Intellectual Competence and Normal Aging

K. Warner Schaie

The Pennsylvania State University

Paper presented

as Part of an Information Exchange on

Alzheimers Disease and Cognitive Impairment

at the

Technology and Aging Conference

University of Massachussetts Medical Center

Worcester, Massachusetts

September 29, 1986

Intellectual Competence and Normal Aging

Introduction

One of the major, if not the major consequence, of the onset of Alzheimer's disease is the progressive loss of intellectual competence. Loss of judgment, memory and many other intellectual skills make it increasingly difficult for the afflicted person to function independently, and places increasing burdens upon those who care for and ultimately must take responsibility for physical care and behavioral control of that person.

Mild decrements in intellectual competence are the typical symptoms that will lead patients and their families to seek professional services that will ultimately result in the diagnosis of the disease. Because of the devastating consequences of Alzheimer's disease for individual and families, there is currently great dread among the elderly that the mild intellectual losses that occur with normal aging, in many albeit not all persons, may signal the onset of the feared disease. It is important therefore to have a thorough understanding of changes that occur in intellectual competence as part of the normal aging process.

For the lay person and human services providers it is necessary to recognize that moderate declines of intellectual competence in otherwise well-functioning individuals may simply result from disuse. Such disuse may occur in many normal older

persons because of less challenging environmental demands occurring upon retirement or restriction of personal networks due to the loss of spouse or friends. Decreases in intellectual competence occurring through such experiential reasons can frequently be reversed, whether by means of formal interventions (Baltes & Willis, 1982; Schaie & Willis, 1986b), or through enriching the individual's life with intellectually more stimulating activities.

The physician or psychologist concerned with the diagnosis of Alzheimer's disease, by contrast, needs to be aware of the fact that normal intellectual aging is a very gradual process, and rarely involves many different abilities at a uniform rate. Since normal changes may be very slight, it may be questionable whether Alzheimer's disease can be ruled out when a simple mental status examination is passed. Assessment on a broad array of intellectual functions such as is offered by the Wechsler tests (Matarazzo, 1972), or the Primary Mental Ability tests (Schaie, 1985) may therefore offer an important way of diagnosing whether an individual's intellectual disfunction is sufficiently pronounced, as compared with average norms, to suggest the likelihood that disease processes above and beyond normal aging might be implicated.

But there are many other reasons why a person's standing on the dimensions of intellectual competence is so important for many decisions involving the elderly, particularly in a society which

is in fast technological flux. I will next sketch some of these issues and then provide some information from my own work on what we know about normal age changes in intellectual competence.

The Importance of Intellectual Competence in the Elderly

The assessment of intellectual competence attains increased importance, when dealing with the elderly population. Questions as to who shall be retired for cause (in the absence of mandatory retirement at an early age), whether a person retains sufficient competence for independent living, or whether a person can continue to conserve and dispose of his or her property, all involve the assessment of intellectual functioning. If issues such as these are of societal importance, it then becomes necessary to consider 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. 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; Schaie, 1981). 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). The 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.

Intellectual Competence and the Quality of Life 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 (cf. Willis, 1985). At any given point in historical time, therefore, the average older person will be at a disadvantage in terms of their educational background and knowledge resources (Schaie, 1986). It is necessary, nevertheless, that most older persons make substantial adjustments of an economic and personal nature at the time they retire. Decisions involved in these adjustments require high levels of intellectual competence to permit individuals to function adequately in a changed environment. Those individuals who have lived in a rather stable and routinized environment may therefore be at particular risk. Loss of control over their circumstances may thus be experienced by those who fail to maintain sufficiently high levels of competence. Consequences that follow may include a lowering in the quality of life, as

individuals fail to make prudent use of their own and societal resources (Schaie & Willis, 1986a).

Successful retirement for most people implies the replacement of work-oriented satisfactions and personal relationships with others that have meaning for the individual. Reduced intellectual competence makes it less likely that purposeful steps necessary for the acquisition of new roles will be successful. More serious, however, is the fact that individuals with reduced intellectual competence are at greater risk to be exploited and victimized. Increased environmental stress reduce s the self-management capability of many older persons who suffer from mild to moderately severe chronic illness. Such reduction in coping skills inevitably leads to increased use of medical and social service facilities. Finally, reduced competence in self-care and management of resources, will lead to the decision that institutional care has become inevitable.

As the proportion of the elderly in the population increases and a "baby-boom" cohort is followed by a "baby-bust" cohort, important decisions must be made regarding the allocation of societal privileges and responsibilities. The reduction in the ratio of wage earners to those receiving pensions will require upward adjustments in retirement ages. Future labor force shortages may induce industry to retain older workers rather than encourage their early retirement. These matters require close scrutiny of the relationship between maintaining intellectual

competence and reducing technological obsolescence, when policies are to be designed that are intended to result in labor force retention for individuals in an age range that contains an increasing proportion of individuals who are at risk of intellectual decline.

Fortunately, there is a substantial body of research showing that noteworthy decline in intellectual abilities is not characteristic of all persons as they age (Schaie, 1984). 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. 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 research that has shown that interventions directed towards the remediation of presumed age deficits is quite feasible.

The Natural Course of Adult Intellectual Development

Over the past few decades research on intellectual aging has progressed steadily from studies that were 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. Such 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, 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 longitudinal studies across successive population cohorts.

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 will illustrate this point by an

example 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 (Schaie, 1983a). What these data suggest consistently 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 substantial decline in intellectual competence begins to become a normative experience. It should be noted further, that these data are adjusted for cohort differences. One of the major contributions of replicated longitudinal studies has been to show that both level of performance and rates of change differ for successive cohorts. Such shifts may be positive as well as negative. Figure 2 shows the cumulative shifts that have occurred for persons born at successive seven-year intervals from 1889 to 1959 on several abilities (Schaie, 1986). Data such as

these permit to evaluate whether observed differences between young and old are likely to be a function of intellectual decline in the elderly or simply due to differential prior experience, that could be remediated by suitable interventions. These data also allow us to predict levels of function to be expected from future cohorts of the elderly.

Insert Figures 1 and 2 about here

The kind of data that I have just presented, however, tend to conceal a very important item of information. These data might indicate to the casual observer that intellectual decrement in old age is universal and unavoidable. More careful analyses, however, argue to the contrary! To illustrate this point, I have obtained frequency distributions of individual changes for the five mental abilities of Verbal Meaning, Space, Reasoning, Number and Word Fluency over a seven year period from age 60 to age 67. 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 less than a third of our subjects 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.

Insert Figure 3 about here

Explanations for Differential Aging Patterns

A number of recent longitudinal studies of intellectual competence 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 then those not so impacted (Hertzog, Schaie & Gribbin, 1978). However, the relationship between disease and intellectual decline is not clearly unidirectional. More detailed analyses suggest that it is unfavorable environments and maladaptive life styles that may be 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 (Gribbin, 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 that they also become less accurate in their response (Willis, 1986a, 1986b).

Reversability of Intellectual Decline in Old Age

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 recent studies give us some 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).

Even more directly pertinent 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 now in progress.

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 62 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.

Insert Figure 4 about here

Some Concluding Comments

Let me end this review by summarizing some of the major findings of research on the normal aging of intellectual functioning:

First, we have learned that intellectual development in adulthood is a highly differentiated process; different individuals change at quite different rates. Second, 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. Third, we have discovered that individual differences in maintenance or decline of intellectual competence are associated with health status, active or inactive life styles, presence or lack of supportive family settings, and flexible or rigid personalities. Fourth, we know that even well functioning older adults can be disadvantaged in at least two different ways: Some age-related decline may occur through disuse, whether by personal choice or environmental restrictions, and some older adults who have not declined may still be disadvantaged because of rapid sociocultural and technological change. Fifth, we have also found that such declines or disadvantages can be reversed in many persons. Prescriptive programs of educational intervention have been successful in reversing well-documented decline for substantial proportions of individuals and have provided for the enhancement and reduction of generational differences in performance for many other older persons who have not declined.

We finally need to ask how this knowledge base is to be applied to clinical practice and questions such as the differentiation of pathological behaviors in old age from normal aging. It should be noted that the comparison of an individual's function on tests of intelligence or mental abilities with appropriate age norms will not necessarily help us understand

whether that individual has undergone consequential changes. Profile differences in age-normed performance on various sub-scales have not proven themselves as strong diagnostic indicators. Obviously a direct diagnosis of the occurrance of significant decrement could readily be made if prior data on objective tests are serendipitously available. Barring that unusual occurrence, the best approach for distinguishing between normal and pathological aging remains the monitoring of patients over time so that an assessment can be made whether the individual is simply functioning at a low but stable level, or whether the low level of performance is indeed part of a rapidly progressing decrement trajectory. To determine how to proceed then requires the clinician to have a better understanding of the extent to which normal age changes occur on various abilities, the extent to which older and younger persons differ, simply because of differential prior educational and life experiences, and the rate of change in intellectual functions that should be expected from non-pathological causes as patients are monitored over time. I hope my comments today has helped to bring to you at least part of the relevant knowledge base.

References

Birren, J. E., & Renner, V. J. (1977). Research on the psychology of aging Principles and experimentation. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (pp. 3-38). New York: Van Nostrand Reinhold.

Eichorn, D. H., Clausen, J. A., Haan, N., Honzik, M. P., & Mussen, P. H. (Eds.). (1981). Present and past in middle life. New York: Academic Press.

Flavell, J. H. (1970). Cognitive changes in adulthood. In L. R. Goulet & P. B. Baltes (Eds.), Life-span developmental psychology: Research and theory (pp. 247-253). New York: Academic Press.

Gribbin, K., Schaie, K. W., & Parham, I. A. (1980). Complexity of life style and maintenance of intellectual abilities. Journal of Social Issues, 36, 47-61.

Hertzog, C., Schaie, K. W., & Gribbin, K. (1978). Cardiovascular disease and changes in intellectual functioning from middle to old age. Journal of Gerontology, 33, 872-883.

Matarazzo, J. D. (1972). Wechsler's measurement and appraisal of adult intelligence. Baltimore: Williams & Wilkins.

Palmore, E., Busse, E. W., Maddox, G. L., Nowlin, J. B., & Siegler, I. C. (1985). Normal aging III. Durham, NC: Duke University Press.

Salthouse, T. A., & Saults, J. S. (1986). The multiple spans of transcription typing. In C. Schooler & K. W. Schaie (Eds.), Social structures and cognitive processes over the life span. New York: Ablex.

Schaie, K. W. (1981). Psychological changes from midlife to early old age: Implications for the maintenance of mental health. American Journal of Orthopsychiatry, 51, 199-218.

Schaie, K. W. (1983a). The Seattle Longitudinal Study: A 21-year exploration of psychometric intelligence in adulthood. In K. W. Schaie (Ed.), Longitudinal studies of adult psychological development (pp. 64-135). New York Guilford Press.

Schaie, K. W. (1983b). What can we learn from the longitudinal study of adult psychological development. In K. W. Schaie (Ed.), Longitudinal studies of adult psychological development (pp. 1-19). New York Guilford Press.

Schaie, K. W. (1984). Midlife influences upon intellectual functioning in old age. International Journal of Behavioral Development, 7, 463-478.

Schaie, K. W. (1985). Manual for the Schaie-Thurstone Test of Adult Mental Abilities (STAMAT). Palo Alto, CA: Consulting Psychologists Press.

Schaie, K. W. (1986, August). The generational ebb and flow of mental abilities. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

Schaie, K. W., & Willis, S. L. (1986a). Adult development and aging. 2nd e. Boston: Little, Brown & Co.

Schaie, K. W., & Willis, S. L. (1986b). Can decline in adult intellectual functioning be reversed? Developmental Psychology, 22, 223-232.

Shock, N. W., Greulich, R. C., Costa, P. T., Jr., Andres, R., Lakatta, E. G., Arenberg, D., & Tobin, J. D. (1984). Normal human aging: The Baltimore Longitudinal Study of Aging. Washington, DC: U.S. Government Printing Office.

Willis, S. L. (1985). Towards an educational psychology of the adult learner. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (2nd ed., pp. 818-847). New York: Van Nostrand Reinhold.

Willis, S. L. (1986a, August). Inductive reasoning: Longitudinal change and cognitive training. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

Willis, S. L. (1986b, August). Spatial ability performance in old age: Descriptive and interventive findings. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

Willis, S. L., & Schaie, K. W. (1986). Practical intelligence in later adulthood. In R. J. Sternberg & R. K. Wagner (Eds.), Practical Intelligence: Origins of competence in the everyday world (pp. 236-268). New York: Cambridge University Press.

Author Note

Preparation of this paper was supported in part by research grant # AG04770 from the National Institute on Aging. Requests for reprints should be directed to K. Warner Schaie, S-110 Human Development Bldg., The Pennsylvania State University, University Park, PA 16802.

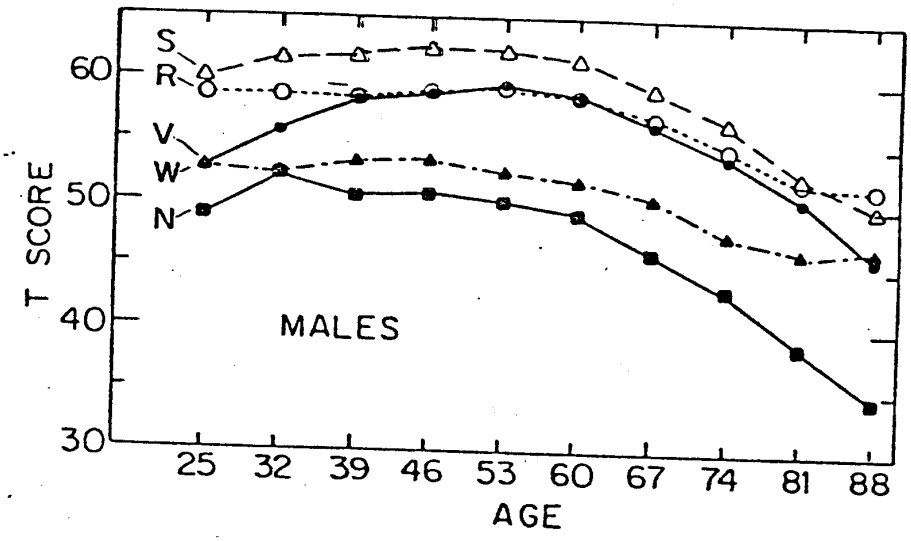
Figure Captions

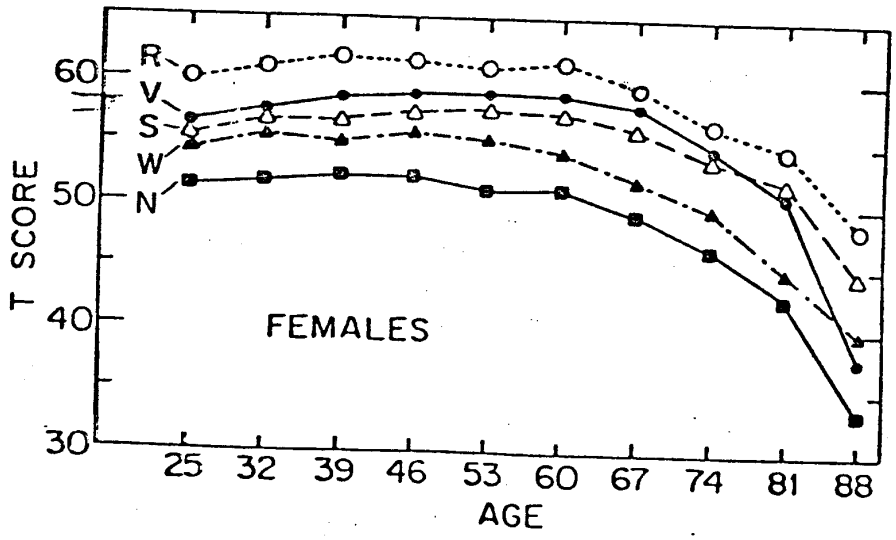
Figure 1. Longitudinal estimates of age changes for the Primary Mental Abilities from ages 25 to 88. From Schaie (1983b). Copyright 1983 by Guilford Press. Reprinted with permission of the publishers.

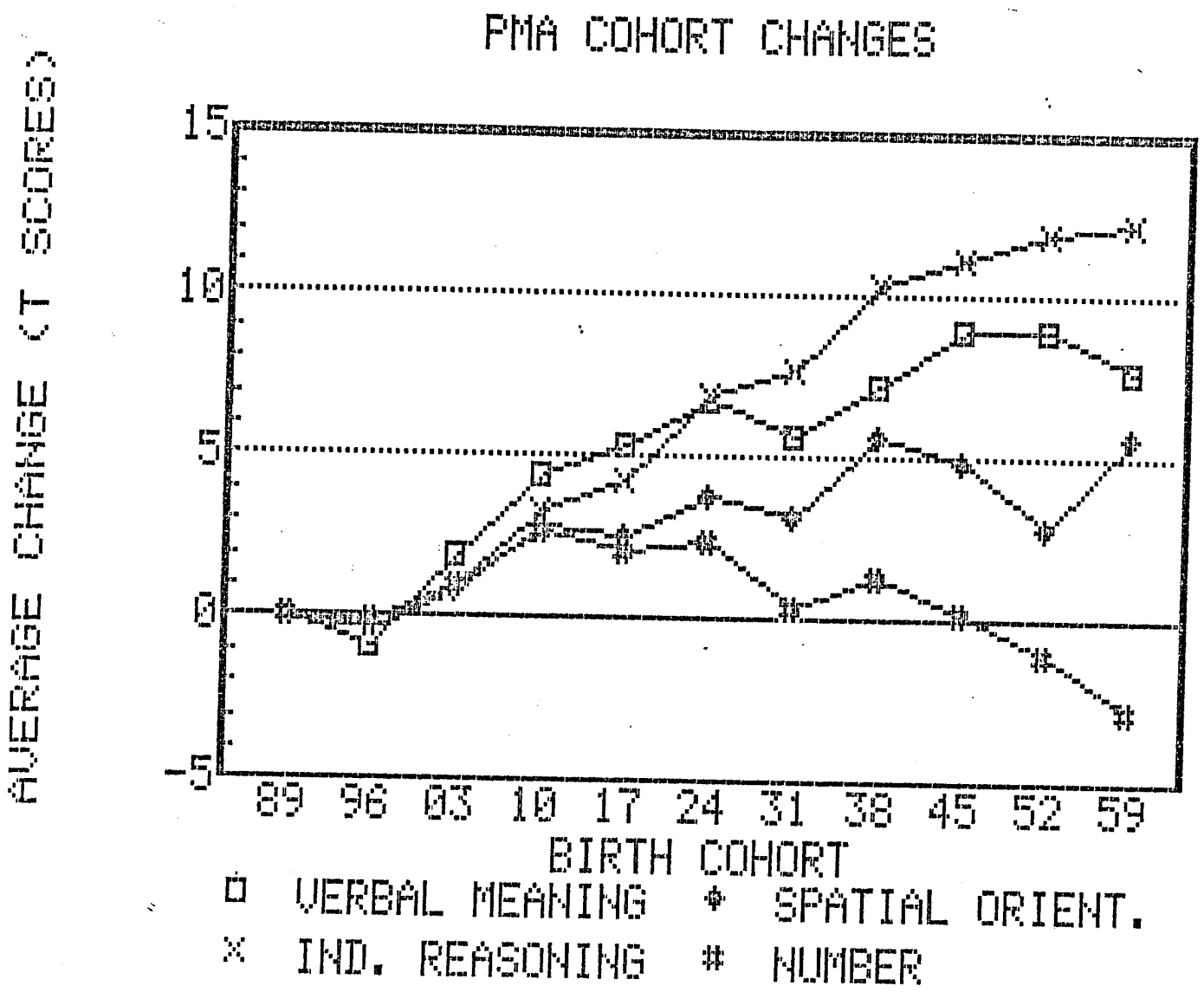
Figure 2. Cumulative cohort differences from 1889 base cohort for the mental abities.

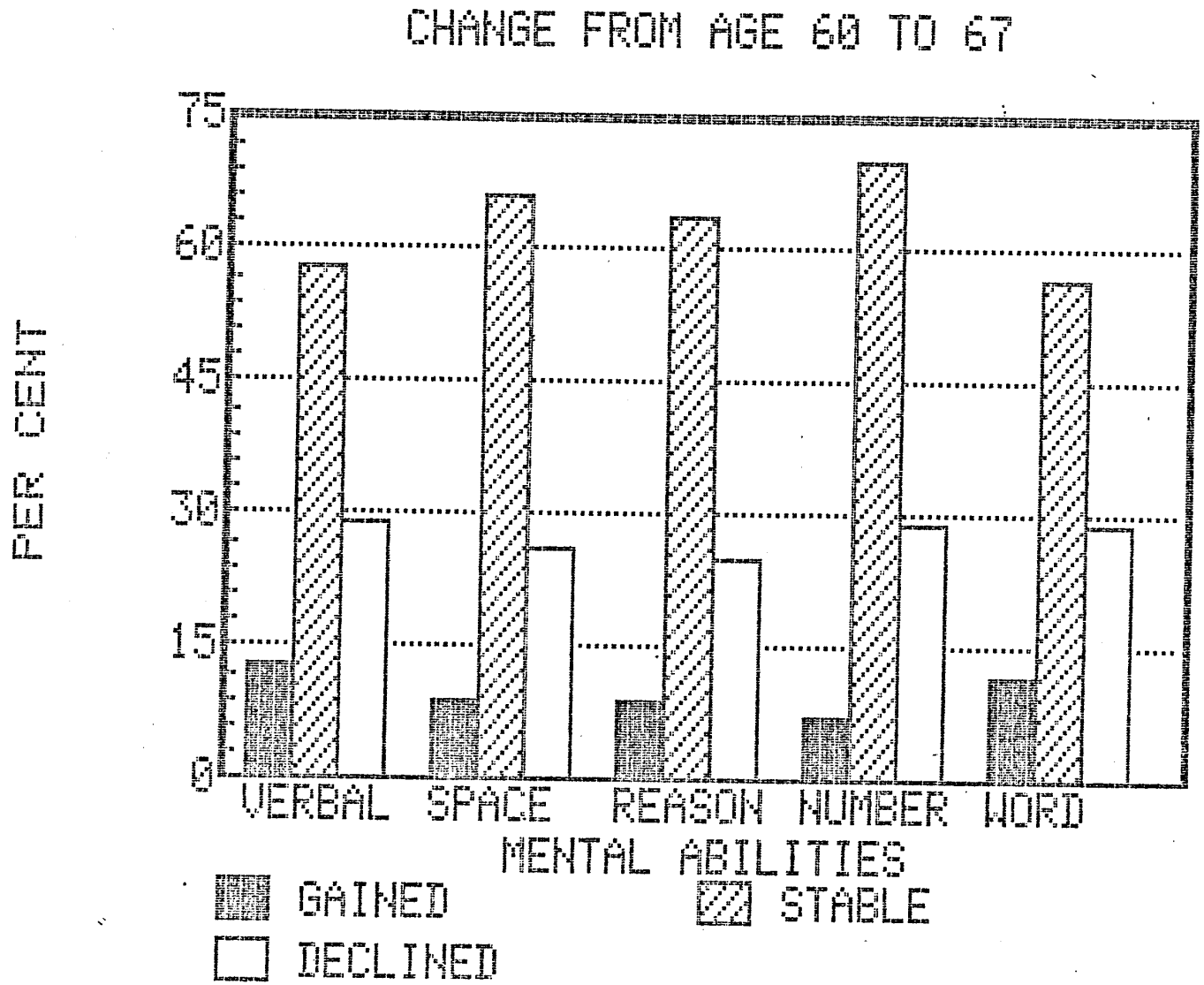
Figure 3. Proportion of persons remaining stable, increasing or declining on the Primary Mental Abilities from age 60 to age 67. From Schaie (1984).

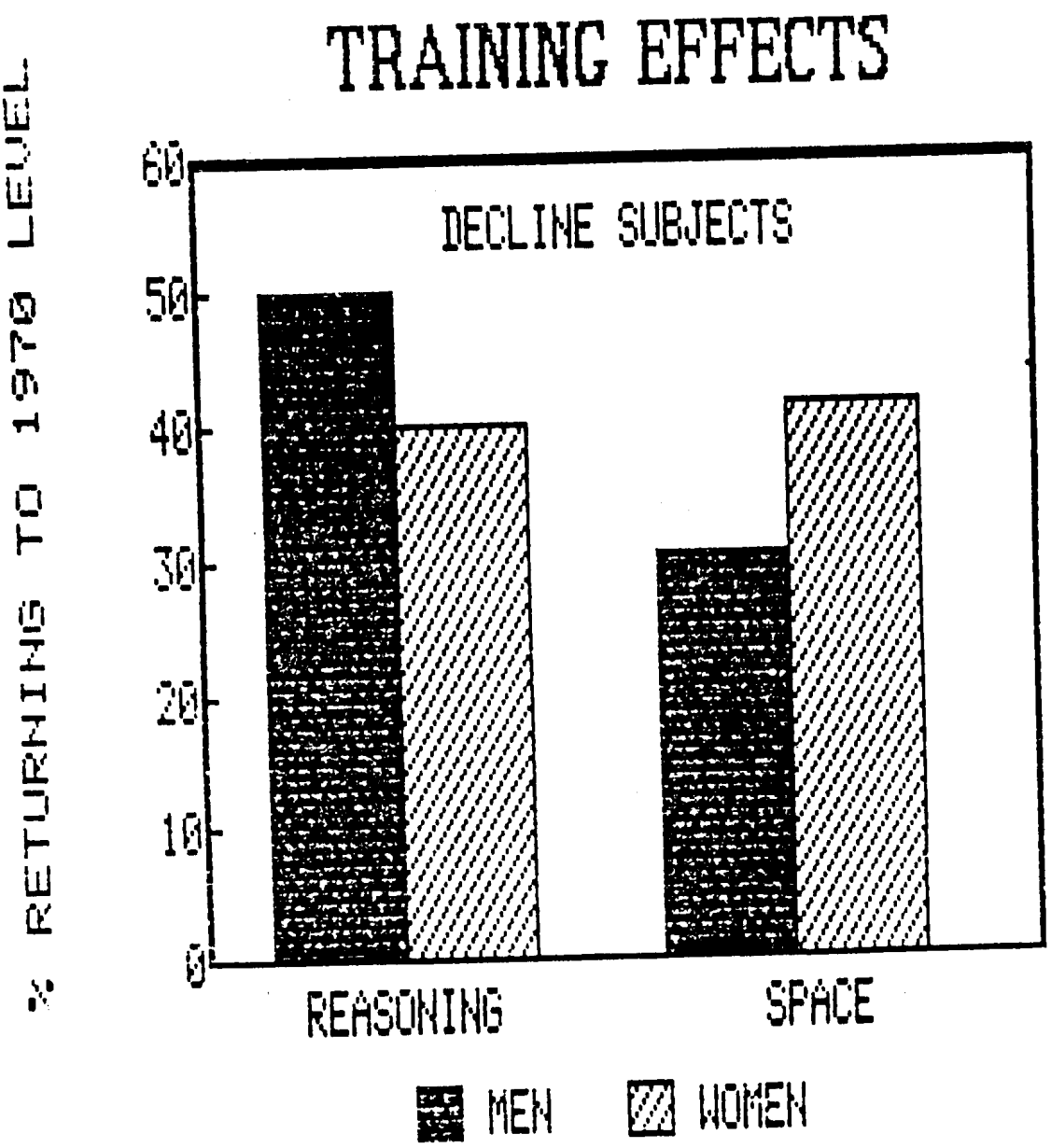
Figure 4. Proportion of subjects returning to or exceeding their 1970 performance levels. From Schaie & Willis (1986b). Copyright 1986 by the American Psychological Association. Reprinted by permission of the publishers.


S
R
V
W
N
60
50
40
30
T SCORE
MALES
25 32 39 46 53 60 67 74 81 88
AGE


R
V
S
W
N
60
50
40
30
T SCORE
FEMALES
25 32 39 46 53 60 67 74 81 88
AGE


PMA COHORT CHANGES
AVERAGE CHANGE (T SCORES)
15
10
5
0
-5
89 96 03 10 17 24 31 38 45 52 59
BIRTH COHORT
VERBAL MEANING
SPATIAL ORIENT.
IND. REASONING
NUMBER


CHANGE FROM AGE 60 TO 67
PER CENT
75
60
45
30
15
0
VERBAL
SPACE
REASON
NUMBER
WORD
MENTAL ABILITIES
GAINED
STABLE
DECLINED



Proportion of decline subjects remediated to 1970 score level.