

Towards Implementing the Results of Empirical
Studies of Human Aging

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The purpose of this brief review is to summarize some of the substantive findings regarding the major variables considered by developmental psychologists to be characteristic of human aging and which need to be considered in gerotechnological interventions. The topics to be covered here include cognition, sensory changes in context, healthful lifestyles, and social support (for greater detail, see Schaie & Willis, 1996a). After a brief review of these topics, we end with a discussion of issues specifically related to behavioral interventions in the social sciences (also see Willis & Schaie, 1994b).

Age Changes in Cognition

Here we distinguish those characteristics that show normative declines in virtually all individuals from other characteristics for which functioning tends to be maintained into advanced old age. For those variables where normative decline has been found, it should be added that there are vast individual differences in the rate of decline, and also that the rate of decline is not uniform across different cognitive dimensions. In general, asymptotic levels are typically reached in the thirties (with the exception of verbal ability, which tends to increase until the fifties) with a near plateau thereafter until the sixties are reached. Decline is seen first for skills which require both speed and complex manipulations. Declines are typically quite modest in the decade

of the sixties, accelerate in the seventies, and on average become profound in the eighties.

Characteristics that show normative decline

Speed. There is evidence of *normative decline* beginning with young adulthood. Most measures of reaction time show a steady increase, with persons at age 60 requiring approximately 1.6 time the amount of response time than do persons at age 20. Age-related declines for many other skills are markedly reduced when speed of response is controlled for.

Abstract Reasoning. Beginning with the sixties normative decline is also found for most complex problem solving task that involve abstract reasoning skills. However, substantial decrements in performance are rarely seen before the seventies.

Memory. Significant age-related declines have been found for working memory. These declines would explain why older persons have difficulty with tasks involving high memory loads. Age related declines have also been reported in the adequate using of encoding strategies. On the other hand, there seems to be little age-related decline in the procedural and semantic aspects of human memory (cf. Smith, 1996).

Characteristics showing maintenance of functioning

Verbal Ability. Perhaps because it is constantly practiced, verbal ability seems to reach a peak only in middle age and is remarkable resistant to age-related decline until shortly before death. In fact, decline in verbal ability has been implicated as a possible indicator of a general organismic terminal drop.

Social Knowledge. This skill seems to be primarily determined by a persons exposure to the relevant knowledge base. Older persons may become obsolete in their social knowledge, if they do not keep up to date. However, they rarely will lose previously acquired social expertise.

Figure 1 shows data from the Seattle Longitudinal Study over the age range from 25 to 88 years of age for six psychometric abilities: Inductive Reasoning, Spatial Orientation, Number facility, Verbal Memory and Perceptual Speed (Schaie, 1994, 1996; Schaie & Willis, 1996b).

Insert Figure 1 about here

Sensory Changes in Context

Here we are concerned primarily with those factors involving sensory functioning which have primary relevance to a person's ability to maintain independent functioning within a typical environment. Vision and hearing have been most extensively studied in an aging context (for a comprehensive overview see Kline & Scialfa, 1996).

Vision

Several biological changes occur in the visual system during the adult years and particularly towards the end of life. By age 40 about half the population, and by age 60 virtually everyone requires some form of visual correction by means of eyeglasses. Changes in the cornea lens and muscles as well as in the retina affect adequate transmission of light waves. Beginning with the 60s pathological changes such as cataracts and glaucoma increase in

frequency and affect almost a third of the elderly over age 75. The most significant changes affecting behavior include changes in contrast sensitivity, susceptibility to glare, as well as reductions in depth perception and the useful field of view.

Contrast. Modest uncorrected decreases in visual acuity are likely to make it more difficult for older persons to be able to identify signs and textures that have relatively poor contrast. This difficulty is further enhanced by the reduction in available light due to the thickening of the retina.

Glare. Increasing opaqueness of the lens results in greater susceptibility towards glare. Older adults need more light to see well, but the additional light tends to increase glare. This is a particular problem in activities such as night driving.

Depth Perception. Reduction in muscular accommodation of the eye and/or uncorrected differences in visual acuity in the two eyes tend to reduce effective depth perception. These changes may introduce additional hazards and eventual reduction in mobility with advancing age.

Useful Field of View. The visual perimeter tends to decrease beginning with the 50s and diminishes markedly in those over 70. These changes are particularly important in understanding increases in motor vehicle and pedestrian accidents with increasing age.

Figure 2 gives some indication of the increase in magnitude of vision problems with aging by charting the percentage of persons requiring visual defects as well as those suffering from cataracts, glaucoma and other visual impairment (National Center for Health Statistics. 1994).

Insert Figure 2 about here

Hearing

Hearing impairments begin to increase around age 40 and show sharp increases after age 60. Although some hearing impairment can be attributed to external factors, most hearing losses are associated with presbyopia. Hearing losses occur first in the high frequencies, particularly for men. Of contextual relevance are the speed of presentation, the presence of background noise, as well as interrupted speech.

Speed of Presentation. Because of reduction in working memory and in the speed of sensory processing it becomes increasingly difficult for older people to deal with very rapidly presented material. As in vision, there is a masking phenomenon in the sense that when several bits of information are presented too rapidly, the later item presented may wipe out the preceding item if they are too closely spaced.

Background Noise - Selective Listening. Effects of age-related hearing impairment are minimal under good acoustic conditions; i.e., where little background noise is present. With increasing background noise, older people have difficulty in identifying the source of the communication they are trying to process.

Interrupted Speech. Older persons are particularly troubled by interrupted or garbled speech, such as might occur when a telephone connection is less than optimal

One of the best illustration of the effects of these contextual problems for effective hearing with advancing age come from an older study by Bergman et al (1976). Figure 3 shows percentage disadvantages by age in speech intelligibility as compared to subjects aged 20 to 29 years.

Other Senses

Age-related changes have also been noted in other senses. Taste and smell decreases only slightly, but the very old report lessened sensitivity to sweet and salty tastes. There is also a decrease in kinesthetic balance, in temperature sensitivity, and in pain sensitivity. The latter changes have particular implications for the construction of housing for the elderly.

Healthful Lifestyles

The assessment of lifestyle factors over which individuals may have at least some control and which are relevant to successful aging include both the maintenance of proactive behavior and the avoidance of risk behaviors.

Proactive Behaviors

Certain behaviors have been related to the maintenance of better health and quality of life as people age. These include regular participation in physical exercise, the selection of a healthful diet, the use of seat belts, and regular health examinations. Behaviors related to the maintenance of intellectual competence furthermore include the seeking out of intellectual stimulation, and the maintenance of flexible behaviors and attitudes.

Risk Behaviors

Other behaviors are likely to impair the physiological infrastructure and thus tend to be associated with the earlier occurrence of various diseases as

well as reduced maintenance of cognitive functioning. The major risks to be avoided in this context include smoking, excessive use of alcohol and other stimulants, as well as obesity.

An extensive discussion of biological and health influences on behavior may be found in Deeg, Kardaun and Fozard (1996).

Social Support

Individuals live in social networks throughout their lives. These networks become increasingly important as individuals age. The individual's family is seen as the most immediate social network. However, societal changes in family structure and the reduction in the size of successive birth cohorts, in conjunction with increasing life expectancy, have resulted in social networks including growing numbers of nonfamilial members, particularly in advanced age.

Maintenance of Lifestyles in Healthy Elderly In elderly who are living independently in the community, social networks often function to maintain one's current lifestyle. The role of social support in maintaining one's lifestyle can be positive or negative. For example, one's spouse or friends may be important in maintaining healthy eating habits or engagement in exercise routines. On the other hand, spouses or friends may foster maintenance of "at risk" behaviors such as smoking, excessive alcohol consumption, or unhealthy eating patterns.

Coping with Acute Crises. With increasing age or the onset of chronic diseases, one's social network takes on additional roles (Antonucci & Jackson, 1987). The support system aids the individual in coping with acute crises such

as those associated with illness, death of a family member, financial problems, or serious accidents. The social network may provide instrumental and/or emotional support. Instrumental support includes provision of physical assistance, financial contributions, or providing a caregiver with respite care for an ill or demented person. Emotional support includes serving as a confident and boosting the individual's self esteem and self efficacy.

Application of Research Findings to Behavioral Interventions

We turn from a consideration of psychosocial topics associated with human aging to discussion of issues related to behavioral interventions in later life.

Who are the Targets of Interventions?

One of the first issues deals with who is to be the recipient of the intervention. Initial consideration of the question would suggest that the elderly themselves are the most likely target of intervention. However, in some contexts this is not the case. For example, in social and behavioral interventions related to dementia, the caregiver, rather than the demented patient, has been the most common target of intervention efforts. This may reflect views within the medical profession and in society at large that most dementias are irreversible and that there is little that can be done to aid the patient; hence, intervention efforts are focused on the family and caregiver cf. Smyer, Zarit, & Qualls, 1990).

In other contexts, the focus is on future generations, rather than current cohorts of elderly. For example, much discussion is focused on the large baby boom generations in the U.S. that are currently in middle age. There is the

issue of how health care and retirement benefits are to be provided for these large cohorts in old age, when there will be smaller successive cohorts in the work force. Some interventions are being instituted to influence the saving patterns and retirement planning of these cohorts while in middle age.

Pharmaceutical companies are marketing products associated with menopause and the chronic disease implicated in estrogen reductions in old age (e.g., heart disease, osteoporosis).

Finally, politicians and policy makers can be the target of interventions related to aging issues. For example, politicians are "lobbied" (a form of intervention) on issues related to health care (e.g., medicare) and social security benefits.

When in the Aging Process are Interventions Useful?

Intervention has been characterized as being preventive, primary, or secondary in nature. Preventive intervention occurs prior to the onset of a problem or disability. Thus preventive intervention into the aging process could begin in childhood or middle age. The health, active young old (aged 65-74) are often involved in exercise and nutrition activities to prevent or delay the onset of health or mobility problems.

Primary intervention is focused at individuals who are "at risk" for a problem or disability. These would include individuals engaged in lifestyles (lack of exercise, smoking, excessive alcohol consumption) that put them at risk for chronic diseases. While preventive intervention is often targeted at the total population or large segments of the population, primary intervention is targeted more narrowly for "at risk" populations. Often times the same

unhealthy lifestyles (e.g., smoking) put an individual at risk for multiple chronic diseases.

Secondary intervention is targeted at those already having a problem or disability. Health and social services such as home care, meal provision, and home nurses are targeted at those who have exhibited a serious limitation and cannot maintain an independent lifestyle.

In a time of limited financial and human resources, the question arises when in the aging process certain interventions are most useful. Certainly intervening after a problem or disability has occurred is the most expensive and often least successful effort. Most intervention experts agree that the goal should be prevention rather than remediation. However, there appears to be a reluctance to commit long term, significant resources to prevention of problems associated with aging. Society tends to respond only when the crisis stage has occurred

What Should Be the Foci for Intervention?

Each of the topics discussed in the first part of this presentation have and could be the foci of intervention efforts. There is considerable plasticity in cognitive functioning even in old age and educational efforts to enhance cognitive functioning of the elderly have been shown to be effective (cf. Willis, 1990; Willis & Schaie, 1994b). On the other hand, interventions into sensory limitations such as prosthetics or changes in the environment have been successful also. Likewise, national programs to intervention in lifestyles, such as the U.S. effort to reduce smoking behavior, can have significant impact on the nature of aging in future cohorts.

Where Should Interventions Take Place?

Time diaries of the elderly indicate that much of the activities of daily living occur in the home and with no one other than the elderly person present. Thus, the home environment would appear to be a prime place for intervention efforts. On the other hand, it may be more economical to provide interventions in the aggregate, rather than at the individual level. Some intervention may also profit from social interactions and peer support. For example, the maintenance of physical exercise routines are often aided by having a peer involved in the activity. Community organizations that are commonly frequented by the elderly and that are easily accessible are also an important context for intervention. Technological advances will play an increasingly important role in future intervention efforts. As communication networks become increasingly interactive, the internet and web site may be important contexts of intervention efforts.

Behavior is Modifiable

There is growing evidence that individuals can continue to change, adjust and learn through much of the lifespan. Learning and change are not the sole province of the young.

Intervening With the Individual . Two lines of recent research have shown that there is considerable plasticity in cognitive functioning and in muscle tone and strength in old age. The work of Willis and Schaie (1994) has shown that in nondemented healthy older adults there can be significant improvement in cognitive ability performance even in late old age. Moreover, we have found that even for older adults who have exhibited decline in

cognitive performance, possibly associated with disuse, behavioral interventions are effective in remediation of performance. In our research forty percent of those showing prior cognitive decline exhibited remediation of cognitive performance. See Figure 4.

Insert Figure 4 about here

Similar intervention efforts have been shown to be successful in strength training in the very old. Resistance training and weight lifting interventions have been shown to significantly increase the mobility and activity levels of older adults, including the elderly in institutions.

Intervening With the Environment

The older adult's level of competence represents an interaction of the individual and the environment. The capabilities of the individual can be enhanced or limited by the environment in which he/she lives. For example, architectural features can enhance mobility in the elderly. Environmental interventions into lighting and acoustics can significantly facilitate the elderly's ability to see and hear in spite of some age-associated sensory loss. Architectural interventions in nursing homes have shown that the environment can be shaped to facilitate wayfinding and provide memory aids for those with dementias (Parmelee & Lawton, 1990; Regnier, 1997).

Likewise, assist devices and prosthetics can significantly enhance the capability of the elderly to function independently. Timers and reminder devices can assist those with memory limitations. New advances in hearing

aids have significantly improved the hearing ability of those with sensory losses. Robotics and computer technology have been shown to have much potential in aiding those with physical and mobility losses.

Summary

In this chapter we have briefly reviewed four domains salient to the psychosocial aging process. The pattern and timing of cognitive aging has been shown to vary by ability. There are wide individual differences in cognitive aging. Hearing and vision are the two sensory domains in which individuals receive and process most information. While there are age-related losses in sensory functioning, environmental factors have been shown to play a significant role in reducing or magnifying these sensory losses. Healthful lifestyles must be considered in terms of both proactive behaviors that are associated with the maintenance of health and the delay of disease, and at risk behaviors that increase the likelihood of disabling conditions. Social support networks are important in maintaining the lifestyles of healthy, independent elderly. In crises or acute conditions, social supports assist the elderly in coping with these situations. While social supports are first considered to involve family members, social change has resulted in non-family members becoming increasingly important factors in the support network.

Research has indicated that individuals retain the capacity to learn and change through much of their life course. Thus, intervention efforts should be focused at later parts in the life course, as well as in the young. Two major issues are who should be the target of intervention efforts and when in the

aging process interventions are most useful. While preventive interventions are considered to have the most potential to benefit the individual, limitations in human and financial resources often result in interventions occurring only after a crisis stage has been reached.

One of the challenges of the future is the utilization of current knowledge regarding the aging process and technological advances to intervene in the aging process for future generations.

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Author Note

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Figure Captions

Figure 1. Longitudinal age gradients for six ability dimensions estimated from cumulated within-subject age changes. Source: Schaie (1994, p. 308). Copyright by the American Psychological Association. Reproduced by permission.

Figure 2. Percentage of persons requiring corrections for visual defects and percentage of those who suffer from cataracts, glaucoma and other visual impairment. Source: National Center for Health Statistics (1994).

Figure 3. Cross-sectional study of speech intelligibility, shown as percentage decrement from the scores of subjects age 20 to 29. Conditions: (1) Normal speech; (2) speeded speech; (3) selective listening, as tracking one speaker among many; (4) reverberated or echoed speech, as in a hall with unfavorable acoustics; (5) interrupted speech as in a telephone connection. Source: Bergman et al. (1976). Copyright by the Gerontological Society of America. Reproduced by permission.

Figure 4. Proportion of subjects who had declined over 14 years who were remediated to within ± 1 SE of their 1970 base scores, and to or beyond their 1970 base score. Source: Adapted from Schaie & Willis, 1986, p. 230.

Fig. 1

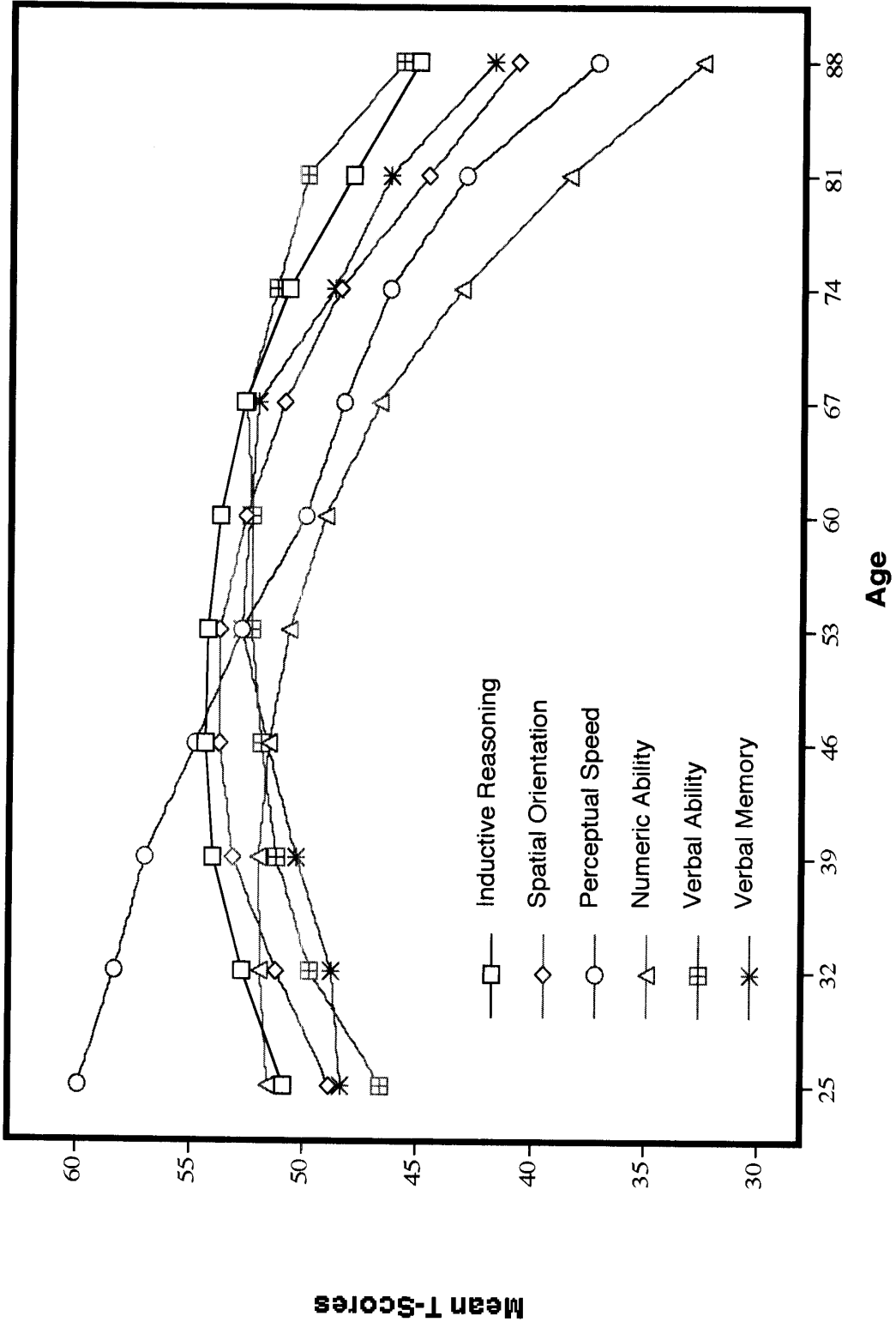


Fig 2

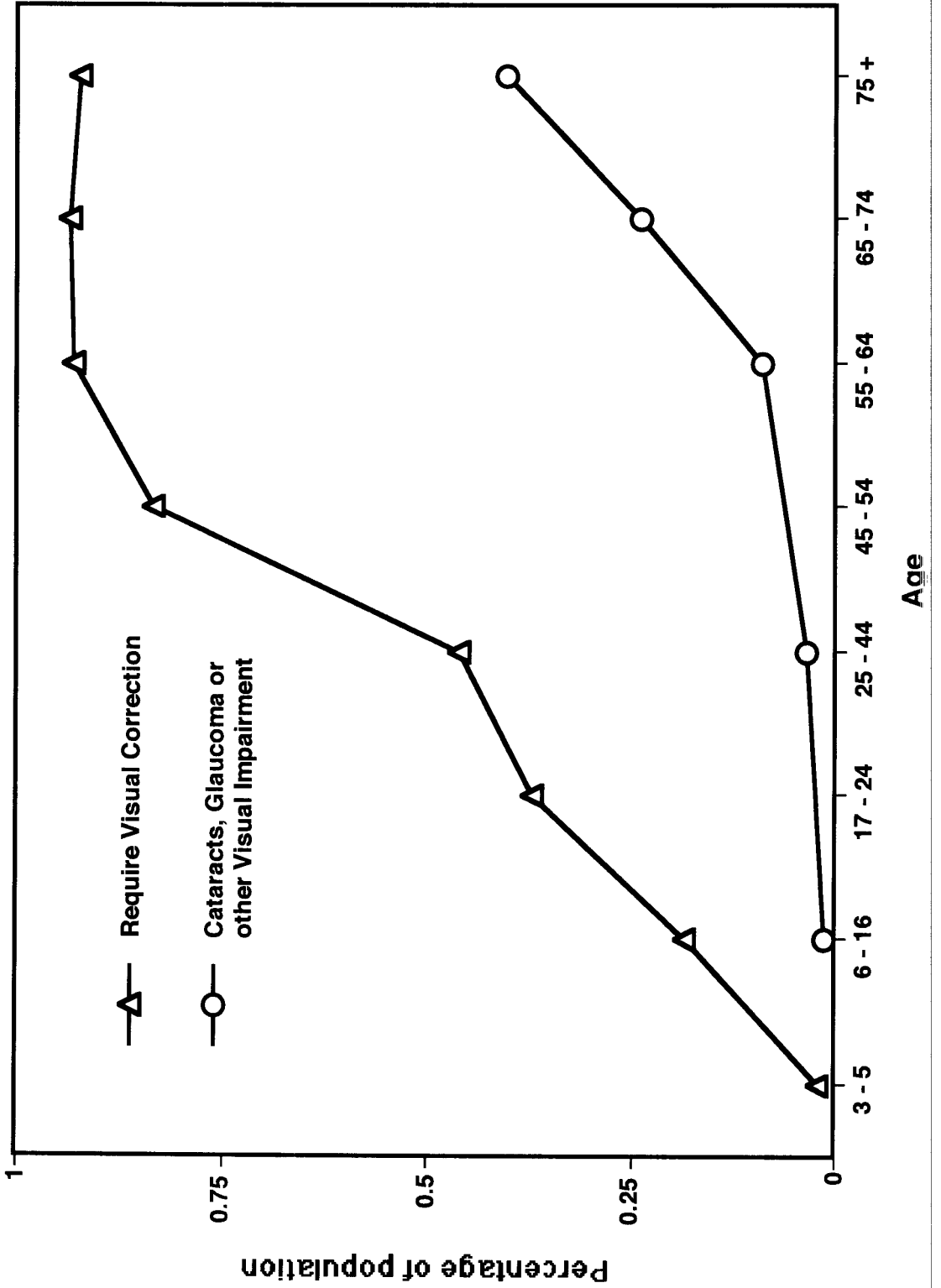


Fig. 3

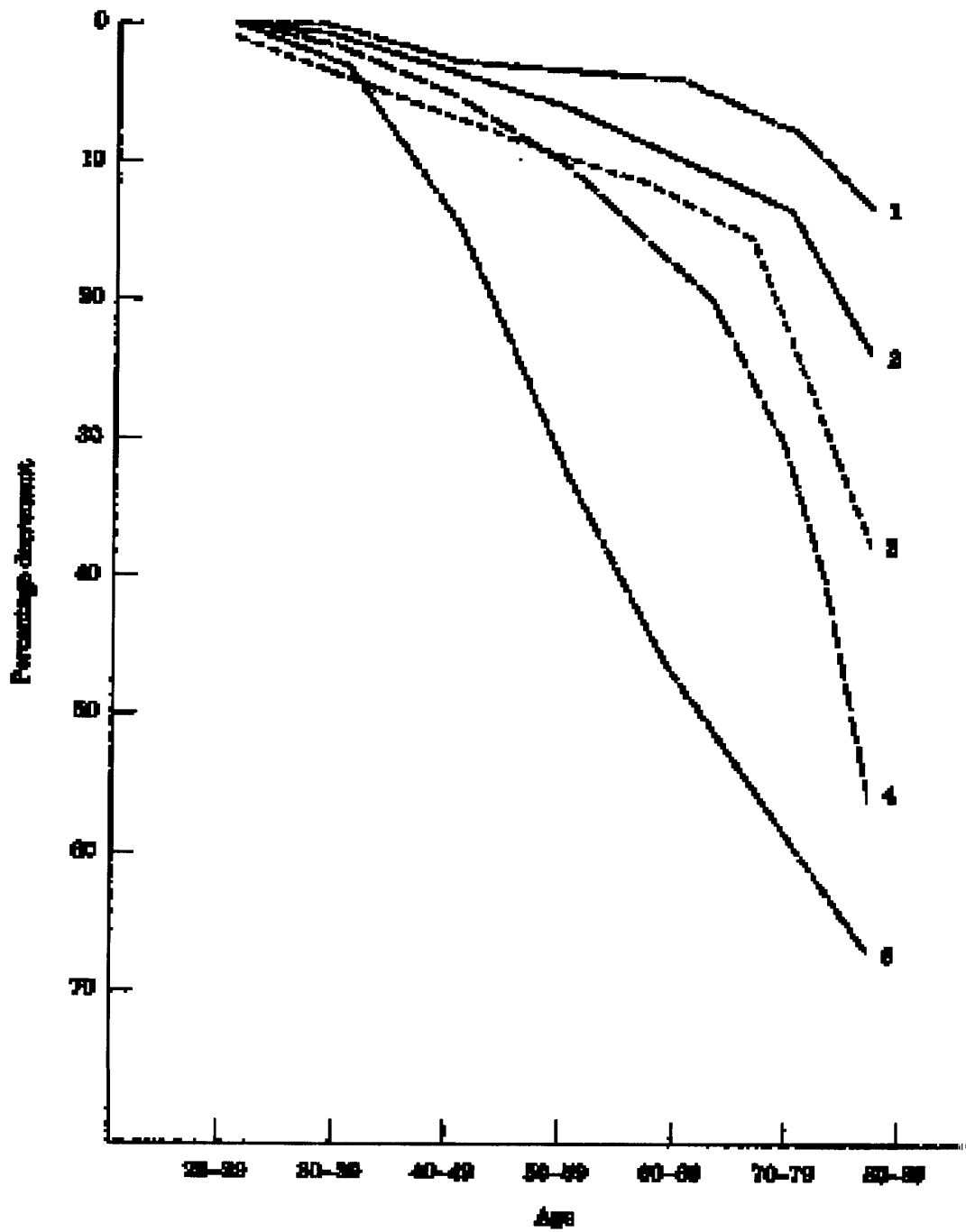
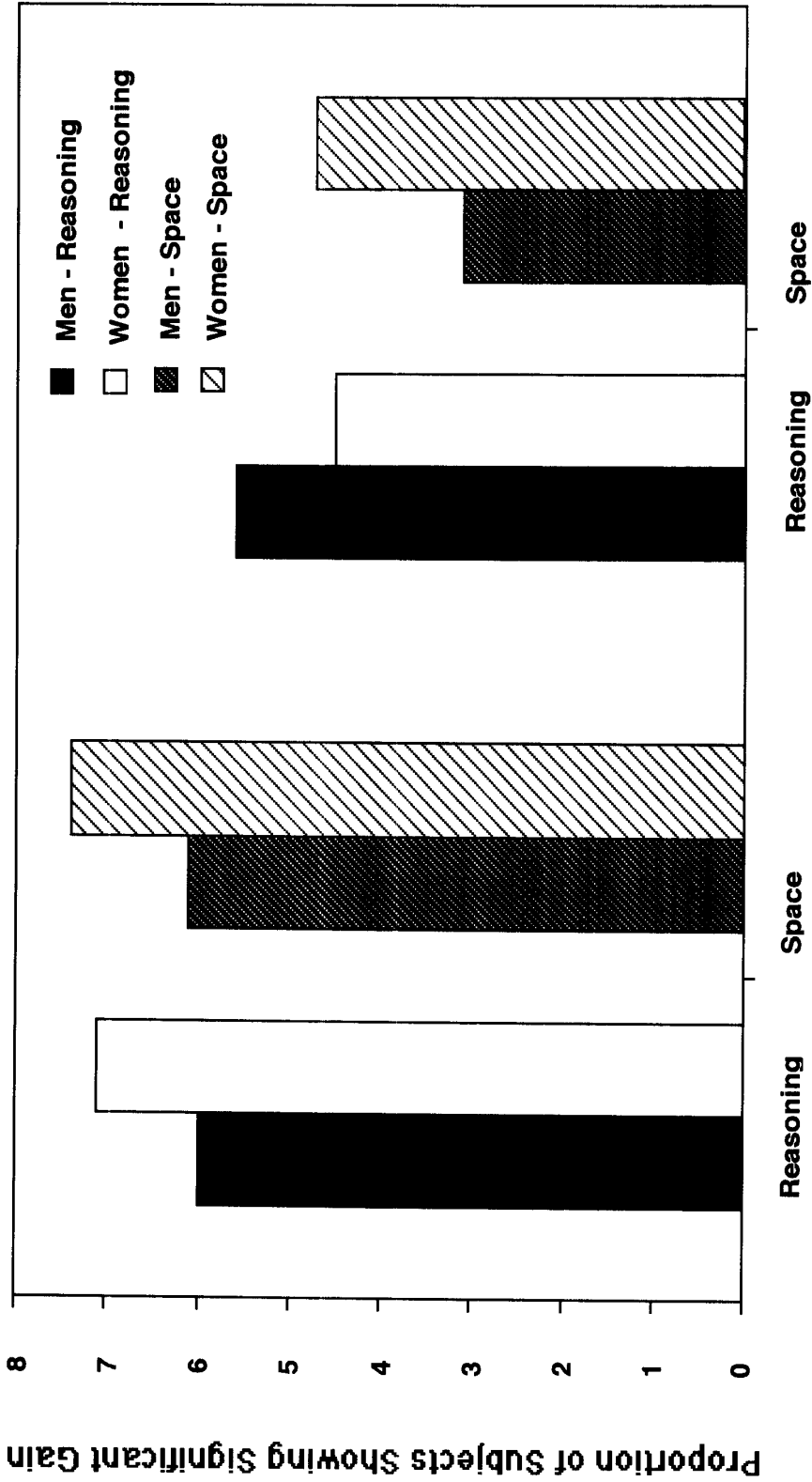


Fig. 4



Remediated to
1970 Level

Remediated by
more than 1 SE