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Life-Span Development: Implications for Education

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INTRODUCTION

The purpose of this chapter is to relate our knowledge about life-span developmental psychology to the emerging interest in education as lifelong learning. We begin by examining several sociocultural factors which have fostered the increasing emphasis on a lifelong approach to education. Next we consider several models of life-span development and their meaning for lifelong education. The role of education at various developmental stages is discussed, and characteristics which differentiate the young adult from the older learner and which must be taken into account in designing educational programs at different periods in the life span are discussed. Finally, implications for education arising from developmental changes in adult learners are considered.

The authors assume that the primary aim of education should be optimization of individual development across the life span, although the specific objectives of education may vary both with individual development and sociocultural milieu (Baltes & Danish, 1979; Birren & Woodruff, 1973; Kohlberg & Mayer, 1972). It is a major thesis of this chapter that the individual continues to learn and change across the life span, and thus educational intervention is a viable mechanism for facilitating optimal development at all periods in life. Since approximately two-thirds to three-quarters of the life span is centered in adulthood, a major reallocation of educational resources seems implied. Therefore, much of this chapter will deal with developmental changes in adulthood and their educational implications.

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LIFELONG LEARNING: AN IMPERATIVE

Historically, educational intervention in the United States has focused on the early stages of the life cycle (Long, 1974). Such a perspective has been associated with a series of assumptions regarding intellectual development across the life span and the primary goals of education. Childhood and adolescence are considered to be the critical age periods for acquisition of all the necessary abilities and skills, while adulthood is viewed as a time of diminishing learning capacity. Thus education is viewed primarily as a process of preparation for adulthood. Formal schooling serves as a system for transmitting information to equip the child with the knowledge and skills that will be needed throughout adult life (Cropley, 1976). This perspective on education assumes a static concept of knowledge—that the knowledge and skills available during childhood are the same as those needed during adulthood.

A variety of social, scientific, and economic conditions has recently brought into serious question the effectiveness of such youth-oriented educational systems. Educational concepts under such diverse labels as *adult education, career education, education permanente* and *lifelong learning* are gaining considerable attention (Birren & Woodruff, 1973; Dave, 1976; Dave & Lengrand, 1974; Houle, 1974). The major commonality among such diverse educational concepts is that terminal education is considered to be philosophically and practically unacceptable (Long, 1974; Peterson, 1975).

Changing Age and Education Structure

Demographic changes in the United States may be contributing to a redefinition of the role of education across the life span. In this century the adult population has been increasing faster than the population as a whole. In 1900, adults aged 35 years and older accounted for 28% of the total population; in 1970, 41% of the population was from this age group (Knox, 1977). As cohorts from the post–World War II baby boom move into this age range, the proportion of the population accounted for should continue to increase.

The most rapidly increasing segment of the adult population has involved older adults. The proportion of adults 65 years and over increased from 3 to 9% from 1900 to 1970. Such a shift in the age distribution can be attributed to attenuated population growth in the mid–1900s and to an extension in the life expectancy of approximately 30 years since 1900 (Knox, 1977). A reduction of the quotas of immigrant youth has also contributed to this age shift. These changes in the age structure suggest a necessary expansion of the role of education to accommodate the educational and learning needs of the largest segment of the population—middle-aged and older adults (Carnegie Commission on Higher Education, 1973; Hiemstra, 1976).

A qualitative and quantitative shift in the educational level of the adult population has further emphasized the need for a life-span view of education.

The younger cohorts of adults in this country are better educated. While the median number of years of formal education for adults generally was 8.6 in 1940, the median in 1970 was 12.1 years for adults generally and 12.6 years for young adults (Knox, 1977). The adult population 65 years and over still has the most depressed educational level. According to 1970 census figures, only 29.3% of individuals now over 65 years were educated through high school or beyond. By 1985, the census bureau projects that 61% of those over 65 will have at least a high school education (Knox, 1977). This rapid increment in educational level of the older adult population is partially due to GI educational funding provided for World War II veterans, who would be approaching later adulthood by 1985. In addition to increases in the number of years of schooling, the length of the school year has doubled in the past century (Moses, 1971).

Johnstone and Rivera (1965) found that the higher an individual's educational level, the more likely he or she would be to seek further educational experience. Likewise, there is some evidence that the quality of an individual's prior educational experience is positively associated with the amount of subsequent learning sought in adulthood (Brown, 1960). Successive cohorts would be expected to show a continuing interest in educational activity throughout adulthood as their average educational levels increase. Educational opportunities will therefore be in greater demand as younger cohorts move into the later adult years. At the same time, of course, adults with low levels of education and thus most in need of further training will be even more educationally disadvantaged in relation to their peers.

Technological Change and Career Patterns

The accelerated rate of technological change (Toffler, 1970) occurring in almost every area of life has served as a critical catalyst for the changing concept of education. It is estimated that the body of information in the exact sciences (e.g., physics, math) is doubling every 8 to 10 years (Wroczynski, 1974). Such technological advancements are affecting the number and types of careers in which an individual is involved. Most workers in the United States today are engaged in specialized jobs that did not exist a generation or two ago. Professional and technical job roles have increased from 4% in 1900 to 15% in 1970; service occupations have increased from 3 to 12% of the job market. In contrast, farm and laborer roles have shown comparable declines. Age differences in job roles are also evident, with the older adult more likely to be involved in obsolete or shrinking job roles. For example 45% of all men now involved in the newly developed technical or professional roles are under the age of 35 (Knox, 1977).

Technological advancement is also related to the growing phenomenon of occupational obsolescence. Educators and employers acknowledge that it is not possible to prepare a student permanently for a job role in a rapidly changing society (Dubin, 1977; Long, 1974). The threat of occupational obsolescence appears particularly acute in the most rapidly expanding job roles, those involving professional or technical competence. The half-life concept of professional competence indicates the time after completion of formal education until professionals become roughly half as competent as they were upon graduation (Dubin, 1972). A recent report (Rosenow, 1971) estimated the half-life of medical knowledge to be five years. In line with this, the newly established American Board of Family Practice requires recertification every six years (Dubin, 1972). A prominent factor in the hastening of professional obsolescence is the rate of increment of new data and knowledge. In order to keep abreast of new publications, according to George and Dubin (1972), 20% of the professional psychologist's working time would need to be devoted to updating.

Closely associated with the phenomenon of occupational obsolescence is the growth in multiple career patterns across the life span. Second careers are becoming increasingly common. Training for second careers typically occurs in adulthood, after completion of the individual's formal education. According to one estimate (Kelleher, 1973), 40% of all Americans changing occupations in a given year were over 35 years of age. Technological specialization increases the number of different occupations and reduces the life expectancy of any given occupation. Thus the most spectacular increase in job turnovers has recently been among higher educated professional, technical, and managerial personnel (Troll, 1975).

Changing Role of Women

The social, educational, and economic statuses of women in society are undergoing rapid change. The participation of women in the labor force doubled, from 20% to 42%, between 1900 and 1969 (Sheppard, 1971). The trend toward earlier marriage and child rearing and a reduction in family size during the first half of this century appears related to the current increase in the number of women over 35 years entering the work force (Troll, 1975). By the 1960s more women in their forties were working than were younger women. This revolution in women's work patterns has been associated with an increasing number of middle-aged women returning to school for further training and job updating.

However, the increasing number of working women is not directly reflected in shifts in the types of job roles occupied by women. In 1966 women accounted for only 3% of all lawyers and 6% of all physicians in the U.S. (Troll, 1975). In fact, the percentage of women in high-status, highly skilled jobs was lower in 1968 than previously. The current depression in high-prestige job roles for women appears related to the increase in the number of middle-aged women entering or returning to the labor force. Such women suffer not only from an initial lower level of job-related education compared to male workers but also from occupational obsolescence.

In summary, the need for continuing education across the life span is becoming increasingly compelling. Technological advance has contributed not only to attenuation in the birth rate and extension of the life expectancy itself, but also to

the increasing rapidity with which nearly every sector of the individual's life is changing. Lifelong learning is now a necessity for optimal individual development.

LIFE-SPAN MODELS

The educational researcher interested in life-span conceptualizations will need to step away from a concept of development which is synonymous with the notion of growth as differentiation. The latter concept assumes that as each new developmental plateau is reached, further development occurs through the emergence of more complex structures. For example, in the area of intellectual development it has been proposed that children do indeed start out with a unitary single-factor component, but as growth occurs it consecutively branches into a number of separate abilities organized in a hierarchical manner. In adulthood this kind of differentiation is likely to cease, and transformations will be of a more qualitative nature in response to environmental presses. In old age there may in fact once again be a return to greater simplicity of structure, if only to counteract information overload (Reinert, 1970).

Stepping away from a growth model does not mean shifting to a symmetric differentiation-dedifferentiation model à la Werner (1957), to which data might be fitted for statistical elegance by means of a simple Gompertz curve. Indeed, one of the first caveats required before the problem of explicating life-span models can be addressed (Baltes & Schaie, 1973) is to accept the notion that there is increasing variability over the life span due to maturation. Although on each specific area of development one may find modal patterns with limited variation in the acquisition of behavior during childhood, there is great variety in the expression of individual differences during adulthood. Our discussion will focus on four topics: First, we will differentiate between development and aging; second, we will distinguish ontogenetic progressions (age change) from the description of the sociocultural attributes distinguishing various birth cohorts (age differences); third, we will distinguish between three life-span models which assume stability, irreversible decrement, and/or compensable decrement during the adult phase; and fourth, we will consider the wide degree of behavioral plasticity that is most noteworthy in adulthood.

How Do Development and Aging Differ?

Some theoreticians prefer to combine the terms *aging* and *development* and address behavioral change as a developmental process which, at all life stages, can take a variety of forms in terms of directionality, range, and intensity (Baltes & Willis, 1977). Nevertheless, it may be heuristic, particularly for educators and educational researchers, to consider some subtle ways in which the emphasis of life-span developmental researchers shifts as interest moves from emerging behavior, to behavioral maintenance, and eventually to deficit phenomena.

One of the remarkable aspects of early development is the relatively isomorphic relationship between changes in the physiological structures which seem to be essential in supporting a given behavior and the observed behavioral function (Flavell, 1970). Not only can we specify that noteworthy behavior change will occur in almost all surviving organisms between birth and maturity, but we can also note that the bandwidth of adaptive behavior is quite narrow, and the absolute number of time units separating the attainment of a given behavior by the least and most advanced children is quite brief. Most organized activities by children are primarily related to the acquisition of cognitive skills and have competitive rather than socializing attributes. Little attention is given to the implications of the child's cognitive activities for the welfare of others.

As young adulthood is reached, the isomorphic relation between structure and function breaks down (Schaie & Marquette, 1975). The attainment of the Piagetian stage of formal operations is *not* tied to the development of a specific physiological structural property of the organism (Piaget, 1972), nor can performance level in the elderly be clearly tied to specific physiological decrement (Birren & Renner, 1977). But perhaps more importantly, the developmental tasks (Havighurst, 1972) of the individual change, and the goal objectives of individual behavior are no longer primarily directed toward skill acquisition but toward the application of acquired skills to responsible social roles and societal tasks (Kohlberg, 1973; Schaie, 1977/78).

The life-span–oriented researcher will therefore be attuned to the predominance of emergent behaviors in childhood, the transformation of behaviors in terms of both small- and large-unit societal goals in young adulthood and early middle age, and the maintenance of behavior within a successively less stable physiological structure in terms of relatively egocentric goals during old age. It is most likely that as members of a species, the basic behavioral constructs found to be important in children, such as self-care, social interaction, problem solving, and language functions, will continue to be worth noting throughout life. But it is not at all certain that the same observable behaviors (phenotypes) will be reliable indicators of the latent behavioral constructs (genotypes). In other words, while the building blocks of behavior remain identical throughout life, their pattern of organization is likely to alter due to changes in the effectiveness of the physiological maintenance mechanisms and in environmental supports and societal expectations (see also Schaie, 1978).

Ontogenetic Changes vs. Intergenerational Differences vs. Effects of Sociocultural Change

Anyone seriously interested in life-span models will soon find that such models are closely related to assumptions about aging as well as selection of appropriate data bases. This chapter cannot present in detail the issues related to the interpretability of data obtained from cross-sectional, longitudinal, or the newer sequential data collection strategies (Baltes, Reese, & Nesselroade, 1977;

Botwinick, 1973; Friedrich & Van Horn, 1976; Goulet, 1975; Schaie, 1965, 1970, 1973b, 1977; Wohlwill, 1973). Nevertheless, it would be remiss if we did not call attention to the assumptions implicit in the more commonly used research designs and then indicate how they relate to life-span models.

We would first like to note that the traditional cross-sectional method compares, at one point in time, individuals from two or more age groups who by definition must belong to different birth cohorts. Longitudinal studies, on the other hand, compare the same individuals over two or more points in time. The former method therefore confounds ontogenetic change with generational differences, while the latter confounds ontogenetic change with the effects of sociocultural change occurring between times of measurement (or what the sociologists call *period effects*). For most behavioral variables these confounds are bound to be large, and it is unlikely that findings of cross-sectional age differences will agree with those obtained from longitudinal age changes (see Schaie, 1967, for a conceptual discussion and Schaie, in press), for extensive research evidence). Further, it has been argued that many age differences reported in the research literature might be more parsimoniously interpreted to be generational differences, and there are serious questions whether results of single-cohort longitudinal studies of human behavior can be interpreted in a meaningful fashion (see Schaie & Gribbin, 1975a).

Several alternative strategies have been suggested which have come to be known as *sequential methods*. The researcher interested in age changes wishes to find functions which describe ontogenetic changes across the life course and must therefore demonstrate that such functions do not simply describe the impact of specific historic events on a single birth cohort. In this instance the same age range should be monitored for two or more successive cohorts, using a design we have called the *cohort-sequential* method. In this manner it is possible to segregate the effect on intraindividual ontogenetic variance from intraindividual generational difference variance. Further complications arise in educational research when variation between and within grade levels may be important. Grade level can take on an alternate role in defining membership of a cohort (see Goulet, 1975).

Researchers studying age differences frequently want to obtain information on the question of whether there are generational differences which account for behavior difference between the young and old at a particular point in time. In this case, however, we need to know whether such differences remain stable or are an artifact of particular age-cohort combinations occurring at a single measurement point. This is best accomplished by use of the *time-sequential* design, which involves two or more replications of the age range covered by a specific cross-sectional study.

Finally, we should note that many developmentally oriented investigators are not really interested in aging per se. What they want to know is whether there are stable generational differences or sociocultural changes which may determine behavior change over time. This argues for the *cross-sequential* method in which

two or more cohorts are sampled at two or more measurement points in order to differentiate between the effects of differential early-life experience or other generation-specific variance and period effects introduced by sociocultural change.

One further caution is in order. The choice of research strategies implies certain prior assumptions about the nature of the data. Thus utilization of the longitudinal and cohort-sequential methods implies postulating trivial period effects, the cross-sectional and time-sequential methods postulate trivial cohort effects, and the cross-sequential method postulates trivial age-related effects.

Alternate Models of Adult Development

As we have noted above, it seems reasonable to argue that during childhood behavioral development can generally be viewed as undirectional, with the direction representing the emergence of more differentiated from less differentiated behavior, as well as the attainment of higher levels of performance or behavioral intensity. No such assumptions seem reasonable for most behavioral variables past adolescence. In our previous writing, moreover, we have called attention to at least three different models, all of which fit at least some available data sets for some portion of the adult life span (Schaie, 1973b).

The first of these models states that once maturity is reached, henceforth adult behavior will remain stable. The *adult stability* model may be suitable for a limited number of behaviors which are biologically mediated but whose biological base remains stable from maturity to death. More important to educators, it is a model which must be seriously considered for the so-called crystallized abilities (Cattell, 1963), if one assumes that in this case the organism has mastered all information made available by the environment. Another important instance involves many personality traits and attitudes (e.g., ego strength, dominance, conservatism) which, barring profound life crises, should be expected to remain stable over the life span (Schaie & Parham, 1976).

Postulating the stability model for a particular variable, of course, implies that the investigator's interest must shift away from a study of age. What is of interest now are shifts in the asymptotic levels attained at maturity for successive generations and the effects of transient cyclical events due to time-specific input. Obviously, situational variables may mimic what seem to be developmental phenomena. Changes in educational curricula which are introduced in one school system before they were acceptable to the professional community at large might have such effects.

If the stability assumption is indeed valid, then data from cross-sectional studies comparing different age groups are direct estimates of cohort differences; those from longitudinal studies yield evidence of cyclical variation; and the cross-sequential method is the experimental strategy of choice, since it permits differentiation of cohort and period effects. Examples of this approach have been provided in studies of the Primary Mental Abilities for samples measured repeatedly by Schaie and Labouvie-Vief (1974) and for independent random

samples by Schaie, Labouvie and Buech (1973). In these studies it was found that for the middle adult range, from the thirties to the sixties, there was little change within individuals that could be attributed to aging on ability variables which did not require highly speeded tasks for measurement. Cross-sequential analyses, however, detected substantial generational differences, as well as secular trends involving individuals at all ages. We suspect that these results in major part reflect both changes in educational level for successive population cohorts and changes over proximal time periods in our efficiency to program and transmit sociocultural information to adults.

A second model, the one which seems implicitly to underlie most traditional discussion of life-span processes, implies *irreversible decrement* past the growth peak. This model is superficially most attractive because if data were to fit the model, it would then be possible to fit age functions and compute functional ages in a manner similar to the mental age concept used with children (see Schaie & Schaie, 1977b, for a detailed discussion of the functional age concept). It is an insidious model, however, because it focuses the researcher's attention primarily on those few behaviors where performance is dominated by peripheral sensory functions and psychomotor speed, which do indeed seem to show systematic age-related decrement. Moreover, these variables may be the very ones which are most likely subject to compensation by means of prosthetic environments. In other words, the model is likely to fit only for a limited number of variables and is most appropriate for the analysis of data in populations of advanced age (say the late sixties and older), where by reason of increasing physiological pathology, irreversible decrement must be expected.

But since this model specifies that ontogenetic changes will occur regardless of environmental input, it is imperative to segregate variance which is maturationally determined from that which may be generation-specific if we wish to learn and generalize about both levels and slopes of decrement functions. That is, we need to know over what age range we can predict systematic age decrement as against age differences attributable to generational shifts in level of performance. Note that the irreversible decrement model implies the absence of period effects, since no compensatory environmental impacts are deemed to be effective.

An example of the application of the cohort-sequential method appropriate to test these questions is provided in a study of the Primary Mental Abilities in which seven-year age changes were contrasted with seven-year cohort differences (Schaie & Parham, 1977). Results suggest that until the sixties there are no age changes on power tests, but substantial cohort differences prevail. From the sixties on both age and cohort differences are found, with age changes accounting for progressively larger amounts of individual-difference variance as the eighties are reached. For highly speeded tests, however, cohort differences are relatively unimportant, while decremental age changes are detected as early as the forties.

Many life-span researchers consider a third model, which we call *decrement with compensation*, more likely to fit behavioral data and, interestingly enough, much easier to test. We might argue that for many behavioral variables beyond a minimal base level, environmental input in childhood may affect growth in observed performance only minimally, since the organism as yet has not reached its asymptote. During the adult phase, however, biologically determined decrement might be compensated in part by environmental input of a quasi-prosthetic nature. The decrement-with-compensation model may be quite appropriate for variables involving fluid intelligence, temperament, and other personality traits; in other words, variables where generational differences seem relatively unimportant, but where changes in educational technology and sociocultural processes may well obscure maturational events. Let us note, further, that data fitting the decrement-with-compensation model will probably either show a moderately accelerating decrement gradient or be compatible with the terminal-drop concept, that is, severe behavioral decrement shortly prior to death (Siegler, 1975), when compensatory input no longer suffices to stabilize the behavior under scrutiny. Obviously, the latter circumstance is difficult to differentiate from an adult stability model. That is why it is probably wise to collect data whereby both the stability and decrement-with-compensation models can be examined.

Tests of the decrement-with-compensation model require the application of the time-sequential method, which is designed to differentiate age and period effects. An example of this approach is provided by a study of ontogenetic and sociocultural change in expressed attitudes of social responsibility (Schaie & Parham, 1974). In this study it was argued that one might expect both age and cohort differences in the expression of social responsibility. Empirical findings, however, supported strong cyclical trends implicating sociocultural effects, but with differential impact depending upon the age of the respondents.

Plasticity of Adult Behavior

Having pleaded the need for different sets of assumptions in research covering the life stages past early maturity, we now need to go a step further to suggest that not only are there likely to be different developmental functions for different behavioral variables, but also we may expect substantial individual differences in maintenance patterns and modifiability (Baltes & Schaie, 1976; Baltes & Willis, 1977; Labouvie-Vief, 1976). We take the general position that behavioral deficit from a young adult level of functioning must generally be attributed to a combination of genetic propensities, unfavorable environment, and physiological functions through adulthood. We would then expect much greater variability in behavioral competence than is observed during childhood. The extent of such variability may, however, not always be obvious across the total population of adults because of the countervailing trend of increased probability of physiological pathology which inhibits expression of many behaviors as well as the increasingly constricted environment and role reduction in later life (Gordon, 1971). But the *range* of observed behavior increases markedly, and we find that

many elderly individuals perform well above the average of young adults (Schaie & Parham, 1977; Schaie & Strother, 1968). Indeed, the fact that we can document an increasing number of individual instances of lack of individual decline on important psychological functions suggests that the average decrement observed beyond the sixties may well be pathology related or modifiable by social intervention.

Of further importance in this context are recent findings that behavior modification paradigms with the elderly are quite successful. Thus, apparent low-level function on intellectual variables, whether due to obsolescence or decrement, has been successfully modified by several researchers (Hoyer, Labouvie, & Baltes, 1973; Labouvie-Vief & Gonda, 1976; Plemons, Willis & Baltes, 1978). Even quite simpleminded changes in instructional or reinforcement conditions may result in increased performance (Birkhill & Schaie, 1975). Considering further issues such as individual differences in life-style and environmental interaction, it has been found that there is very little decrement in function at most ages over periods as long as 14 years in individuals who have a complex environment and who are involved in many interpersonal contacts, while substantial decrement is noted in those living isolated lives (Schaie & Gribbin, 1975b).

It follows, then, that we must be much more analytic in considering the circumstances under which an individual's behavior remains stable or undergoes change over the life span. Nevertheless, those interested in educational planning, in addition to knowing that the range of individual variability is substantial and that many older individuals can well profit from technologies appropriate for young adults, must still take due note that for many of today's adults there are age changes which must be taken into account.

Life-span Developmental Models and Education

The relevance of a life-span approach for education is based on several assumptions. First, it is assumed that education, as an applied science, involves application and utilization of knowledge from several disciplines and that life-span developmental psychology is generating a relevant knowledge base. The linkage between life-span development and education is particularly relevant if the primary goal of education is the facilitation and optimization of individual plasticity—that is, if individual development is modifiable through both macro sociocultural change and micro-level ontogenetic life events. Education too is based on the assumption that behavior is modifiable and thus subject to educational intervention strategies.

Developmental Discontinuity. A life-span perspective suggests that qualitative and quantitative developmental changes occur across the life course, resulting in developmental discontinuity. Such developmental discontinuity implies the need for qualitatively different educational goals and instructional strategies at different life stages. For example, an educational focus on skill acquisition in childhood shifts to an emphasis on social application of such skills in young adulthood. The acquisition-to-application shift is suggestive of different levels of Bloom's hierarchy (1956). Likewise, the three adult development models of stability, decrement with compensation, and irreversible decrement suggest different educational approaches. While a stability model suggests emphasis on maintenance of acquired skills and knowledge, a decrement-with-compensation model focuses on the design of compensatory strategies involving quite different educational foci and strategies. Such model differences are similar to the "teaching to the weakness vs. teaching to the strength" concept.

Moreover, such developmental discontinuity implies differential developmental antecedents across the life course and a shifting relationship between maturational neurophysiological structures and cognitive functions. Maturational influences may predominate in childhood such that emergence of a behavior occurs within a relatively narrow chronological age period. Thus, age-graded educational intervention may be merited in view of uniformity in development sequences deriving from this isomorphy between physical structure and cognitive function. However, experiential factors appear to become more salient in adult cognitive functioning and the structure-function relationship breaks down. The educational implication is that educational endeavors in adulthood should be organized by criteria other than chronological age. Developmental tasks and social roles based on experiential factors and social expectancies may be more useful indices for defining educational programs in adulthood.

Dialectical Relation between Social Change and Individual Development. A life-span approach maintains that individual development occurs in the context of social change and that such macro-environmental influences can result in differential developmental patterns for cohorts experiencing different slices of history (Riegel, 1976). The implication for education is that there must also be a dialectical relationship between the educational system and social change. That is, education must be responsive to the changing social milieu and thus to the changing nature of the student population. Students of the same grade level but from different cohorts may well differ in terms of academic performance and attitudinally related variables. Note the recent decline in performance on college entrance exams. All aspects of the educational endeavor, including curricula, instructional technology, and assessment, must be continually reexamined for possible cultural obsolescence.

ROLE OF EDUCATION AT DIFFERENT LIFE STAGES

Early and Middle Childhood

Childhood has traditionally been considered the period for development of social and intellectual skills related to effective functioning within a particular society. It is a period of emerging behavior, and preschool and primary early education has focused on knowledge and skill acquisition. Recently greater

attention has been given to cognitive abilities and processes rather than specific factual information (Evans, 1977; Lay, 1971). Such factual information quickly becomes obsolete in a rapidly developing society. Accelerated change suggests the need for basic cognitive abilities which facilitate the individual's adaptiveness and flexibility in changing environments. Thus in focusing on cognitive processes, early childhood education assumes a preventive function in facilitating the a priori development of strategies for coping with change.

The research literature suggests that the child's development of certain attitudes as well as cognitive abilities has a significant impact on later development. It is suggested that certain attitudes developing in early childhood, such as achievement motivation and sex role types (Kagan & Moss, 1962), may be significant to a lifelong learning approach. For example, perceptions of age-specific and life roles begin to develop in childhood, and thus learning should be perceived as a lifelong endeavor rather than an age-specific role (Houle, 1974). Likewise, need for achievement has been shown in educational settings to develop in childhood (Atkinson, 1964; Kagan & Moss, 1962) and to be subject to modification (Atkinson, 1964). The changing age structure of the society and the impact of environmental change on career patterns suggest the need to examine attitudinal development with regard to work roles and the perception of aging. Research (Ahammer & Baltes, 1972; Hickey, Hickey, & Kalish, 1968; Seefeldt, Jantz, Galper, & Serock, 1977) suggests that the individual's perception of age-graded stereotypes develops early in the life span. Seefeldt et al. (1977) reported stereotypic views among children of physical and behavioral aspects of aging. Age segregation in the formal educational process provides little opportunity for children to interact with older adults and thus to challenge stereotypes of aging. Perception of work roles has also been found to have early developmental patterns (Kirchner, 1973).

Interestingly, one of the first steps toward a lifelong learning approach may have been the extension of early education into the preschool years and even infancy. Some perspectives gained from the compensatory education movement in the 1960s may be useful as lifelong learning expands into other age periods which have not been within the traditional educational domain. Such perspectives appear to support some of the concerns of a life-span approach. First, early intervenors became increasingly aware of the qualitative differences in cognitive functioning in infants and young and middle-aged children. Such qualitative changes imply the need for different educational goals, instructional strategies, and even assessment batteries at different developmental periods. Early childhood education has not been a simple extension downward of the elementary grades (Cropley, 1976). Furthermore, the need for a conceptual or theoretical framework for explicating the relationship between these developmental periods became evident. Piagetian theory appears to be one of the few theories which deals with qualitative change across early developmental periods (see Flavell, 1963, for a discussion of Piaget's theory). Finally, since the target of early

intervention was the culturally disadvantaged child, educators became increasingly aware of the impact of sociocultural variables on development. For example, the influence of sociocultural variables on language development became a focus of much research. Thus expansion of the learning process across a wider age span illustrates the relevance of some of the life-span models previously discussed.

Adolescence and Young Adulthood

The period of adolescence marks a qualitative developmental shift from emergence to transformation of abilities and skills. The nature of such a transformation may be considered from several perspectives. In Piagetian theory, adolescence is the period during which there is a transformation from concrete to formal operational thought. However, formal reasoning tends to occur primarily in modern technological societies and varies with individuals according to the substantive area in which it develops (Piaget, 1972). It may be that with further rapid technological advances future career options will increasingly require formal reasoning. Both Piagetian theory and recent training research (Hornblum & Overton, 1976; Tomlinson-Keasey, 1972) suggest that formal reasoning is susceptible to educational intervention.

Transformation is also evident as the general intellectual and social abilities developed in childhood are channeled into acquisition of adult role competencies, particularly those involving career preparation. Such transformation of general intellectual and social abilities developed within a school setting into adult role competencies involves more than a simple transfer of a particular skill into a different context. As Schaie (1978) has recently noted, real-life tasks involve a cluster of skills rather than isolated abilities. Moreover, while the same generic intellectual abilities (genotypes) may be involved in success in both academic and job settings, the behavioral expression of these abilities (phenotypes) in different settings can vary greatly. Thus the complex of abilities involved in career-related tasks would be best developed through a problem-centered, multidisciplinary approach within the job setting itself (Cropley, 1976; Wroczynski, 1974). In contrast to the prior educational pattern of compartmentalizing learning into a series of academic courses and isolating career preparation from the workplace, the present approach would require the student to integrate knowledge of several disciplines (marketing, English, public speaking, psychology) in solving a real-life problem (selling a product).

The need to integrate work and study in young adulthood has been strongly recommended in the United States by Coleman (1972) and in several European countries (Bengtson, 1974). Coleman maintains that the isolation of the adolescent from adult-oriented contexts has seriously delayed development of adult role competencies. If work and study were integrated, school-based activities per se would be reduced, while education within the workplace would be expanded. The passive, teacher-oriented learning of the classroom would be replaced by

self-initiated, active, experiential learning—an educational model more consistent with future learning across the adult life span. Partially in line with these suggestions, the Oregon Board of Education has prescribed a new set of high school graduation requirements focusing on six life competency roles: learner, individual, producer, citizen, consumer, and family member (Long, 1974; Shaffer, 1974). Likewise, the extensive literature on career development education (Holland, 1973) advocates a lifelong education.

The integration of work and study in adolescence is in line with the lifelong learning approach to combining work and continuing education across the adult life span (Houle, 1974). Rapid technological advancement and multiple career patterns make it unfeasible to crowd lifelong vocational training into a few years in adulthood (Carnegie Commission, 1971). Multiple entry points into both the educational system and the job market must be made available during adolescence and continue across adulthood. Such an approach could result in a reduction in the time required for initial job preparation, in contrast to the increasing length of college or vocational education during the past few decades. It is likely that certain job-related skills are best learned after a period of on-the-job experience. A future task for the educator is to determine the optimal timing for training for certain occupational skills.

Middle Adulthood

One of the most important challenges for a lifelong learning approach involves the formulation of educational opportunities for the middle-aged adult. Currently, adults in early middle age (35–40 years) are the most active consumers of formal continuing-education courses. This age group is also heavily involved in organizations and civic participation. Schaie (1973a) has suggested that educational intervention in middle adulthood may have the greatest impact for society, due to these adults' positions in the power structure of society.

Projections for future later-middle-age cohorts, the age group which Neugarten (1975) calls the "young-old" (55–75 years), suggest an increasing demand for educational opportunities from this age group also. Neugarten predicts that by the year 2000 the young-old population will include approximately 15% of the entire population. With a 2% per year reduction in the mortality rate and the anticipated reduction in modal age of first retirement to 55 years, it is predicted that the postretirement life span of men in this age cohort would double, from the present 13 years to 25–28 years. The significant increase in leisure time as well as the anticipated improvement in health and educational level suggest this age cohort as a prime consumer of education. Compared to earlier age periods, little is known about the middle-aged learner (Knox, 1977; Troll, 1975). It appears that cognitive psychology and educational research have focused primarily on the acquisition phase of learning, and thus on the younger learner. Due to an increasing experiential history, the task for the middle-aged learner increasingly becomes the maintenance and transformation of information rather than acquisition de novo. Rapid environmental change increases the situations requiring unlearning of material or the relating of new information to much prior learning. Within a lifelong learning approach, formal educational institutions must become increasingly sensitive to qualitative developmental changes in the adult learner (Huberman, 1974). Furthermore, multiple entry points into the educational system must be created to accommodate the expanding adult population of students which will approach continuing education with a variety of learning backgrounds.

The middle years are particularly salient in women's changing role in relation to work and education. Whereas fewer men continue to work as they get older (from 44 on), more women work between 45 and 54 than at younger—or older—ages (Troll, 1975). Such data illustrate the contrasting life patterns of the sexes, since in middle age the woman is initially freed of the child care role which has made extensive time demands in early adulthood. Such initial entry or reentry into the work world during middle age often requires career preparation or retraining. Education must become increasingly sensitive to the educational and personal needs of women undergoing role changes. Alternative educational programs and credentialing would allow consideration of the competencies acquired by such women through volunteer work or in relation to their child care role.

DIFFERENCES BETWEEN YOUNG AND OLD LEARNERS

A major concern for the systematic analysis of life-span changes in learning processes and thus relevant instructional technology is the fact that there are systematic changes in a number of basic processes between the life stage at which formal education has traditionally centered and the stages at which adult education or second career training are most likely to occur. The chronological ages at which relevant behavior changes occur differ by area of function and depend to some extent on the individual's life course. Nevertheless, even though many adult experiential phenomena occur with great chronological latitude (see Neugarten & Datan, 1973), there are at least several well-defined changes from young adulthood into late middle age which occur for most aging individuals. This section will summarize some of the clearer findings from the research literature for the areas of sensory and perceptual function, learning and memory, intellectual abilities related to educational competence, and differential motivation. A more extensive version of this section may be found in Schaie and Quayhagen (1978).

Sensory and Perceptual Differences Between Young and Old Learners

Visual Acuity. Age-related changes in the structure of the eye include lessening of transmission ability and accommodation power of the eye beginning at ages 35 to 45. Progressive thickening in the cortex region of the crystalline

lens renders it less transparent, resulting in interference with the optical functions of transmitting and refracting light, as well as decreasing accommodative power. The yellowing of the lens not only reduces the amount of light to the retina but also results in loss of sensitivity to the shorter wavelengths of the visible spectrum (Weale, 1965). The older adult therefore has greater difficulty discriminating between blue, blue-green, and violet colors. Changes in the accommodative power of the eye further affect distance vision, sensitivity to glare, binocular depth perception, and color sensitivity. Circulatory and metabolic changes in the retina around age 55 to 65 years also result in reduction of the size of the visual field, along with decreased sensitivity to flicker and to low quantities of light.

Fozard, Wolf, Bell, and Podolsky (1977) conclude that it is the brightness gradient of the image on the retina that is critical in determining visual acuity. Corrective lenses can improve visual acuity by increasing retinal illumination, but acuity can also be sharpened by increasing the contrast between the object and its surrounding field or by increasing overall illumination.

There is evidence from a number of studies that age-related changes occur in visual perception. Older people tend to adhere to initial perceptions in a given stimulus situation and show evidence of resistance, or possibly inability, to reorganize their perception. Whether this phenomenon is due to a personality trait of cognitive rigidity or to a decline in visual acuity which limits discriminability of objects is not yet clear (Corso, 1971).

The combined impact of physical and perceptual deficits in the overall visual functioning of the older adult has been studied by Pastalan, Mautz, and Merrill (1973). In order to duplicate relevant environmental experiences of the aged person with "normal" sensory losses, these investigators attempted to simulate the effects of yellowing of the lens, increased lense opacity, and light scatter in combination. It was found that these age-related decrements have a limiting effect upon the older adult's use of buildings, facilities, and environmental space. Also, structural changes in the eye would suggest that visual aids should have distinctly outlined configurations and adequate illumination level.

Auditory Acuity. The most common auditory deficiency with advancing age is presbycusis, a sensorineural bilateral loss of auditory acuity for the high frequency tones, due to physiological degeneration in the auditory system (Corso, 1977). Such changes produce functional decrements in the auditory thresholds for pure tones, speech and pitch discriminations, and information for processing of dichotic stimuli. Such deficits may interfere with older adults' ability to communicate and therefore limit their range of interaction.

Corso (1971) reports sex differences in auditory sensitivity, with the hearing level of men higher than that of women at or above 2000 Hz, but below that of women for frequencies of 1000 Hz and below. This finding may be due to exposure to differing amounts of environmental noise. Some degree of hearing loss is found from about 32 years of age for men and 37 years for women (Lebo & Reddell, 1972). Impairment in pitch discrimination has been noted as early as the fourth decade (Konig, 1957). However, Corso (1971) has suggested that age-related performance decrements may reflect different criteria of judgments (such as cautiousness) rather than functional losses in the auditory sensory modality.

Because presbycusis affects high-tone auditory sensitivity, there is a loss in discrimination of consonants with high frequency components in their acoustic patterns, such as *s, t, q, f,* and *g*. As a result, older adults have greater difficulty in discriminating phonetically similar words, with subsequent difficulty in following normal conversation. Increased noise levels can enhance these difficulties (Corso, 1971, 1977).

Older adults need additional information-processing time in the perception of speech (Calearo & Lazzaroni, 1957). Complete intelligibility could be obtained for subjects over 70 years of age, for discrimination of words presented at the normal rate of 140 words per minute if the intensity was sufficiently increased. But as the rate of presentation was increased, intelligibility decreased to 45 percent, regardless of intensity.

Schaie, Baltes, and Strother (1964) investigated auditory sensitivity in relation to intellectual functioning in persons over 70 years of age. All individuals showed acuity loss at higher frequency ranges with age. But men were found to have significantly greater acuity loss than women for the higher frequencies and showed greater impairment in intellectual functioning. Substantial associations have also been found between hearing loss and intellectual functioning as measured by subtests of the WAIS and the Raven Progressive Matrices (Granick, Kleban, & Weiss, 1976).

Educational programs can alert the adult learner to an understanding of the impact that sensory deficits can have on social, psychological, and cognitive behavior. Furthermore, educators need to regulate their presentation rate of auditory inputs and to adjust intensity and frequency to a level appropriate to the age of their students, in order to achieve optimal communication.

Perceptual Speed. Birren (1965) attributed age-related slowness in behavior to a slower mediation process in the central nervous system. Whether central or peripheral processes are most strongly implicated in the reduction of perceptual speed has recently been investigated by means of studies of perceptual masking. *Perceptual masking* is the failure to recognize a stimulus or signal if the first stimulus is followed too quickly by a second stimulus. The masking techniques employed in recent visual perception studies (Turvey, 1973) allow the experimenter to localize decrements and to distinguish between peripheral and central masking. No qualitative differences in central perceptual processes have been found between young and older adults (Walsh, 1976). However, in a study using experimental techniques specific to peripheral masking, Walsh, Till, and Williams (1978) found a slower operating rate for the peripheral perceptual system of the older adult over 60 years of age, as compared with the young.

In information-processing studies with techniques other than masking, a longer scanning time was needed for the older subjects to extract information when a target object was embedded in a complex display (Rabbitt, 1965). With a changing display task, Talland (1966) found that rate of presentation and task duration were important variables. But response bias such as practice effects, boredom, or fatigue can affect results.

Research results point to a slower processing mechanism for incoming stimuli with advancing age. This suggests a need for a self-paced or slower presentation rate of stimuli, consideration of varying complexity effects, and greater redundancy in stimulus material.

Age Differences in Learning and Memory Which Affect Educational Technology for the Older Learner

It is currently accepted that many of the observed deficits in learning abilities which are assumed to be age-related should be interpreted as performance differences rather than as decreased ability to learn. Decrements with increasing age have also been noted in memory, and current research is attempting to ascertain whether the observed age differences should be attributed to information acquisition, retrieval, or storage mechanisms, or to other factors.

Acquisition. Since age differences in short-term memory are minimal, age-related acquisition difficulties must be looked for at the deeper level of processing required for retention in secondary or long-term memory (Craik, 1977). Variables implicated include pacing, redundancy of cues, and meaningfulness of content.

Deficits have been noted for older persons on *paced tasks* (Arenberg & Robertson, 1977; Kinsbourne, 1973). When the learning period is slow, older individuals benefit from increased response time. However, when older learners are rushed, increased response time will not help. Although some age differences in performance have been found, even with self-pacing tasks the benefits of self-pacing for the older learner should not be ignored.

Craik (1968) concluded that the elderly make less efficient use of linguistic *redundancy* when a lower performance level was found for older subjects in two experiments designed to test the effect of redundancy in English text. In other studies it has been found that retrieval cues become less effective as more items are nested in a category, in which case noncued or random recall results in better performance for older subjects (Hultsch, 1975; Tulving & Pearlstone, 1966). Craik (1977) suggests that older adults may fail to remember events due to an overabundance or redundancy of functional items associated with the retrieval cues.

Age differences also have been found in relation to *meaningfulness of content*. However, the evidence is somewhat confused, with generalizations limited to specific situations (Botwinick, 1973; Craik, 1977). In a concept identification study, Arenberg (1968) found that older subjects had difficulty with abstract

dimensions but their performance increased with the more concrete dimensions. The results of a similar study in which older adults were found to benefit disproportionately from the use of meaningful tasks as compared to nonsense tasks (Hulicka, 1967) suggests that older adults may refuse to learn meaningless tasks, even though learning occurs for meaningful materials which reflect real-life situations.

Information Retrieval. Although there is insufficient evidence to indicate faster loss of stored material with increased age (Craik, 1977), several retrieval processes have been found to place the older learner at a disadvantage. Those studied most intensively include the roles of response competition, effects of cross-modal presentation, and, in particular, performance on classification problems.

Age-related decrements have been noted when attention must be divided between two incoming stimuli, incoming stimuli and memory, or memory and response. Older persons tend to concentrate on one task and let the other deteriorate markedly (Craik, 1977). The negative effects of divided attention are also found in dichotic listening studies in which different stimuli are introduced to each ear simultaneously (Moray, 1970). Greater age differences have been found if a memory task is presented visually rather than auditorily. When older subjects were asked to reorganize material, even greater performance decrements were apparent (Craik, 1977).

Cross-modality effects have been studied by means of presentations to dual sensory modalities and to dual encoding systems within the sensory modality. Using auditory cues along with a visual presentation was found to improve memory in both younger and older adults (Arenberg, 1968). But hearing the cues seemed to be the critical variable, with better recall for the auditory-augmented conditions (Penney, 1975). However, visual stimuli augmented by active auditory vocalization tend to impair rather than improve recall in the elderly for early items in a list; such items were better recalled under a visual-only condition (Arenberg, 1976). This finding indicates that active auditory augmentation would not be feasible where long term memory is important.

Parham and Schaie (1976) investigated dual coding effects on recall of auditory and visual presentation using combinations of conflicting verbal-symbolic and pictorial stimuli. Better performance occurred when pictures accompanied the verbal stimuli, whether the verbal was presented by auditory or visual means. But cognitive overload in processing seemed to occur when the same encoding system (verbal symbolic) was tapped by different modalities, as was the case when verbal stimuli (passive auditory) were accompanied by visually presented words. These findings suggest that stimuli which enhance dual encoding, such as pictorial stimuli accompanied by verbal (auditory or visual) stimuli, may also enhance recall.

Age-related decrements have been found in organizational ability, and when instructions in efficient organization are given to older adults, performance has

been found to improve (Hultsch, 1974). However, when older persons are asked to reorganize material, the added complication of divided attention produces even poorer performance. When they are taught a learning strategy, overall improvement is noted on successive tasks, but the learning effect varies as a function of age and stage of the task. Older subjects require more time to overcome negative transfer effects and to show improved performance.

The generalizability of training effects has been studied by Labouvie-Vief and Gonda (1976), who trained individuals to perform complex reasoning problems by strengthening their covert self-monitoring strategies. Training conditions involved cognitive self-guidance, anxiety reduction, or unspecified training. Cognitive strategy training produced significant increments in intellectual performance across tasks and over time. Subject-generated strategies may be more effective with older subjects than strategies imposed by the experimenter, since the unspecified training group showed the strongest training effects.

The educator planning to develop programs for older learners must thus be aware of at least several qualitative and quantitative differences which require attention, both in curriculum planning and in the development of teaching materials. We shall defer a discussion of general implications for educational programming to the final section of this chapter, but note that the most important variables seem to be the need for redundancy of cues, the appropriate selection of instructional pacing, and close attention to age- and cohort-relevant meaningfulness of content. Retrieval of information seems further enhanced by careful use of several media, as long as the same encoding system is addressed by several modalities, rather than creating conflict by requiring the simultaneous use of different systems.

Intellectual Abilities Related to Educational Aptitude

Should We Measure Intelligence or Competence? Intelligence can be defined in this context as a spectrum of genotypic factors (latent variables or constructs) which may be derived from phenotypic (directly observable) expressions of adaptive behavior as measured across situations. And competence is defined as the phenotypic expression of a combination of genotypic intelligence factors, which, given minimal motivational incentives, will permit adaptive behavior within a specific situation or class of situations (Schaie, 1978).

In practical terms, the construct of intelligence relates to the basic cognitive skills required for many adaptive behaviors. An intelligent person has *acquired* such skills, while a competent person is able to *express* a particular combination of intellectual abilities in a specific life situation (see Connolly & Bruner, 1974).

Intelligence is basic to an understanding of cognitive behavior, and competence is the manner in which intelligence relates to the problem of daily living. Multifactor batteries measuring intelligence defined by factor analytic methods, as well as Piagetian tests, have not done well in predicting competence, either within a specific situation or across situations (Kamin, 1974). Traditional intelligence measures assume the presence of competence motivation in the young, which allows assessment without regard to the meaningfulness of the task. But older adults may require ecologically relevant and valid measures to elicit maximum performance. Current measures used for the assessment of cognitive functioning are inadequate, since their validity as measures of competence pertains to situations which are quite different from those faced by middle-aged and older adults (Schaie, 1978).

Why bother, then, with the assessment of intelligence at all? Indeed, if we knew all specific outcomes of interest, we might do better to construct tests of behavioral competence for all likely situations. Work in vocational and job assessment has shown this approach to be prohibitive, particularly when differential prediction or placement is required. But if tasks are developed which indeed refer to basic intellectual genotypes, we can then map out the relation of profiles on such tasks to a wide array of criterion situations of interest.

Valid assessment of education aptitude in adulthood requires: (1) the development of a taxonomy of adult situations which are transindividual and transcultural in scope, (2) the development of intelligence tests based on phenotypic tasks that are relevant to real-life situations, extending across ages and cohorts, (3) investigation of the effects of personality and situationally induced motivational variables on cognitive tasks, and (4) achievement of generalizability through ecologically valid measures.

Criterion Group Problems: Age or Cohort-Appropriate Norms? Thomae (1976) stresses the need to consider interindividual variability as well as cohort specific differences in performance and behavior of older adults. Not only may cohort differences be influenced by such variables as health, education, occupation, varying environmental stimulations, and test-specific personality variables, but these variables also result in interindividual variability in performance of age-specific groups (Mathey, 1976; Thomae, 1976). Rudinger (1976) further notes that sex differences may show both cohort and interindividual variability. The meaningfulness of tasks may differentially affect younger and older adult learners, thus making performance comparisons between them difficult and of questionable validity. Other variables of import which may differentially influence the older learner are cautiousness, risk taking, speed of response, and sensory acuity. When comparing cognitive performances, a question yet to be resolved is the degree to which there may be factor stability or change in the organization of abilities in older adults as compared with the young (Schaie & Gribbin, 1975a).

But the major issue in using available assessment tools remains whether we want to compare an individual with his own performance over age (and time), or we want to know where a person stands with respect to his own cohort or as compared with young adults who have had quite different socialization and early educational experiences (see Schaie & Schaie, 1977a). Further, age-corrected norms based on cross-sectional data have at best transient value, especially where

corrections have been obtained from nonrepresentative samples, as is typically the case (Green, 1969; Matarazzo, 1972). Regular follow-up studies of normative samples are therefore needed to provide current norms for test users.

Situation-Relevant Assessment Tools. Both incentive and performance level can be maximized by using situation-relevant assessment tools. In order to achieve contextual relevancy, test batteries should be tailored to the interests and goals of groups of individuals. Such a procedure involves consideration of personal, situational, and task variations, since differing situations require differing performance measures of success, and the nature of the tasks should be determined by the interests of the subjects to be tested. For example, Krauss and Schaie (1976), in their attempt to explore ecologically valid measures for the assessment of spatial rotation skills, employed a technique which used playing cards of various shapes and sizes. It was argued that the utilization of stimulus material with which subjects would be familiar and comfortable ought to enhance the likelihood that one could validly assess the construct of interest rather than measure ability to handle unfamiliar tasks. Besides selecting situations of relevance to the older learner, tasks must also maximize performance motivation in the test situations.

Scheidt and Schaie (in press) developed a taxonomy of situational attributes as a means of determining how older adults of varying backgrounds differentially adapt to classes of situations. This taxonomy, derived from analysis of the literature and from situations generated by direct contact with older adults, makes it possible to estimate previously undetermined behavior in any situation by the comparison of sociophysical and psychological behavior similarities across situations. The development of situation-relevant assessment tools should permit identification of the relationships between competent performance and varying situational contexts, while respecting individual differences.

Differences in Intellectual Performance across Age. In general, cross-sectional studies tend to identify peak ages of performance and age at which significant decrement occurs at much earlier points than are found in longitudinal or sequential studies. As indicated earlier in this chapter, these findings reflect the positive trend in cohort differences found over the past half century. Some of these problems have been addressed by the use of sequential methodologies (Baltes, 1968; Schaie, 1965, 1973) which have attempted to separate ontogenetic change from generational differences. While the sequential methods allow analyses which provide a more detailed description of the data than the traditional cross-sectional and longitudinal designs, they are nonetheless subject to confounds of sampling representation, as are the traditional developmental methods (Horn & Donaldson, 1976). Furthermore, developmental studies are subject to generalizability difficulties because of generational differences, sociocultural trends, ontogenetic changes, and differential attrition and mortality across successive cohorts (Schaie, 1977, 1978).

In spite of these methodological problems it seems fair to conclude that for

those abilities where speed of response is not of intrinsic importance, ontogenetic age changes in healthy populations are observed reliably only in the early sixties and do not become of great practical import for educational application until even later in life (Schaie, 1974; Schaie & Parham, 1977). Thus cohort differences appear of substantial importance in accounting for age differences through late middle age, while some decrement in function becomes implicated beyond the sixties. Contrary to the argument of some (Horn & Donaldson, 1976), this pattern does not seem to differ markedly for measures identified as either fluid or crystallized (see Botwinick, 1977).

Figure 1 illustrates the limited magnitude of age decrement for an estimate of Educational Aptitude (a linear combination of the Primary Mental Abilities tests for vocabulary recognition and inductive reasoning). This figure (from the senior author's sequential studies) indicates proportion of performance as a function of the level of a 25-year-old reference group, based on the longitudinal study of successive random samples from the same cohorts (shaded bars) and from repeated measurements of the same groups (solid bars). These data were obtained from studies of panel members and comparison of independent samples assessed seven years apart. Cumulative age changes were then computed by adding the appropriate seven-year segments (Schaie & Parham, 1977; Schaie, in press). We concluded that the independent-samples study (shaded bars) reflects changes with age in the general population, but that the data for the panel (solid bars) are probably more characteristic of population groups which would seek continued educational exposure. At the extreme right of Figure 1 we provide the lower bound of the middle 50% range (−1 probable error) for the 25-year-old group. It is of particular interest to note that even at age 81, within-generation performance level is above the lower bounds of the middle or 50% range for individuals at age 25. Thus it would seem that reasonably healthy community-dwelling adults, if they were ever educable by reason of intellectual abilities, would retain such educability throughout life, even though both content and technology of education will differ over age and time.

Motivational Variables Affecting Adult Learning

Cautiousness and Risk Taking. Early studies of cognitive ability and cautiousness concluded that in later life cautiousness occurs as a function of decline in cognitive ability. However, Botwinick (1973) suggested that the reverse may be true; that is, that decline in ability may be attributed to an age-related increase in cautiousness. Wallach and Kogan (1961) and Botwinick (1966, 1969) have investigated cautiousness in relation to risk taking using "life situations" with problems and consequences specific to the generations studied. Sex and educational level did not differ in terms of cautiousness. Older adults were more cautious and often exercised the option of not selecting a risky course of action, regardless of success. But when the option to avoid a decision in a risk-taking situation was removed, no age differences in cautiousness were noted.

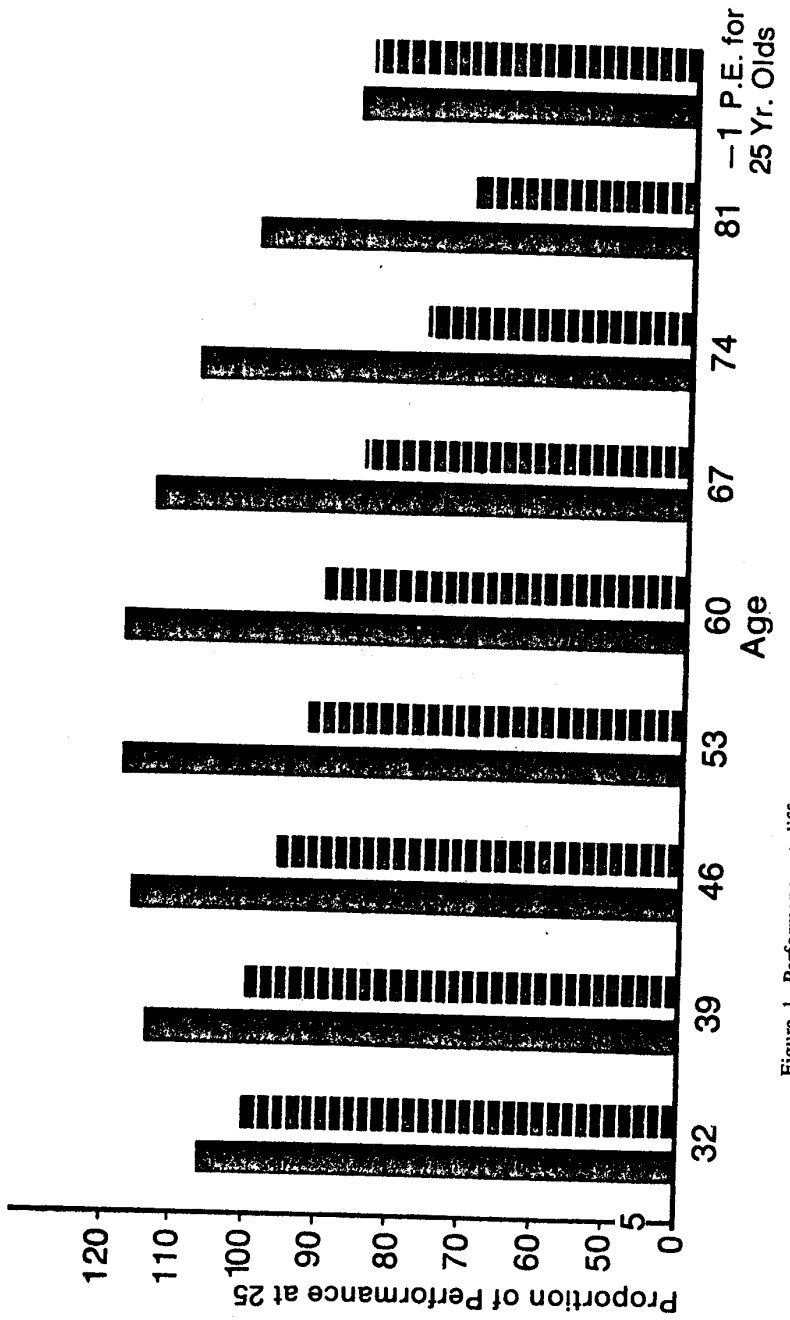

Figure 1. Performance at different ages on an index of educational aptitude as a proportion of performance at age 25.

Note: Solid bars from panel data; shaded bars from independent random samples.

Birkhill and Schaie (1975) investigated high and low risk levels in situations where the omission of responses was differentially reinforced. Older subjects in a low-risk situation performed better only when they had the option to omit responses, and they were more hesitant to become involved where risk was high. Performance was improved when subjects in high-risk conditions were discouraged to omit responses. Okun and DiVesta (1976) studied cautiousness in relation to need for achievement. The older adults they studied were more cautious, chose the difficult levels to maximize success (which would minimize obtaining potentially threatening feedback information on ability), and were less likely to raise their aspiration levels after attaining success. It is apparent that motivational factors such as cautiousness may influence the performance of older adults on measures of cognitive ability, thus causing an overestimation of age-related decrements.

Changes in Value System. Payne, Summers, and Stewart (1973) found substantial differences across three generations in judgments about behaviors having social and personal implications, with the oldest generation the most severe in its judgments. A theoretical model of adult cognitive development has recently been proposed (Schaie & Marquette, 1975; Schaie, 1977/78) which includes stages of life that incorporate the effects of environmental press and under which value changes may be subsumed. The four adult stages of development are: acquisitive, achieving, responsible, and reintegrative. These stages also fit the data presented by Lowenthal, Thurnher and Chiriboga (1975).

During the *acquisitive* stage (high school age), intellectual skills are acquired for participation in the human experience within a protective environment. In terms of value perceptions, Lowenthal et al. found high instrumental material values among both boys and girls of high school age, with the boys giving predominance to personal achievement in occupational attainment and social success, while the girls focused on personal achievement in self-actualization.

In the *achieving* stage, the young adult strives toward goal orientation and role independence, integrating this independence with assumption of responsibilities. In the newlywed members of this stage, Lowenthal et al. found a decline in instrumental-material values, with men having high personal growth values which may be attributed to a nurturant orientation.

The *responsible* stage of development consists of a pattern of long-term goal integration and increased problem-solving skills. For some individuals at this time an additional stage is reached, that of executive abilities with responsibility for societal systems and the development of cognitive strategies capable of integrating complex hierarchical relationships. Middle-aged adults were found by Lowenthal to have an abatement of personal growth values for men, and both sexes gave priority to interpersonal-expressive values. Women also showed a rising concern for ease and contentment, as well as higher social service values.

In the *reintegrative* stage, there is a relinquishment of occupational and familial responsibilities as well as a simplification of cognitive structures by selective attention to meaningful demands. This stage incorporates the preretire-

ment stage of Lowenthal in which there was found to be a decline in interpersonal-expressive values for both men and women and in instrumental material values for men. There was also a subsequent increase in ease-contentment and hedonistic values in older men.

In his most recent conceptualization of moral development, Kohlberg (1973) proposes adult stages of principled moral thought which first appear in young adulthood. These stages are subdivided into a social contract, utilitarian orientation stage, and a higher stage of universal, ethical principled orientation. Cognitive-moral reflection based on personally experienced questioning of commitment is necessary to move into the principled thought stage in adulthood.

Havighurst (1976) offers some meaningful comments on how value and life stages are or are not currently served by instrumental education. If adult learning is to be maximized at various stages, planning and implementation of educational goals means incorporating an awareness of the individual's stage of values and competencies. For students in the stages of increasing responsibility, learning would be more goal directed and specific to the nature of the individual's responsibilities. But as values change from instrumental to expressive, enrichment courses may need to replace more goal-oriented professional training.

Social Conformity. An individual is said to conform socially when he comes to agree with a new opinion or judgment which he had not held previously. Klein (1972a, 1972b) investigated age differences in such conforming behavior on visual perceptual and auditory detection tasks and found that older persons were more susceptible to social influences. When the tasks increased in complexity, conformity occurred more frequently for all subjects, but there was a larger increase in conforming behavior for the older age group.

Age functions as a normative criterion for role definitions and age-related expectations and sanctions, as well as for age-appropriate behavior (Nardi, 1973). Maintaining that age-related expectancies can act as a constraint on social behavior, Neugarten, Moore, and Lowe (1965) investigated the interaction between perceived societal age norms and perceived personal norms. They found that the older group (age 65+) had a higher degree of congruence between personal and societal norms which may represent the internalization of age norms through the adult socialization process.

If older adults are more influenced by social pressures, they are also more likely to be targets in advertising schemes and frauds. Educating these individuals toward greater self-assurance in recognizing and coping with complex and ambiguous judgments might well improve competence in coping with the requirements of daily living.

EDUCATIONAL IMPLICATIONS OF CHANGES IN THE LEARNER ACROSS THE LIFE SPAN

Life-span models and differences between young and old learners have several implications for a life-span approach to education. While educational

specialists have given some attention to these issues at earlier points in the life span, comparison of learning functions across a greater portion of the life span brings them into sharper focus. In this section we will examine implications related to educational goals, instructional methodology, and the context for lifelong learning.

Expanding the Concept and Goals of Education

A life-span approach suggests that ontogenetic-individual development must be studied in the context of sociocultural change. Interactions between the individual and the environment are involved in defining both normative patterns of development and individual variability. Traditionally, education has tended to define goals in terms of either normative or differential views of individual development. Emphasis on normative patterns of development has led education to focus on developmental tasks in defining educational goals. In contrast, emphasis on individual differences has resulted in a concern for differentiation and individualization of educational objectives. Such an orientation is reflected in the current concern for cultural pluralism.

A life-span perspective would consider both normative and differential developmental patterns in the context of social change, and thus it would suggest three sources of educational goals. These are normative developmental patterns, individual variability, and sociocultural change influences (Baltes & Danish, in press). Educational goals focusing on normative developmental patterns have been particularly critical in early stages of the life span. A traditional area of education has focused on socialization of the child for adult roles and thus has emphasized normative developmental tasks and universal academic skills. In a life-span approach to education, individualization of educational goal setting becomes increasingly important with the wider range of individual differences in development during the adult life period. Educational goals during adulthood may vary both qualitatively and in the timing of achievement.

Moreover, recognition of social change in educational goal setting emphasizes the dynamic nature of the educational process. Educational goals and methodology must be sensitive and adaptive to social change. However, this suggests not only that education must be responsive to social change but also that education can be involved in directing the nature of this change. It is evident that education can remediate for obsolescence due to social change and can also provide individuals with generic skills for coping, adapting, and optimizing their development in relation to future change.

Instructional Methodology

The Increasing Importance of Noncognitive Factors in Learning. The concept that intelligent behavior may be a function of cognitive abilities plus performance-related, noncognitive factors has been discussed in the child development literature in relation to the performance-competence distinction (Flavell & Wohlwill, 1969). The influence of the child's limited linguistic

capacity in assessing intellectual development through verbal means, and the necessity of screening for sensory deficits before evaluating intellectual competence in the exceptional child, are illustrations of such noncognitive factors.

A careful examination of the learning differences discussed in the preceding section suggests that noncognitive factors (e.g., sensory deficits, motivation, response speed) play an even more important role in learning performance in adulthood. A current research thrust in adult psychology is to ferret out the learning changes in later adulthood that are due to cognitive and to noncognitive factors (Woodruff & Walsh, 1975).

Instructional Pacing. Some cross-age learning differences have been related to the increasing time required for the aging adult to acquire and retrieve new information from memory (Craik, 1977). Providing a longer acquisition and response period has been shown to improve the adult's learning performance. Furthermore, the amount of material and the number of task demands presented at a given point in instruction have been shown to influence learning in later adulthood (Craik, 1968, 1977). Such findings suggest the utility of a self-pacing approach, with the number of task demands and the amount of information presented being carefully regulated. Initial research by Siemen (1974) suggests that a programmed instructional approach can be effective with the older adult. In addition, the mastery learning approach developed by Bloom (1968), as well as the competency-based method in general (Torshen, 1977), provides accommodation for variations in learning pace.

Motivation to Learn. Prior to adulthood, motivation to learn seems to have a strong extrinsic component, since education of the young is compulsory. Continued learning in adulthood, however, is primarily self-initiated. The intrinsic nature of motivation in the adult learner poses an enormous challenge to education. Dubin (1977) sees motivation as the key factor in updating the obsolete worker. House (1961) suggests three motivational orientations in the adult learner: goals, social activities, and learning. While the goal-oriented learner usually is pursuing vocational or professional goals, the activity-oriented learner seeks social contact and interaction. In relation to the academic system the goal-oriented learner may well enter a certification or credentialing academic program, while for the activity-oriented learner a nondegree program would probably be more appropriate.

Increasing Individual Differences in Learning. Individual variability in almost every type of intellectual capacity increases across the life span. The greater range of individual differences in adulthood should be of primary concern to the educator. Extreme individual differences in an intervention population (e.g., exceptional child, disadvantaged child) have usually required an individualized instructional approach. Such an individualized orientation would seem imperative in adult instruction. Variability in noncognitive factors related to learning and in motivation, as well as in cognitive ability, must be considered in designing instructional approaches for the adult learner.

The increasing importance of individual variability in adulthood should provide a fertile area for educational trait-treatment interaction/research (Berliner & Cahen, 1973). The type of studies investigating the relationship between learner aptitudes and instructional approaches initiated by DiVesta, Sanders, Schultz, and Weener (1971), Kropp, Nelson, and King (1967), and Cronbach and Snow (1977) are particularly relevant in mapping out appropriate instructional strategies for the adult learner.

The Changing Nature of the Instructor-Learner Relationship. As indicated previously, the role of the teacher across the life span appears to change from director of learning to that of a facilitator or resource person (Houle, 1974; Huberman, 1974). Whereas society and the educator direct the education of the young, the content and method of learning in adulthood are largely determined by the learner. Developmental changes in the learner across the life span suggest the need for qualitatively different types of teacher training for educators working with different age groups. The techniques of the high school or even college instructor may be inappropriate in teaching middle-aged or older persons. Teacher training institutions must be involved in translating the information concerning adult learning into a delineation of skills required of the adult educator.

Much has been said about changing characteristics as the learner ages, but we should not forget that career teachers age as well. Thus principles applying to the adult learner may equally apply to the teacher's own continued updating and learning endeavors.

Extending the Educational Context

As the role of education broadens conceptually and lengthens temporally, the context for education must also expand. With lifelong learning only a small portion of the individual's education would actually be acquired within a classroom. Except for the years of formal schooling, most of the individual's education is experiential and active, rather than receptive, and occurs in the context of daily living. Thus the home, workplace, and public facilities are all contexts for education. Education can extend geographically across the individual's total life space as well as temporally across the life span.

In summary, a lifelong approach to learning broadens the concept of education beyond the traditional youth-oriented preparation for adulthood. Education serves preventive, facilitative, and remedial, as well as preparatory, functions. The focus of educational intervention extends beyond the acquisition of academic and vocational skills to enabling the individual to master developmental tasks associated with each period in the life-span. Early education assumes preventive as well as preparatory functions as the intervenor's understanding of the relationship between developmental periods across the life span increases. Rapid technological changes suggest that learning in adulthood serves both facilitative-adaptive and remedial roles. Thus, a lifelong view of education suggests a reallocation of educational opportunity across the life span to accommodate

to the changing learning needs and capacity of the individual. The individual continues to change across the life span due to ontogenetic and sociocultural factors. A life-span approach to education focuses on such individual and societal change. Lifelong learning seeks to optimize the nature and direction of these development changes.

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