Aging and Intelligence

The general view of aging and old age predominantly held in Western societies is one of general decline in capacity and efficiency. Older people are judged to be less efficient and less intelligent than younger adults. It has long been thought that intellectual powers peak in early adulthood and then show an inexorable decline. This conclusion often is based upon public stereotypes about the elderly correlating decline of physical vigor with decline in intellectual abilities. This image of old age as a period of decline seems deeply embedded in the social fabric of society.

Much of the earlier psychological research literature supported this stereotype. Early work on intelligence suggested that intellectual development peaked at age 16 and then remained constant (Terman, 1916). Empirical work based on a cross-sectional study of subjects using the Army Alpha Test showed substantial age differences across adulthood on some of the subtests (Jones & Conrad, 1933).

Further findings obtained int he standardization of the Wechsler-Bellevue Intelligence Test showed that growth of intelligence does not end in early adolescence and that peak ages are not the same for different aspects of intellectual functioning (Wechsler, 1939). Schaie (1980) stated that much data from longitudinal studies and replication of cross-sectional work have further questioned what we thought we knew about adult intelligence. Baltes and Kliegl (1986) wrote that counterexamples to the view of aging as decline are considered exceptions to the rule in the traditional framework. Individuals undoubtedly exist who perform

extraordinary mental and physical feats in old age. These exceptions from aging as universal and inevitable decline are important to note because they serve to challenge the boundaries of the normal and suggest the value of re-examining the limits of reality. He further indicated that in the area of intelligence, we are interested in understanding the conditions and range of reserve capacity of plasticity that older individuals hold in intelligence and cognitive functioning.

There are those who state that it is not a question whether decline can be established for some variables for some individuals, I can, but instead, there may be some variables on which there is little or no decrement. Also, thee are some individuals who show no decrement on most variables into very old age (Baltes & Schaie, 1976; Schaie, 1974). Botwinich (1977) stated:

After reviewing the available literature, both recent and old, the conclusion here is that decline in intellectual ability is clearly part of the aging picture. The more recent literature, however, is bringing attention to what has been underemphasized in the older literature, via., these declines may start later in life than heretofore thought and may be smaller in magnitude. They may also include fewer functions (p. 580).

According to Sternberg and Berg (1987), most agree that some decline sometimes occurs, but there is no resolution as to the exact circumstances under which it occurs. They state that these circumstances will vary according to person, task, and situation measurement. We must determine what intelligence is during adulthood, Is it the same thing as in younger ages? What is

traditionally meant by intelligence remains static across adult age levels. Therefore, intelligence of older adults can be compared with that of younger adults. However, if intelligence is dynamic over adult intellectual development, then it is not possible globally to compare intelligence across age levels. Limited comparisons are possible, but only of those aspects of intelligence that are indeed the same across the age span (Sternberg & Berg, 1987).

The Nature of Intelligence

What is the nature of intelligence? According to Lohman (1990), controversies about the nature of intelligence seem to repeat themselves. The first controversy relates to the question of whether the general (sometimes called g) factor that is commonly equated with intelligence should be viewed as a psychological entity or whether it is merely a mathematical abstraction. Thorndike, Bregman, Cobb, and Woodyard (1926) were early advocates of the view that responses to items on intelligence tests represent a particular sample of mental bonds, and thus intelligence was better understood as a mathematical abstraction than as a psychological entity. If the ubiquitous general factor is simply a mathematical dimension, then analyses of tasks used on intelligence tests are unlikely to isolate a particular set of mental processes that are the core of intelligence.

The second controversy is whether intelligence is an innate cognitive capacity or, instead, an acquired set of cognitive competencies. The implication of this point is that if intelligence is simply neurological or biological in nature, then the explanation of intelligence would be in terms of structural differences. On the other hand, those who believe that abilities are acquired competencies

tend to emphasize the importance of knowledge in thinking and to study the development of abilities rather than attempt to explain individual differences at a particular point in time. This is important in the consideration of intelligence in adulthood in some of the more contemporary theories.

The third perennial controversy concerns the question of whether intelligence is unitary, or has multiple dimensions as Thorndike, Thurstone, and Guilford emphasized (Lohman, 1990). Sternberg and Berg (1986) stated that intelligence is not one thing, but rather has multiple aspects. These aspects may shift in importance as a function of age, environment, and life contexts. Some of these aspects show decline with age; others do not. Zander (1989) surmised that people do not have intelligence as such, but, rather, intelligences. Thus, different abilities may follow quite different courses as a person grows older.

Horn (1989) postulated a mixture concept of intelligence. he likened this concept to a dinner. One can make a good dinner from a number of different ingredients. Whether this dinner is good or bad is determined by how it is judged against different standards. If a mixture of intelligence happens to be loaded with the abilities that decline with age, one using that measure can argue that intelligence declines with age in adulthood. If most of the mixture-measure is made up of abilities for which there is aging increase, those who use that measure can argue that intelligence increases with age in adulthood. On the other hand, if the two kinds of abilities are about equally weighted in a mixture, then the pronouncement can be that intelligence reaches a plateau of growth in adulthood.

Theories of Intelligence

What is intelligence? How does it develop? Certainly, it is more than the simplistic statement that intelligence is what the intelligence tests measure. Lohman (1989) observed that old questions about intelligence have been raised with a renewed vigor, and new questions have been posed. He further stated that there has been a remarkable resurgence of research on human abilities in the past 15 years, partly because of legal challenges brought to intelligence tests. It also is due to renewed interest in cognition in psychology.

Horn (1989) contended that the concept of IQ is outdated. He made this observation:

> We should stop the practice of defining intelligence as just any old mixture of abilities that someone decides to call IIQ or g; we should stop the practice of treating different mixtures as if they represent the same thing. The concept of intelligence has outlived its usefulness in science (p. 30).

There has been an evolution of thought through the most part of this century. Very early on, intelligence was simply thought of as a single global entity expressed as a general ability. Spearman (1927) introduced the Two-factor Theory of Intelligence. Actually, he was not claiming that there are only two factors of intelligence, but rather that there were two kinds of factors: general and specific. The general factor did represent one global measure of intelligence, while the specific factor actually contained as many specific factors as there are tests to measure mental abilities, and each specific factor is uncorrelated with every other. Since the global measure of

g could not be obtained directly, the measurements of these specific factors were necessary to arrive at a general measurement.

Thorndike et al. (1926) suggested principles that clarified their notions about intelligence. First, other things being equal, the harder a task a person can master, the greater the person's intelligence. Second, other things being equal, the greater number of tasks of equal difficulty a person masters, the greater his intelligence. Third, other things being equal, the more quickly a person produces the correct response, the greater the intelligence.

Theories involving factor analysis began to evolve. Thurstone (1938) was an ardent advocate of such an approach. His theory of primary mental abilities comprised of seven factors. One of the most ambitious factorial theories of intelligence eve proposed was that of Guilford (1985). he posited 120 distinct abilities organized along three dimensions. he later increased these factors to 150.

The theory of intelligence that has perhaps had the greatest impact over the past 25 or so years is that of Fluid vs. Crystallized Intelligence, proposed by Cattell (1963). The function of fluid intelligence may depend more on genetic endowment. It is tied primarily to neurophysiological antecedents reflecting gene-related differences. However, it is not just a measure of hereditary differences. It also represents that part of intelligence that results from the interaction of basic physiological capacity with a set of subject- and culture-invariant experiential antecedents (Schaie, 1980). It deals with the "content-free" basic processes of information processing and reasoning and represents the basic architecture of "mechanics" of intellectual functioning (Baltes &

Kliegl, 1986). Fluid intelligence minimizes the role played by cultural content and is noted as the ability to make original adaptations in novel situations (Zanden, 1989). This form of intelligence is generally tested by measuring an individual's facility of reasoning, often by means of figures and nonword materials such as matrices, mazes, block designs, and picture arrangements (Horn, 1976). This is the intelligence that generally shows a decline in late life (Horn & Cattell, 1967; Horn & Donaldson, 1976).

Crystallized intelligence is determined by abilities which depend most on sociocultural influences. It is assumed to be a precipitate of experience. Crystallized intelligence refers to a cluster of subabilities that deals with content- and knowledge-based elaboration of reasoning (Baltes & Kliegl, 1986). It is the ability to reuse earlier adaptations on late occasions and is commonly measured by testing an individual's awareness of concepts and terms in vocabulary and general information tests, such as science, math, social studies, English, and many other academic areas (Horn & Cattell, 1967; Horn, 1976; Horn & Donaldson, 1977). Crystallized abilities reach an early adult optimal level and remain stable from then on (Horn, 1970).

Perhaps the most comprehensive psychometric work on intelligence to be conducted to date is that of John Carroll (1988). he reanalyzed via factor analysis practically every major data set, and many minor ones, that has ever been reported in the psychometric literature. Carroll's exhaustive analysis has tentatively revealed 20 separate factors of intelligence.

The factor-analytic method has become increasingly less popular

in some circles in the second half of the twentieth century. There are those who reason that factor analysis has little if anything to say about mental processes. As a result, more interest is being shown toward a theory embracing information processing (Sternberg, 1990). New efforts at defining intelligence have benefitted from advances in componential theories of the mind and investigations of cognitive processes (Sternberg & Wagner, 1986).

Sternberg (1989) postulated that there are three approaches to the study of intelligence: The psychometric approach, the information-processing approach, and the diversified-ability approach. The psychometric approach has been the one most used for many decades, and it seeks to understand the nature of intelligence based primarily upon the notion of IQ and the factors that underlie it. The wave of theory and research in the 1970s increased our conceptualization of human intelligence by seeking to understand the mental processes underlying intelligence by the information-processing approach. The diversified-ability approach represented the second wave of research during the 1980s. Whereas the theories of the 1970s seemed to focus primarily on the mechanisms of intelligence, the theories of the 1980s seem to be focusing on the extent of intelligence.

In general, theories of intelligence can be classified as being of two kinds: explicit and implicit. Explicit theories of intelligence are constructions of psychologists or other scientists that are based on data collected from people performing tasks presumed to measure intellectual functioning. Implicit theories of intelligence are constructions of people that reside in the minds of

these individuals, whether as definition or otherwise. These are not formal scientific theories but rather merely people's conceptions of a given phenomenon. Implicit theories are important inasmuch as they give people the means by which they can informally judge another intelligent. They also provide a valuable means for gaining insight regarding the formulation of explicit theories (Sternberg & Berg, 1985).

Not all theorists view intelligence as residing within the individual. Some view it as residing within the environment, either as a function of one's culture and society or as a function of one's niche within the culture and society, or both. What the culture of society deems to be intelligent will generally be a function of the demands of the environment in which people live, the values that are held by the people within that environment, and the interaction between demands and values. Other theorists of intelligence would define the locus of intelligence as occurring neither wholly within the environment, but rather within the interaction between the two (Sternberg, 1990).

Contemporary Models of Intelligence

The neofunctionalist position, articulated by Baltes, Dittmann-Kohli, and Dixon (1984) acknowledges that although some intellectual decline may occur with age, stability and growth also exist in adult mental functioning. this approach to intelligence emphasizes the role of human adaptation in intelligent behavior. They proposed four concepts: plasticity, multidimensionality, multidirectionality, and interindividual variability. Plasticity of intelligence refers to the modifiability of intelligence within an

individual. Multidimensionality relates to the idea that intelligence consists of a multitude of abilities which has properties that may change with development. The concept of multidirectionality has reference to the different patterns of change that occur for different abilities over the life span. The last concept of interindividual variability refers to the large difference in intellectual development that occur across individuals in adulthood.

Denney's (1982) Theory of Unexercised and Optimally Exercised Cognitive Abilities helps to predict results of studies of life span differences in psychometrically measured intelligence (Botwinick, 1977; Denney & Palmer, 1981; Denney, 1982). Tests of fluid ability are said to be measures of relatively unexercised abilities and tests of crystallized intelligence and measures of everyday cognitive functioning are said to be measures of more exercised abilities.

Post-formal operational models (Commons, Richards, & Armon, 1983; Kramer, 1983; Labouvie-Vief, 1982) examine qualitative changes that may occur in the nature of intelligence with age, concentrating on the new cognitive structures that might emerge in adult intellectual life. Kramer (1983) identified three basic characteristics of postformal thinking:

1. Postformal thinkers possess an understanding of relative, nonabsolute nature of knowledge.

2. Postformal thinkers accept contradiction as a basic aspect of reality.

3. Postformal thinkers possess an ability to synthesize contradictory thoughts, emotions, and experiences into more coherent, all-encompassing wholes.

Sternberg (1990) viewed intelligence as theories which are guided by underlying metaphors of the mind. He categorized theories of intelligence as those that looked inward, those that looked outward, and those that looked inward and outward. Those that look inward are represented by the geographic metaphor, which would help to understand our basic processes of thought, and the computational metaphor, which views the mind roughly in terms of the software of a computer. Also, the biological metaphor, which connects the organ of intelligence to the brain, characterizes an inward theory of intelligence. Theories that look outward are represented by anthropological and sociological metaphors. These concepts relate how cultural and social settings affect or even determine the nature of intelligence. Three theories that summarize the interactional modes are Howard Gardner's Theory of Multiple Intelligences, Stephen Ceci's Bioecological Theory of Intelligence, and his own Triarchic Theory of Human Intelligence.

Three principles underlie Gardner's theory (Sternberg, 1990):

1. There exist multiple intelligences, each distinct from the other.

2. These intelligences are independent of each other.

3. These intelligences interact with each other.

Cecil's theory (Sternberg, 1990) can be characterized by the following principles:

1. there does not exist any one cognitive potential--rather multiple potentials.

2. The role of context is critical in the development of cognitive potentials.

3. Knowledge and aptitude are fundamentally inseparable.

A Broader Concept of Intelligence

From the beginning of empirical investigations into intellectual aging, there has been a decided lack of consensus concerning whether the course of adult intelligence is typified by stabilization, progression, or decrement. There is a preponderance of evidence for decline in psychometric test performance, especially in the later years of adulthood. However, several authorities have suggested that there are aspects of intelligence that exhibit stabilization or even progression (Baltes et al., 1984; Denney, 1982; Labouvie-Vief, 1982; Dixon & Baltes, 1986).

In attempting to account for and to understand the dynamic interplay between growth and decline in life-span intellectual performance, it is necessary to examine both the mechanics and the pragmatics of intelligence. Dixon and Baltes (1986) called this a dual process model. According to them, to understand life-span intellectual development, applications must be made to those functional aspects of intelligence associated with the practical demands of adult life.

While new efforts at defining intelligence have benefitted from advances in componential theories of the mind and investigations of cognitive processes, there has been a major push toward broadening the substantive scope of behavior (Sternberg & Wagner, 1986). The broadening of the concept of intelligence to include not only psychometric intelligence, but practical intelligence, would include such constructs as practical reasoning, judgment, common sense, expertise, deliberation, and wisdom (Dixon & Baltes, 1986). Baltes et al. (1984) stated that on this conceptual basis researchers in the

field of intellectual aging have begun to consider the influence of experience, knowledge, and expert skills on processes such as cognitive performance. It is in part these domains that comprise what we have called the pragmatics of intelligence and may not suffer inevitable age-related decline.

Sternberg (1985) stated that environments, and subsequently one's life, also changes with increasing age. Because of this change of environments, there is no single answer to the question of whether the components of intelligence as they function in real-world environments decrease with age. It depends on the context. He goes on further to say that if the environments for older people were exactly the same as for younger people, contextual performance would almost certainly decline. Therefore, if the older adult selects and shapes his environments carefully, then declines of performance may be minimized by capitalizing on those abilities that have remained most intact and by utilizing accumulated knowledge that younger adults may not have.

Several researchers (Kramer, 1983; Sternberg & Berg, 1986) have recently noted the importance of the social context in which intelligence occurs. They suggest that with advancing age, adults are more likely to conceptualize intelligence as the ability to cope and to adapt to those salient interpersonal and intrapersonal problems that characterize everyday life. Thus, with increases in age, adults' implicit understanding of intelligence becomes more social in orientation.

Wisdom is another example of what many label as the pragmatics of intelligence, one that is of particular interest to life-span

researchers. Baltes and Smith (1990) pointed out that wisdom is often considered as a peak performance, perhaps even as a possible end-state of human knowledge and its development. For several thousands of years wisdom has been mentioned as the capstone of human knowledge.

According to sternberg (1990b), the wise individual is found to have much the same analytical reasoning as is found in intelligent persons. yet, he goes further. The wise person listens to others and knows how to weigh advice. He is especially well able to make clear, sensible, and fair judgments, and in doing so, takes a long-term as well as short-term view of the consequences of the judgments made. Sternberg (1990b) characterizes the wise person as one with a megacognitive stance. he knows what he knows and what he does not know, as well as the limits of what can be known and what cannot be known.

Dittman-Kohli and Balte's description of adult intelligence suggests that adults develop the capacity for wise decision-making. They proposed that wisdom entails the following characteristics:

1. Skill or expertise within the domain of personal knowledge.
2. Emphasis on the pragmatic or practical aspects of intelligence and knowledge.
3. Emphasis on the context of the problem.
4. Uncertainty as a characteristic of problems and solutions.
5. Reflection and relativism in judgments and actions.

Holliday and Chandler (1986) used an implicit-theories approach to understanding wisdom. Principal-components analysis of one of their studies revealed five underlying factors: Exceptional understanding, judgment and communication skills, general competence,

interpersonal skills, and social unobtrusiveness.

There is very little explicit-theoretical research on wisdom. However, the most well known program of such research is that of Baltes and Smith (1987). They presented a five-component model that consisted of factual knowledge, procedural knowledge, life span contextualism, relativism, and uncertainty.

Wisdom is commonly associated with aging, and as an intellectual construct, would tend toward a theory of intellectual growth in the later years. It is not measured in the psychometric sense, but is tied to the pragmatics of everyday life. As Sternberg (1989) stated, wisdom is not in measurements that are highly speeded and academic. In this respect, the measurement of wisdom differs from the measurement of "fluid" intelligence, which tends to be highly speeded and academic.

Plasticity and Training of Intelligence

Although determination of a minimally acceptable level of current performance may be essential, it may also be important to know what can be expected in terms of further intellectual development. It is relevant to determine whether or not older persons are likely to gain and show growth as a consequence of participation in some intervention program. The characteristic of intelligence to expand its capacity is known as plasticity and is not often affected through the intervention of training.

Baltes and Kliegl (1986) spoke about the interest researchers have in understanding the conditions and range of reserve capacity or plasticity that older individuals hold in intelligence and cognitive functioning. A decline in internally-oriented abilities is typically demonstrated, but declines in external-oriented abilities are far less

clear. However, Baltes et al. (1984) hypothesized that even internally-oriented abilities show plasticity, which weakens any general conclusion that can be drawn. Baltes and Schaie (1976) contend that throughout life, intelligence is quite plastic, molded by health, education, life experiences, and many other factors.

Evidence from cognitive training research (Baltes & Lindenberger, 1988; Willis, 1987) demonstrates that many older adults, if they are spared from brain-related diseases, possess the capacity to engage in further efforts toward their own development by acquiring new cognitive skills or by nurturing their past strengths. Baltes and Kliegl (1986) concluded that when given cognitive enrichment and practice, most elderly people up to age 75 or so are capable of remarkable gains and peaks of intellectual performances, including those areas of functioning, such as memory, where the typical expectation is one of early and regular decline.

Contextualists also suggest some age changes might be reversible through practice or changes in life-style. Baltes and Willis (1982) showed that if persons aged 60-80 are given practice on test of fluid ability, their performance improves substantially. However, Denney (1982) pointed out that benefits of practice were not limited to the elderly. She said that the same could be said for the younger. In fact, she surmised that the younger might even perform better.

In recent literature, Hayslip (1989) concluded that there is little support for the notion that interventions specifically designed to impact a priori targeted skills cannot be effective with aged people. he further elaborated that training research has undoubtedly settled the question of whether performance on fluid-type intellectual

abilities can be remediated through training. In fact, he pointed out that recent research by Schaie and Willis 91986) has impressively demonstrated that ability training enhances performance even among those aged people who have experienced documented longitudinal, 14-year declines in either inductive reasoning or spatial orientation performance.

Baltes and Lindenberger 91988) summarized 15 years of cognitive research conducted by P. B. Baltes and his colleagues. this research is purported to have shown that many older adults have the reserve capacity to improve their performance on tests of intelligence and other indicators of cognitive efficacy. Improvement results both from self-guided learning and trainer-guided training in relevant cognitive skills. At the same time, there is increasing evidence that there are aging-related limits in the level of training-based performance attainable through practice and other strategies of cognitive engineering. Near maximum limits of capacity, aging loss seems less subject to reversibility.

Baltes, Dittman-Kohli, and Kliegl (1986) investigated the range of intellectual reserve available to aging individuals. The pattern of outcomes replicated and expanded on earlier studies. The findings showed that older adults had the reserve to evince substantial increases in levels of performance in fluid intelligence test. Training also increased accuracy of performance and the ability to solve more difficult test items.

Some Other Research Findings

Sternberg (1989) reported the results of a study that suggested that the speed of intellectual functioning that is represented by Gs

is implicated in the quality of reasoning measured in Gf (fluid intelligence). This finding supported previous findings that Gs is an element of Gf (Jensen, 1982). It is also consistent with results on which Birren (1974) has based the theory stipulating that loss of speed of intellectual functioning is the principal feature of decline of intellectual abilities with aging in adulthood.

There is not doubt that speed of thinking is a critical component of fluid intelligence, as many standard intelligence tests include speed of response as one component. this is one aspect of intelligence testing that many specialists in adult development consider unfair. One reason is that older adults are slower than younger adults at almost everything. yet, slower thinking does not necessarily mean poorer quality thinking. Botwinich (1973) noted that slower thinking may be deeper and better thinking.

While some may contend that slower responses of older adults would reflect great carefulness and cautiousness, Sternberg 91989) suggested that the decline of Gf-reasoning does not result because older adults are more careful and persistent than younger adults. to the contrary, these results add to the reasoning that slowness of thinking comes about as difficulties of Gf-reasoning occur and are recognized by the person.

Woodruff (1983) pointed out that there is extensive evidence to support the contention that the speed of behavior slows with age, and the slowing affects efficiency of behavior rather than simply causing the response to occur more slowly.

According to Bennett and Eklund (1983), visual limitations may contribute to motivation deficits, cautiousness, and decreased

reaction time. Deficits documented in short-term memory and search and retrieval aspects of retention could be, at least in part, attributable to these factors. They hypothesized that visual factors cannot be ignored when assessing intellectual changes in the elderly and may contribute to mental impairment previously ascribed to other factors.

Stankov (1988) sought to determine whether attentional abilities play a role in the changes in fluid and crystallized intelligence that occur with increasing age. The results from his research study indicated that the decline in fluid intelligence with increasing age disappears if attentional factors are parted out. Similarly, the increase in crystallized intelligence with increasing age becomes even greater if one controls for attentional processes. He concluded that changes in attentional processes play an important part in changes in human intelligence with age.

Cornelius, Willis, Wesselroade, and Baltes (1983) conducted a study that examined the convergence between major factors of psychometric intelligence and several attention variables. They hypothesized that processes involved in attention would be most highly related to ability dimensions of fluid intelligence and/or short-term acquisition and retrieval in the theory of fluid-crystallized intelligence. Results indicated that the attention variables included in the study converge chiefly with the ability factor of Perceptual Speed rather than with factors of Broad Reasoning or Memory Span.

Willis, Blow, Cornelius, and Baltes (1983) examined the modifiability of older adults' performance on measures of attentional

processes and training transfer to the psychometric ability domains of Perceptual Speed, Memory Span, and Fluid-Crystallized Intelligence. They found that significant training effects occurred for attention measures, and these effects were maintained at a six-month posttest. However, they found no far training transfer to the ability factors of Fluid-Crystallized Intelligence or Memory Span.

Earlier research by Horn 91982) suggested that attentional processes may be associated with age differences shown in fluid intelligence performance. Specifically, Horn stated that attentional processes may operate in the aging decline of Gf, as implicated in STM and perceptual speed performance.

A research study was conducted by Drachman 91988) on memory and cognitive functioning in normal aging. he discussed research showing that memory and cognitive impairment in normal aging is due both to inevitable biologic attrition of brain function and to intercurrent disease processes. Memory storage, speed of response, channel capacity, visuo-motor performance, and performance IQ on the Wechsler Adult Intelligence Scale (WAIS) tend to be most impaired. Verbal IQ and previously learned skills tend to be preserved. Differences between individuals, independent of age, are often more significant than age-related losses until very advanced age.

Toner (1991) reported the most recent research on aging and intelligence, which was presented to the American Association of Science by Dr. Sandra Weintruab, a neurologist at Beth Israel Hospital in Boston. Dr. Weintruab reported two major new studies showing that many people in their 80s have intellectual skills comparable to those of 35-year olds. Tests of more than 1000 active and retired doctors

in Florida, Texas, and Massachusetts found that the sharpest of those over 75 were intellectually comparable to doctors who were barely out of medical school. Many of the oldest who scored best on a battery of tests, in fact, were still practicing medicine. She reported that she was unclear whether this study reflected the old adage that you either use it or lose it, or whether it simply shows that those who have the skills continue to stay active.

Conclusion

Why study intelligence in adulthood? Schaie (1980) summarized the following values of adult intelligence:

1. It is useful in predicting a person's competence in dealing with our society's educational system.

2. It is useful in predicting success in vocational pursuits which require educationally based knowledge and skills.

3. it is useful in determining intellectual competence which may be directly relevant to such issues as mandatory retirement, educability for new careers and life roles, maintenance of living arrangements.

He further state that if we address the above issues intelligently, we must then know the developmental patterns of different aspects of mental ability and the ages at which developmental peaks occur. We must understand what variables contribute to the apparent fact that some individuals show intellectual decrement beginning with early adulthood, while others maintain and increase their functioning until advanced old age.

Conclusions drawn in a study by Baltes and Kliegl (1986) could well summarize this study of aging and intelligence;

1. Reliable decrement until very old age (late 80s) cannot be found for all abilities or for all individuals.

2. For most individuals there is decrement on those abilities which require speed of response and for those abilities whose measurement is particularly sensitive to relatively modest impairment of the peripheral nervous system.

3. Decrement is likely to be found on most abilities for individuals with severe cardiovascular disease at any age.

4. Decrement is likely to be found on most abilities for individuals living in socially deprived environments beginning with the late fifties and early sixties.

5. Data from independent random samples tend to over-estimate "Normal" age decrements for those variables where ontogenetic changes indeed occur.

6. In healthy, well-educated populations, ontogenetic change on intellectual-ability variables is proportionally small, such that many individuals perform with the middle range of young adults.

Schaie (1983) reported that overall, the results of most research have lead to two general conclusions about the assessment of cognitive development during adulthood:

1. While cross-sectional research comparing adults of various ages shows a gradual decline in intellectual ability, longitudinal research shows an increase in most abilities throughout early adulthood, and usually throughout middle age.

2. Cohort differences affect test scores more powerfully than age differences until about age 60.

Personally, in my study of the research on aging and intelligence,

I have found that Baltes et al. (1984) best describes adult intellectual competence in their neo-functional approach. I will again summarize it as follows:

1. Intelligence is multidimensional, that is, that it involves several distinct dimensions.

2. Intelligence is multidirectional in that it can follow different trajectories with age. For example, short-term memory generally falls quite steadily, while vocabulary generally rises.

3. Intelligence shows interindividual variation. Some individuals decline in some or all mental abilities by 40, while others are just as capable in some or all at age 70 as they werre at earlier ages.

4. Intelligence is plastic, in that it has the capacity to expand or to improve with training.

In conclusion, what effect does aging have upon intelligence? As we have seen there apparently is no clear-cut answer. There are many factors to be considered. Intelligence must be reconsidered as to what it is in light of internal mental processes, as well as external factors, such as environmental influences. Consideration should be given in relating the two. Intelligence is not one thing, but rather it has multiple aspects which may shift in importance as a function of age, environment, and life contexts. Some of these aspects show decline with age; others do not. Test-relevant abilities do decline, on the average, but life-relevant abilities may or may not, depending on the course and contexts of one's life.