. We shall attempt to show that this method of treating data acts in part to produce the productivity differentials which Lehman discovers.

Let it be noted that each man whose record is used by Lehman is required to produce only one important work in order to qualify for inclusion. In most lists of outstanding works used by Lehman, each individual contributes one, or only a few items. In his collections of data, the mean number of contributions per man is often only two or three. Furthermore, the mean number of "significant" contributions per man is only slightly greater for the men who lived to age 70 than it is for the men who died relatively early.

In order to be included the short-lived man must have produced a significant work at an early age. To qualify for inclusions, a long-lived man was required to produce one significant work but this could have been done either early or late. In other words, in order to achieve a certain degree of eminence, the short-lived man must have fulfilled in a few years what the longer-lived achieved in a more leisurely fashion. We shall show that the consequence of combining data for men of different longevities is a higher average productivity in the early decades.

In this connection Lehman says. . . , "Adequate allowance for the unequal numbers of individuals alive at successive age levels was made. . . ." It seems to us that no adequate allowance can be made for the fact that all of the significant contributions of short-lived people occur in the early decades, whereas the long-lived can contribute both early and late. In tabulating entries for different decades, the twenties or thirties receive a score for each short-lived person. On the other hand, the later decades, such as the sixties, contain no entries for short-lived persons and only part of the entries for the septuagenarians. When data from men of different degrees of longevity are included in the same table, the early decades have an inevitable loading which is not shared by the later decades. To give the later decades a similar loading, it would be necessary to adopt the rule of including a long-lived person only if he made a significant contribution in his later years, because, conversely, the short-lived person is included only if he made a significant contribution in the early decades of life. This is a somewhat subtle point, but one which is essential to the correct evaluation of Lehman's data.

From the point of view of the consideration presented above, a very interesting table is presented by Lehman in his penultimate chapter. . . . This table represents 1,540 notable contributions to various sciences. In this case, the data for persons of different longevity are treated separately. For this reason, the criticism presented above does not apply.

The table shows that for each group the decade . . . of the thirties is most productive but the differences between the thirties and the forties are not large. The largest difference between the thirties and forties occurs among those dying in the forties. In this group ill-health may have contributed

to the decrement. For longer-lived groups, even the decrements in the fifties, compared to the thirties, are not dramatic. No group in the fifties drops to the extent which is found when persons are not segregated according to longevity. In other words, this table shows that the combining of data for men of unequal longevity in other tables seems to have exaggerated the apparent age decrement. Nevertheless, even when data refer to men of equal life-spans some age decrement is still found.

This table is so significant in regard to age decrement that it is surprising that Lehman makes no reference to it when discussing the striking decrements reported in his earlier chapters. Nor are its findings adequately reflected in the summary chapter of his book. For these reasons it seems necessary here to emphasize the importance of the data which it contains.

We believe that much of this residual decrement is the product of other deficiencies in methodology. For one thing, it seems likely that the very high peaks of productivity which Lehman reports in his early chapters may be due to errors in sampling and to choosing age-intervals in such a way as to maximize the effects of sampling errors.

Many, but not all, of the curves presented by Lehman are based upon a relatively small number of entries. Thus figure 14 is the result of only 52 entries, figure 16, 30, figure 51, 53, figure 53, 67, and figure 56, 40. These entries are divided among age-intervals, usually 5-year periods, extending from age 20 to age 70 and beyond. With small numbers of entries divided among 10 or more age intervals, one would expect that, even though no true age differences are present, high values in some age-intervals would frequently be obtained through the operation of sampling errors. This fact is important because the highest age score in any body of data is taken as the peak from which decrement is measured. Therefore any exaggeration of the peak naturally results in finding exaggerated decrements.

This factor is further aggravated by the fact that Lehman did not limit himself to a fixed set of age-intervals, but apparently altered them in order to determine the particular "peak years" which seem to characterize a particular set of data. Thus, as the final chapter indicates, the step-intervals for peak years for different activities are variously reported as 22-26, 24-28, 25-29, 26-31, 30-34, 32-36, etc. The modification of age-intervals in order to find "ages of maximum productivity" would be legitimate if the findings were cross-validated against new data, but this was seldom done. Hence the extent to which "peak years" are affected by random errors of sampling is unknown.

There can be little doubt that some part of the decrements reported by Lehman are to be explained by the considerations just presented. The reader of Lehman's book will note that decrements are less precipitous in the graphs which are based upon numerous data and in the construction of which the step intervals follow the decimal system instead of being varied to maximize the peaks.

The preceding arguments have been of a mathematical or statistical sort. Those which follow are of a different kind, but, we think, no less cogent.

Lehman used as a criterion for inclusion of a work as a "significant contribution" the appearance of the work in histories of the appropriate area, or its appearance in lists of "best" books, "best" operas, etc. Perhaps, no better indices of importance are available, but it should be pointed out that these criteria may have certain weaknesses from the point of view of the study of age differences. It is possible that biographies, histories, and lists of best works contain systematic errors somewhat favoring a man's early work at the expense of his later products, and Lehman's findings may reflect these biases. For example, the art historian may be more likely to mention a painter's first significant contribution than he is to mention his last important piece of work. Likewise, an historian of science may be more likely to mention a young man's pioneering research which opened a new vista than he is to describe the subsequent painstaking investigations which

were necessary to develop and validate the promise of the pioneering study. It is difficult to know to what extent an apparent age decrement may be due to the proclivities of anthologists and historians rather than to age itself.

In this connection, the possibility of a bias against the evaluation of recent contributions should be considered. It is our impression that critics and historians tend to consider the evaluation of recent contributions to be more difficult than the evaluation of more remote works. They may, therefore, suspend judgment in connection with recent contributions. Now a considerable number of Lehman's subjects were born after 1800. . . . Their later works were recent works at the time of the preparation of the source books from which Lehman obtained his data. Unwillingness, on the part of historians and editors, to evaluate recent works would therefore lessen the number of significant works recorded for the later years of some of Lehman's subjects. Consonant with this interpretation is Lehman's report that in former centuries the decrement with age in several fields seems not to have been as great as in recent times. . . . A century or more ago the apparent decline of creativity with age was slight.

Let us note, too, that the assessment of the relative excellence of work done early and late in a man's career is made exceedingly difficult, if indeed not impossible, by the changes in standards which occur during a man's lifetime. For example, the situation in biology in 1880, when Darwin was 71, was extremely different from what it was when "The Origin of the Species" appeared in 1859 when Darwin was 50. In fact, the difference was due in large part to Darwin's own work. It seems relatively meaningless to compare biologic contributions made before and after the publication of the theory of evolution. This argument, of course, is not limited to biology. Changing standards characterize all fields, whereas judgments of quality in regard to works separated by several decades seem to imply absolute standards.

Standards for the judgment of quality are further complicated by the great increase in the number of creative workers in most fields which has taken place in recent times. Thus the best psychologist in America in 1900 was the best in a group of approximately 100. The best psychologist today, if he were ascertained, would have to be judged the best among 13,000. A psychologist living in 1900 and still living today, had 99 competitors for distinction in his youth and has 12,999 rivals (or thereabouts) in his later years. Similar, if perhaps less striking, increases in personnel have taken place in other fields. Curves for age changes in number of significant contributions do not, and probably cannot, correct for changes in standards of evaluation which occur during a lifetime.

In summary, we have presented several reasons for skepticism in regard to accepting the view that there is a decrement with age in the production of creative works of high level. We have not attempted to be exhaustive in this treatment. We submit, however, that there is a reasonable doubt that the curves presented by Lehman depict an age decline. Quality of creative work *may* decrease with age, but data presently available do not offer satisfactory evidence.

We would like to be able to suggest a method by which valid conclusions concerning changes in the quality of creative contributions with age could be reached, but we are unable to do so. All sources of data, and all methods of evaluation which we have considered seem to suffer from one or more of the difficulties discussed above. Nevertheless, it has been noted that as the methodologic difficulties in Lehman's work are reduced, the apparent decline with age becomes smaller. Whether ideal data would show no decline prior to extreme old age it is at present impossible to say, but this possibility should not be ignored.

Reference

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Reading 39

Creative Productivity Through the Adult Years

Dean Keith Simonton

All too often the years in the latter part of life are seen as a phase of decline in creative powers. Supposedly once an individual enters his or her 40th year, society cannot and should not expect much, for the best years have been left behind. This notion is expressed cruelly in Shakespeare's words, "When the age is in, the wit is out." No wonder that many otherwise productive individuals sense a "midlife crisis" coming on as they pass into the putative region of decline and deterioration. Indeed, some commentators have aggravated matters by claiming that the downhill slide normally begins in the 30s rather than the 40s, as is evident in a little poem written by Paul Dirac, who received the Nobel Prize for Physics when only 31 years old for work he had completed when just 25:

> Age is, of course, a fever chill that every physicist must fear. He's better dead than living still when once he's past his thirtieth year. (quoted in Jungk, 1958, p. 27)

Presumably these conceptions of the superiority of youth to maturity are based on straightforward empirical observations—solid facts rather than prejudicial stereotypes. But is that necessarily so? One can always offer anecdotes, about the exceptional accomplishments of youth, such as Newton's *annus mirabilis* that reportedly occurred before his 24th year, but such instances can always be balanced by stories of phenomenal achievements by personalities in advanced age; for example, Copernicus saw his treatise on the heliocentric system published as he lay on his deathbed in his 70th year. So what is required is not the compilation of anecdote and counter-anecdote, but rather the systematic investigation of how creative productivity changes over the life span.

Interestingly enough, scientific inquiries on this very question have been going on for over a hundred years (e.g., Beard, 1874; Quetelet, 1835/1968). The classic study in this area is Harvey C. Lehman's (1953) well-known *Age and Achievement*, in which the connection between creative productivity and chronological age is examined for virtually every endeavor under the sun. Although Lehman's work suffered from a number of methodological problems—not surprising for such a pioneer effort—recent years have seen a resurgence of investigations that exploit more sophisticated techniques. Indeed, the fact that so many children of the baby boom generation are now entering the latter half of life may have made this a hot issue in life-span developmental psychology. Accordingly, despite the existence of several published reviews of the most current literature in the past few years (see, especially, Simonton, 1988, 1900a, 1990b), the burst of activity has already rendered these surveys somewhat obsolete! An updated summary of key findings is thus in order.

Let us begin with one solid empirical generalization that was first promulgated in 1835 and

Source: "Creative Productivity Through the Adult Years," by Dean Keith Simonton, *Generations*, Spring 1991, pp. 13-16.

that remains robust today. If one plots the number of creative products, such as articles, paintings, or plays, as a function of a creator's chronological age, the output rate first increases rather quickly, attaining a peak in the late 30s or early 40s of life; thereafter, productivity gradually declines. It is the latter portion of the age curve, naturally enough, that seems to shatter the hopes of those wanting to continue creativity in the final half of life. Indeed, ever since Beard (1874), this downward tendency has led to pessimistic expectations about the utility of advanced maturity. Nevertheless, while the observed age curve has been replicated hundreds of times, more detailed theoretical and empirical analyses reveal that the picture is not as bad as first meets the eye. Six considerations, discussed below, are paramount.

Exceptions Expected

It cannot be stressed too much that the typical age curve is merely a statistical average of hundreds of separate age curves for individual creators. Like any statistical summation, the result is far from deterministic; no creative person is forced to have his or her career trajectory follow the exact same course. Rather, these averaged age curves can be taken to represent merely the probability of creative output at particular stages in a human life. Because we are dealing solely in probabilities, "exceptions to the rule" must be necessarily expected, not categorically denied. This point takes on special force when we introduce a central finding of the recent empirical literature: The generalized age curve is not a function of chronological age but rather it is determined by *career age* (e.g., Simonton, 1991, in press). People differ tremendously on when they manage to launch themselves in their creative activities. Whereas those who get off to an exceptionally early start may—if circumstances to be discussed later are held constant—find themselves peaking out early in life, others who qualify as veritable "late bloomers" will not get into full stride until they attain ages at which others are leaving the race. It is for this reason that some creative personalities have failed to reach the acme of their achievements until near the close of their lives.

Magnitude of Decline

But to make matters simpler, let us now suppose that we are confining our analysis to individuals who all initiated their creative activities at the same chronological age, such as the mid-20s, thus taking the respective career ages of these individuals as identical—what then? Notwithstanding the general occurrence of an age decrement in productivity in the final decades of life, the magnitude of this decline is seldom so substantial that an individual must become devoid of creativity at life's close. On the contrary, the average rate of output in the seventh decade of life falls to around half the rate seen at the career optimum in the 30s and 40s (Simonton, 1988). Consequently, even an octogenarian can expect to produce many notable contributions to a chosen creative endeavor. Indeed, even though a 50% decrement may look depressing, the drop by no means necessitates the last decade of a typical career to suffer in comparison to the first decade of that same career. Quite the contrary: Creators in their 60s and 70s will most often be generating new ideas at a rate exceeding that of the very same creators in their 20s (e.g., Dennis, 1966). In fact, toward the end of life the postoptimum decrease in output decelerates, so that rather than a plummeting we witness a leisurely asymptotic approach to the zero productivity level (Simonton, 1984). Of course, those persons who experience severe disabilities may exhibit a "terminal drop," but such an unfortunate happenstance is far from normal so long as a creator's health holds out. As a consequence, it is easy to list impressive accomplishments by people who were well along in years, yet not necessarily late bloomers (Lehman, 1953, chap. 14).

Variation Across Disciplines

The overall age curve described earlier is not only the statistical average of hundreds of separate career trajectories that can depart from the norm in manifold ways, but in addition the generalized

trend represents a kind of rough summary of age curves that vary substantially across disciplines (Simonton, 1988). Especially noteworthy is the realization that the expected age decrement in creativity in some disciplines is so minuscule that we can hardly talk of a decline at all. Although in certain creative activities, such as pure mathematics and lyric poetry, the peak may appear relatively early in life, sometimes even in the late 20s and early 30s, with a rapid drop afterwards, in other activities, such as geology and scholarship, the age optimum may occur appreciably later, in the 50s even, with a gentle, even undetectable decrease in productivity thereafter (e.g., Dennis, 1966). Expressed in precise terms, whereas in some endeavors the last decade of life may see output rates only 10 percent as high as witnessed at the career maxima, in other endeavors the productivity seen in the closing years may remain quite near the magnitude of output reached in the supposed productive prime.

The occurrence of such interdisciplinary contrasts endorses the conjecture that the career course is decided more by the intrinsic needs of the creative process than by generic extrinsic forces, whether physical illness, family commitments, or administrative responsibilities. This conclusion is bolstered further by the fact that the distinctive age curves for various disciplines tend to replicate across different nationalities and historical periods (Lehman, 1962; Simonton, 1975). Now clearly, if creativity in some domains can persist until the final days, it becomes obvious that we cannot speak of broad decrements in psychological functioning required for creative output (Simonton, 1988). Significantly, a theoretical model that quite accurately predicts such interdisciplinary differences in the career trajectories does so solely by taking into consideration the information-processing requirements of distinct fields (Simonton, 1989a).

Admittedly, for creators whose aspirations fall into fields that feature early career optima, these empirical findings may still look discouraging. A lyric poet, after all, will yet be "over the hill" at a relatively youthful age. Even so, nothing prevents a person from switching fields in order to preserve creative vitality. By carefully designed mid-career changes, individuals may resuscitate their creative potential (cf. Root-Bernstein, 1989).

Quantity or Quality

One critical question lies lurking in the preceding discussion, namely, whether we are speaking of quantity or quality when publicizing the age trends. Lehman's (1953) classic summary of his extensive empirical findings has often been attacked for excessive reliance on tabulations of only those creations recognized as notable or influential, ignoring the much larger body of potential contributions that underlie the few works that are thus singled out (Simonton, 1988). Dennis (1966), in particular, argued that, whereas tabulations of famous contributions may exhibit sharp declines in the later years, truly exhaustive tallies display far more gradual decreases. Therefore, if we choose to reject the judgments of posterity and focus on strictly behavioral measures, the age decrement in creativity is much less substantial.

This criticism has two deficiencies, however. First, if the term "creative" is to have any genuine meaning, it must ultimately be tied to real social value, and thus mere behavioral productivity is largely irrelevant. Second, and more profound, empirical studies actually demonstrate that quality of output across the life span is strongly associated with quantity of output (e.g., Over, 1989; Simonton, 1977, 1985). In other words, those periods in a creative career in which an individual is generating the most total works tend to be, on the average, the same periods in which the most successful pieces emerge. In fact, if one calculates the ratio of creative products to the total number of offerings at each age interval, one finds that this "quality ratio" exhibits no systematic change with age. As a consequence, the success rate is the same for the senior colleague as it is for the young whippersnapper. Older creators may indeed be producing fewer hits, but they are equally producing fewer misses as well. Hence, on a contribution-for-contribution basis—that is, by

determining the probability that a particular product will prove influential in a given domain of cultural endeavor—we cannot speak of an age decrement at all! This probabilistic connection between quantity and quality, which has been styled the "constant probability of success" principle (Simonton, 1988), strongly implies that an individual's creative powers remain intact throughout the life span.

Individual Variation

Individuals vary immensely in what may be termed *creative potential,* which may be roughly defined here as the maximum number of attempted contributions an individual is capable of making given an unlimited life span (Simonton, 1988). The primary behavioral manifestation of this variable is the sheer rate at which ideas are generated throughout the career: The higher the creative potential, the faster the output per annum. Now because this individual difference variable is independent of the age of career onset (Simonton, in press), it provides yet another factor that can enhance the creativity of the later years. In particular, given a set of persons having all launched their careers at the same chronological age, that subset of individuals who score high on this attribute will tend to generate possible contributions at a more prolific rate in the closing years and thus, according to the constant-probability-of-success principle, manage to produce more truly notable works as well. The age curves do not really differ for those highest in creative potential, but rather the curves function at a larger scale; thus a person with exceptional potential will be producing at rates in the final years that can surpass the productivity of an individual with lower potential who is operating at his or her career peak. Consequently, predictions about the expected creativity in the last decade cannot be made without reference to substantial cross-sectional variation in both the age at which the career commences and the individual's total creative capacity (see, e.g., Over, 1982a, 1982b).

A Secondary Peak

In all of the preceding points we continued to speak of an age decrement in the last years of life, the main thrust of the arguments being that certain factors can intervene to impede the seemingly inevitable decline. Yet empirical research actually suggests that creative productivity can undergo a substantial renaissance in the final years, especially toward life's close. For example, some time after the late 60s a resurgence in output often appears (Simonton, 1988). This secondary peak, to be sure, is not nearly so pronounced as that appearing in the so-called prime of life. Even so, its very existence contradicts the supposed inevitability of the downhill slide.

This contradiction gains even greater force when we consider the recent demonstration of the swan-song phenomenon, or "last works" effects (Simonton, 1989b). After subjecting 1,919 works by 172 classical composers to detailed quantitative scrutiny, one striking pattern emerged: As the composers neared their final years, when death was becoming more than an abstract contingency, they began to create compositions that were more concise, with simpler and more restrained melodic lines; yet these compositions scored extremely well in esthetic significance, as judged by musicologists, and eventually joined the popular mainstays of the classical repertoire. It is as if each composer, when seeing the end approaching fast on life's horizon, put the utmost into everything undertaken, with the knowledge that among the current works-in-progress dwelt a last artistic testament. Whatever the motivation, the mere fact that dying creators can pull off such feats provides another argument on behalf of the theory that the general decline in output need not be synonymous with a deterioration in creative powers.

The foregoing six points by no means exhaust all that might be said on this critical life-span developmental issue (cf. Simonton, 1988, 1990b). But these empirical findings should enable us to appreciate that the final phase of life can be, and often is, a period of phenomenal creativity. At the very least we should understand how it can come

to pass that certain creators manage to leave posterity with monumental creations that would have been sorely missed had their late-life endeavors been summarily dismissed. Thus in the arts, Cervantes could complete Part II of *Don Quixote* at age 68, Verdi compose *Falstaff* in his 80th year, and Titian paint *Christ Crowned With Thorns* when approaching 90 years of age. And turning to science, Laplace finished his *Celestial Mechanics* at age 79, Humboldt put out the last volume of his *Cosmos* when 89, and, most remarkably, the chemist Chevreul took up the study of gerontology in his 90s and published his last scientific paper when 102! Nor are such examples restricted to a bygone era, as the recent example of Elizabeth Layton well exemplifies: At the age of 68, she combated thoughts of suicide by taking up artistic expression, propelling herself on an enterprise of distinctive creativity at an age when most would be contemplating retirement.

The important implication of these examples is that the career trajectory reflects not the inexorable progression of an aging process tied extrinsically to chronological age, but rather entails the intrinsic working out of a person's creative potential by successive acts of self-actualization.

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Reading 40

The Creative Age

Gene Cohen

Creativity: Different Styles

Thomas Edison took out more than one thousand patents during his career, continuing to invent throughout his life. When he was sixty-five (1912), he produced the first talking motion pictures. During World War I, when he was in his seventies, he headed the Naval Consulting Board and directed research in torpedo mechanisms and antisubmarine devices. He devoted his eighties to efforts to develop from domestic weeds a substance that would resemble rubber.

When we think about creativity as a life force, we often think first of renowned artists, leaders, scientists, or inventors whose works powerfully illustrate creativity as "the process of bringing something new into being," as suggested by author Rollo May. But where does that leave those who live lives of less spectacular achievement, lives of more ordinary interests and activities?

In order to have a better grasp of creativity, we must first understand a simple truth: Creativity is not just for geniuses. You don't have to be born with inherited talent or raised in a special environment to be creative. Silvano Arieti, a renowned psychiatric researcher and author of *Creativity: The Magic Synthesis*, celebrated the importance of what he called "ordinary creativity" that is satisfying and often may eliminate a sense of frustration.

In a similar vein, Harvard Prof. Howard Gardner, a noted expert on human development, distinguished two types of creativity: Creativity with a "big C" and creativity with a "little c." Creativity with a "big C" applies to the extraordinary accomplishments of unusual people, for example, Albert Einstein's theory of relativity or Georges Braque's Cubist paintings. These forms of creativity not only changed entire fields of thought—in these cases, physics and art—but also influenced other fields of thought and, in some ways, world history.

Creativity with a "little c" is grounded in the various and sundry realities of life. "Every person has certain areas in which he or she has a special interest," Gardner explains. "It could be something they do at work—the way they write memos or their craftsmanship at a factory—or the way they teach a lesson or sell something. After working at it for a while they can get to be pretty good—as good as anybody whom they know in their immediate world." For example, the man from whom I bought my first house began during his retirement to plant and sculpt the backyard garden, creating a beautifully landscaped three-level visual experience, which in his late eighties

was photographed for a national magazine featuring houses and gardens.

Creativity with a "little c" also applies to individuals who set small challenges for themselves, like making a meal a little differently or approaching a problem at work from a new perspective. While these examples would not seem on the level of significance as Einstein's theory of relativity, creativity with a "little c" is no less important in the way we develop our individual potential for highly successful creative lives in our own realms.

My own view of creativity, drawn from my years of research and other work and life experience, is that there is *public* creativity and *personal*, or more private, creativity.

Public creativity represents creative acts that are recognized and celebrated as such by your own community, culture or beyond. We often think of public creativity along the "big C" lines, something widely recognized that is the product of a famous person. Indeed, public creativity can be as obvious as a major sculpture or a cure for a disease. But public creativity also includes something as close to home as a wall mural in your community, or a bulletin board display you might create as a volunteer in the school down the street.

Personal creativity depicts something new, perhaps a product or idea, or simply a fresh perspective; something that you have brought into being that has enhanced your life and given you satisfaction. It simply hasn't reached a level of public awareness or impact, and it may never do so. You may not have even intended for it to matter to anyone but you or those close to you.

For instance, through your imagination and inventiveness you may have created a new recipe, a new floral arrangement, a poem you can send via E-mail to your daughter or granddaughter, a new trick you taught your old dog, or a new exercise regimen. These are examples of personal creativity.

Comparing public and personal creativity, your result may seem quite different, but the value of the underlying creative process, the emotional experience of creative expression, is the same. Both dimensions of creativity are valuable and both continue robustly throughout the human life cycle, independent of age. . . .

It is reasonable to believe we all have varying levels of each kind of intelligence, and that they evolve with life experience and inner growth. Intelligence is not the same as creativity, because you can be intelligent without bringing something new into being. But creativity can build upon intelligence. That is why each of us, depending upon our inner resources and external influences, has the capacity for unique creative discovery and self-expression. . . .

Social creativity is a form of creative expression that has been especially strong among older members of society throughout the history of civilization. Prior to the technological age, older adults were the keepers of knowledge, the key to transmitting knowledge to younger members of society.

Now, as we have become deluged with data, older adults, through their wisdom, help us determine what matters and what doesn't. It is not surprising that so many diplomats and Supreme Court justices are older persons; life experience and developmental gains have enabled them to build social creativity. It is also not surprising that many unique aspects of our cultures, such as indigenous foods, crafts, trade, song, or dance, are passed down from an older generation to a younger one. One of the most important creative roles of older persons is as *keepers of the culture*. . . .

Many of us do not have the time to spend developing an expertise to pursue a dream, at least not until later in life. You may not have been able to take that class on embroidery, woodworking, photography, or writing until your children were in high school or your professional work demanded less of your attention.

Experience from the outside world is a combination of opportunities and avoidance of too many obstacles. If you grow up in a house where people love to work with their hands, you see that work modeled and you learn the language of it, so to speak. It becomes part of your experience, perhaps to be expressed in your later tangible expressions of creativity. If you grow up in a musical household, that culture and language becomes

part of you, perhaps to be expressed in the creativity of music. If you grow up in a household of social activists, your life experience may be reflected in how socially creative you become.

This helps explain why some people appear to be "more creative" than others or have an easier time gaining access to their creativity. Some people have had more opportunity and fewer obstacles in acquiring experience or expertise; some have had the good fortune of ample exposure to positive influences and opportunities.

But it is never too late to benefit from new opportunities and positive influences. We can more actively seek them out by taking special-interest classes or meeting new people who affirm our sense of self-worth. Retirement takes on a new and exciting sense of promise when you view it as time to explore and discover. We also can confront our inner obstacles to creativity—depression, anxiety, and fears—and seek help in overcoming them, from informal support or self-help groups to professional counseling, if necessary. . . .

In a time when our lives are dictated by demanding schedules and expectations, when days are crammed with organized living, when our vision of ourselves and our future is darkened by distorted media images and cultural messages, then simply to remain open to the possibilities requires a kind of courage born of creativity. It is that inner voice that whispers: "Why not?"

FOCUS ON PRACTICE OLDER ADULT EDUCATION

Increasingly, education is not limited to the first stage of life but is instead extended over the life course. One obstacle to late-life education, however, is a stereotype that the elderly are too old to learn. Sometimes older people themselves accept the stereotype, but we have seen that continued involvement in learning helps to maintain the ability to learn.

Today's opportunities for late-life learning are more plentiful than ever before. Along with organized educational programs, many informal opportunities for older people also abound. One example of a successful program is Elderhostel, founded in 1975 as a summer residential college program for people over age 55. It offers noncredit courses in the liberal arts and now attracts more than 200,000 participants each year at 1,000 campuses around the United States and in 70 countries overseas. Elderhostel involves no homework, papers, or grades. But it does offer an opportunity for low-cost travel and an intellectual challenge for those interested in learning.

For those who do not want to travel to another community, tuition-free space-available courses are offered at most public universities. In addition, a national survey of community colleges showed that up to a quarter of 2-year institutions provide some offerings for older adults, mostly in the areas of personal financial planning; health and life enrichment (for example, arts and humanities, exercise, and nutrition); and contemporary civic or political issues (Ventura-Merkel and Doucette, 1993).

Still another approach is the local Learning in Retirement Institute, where retired people with special skills or knowledge teach courses to one another. This mutual-aid model has been replicated in 280 communities around

the United States and is now sponsored by Elderhostel. In the Scandinavian countries, France, Spain, and other countries, older people have created similar "Universities of the Third Age" affiliated with institutions of higher education.

In the future, we can expect that older adult education will increase substantially. One reason is the rising level of prior education among successive cohorts of older people. Previous education is the best predictor of interest in lifelong learning. The median level of education for people over age 65 in the year 1900 was only 8 years, wheras by the 1980s it had risen to 12 years. Between 1970 and 1994 the proportion completing high school rose from 28% to 62%. Today, younger people have comparatively higher levels of education, but after the year 2000, Americans over age 65 will have nearly as many years of schooling as the general adult population (U.S. Bureau of Census, 1984).

An explosion in lifelong learning among mature adults is already taking place. In 1984, there were 2.7 million people age 55 and older who had taken adult education courses, and nearly a million of these were persons 65 and older. The number of older people participating in adult education courses is growing rapidly. The expanding population of educated adults should make lifelong learning even more appealing over the entire life course.

FOCUS ON THE FUTURE LATE-LIFE LEARNING IN THE INFORMATION SOCIETY

Dateline: May 1, 2015, Washington, DC. Associated Press.

Today, President Martha Jefferson welcomed 30,000 delegates to the White House Conference on Aging. At the same time, on a specially dedicated Web Site, she announced the beginning of Older Americans Month.

President Jefferson noted that this White House Conference on Aging, the first in the 21st century, was held exactly one decade after the last conference. The big difference, she noted, is that this time there were 10 times as many official delegates—far more than any hotel in Washington could accommodate.

In fact, conference "delegates" didn't meet face to face at all but "convened" in cyberspace. They used high-speed fiber-optic connections made possible for Internet III CyberSystem.

President Jefferson also took special note of the more than 1,000 older people at the Conference who had earned an advanced degree through distance learning under Internet III or its predecessors. She noted that students over the age of 55 are now the fastest growing segments in U.S. higher education.

* * *

The likelihood of this scenario all depends on how quickly new computer and telecommunications technologies achieve acceptance and widespread

use among the aging population. Technology is advancing rapidly, and signs of late-life learning in an information society are already evident at the dawn of the 21st century. Today, many older people still have anxiety about using a computer. But technophobia is a stereotype, and their anxiety can be overcome.

Studies have shown that computer communication can be an aid to independence for older adults. For instance, one study looked at a sample of women aged 55 to 95 in a Florida community, a group with no prior experience with computers. Participants in the study were at first given a simplified electronic mail and text-editor system, and their software was later upgraded to offer news, weather, movie reviews, health information, and entertainment news. A follow-up survey showed that participants easily learned to use the system and came to value it as a means of social interaction (Czaja et al., 1993).

Another study looked at older adults' ability to learn a specific computer skill: using the Lotus 1-2-3 spreadsheet program (Garfein, Schaie, and Willis, 1988). Participants, whose average age was 58, were tested on measures of fluid and crystallized intelligence and given training on computer tasks. More than half of the participants performed well on criterion tasks, suggesting that older individuals can benefit from formal educational experiences as well as trial-and-error learning. As might be expected, fluid intelligence scores were the key predictor of success.

One of the leaders in the "seniors in cyberspace" movement is SeniorNet, a nonprofit organization founded in San Francisco in 1986 to teach computer skills to older persons (Furlong and Lipson, 1996). SeniorNet has grown rapidly as a membership organization with more than 70 learning centers around the country supporting more than 15,000 individual members. SeniorNet publishes its own educational materials, holds annual conferences, and operates its own online network. SeniorNet Learning Centers, run by senior volunteers, are found in community centers, in senior centers, at schools and on college campuses, in libraries, and at health care facilities. Through America Online, SeniorNet also offers classes and discussion forums, live chats, and file downloading.

SeniorNet is not the only service for elders in cyberspace. The Cleveland Free Net has become a nationally recognized example of how an entire city can be "wired" to promote maximum access by all groups, with prominent participation from the elderly and disabled. For example, the local Cleveland Alzheimer's support groups are plugged in to the Free Net, providing a combination of "high tech" and "high touch." In this way, the "virtual community" of cyberspace becomes a means of reinforcing and extending face-to-face mutual support networks.

In growing numbers, older people are using computers to entertain themselves, improve their productivity, and enhance quality of life (Lawhon, Ennis, and Lawhon, 1996). People aged 55 and older are using the Internet and World Wide Web in a variety of creative projects, including writing for fun and profit, preparing family histories, communicating with distant family members, and maintaining community involvement through bulletin

boards. Typical computer projects may involve recipe files, personalized children's books, bridge tallies, computer portraits, genealogies, family newsletters, and computer-related poems.

For older people to realize the benefits of new computer and telecommunications technologies, those technologies must be made widely available, easy to use, accessible to people with disabilities, reasonably priced, and capable of supporting a wide variety of applications. Among the new technologies that might benefit older adults are self-paced distance learning with feedback via modems, computerized technologies to allow older workers to work at home, online networks organized by support groups for specific diseases or impairments, and monitoring services and automated check-ins that help the frail elderly maintain their independence (Koch, 1992).

The key to lifelong learning in an information society will be to perceive older adults as active users of new technologies rather than as passive recipients (Czaja and Barr, 1989). Two-way interactive TV can address loneliness and isolation among the elderly. For instance, a two-way television system in Reading, Pennsylvania, has been programmed, operated, and financed by senior citizens. The Leisure World retirement community in California has long operated its own cable TV station and generated local programming. Interactive and self-directed activities using new technologies can enhance knowledge, skills, and adaptability—a high-tech/high-touch world with great promise for older people in years to come.

QUESTIONS FOR WRITING, REFLECTION, AND DEBATE

1. Harvey Lehman's data about the peak years of creativity for different fields are derived from creative people who lived in the past. Would it be reasonable to argue that his conclusions don't apply to older people today because health and life expectancy in recent decades have increased rapidly? Does Wayne Dennis succeed in refuting Lehman's argument that age generally means declining creative power? What are Dennis's strongest points in his criticism of Lehman?

2. Dean Simonton, like Lehman, assumes that in judging late-life creativity we should measure how many "masterpieces" or "breakthroughs" are produced by older people. Do you think this standard is the right one for judging late-life creativity? Would other standards or definitions of creativity be more appropriate?

3. What are the most important points in which Simonton's article supports or modifies Lehman's conclusions about age and achievement? Assume that you are Harvey Lehman looking today at the question of late-life creativity. Write a statement describing how your views have been changed or maintained by the aging of America in recent years.

4. Gene Cohen distinguishes between public and personal or private creativity. Using his distinction, how would you develop an argument about what is limited in Harvey Lehman's measurement of late-life creativity? Can you come up with some measures or benchmarks for what Cohen calls personal or private creativity?

5. Imagine that you are writing a long obituary for "Louise Bachelard" (an imaginary name), who died recently at age 78. "Bachelard" was a famous painter whose style changed dramatically in her later years. In the obituary, describe the ways in which the painter's creativity changed as she grew older, and connect this with what you have learned about the psychology of aging.

6. Paul Baltes and his colleagues define wisdom as accumulated expertise, but this definition makes no reference to character or the ethical behavior exhibited by a wise person. Could a bank robber, like Willie Sutton, be judged to have "wisdom" if he showed skillful judgment in crime based on long experience?

7. Pick an example of an older person who seems to you to have developed some of the traits of wisdom, whether in general or in some specific field of activity. Write to a stranger explaining why this wise older person is someone whose advice should be taken seriously.

8. If we were designing classes or educational programs for older adults based on what we know about older adult intelligence and cognition, how should we organize the learning activities? How would such an older adult educational program differ from what is offered in schools and colleges today?

9. Visit three Web sites: one for Elderhostel—www.elderhostel.org—one for www.thirdage.com and one for SeniorNet—www.seniornet.org. What similarities do you see in these three sites concerning age-appropriate behavior for older adults? What issues do you see *not* reflected in these sites that seem important for successful living in later life?

SUGGESTED READINGS

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