

I n t e l l e c t u a l   F u n c t i o n i n g

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Intellectual Functioning

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Introduction

One of the earliest attempts to take behavioral science research out of the laboratory and to apply it to problems facing our society occurred in the area of human intelligence. It is not surprising, therefore, that human intelligence has been a lasting topic of scientific interest. The study of this topic, however, began by charting the growth of competence in children. I propose to begin my discussion, therefore, by trying to answer the question why we should be interested in extending the study of intelligence to the periods of adulthood and old age. I will then try to sketch the role of intellectual competence with regard to the maintenance of high quality of life and societal viability of the elderly, and discuss the importance of intellectual competence for health-relevant behaviors. Next will follow a brief summary on what we know about the natural course of intellectual development from young adulthood until advanced old age. And finally, I will address the question of whether it may be possible to identify measures for the primary prevention of intellectual decline in old age, and even more importantly whether it may be possible to reverse intellectual decline once it has occurred.

### Why Should We Study the Aging of Adult Intelligence?

Serious work in applied psychology virtually began with the investigation of intellectual competence. Early objectives of such work varied from the identification of mentally retarded children in public schools (Binet & Simon, 1905) to the demonstration of evolutionary characteristics in human behavior by means of the study of individual differences (Galton, 1869). Indeed, the definition of intelligence given by Alfred Binet, the originator of one of the earliest widely used intelligence tests, remains a classic guide for contemporary endeavors. Binet stated that: "To judge well, to comprehend well, to reason well, these are the essentials of intelligence. A person may be a moron or an imbecile if he lacks judgment, but with judgment he could not be either" (Binet & Simon, 1905, p. 196).

Although early work on intelligence was concerned with the acquisition of mental functions in early life, questions soon began to be raised concerned with intellectual development beyond childhood. Early empirical work, for example, suggested that intellectual development reached a peak at age 15 and remained level thereafter (Terman, 1916). And large-scale studies with an intelligence test used to classify soldiers during World War I (Yerkes, 1921) further implied that average young adults crested at a mental age of thirteen! Other studies questioned these inferences. A study that examined most inhabitants of a New England community between the ages of 10 and 60 (Jones & Conrad,

1933) found that there were substantial age differences for some of the abilities measured by intelligence tests, but no such differences on others. And in the standardization studies for the most widely used intelligence test used in clinical assessment, it was found that growth of intelligence does not cease in adolescence, nor does intelligence decline uniformly at older ages (Wechsler, 1939).

The assessment of intellectual competence attains increased importance, when dealing with the elderly population. For example, questions such as who shall be retired for cause (in the absence of mandatory retirement at an early age), whether individuals retain sufficient competence for independent living, or whether individuals can continue to conserve and dispose of their property, all involve the assessment of intellectual functioning.

If the above mentioned issues are of societal importance, it then becomes necessary to obtain data on the factual issues involved. Intellectual decrement within individuals needs to be distinguished from differences between younger and older persons that have resulted from different life experiences. Such differences in life experiences may express themselves in the obsolescent functioning of the older generation when compared to younger peers. We must know at what age intelligence does peak and assess generational differences in intelligence as well as study within-generation age changes. We must further learn why

some individuals show intellectual decrement in early adulthood while others maintain or increase their level of functioning on some ability variables well into old age.

Contrary to the close relation of between physiological growth and the development of intellectual competence in childhood, there is little congruence between structure and function once adulthood is reached (Flavell, 1970). Indeed, performance decrements in the elderly are only in instances of severe pathology (e.g. Alzheimer's disease) tied to specific physiological deficits (Birren & Renner, 1977). These differential progressions for the physiological and behavioral domains in adulthood result in substantial variability both in the maintenance of adaptive functions and in the ability to modify undesirable behaviors or relearn lost skills (Baltes & Schaie, 1976; Baltes & Willis, 1977). Much of the work supported by the NIA in the area of intellectual functioning over the past decade has served to provide a clearer understanding of these heretofore puzzling relationships.

#### The Role of Intellectual Competence in the Quality of Life and Societal Viability of the Elderly

Rapid technological change presents a disproportionately heavy burden upon older persons because they received their substantive education and training in problem solving skills at a time when many of the societal demands and complexities of today's

world had not even been conceptualized. At any point in historical time, therefore, the average older person will be at a disadvantage in terms of their educational background and knowledge resources (Willis, 1985). Nevertheless, it is necessary for most older persons to make substantial adjustments of an economic and personal nature at the time they retire. The decision processes involved in these adjustments require the maintenance of high levels of intellectual competence to permit individuals to function adequately in a changed environment (Willis & Schaie, 1986). Those individuals who have lived in a rather stable and routinized environment may be at particular risk. If sufficiently high levels of competence fail to be maintained, the individual may experience loss of control over their circumstances. Practical consequences that follow include first of all a lowering in the quality of life, as individuals fail to make prudent use of their own and societal resources. Successful retirement for most implies the replacement of work-oriented satisfactions and personal relationships with others that have meaning for the individual. Reduced intellectual competence will make it less likely that the purposeful steps that must be taken to acquire new roles can succeed. Even more serious, however, is the fact that individuals with reduced intellectual competence are at greater risk to be exploited and victimized. Increased environmental stress is likely to reduce the self-management capability of many older persons who suffer

from mild to moderately severe chronic illness. This reduction in coping skills, in turn, is likely to lead to an increased use of medical and social service facilities. Finally, reduced competence in self-care and management of resources, is likely to lead to the decision that institutional care has become inevitable (Schaie & Willis, 1986a).

As the proportion of the elderly in the population increases and a "baby-boom" cohort is followed by a "baby-bust" cohort, important decisions will be made regarding the allocation of societal privileges and responsibilities. The reduction in the ratio of wage earners to those receiving pensions may require upward adjustments in retirement ages. Future labor force shortages may lead to industry trying to retain older workers rather than encourage their early retirement. These matters will require close scrutiny of the relationship between maintaining intellectual competence and reducing technological obsolescence, when policies are to be made with respect to labor force retention in an age range where an increasing proportion of individuals may be at risk of intellectual decline.

Fortunately, our collective research efforts, largely supported by NIA, have shown that all persons do not experience noteworthy decline in intellectual abilities as they age. It must be stressed in particular that individual differences in observed behavior increase markedly throughout most of adulthood, to the extent that we can identify many elderly adults who perform well

above the average level of young adults (Schaie, 1984).

Individual differences in adulthood are maximized by differential life styles that can markedly affect the maintenance or decline of cognitive functions. Unlike most children, adults typically have sufficient control over their lives to determine or change their life styles in adaptive or maladaptive ways. It is the increasing number of instances of quite elderly persons who do not show substantial decline with age, that have encouraged the work that has shown that interventions directed towards the remediation of presumed age deficits may be quite feasible.

#### Intellectual Competence as a Major Component of Health-relevant Behavior

It is often assumed that primary prevention efforts that would encourage the practice of health-relevant behaviors might have substantial effects in reducing health care expenditures. The National Institute of Aging has done pioneering work on topics such as "Behavioral Factors in Sudden Cardiac Death, "Smoking and Behavior," and on "Combining Psychosocial and Drug Therapy in Hypertension, Depression and Diabetes." This has been part of an effort to identify social and behavioral processes not only as correlates or risk factors, but also as specific antecedents or consequences for the major chronic diseases. Such efforts with the elderly, however, depend upon the assumption that relevant information can readily be communicated to and assimilated by the



target population. While this assumption is difficult to test directly, data on intellectual competence in the elderly and the relations between such competencies to everyday behavior may be illuminating. For example, it has been possible to show, that misinterpretation of drug prescriptions, a major concomitant of noncompliance, may be directly related to lowered competence in the inferential thought processes required to interpret medicine labels correctly (Willis & Schaie, 1986). Meaningful participation by the elderly person in treatment planning and compliance with therapeutic regimens involving diet, activity, and alteration of life style all involve the availability of adequate levels of cognitive function. While it might be argued that many health-relevant behaviors are motivationally determined, it is clear that the patient's understanding and comprehension of what is to be accomplished is at least a necessary if not sufficient condition for his appropriate participation in the treatment process.

#### What Do We Know About the Natural Course of Adult Intellectual Development?

The program of research sponsored by NIA has steadily progressed from studies that have been designed to establish basic facts about the aging of intellectual competence to efforts that begin to determine some of the causal factors that lead to the vast differences in the development of individuals. But

determination of causal factors requires more than a spectrum of age-comparative studies. As has been found essential in the investigation of disease processes that develop slowly and are subject to complex influences, so it is true for the study of intellectual functioning, that our major knowledge must come from longitudinal studies of panels of the same individuals. Since changes in adult intelligence occur slowly, such longitudinal studies must be conducted over long periods of time (cf. Schaie, 1983b; Shock et al., 1984). Moreover, the rapid societal changes that affect intellectual competence make it necessary to replicate such studies across successive population cohorts. Studies of this kind require tenacious investigators and long-term support. But much of our more secure knowledge is derived in this manner and I will now give you some brief examples of what we have learned from the few long-term studies of adult intellectual development.

#### Adult Life Course of Mental Abilities

One of the most important findings from the longitudinal studies of intellectual abilities has been the recognition that intellectual growth and decline does not occur uniformly across all of the facets of human intelligence. Moreover, it has been demonstrated in several studies, those conducted at Duke University (Palmore et al., 1985), at the University of California (Eichorn et al., 1981), and in our own Seattle Longitudinal Study (Schaie, 1983a), that the apparent early adult peaks and the steep

decrements thereafter were artifacts of comparing cohorts with different life experience. I would like to give you a few examples of what we now know from my own work that has traced a limited number of intellectual abilities for as long as 28 years. In this work we have dealt with the adult life course of five major components of intelligence: Verbal Meaning or recognition vocabulary (V), Spatial Orientation (S), Inductive Reasoning (R), Numerical ability (N), and Word Fluency, or recall vocabulary (W).

Figure 1 presents longitudinal data obtained by averaging over seven-year intervals that have been adjusted for cohort differences and transient period effects. What these data consistently suggest is that (depending upon gender and ability) a plateau is attained in the thirties, one that is generally maintained to age 60 (albeit with some almost trivial decline for some abilities in the fifties). Thereafter we note significant and accelerating average decrement, occurring at different rates by gender and ability. Note that until the early eighties decrement remains quite small on average. It is only for the very old that decline in intellectual competence begins to become a normative experience. Keep in mind further, that these data are adjusted for cohort differences. One of the major additional findings of replicated longitudinal studies has been the recognition that both level of performance and rates of change differ for successive cohorts. Figure 2 shows the dramatic shifts

that have occurred across successive generation groups on several abilities. Such data permit us to predict levels of function to be expected from future cohorts of the elderly.

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Data such as those just presented, however, tend to conceal a most important item of information. That is, they might indicate to the casual observer that intellectual decrement in old age is universal and unavoidable. Detailed analysis of our data argues to the contrary! Figure 3 depicts individual changes for the three mental abilities of Verbal Meaning, Space and Reasoning over a seven year period from age 67 to age 74. This figures shows the proportion of individuals who have either gained (the solid bars), have remained stable (the cross-hatched bars), or have declined reliably (the open bars). Note that only about a third of our subjects (less for Reasoning) declined reliably. The greater proportion of the individuals monitored remained stable, and about 10 percent even showed significant gain over their earlier level of functioning.

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Insert Figure 3 about here  
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Much of our information on intellectual aging comes from the assessment of ability dimensions that may be more important for

optimal functioning in youth than in adulthood. In its efforts to identify dimensions of behavior that might show increased strength as we age, the NIA has recently sponsored a number of efforts to begin to study topics such as "wisdom" the dimensions and life course of which yet remain to be identified in depth. Once adequate measurement instruments germane to the experience of older adults are developed it may then be feasible to pay greater attention to those aspects of adult intelligence that for some at least may represent continued growth and development (cf. Labouvie-Vief, 1985; Schooler & Schaie, 1986).

#### What is the Basis for Differential Aging Patterns?

While some of the long-term studies have been important in increasing our knowledge on normative aging, a number of recent projects supported by NIA have begun to ask questions regarding differential age changes. Both the Duke and Seattle longitudinal studies of intellectual aging have had access to illness incidence data, and it has been shown for example that persons suffering from cardio-vascular disease show earlier decline than those not so impacted (Hertzog, Schaie & Gribbin, 1978). However, the relationship between disease and intellectual decline is not clearly unidirectional. Detailed analyses are beginning to suggest that it is unfavorable environments and maladaptive life styles that are at the root of both increased risk for cardio-vascular disease and for intellectual decline (Schaie, 1984). More important, therefore, have been the findings that

lack of stimulating environments, disengaged life styles, inflexible attitudes, and lack of supportive interpersonal networks may all be causal factors in the experience of intellectual decline (Gribben, Schaie & Parham, 1980). Disuse factors have further been implicated by showing that those individuals who do decline not only produce fewer adaptive responses in laboratory and everyday situations but become less accurate in their response. Just a beginning has been made in explaining the vast differences in individual development. These matters await information from a variety of laboratory studies now in progress that are designed to study decline phenomena in as much detail as has been required to understand the acquisition of cognitive processes in young organisms.

#### Can Intellectual Decline in Old Age be Prevented and/or Reversed?

Studies that have dealt with the life styles and personality variables associated with intellectual maintenance and decline are valuable in suggesting some of the aspects of a person's life where suitable changes might prevent individual decline. A whole series of more recent studies supported by NIA are currently investigating specific mechanisms of intellectual functioning that might give us clues as to the development of compensatory techniques that might be more widely applied. Some of this work involves the study of expertise that shows maintenance of high levels of competence (for example by older typists or chess

players) in the presence of decline on some sub-processes but with suitable compensation and greater efficiency in others (Salthouse & Saults, 1986).

Perhaps even more exciting is a line of research that shows that the intellectual competence of the elderly can be increased by suitable training. Studies employing brief educational types of training have been found to improve performance in two thirds to three fourth of persons over 60 for intellectual skills such as spatial orientation or inductive reasoning that show relatively early average decline. One of the earliest studies of this kind by Baltes and Willis (1982) in Pennsylvania rural residents, is currently being replicated in several other settings, and studies of long-term follow-up of the effects of brief training are about to begin.

One of the dilemmas of the early training studies has been the fact that we do not know whether training remediates cognitive loss or builds in new skills unless the past history of the trainees is known. Of great interest therefore are recent findings in which participants in a longitudinal study who were 65 years or older were given 5 hours of individual training on either Spatial Orientation or Inductive Reasoning (Schaie & Willis, 1986). Again, about two thirds of all participants experienced significant gain. The most important findings, however, shown in Figure 4, were that training benefitted particularly those participants who had reliably declined over a fourteen year

period. Approximately 40 per cent were returned to the performance level at which they functioned prior to the beginning of their decline.

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#### Some Conclusions

Let me summarize this review by indicating some of the major findings of NIA sponsored research in the area of intellectual functioning and aging:

We have learned that intellectual development in adulthood is a highly differentiated process; different individuals change at quite different rates. We now know that intellectual development peaks in early midlife, and that there is virtually no practically significant decline until the sixties are reached. Thereafter, there is steady acceleration in average decline, but most persons do not decline across the board, and some retain most of their abilities into the early eighties. Individual differences in maintenance or decline have been found to be associated with health status, active life styles, supportive family settings, and flexible personalities. Nevertheless even well functioning older adults can be disadvantaged in at least two different ways: First, some age-related decline may occur through disuse, whether by personal choice or environmental restrictions. Second, even



older adults who have not declined may be disadvantaged because of rapid sociocultural and technological change. We have also found that such declines or disadvantages are not irreversible in many persons. Prescriptive programs of educational intervention have been successful in reversing well-documented decline for substantial proportions of individuals and provided for the enhancement and reduction of generational differences in performance for many other older persons who have not declined.

The past work supported by NIA has already had major impact upon public policy related to the welfare of our elderly citizens in three areas: The first is concerned with educating the media and the public services sector. Many of the assumed disabilities of early old age are directly related to stereotypes about aging that become self-fulfilling prophecies. The findings reported here have begun to convince the media that they ought to attend more extensively to the 95% of the elderly who are not institutionalized and to report on and show successful older individuals who display full cognitive competence. As a result, the public service sector is beginning to be more understanding of the moderate changes occurring with age and to value older clients as being of equal importance and deserving of high quality service and attention. Secondly, these findings are encouraging extensions of health education in new directions designed to stimulate life styles that are supportive of the maintenance of intellectual functioning. Thirdly, evidence on the status of

intellectual competence and its change in aging has affected both legislation and litigation with respect to the elderly in areas such as mandatory retirement and age discrimination in employment.

Programs of the NIA now in place will further our understanding of the precise mechanisms that are implicated both in the decline and in the maintenance of intellectual functioning in old age. This work will identify the important intellectual contributions of dimensions such as wisdom, will provide further understanding of techniques designed to reverse intellectual decline, and will thus provide for an essentially knowledge base that is needed if we wish to increase the quality of life for our elderly population.

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Figure Captions

Figure 1. Longitudinal estimates of age changes for men and women for the Primary Mental Abilities based on 7-year data.

Figure 2. Estimates of mid-life performance level for the Primary Mental Abilities for cohorts born from 1889 to 1952.

Figure 3. Proportion of persons who gain, remain stable, or decline from age 67 to age 74 on the abilities of Verbal Meaning, Space and Reasoning.

Figure 4. Proportion of training participants whose 14-year intellectual decline was reversed successfully.

### CUMULATIVE COHORT CHANGES

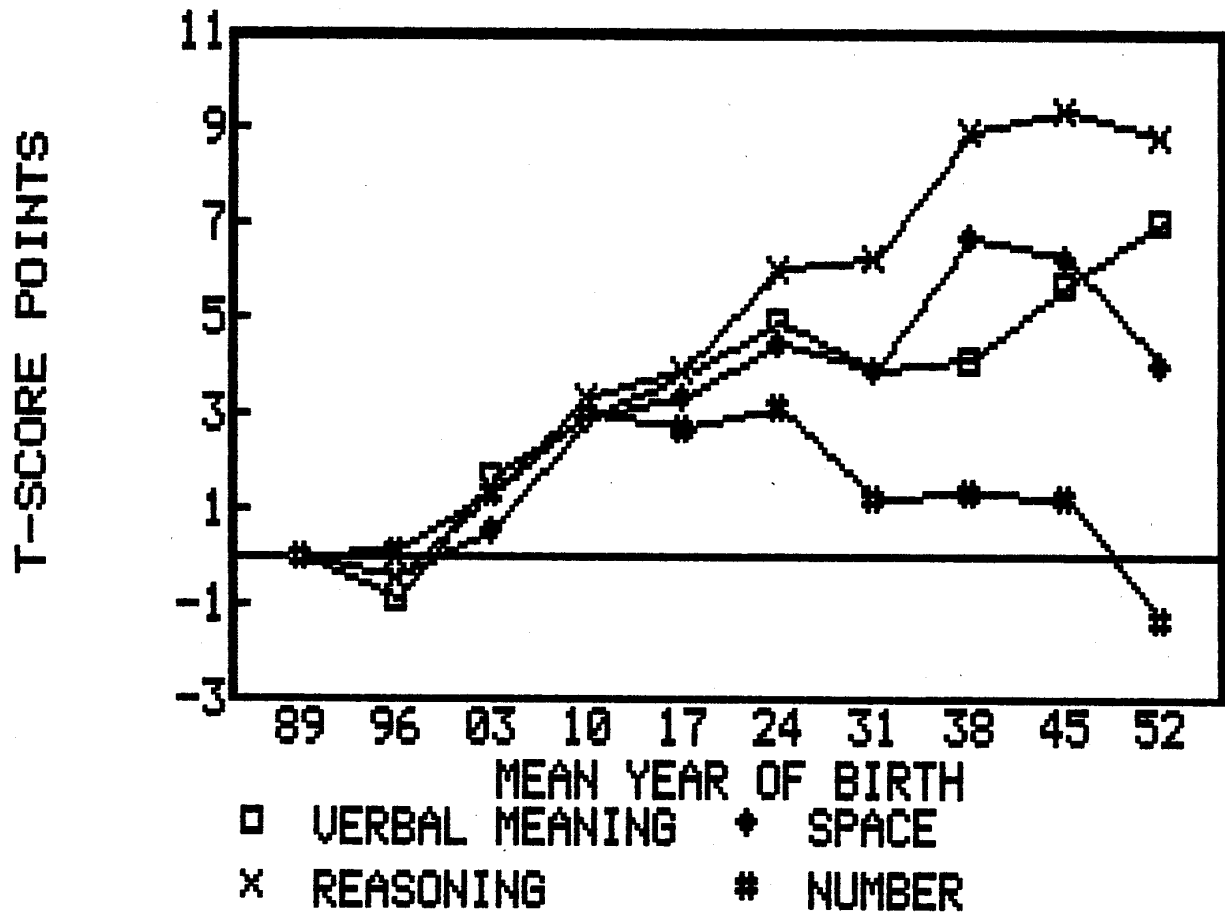
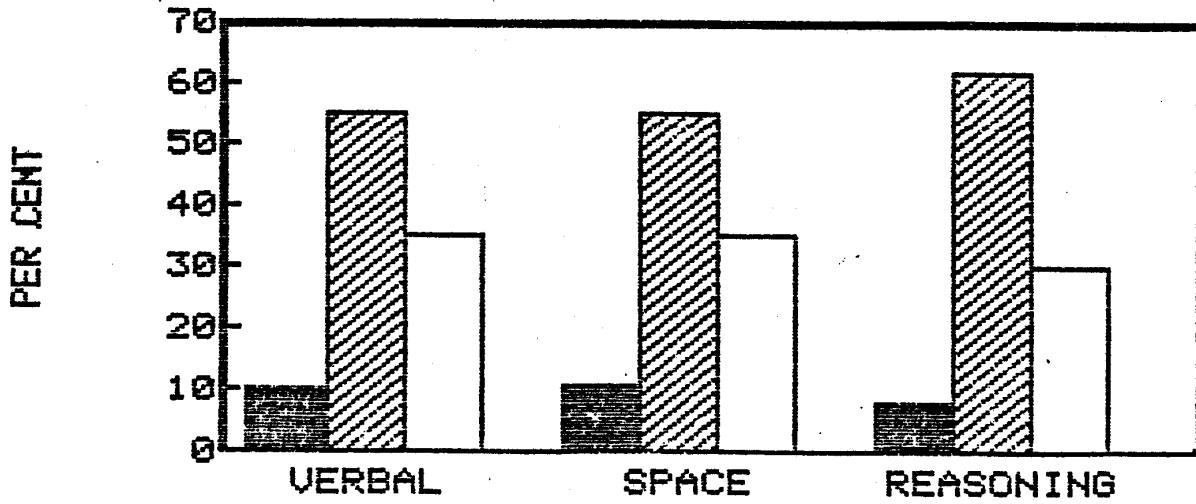




Fig 2

AGES 67 TO 74



CHANGE STATUS  
■ GAINERS    ▨ STABLES    □ DECLINERS

DECLINE SUBJECTS

% RETURNING TO 1970 LEVEL

