In J. E. Birren & K. W. Schaie (Eds.), Handbook of the Psychology of Aging. 2nd Ed. New York: Van Nostrand Reinhold, 1985.

30
TOWARDS AN EDUCATIONAL PSYCHOLOGY OF THE OLDER ADULT LEARNER: INTELLECTUAL AND COGNITIVE BASES

Sherry L. Willis
The Pennsylvania State University

INTRODUCTION

A primary purpose of this chapter is to examine theory and research within selected areas of adult developmental psychology, as they have implications for formulating an educational psychology of the adult learner. A primary focus will be on the intellectual and cognitive bases for the development of an educational psychology of later adulthood. The older adult learner brings to the learning context a long developmental history. Thus, long-term developmental change, as well as short-term behavioral change associated with learning in a specific educational context, must be considered. The first part of this chapter examines findings regarding long-term change in intellectual functioning, based on longitudinal and cohort-sequential research. The second part of the chapter considers educational implications of these research findings regarding long-term intellectual change. The third part of the chapter deals with short-term behavioral change, which is associated with cognitive training research in later adulthood, and considers some of the methodological and conceptual issues related to cognitive training research. In the final section of the chapter, potential goals of the older adult learner are considered, and the motivational and personality factors associated with lifelong learning in later adulthood are examined.

The term *education* conjures up an image of young students in a classroom setting, receiving instruction from a teacher. The focus is on the acquisition of the academic knowledge and skills that are assumed to prepare the young person for the responsibilities of adulthood. Most of our educational efforts and resources are concentrated in the first quarter of the life span. There has been the implicit assumption that the individual can acquire in childhood sufficient knowledge and skill for effective functioning in adulthood. As a function of our rapidly changing and increasingly complex and differentiated society, the period of initial schooling has been increasing to include not only childhood but adolescence and early adulthood, and, as a result, assumption of many adult responsibilities has been delayed (Parsons and Platt, 1972). As our society continues to change and becomes ever more complex, the question arises whether further extension of the period of initial schooling is functional or desirable.

The term *education* as employed in this chapter refers to lifelong learning. Learning, as a form of adaptation, continues throughout

adulthood. A primary function of lifelong education should be the facilitiation of adaptation and optimal development across the life course (Cropley, 1977; Dave, 1976; Houle, 1981; Schaie and Willis, 1978, 1982). In contrast to early schooling, much adult learning is self-determined and self-directed. Learning occurs less frequently in a formal classroom setting that has an instructor as the primary agent of knowledge dissemination. The learning context is more diverse, including the home, social functions, community organizations, and the work place. The "teacher" may now be the mass media, the printed word, friends and relatives, work colleagues, or the computer. Although acquisition may be the primary mode of learning in youth, learning in adulthood increasingly involves processes, such as application, synthesis, and integration of new learning with prior knowledge (Schaie, 1977/78) and the inhibition ("forgetting") of prior information that is irrelevant or obsolete (Goulet, 1973).

From a sociological perspective, lifelong learning is conceptualized in terms of socialization after childhood (Brim and Wheeler, 1966; Parsons and Platt, 1972). In a complex, fast changing society, socialization in childhood is not adequate for the tasks of adulthood. There may be little continuity in significant others from childhood to adulthood, and successive societal roles expected of the individual may not build upon one another. Thus, society must provide for the resocialization of individuals into roles they were not developmentally prepared for in childhood.

INTELLECTUAL AGING: AN OVERVIEW OF LONGITUDINAL AND SEQUENTIAL RESEARCH FINDINGS

A number of recent review chapters have noted the lack of integrative theories of intellectual development (Baltes and Willis, 1977; Birren, Cunningham, and Yamamoto, 1982; Labouvie-Vief and Schell, 1982). This deficiency is partly a result of the plurality of approaches (psychometric, cognitive developmental, information processing) to the study of adult intellectual development. Given the current state of the field, we will focus our discussion on several dimensions of intellectual development that would need to be considered in such an integrative theory and that have particular relevance in deriving educational implications.

There is general consensus that two of the major aims of developmental theories of intellectual aging are the study of change occurring within a given individual (i.e., intraindividual change) and of differences between individuals in intraindividual change (i.e., interindividual differences in intraindividual change) (Hoyer, 1974; Willis and Baltes, 1980). Much of the research on adult intellectual development has presumably focused on the description and explication of changes in intellectual functioning *within* individuals (intraindividual) over time. The rate and magnitude of such change is the focus of much current debate (Botwinick, 1977; Horn and Donaldson, 1976; Schaie and Baltes, 1977). These issues focus on quantitative aspects of change. Study of qualitative aspects of change focusing on the pattern and nature of change is gaining increasing attention (Labouvie-Vief, 1977; Overton and Newman, 1981).

Developmental change has typically been construed as a *long-term* intraindividual change, that is, change occurring in the same individual over time. In contrast, there has been much less attention and research focused on *short-term* intraindividual change, that is, systematic sustained change in performance occurring over a brief time period (Baltes and Baltes, 1980; Baltes and Willis, 1979). Short-term change has typically been studied within a cognitive training paradigm, the magnitude of changes being examined as a function of training. The paucity of research on short-term change is unfortunate, since it is this type of change that is likely to have the most direct and immediate implications for an educational/instructional psychology of the adult learner.

Long-term Intraindividual Change

Intraindividual change has been studied via longitudinal and cohort-sequential research paradigms (Nesselroade and Baltes, 1979; Schaie and Hertzog, 1982). In longitudinal

studies, changes in the intellectual functioning of the same individuals are examined over a number of years. Since longitudinal studies examine only one birth cohort, however, intraindividual change and cohort effects are confounded. Cohort-sequential designs involve the examination of several birth cohorts over the same chronological age period and thus permit differentiation of intraindividual change vs. birth cohort effects.

Almost all of the longitudinal and cohort-sequential studies examining intellectual functioning have been conducted within a psychometric approach to intelligence. Thus, our understanding of long-term change is largely limited to the description of changes in the individual's performance on a number of ability measures (e.g., spatial orientation, verbal ability, numerical computation, inductive reasoning, etc.). A number of review chapters have described the findings of these longitudinal and cohort-sequential studies (Botwinick, 1977; Cunningham and Owens, 1983; Eichorn et al., 1981; Schaie, 1983; Siegler, 1983; Thomae, 1976). We will only briefly summarize some of the major findings.

Peak Performance Levels. There is considerable evidence that different mental abilities exhibit different patterns of intraindividual change, both with regard to timing of peak levels of ability performance and onset of significant decline. Findings from a number of longitudinal studies (Bray and Howard, 1983; Cunningham and Owens, 1983; Schaie, 1983) suggest that contrary to the traditional assumption of maximum intellectual functioning in adolescence, there are modest increments in ability performance into the thirties and forties.

Schaie's (1983) cohort-sequential study indicates that performance on numerical computation and inductive reasoning peak in the thirties. Peak performance levels for spatial orientation occurred in the forties, and for verbal ability in the fifties. Statistically significant performance increments (from age 25) were found into the fifties for verbal ability. Figure 1 graphically summarizes the patterns of intraindividual change for four Thurstonian abilities (Verbal Meaning, Spatial Orientation, Number, and Inductive Reasoning). Average performance at seven-year intervals (ages 32, 39, 46, 53, 60, 67, 74, 81) is shown as a proportion of performance obtained at age 25.

These data represent normative intraindividual change averaged across several cohorts. Note that even at age 81 normative performance levels are at or above 75 percent of the performance level at age 25. Given his interest in predicting academic success, Thurstone (1938) derived from ability performance an index of educational aptitude ($EA = 2$ Verbal + Reasoning). Due to increments in Verbal and Reasoning ability in young and middle adulthood, this index of educational aptitude actually peaks in the forties rather than in childhood. Although such an index of educational aptitude was not developed specifically for adult learners, the index would appear to be valid, at least for adults engaged in academic pursuits in traditional instructional settings.

Decline in Intellectual Performance. There are also differential patterns of decline for various abilities. Longitudinal research, however, indicates a later onset of significant decline than stereotypic notions have assumed. When intraindividual change is assessed from young adulthood, significant normative decline is not

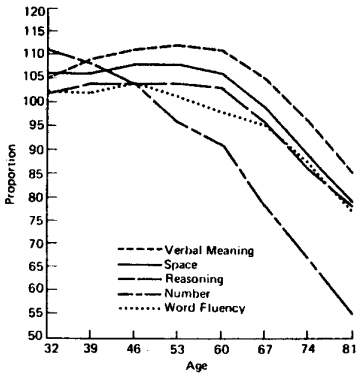

Figure 1. Performance at various ages as a proportion of performance at age 25.

evident until the late sixties (Figure 1). This finding has been reported in a number of longitudinal studies (Cunningham and Owens, 1983; Jarvik and Banks, 1983; Schaie, 1983).

Abilities measured under speeded conditions, those involving perceptual-motor functioning or abstract reasoning, show earlier patterns of decline than abilities involving nonspeeded performance and which draw upon overlearned, culturally acquired knowledge. This differential pattern of ability change has been described as the "classical pattern of intellectual aging," given its replication across studies. Specifically, abilities assessed through speeded tests, such as the Thurstone number factor and the performance measures on the WAIS, have shown earlier decline (Jarvik and Banks, 1983; Siegler, 1983). In contrast, significant decrement in passive vocabulary does not appear until the mid to late seventies (Botwinick, 1977).

Normative data on intraindividual decline indicate a pattern of gradual, cumulative decline rather than a sudden precipitous drop in performance. The decade of the sixties appears particularly critical, since it is in this age period that significant decline is first shown for a number of abilities (number, reasoning, spatial orientation).

These differential patterns of intraindividual change bring into question the conceptualization of adult intelligence as a global, unidimensional construct (Baltes and Labouvie, 1973; Botwinick, 1977; Salthouse, 1982). Rather, a multidimensional conceptualization of intellectual functioning is required. Such differential patterns of change have led to considerable skepticism regarding a pervasive, universal pattern of decline. Smith (1980, p. 224) recently summarized this view: "A single, definitive 'deficit' hypothesis does not seem capable of surviving the weight of all the evidence . . . there is the realization that cognitive behavior is multivariate in nature."

Interindividual Differences in Intraindividual Change

In the previous section we attempted to summarize major findings regarding long-term intraindividual change. Equally important to an understanding of adult intelligence, however, is the wide range of individual differences in intraindividual change. The magnitude of these individual differences has led some (Flavell, 1970) to question whether a normative pattern of intellectual aging should be the primary focus of study. Differential patterns of aging have come to be considered by some (Thomae, 1976) as the most prominent feature of adult intellectual development. We will begin by examining the magnitude of interindividual differences in intraindividual change. Second, we will consider cohort (generational) effects as one critical source of individual differences in change. Third, we will consider several personal life style variables implicated as important sources of interindividual differences in intellectual change.

Range of Interindividual Differences in Intraindividual Change. Figure 2 provides a graphic summary of the pattern and magnitude of interindividual differences in intraindividual change for four Thurstonian abilities (Schaie, 1980, 1983). The data are expressed in standard deviations of change scores (seven-year longitudinal change scores). These data suggest that the magnitude of interindividual differences in change varies by ability and by age period. For three of the abilities (Verbal

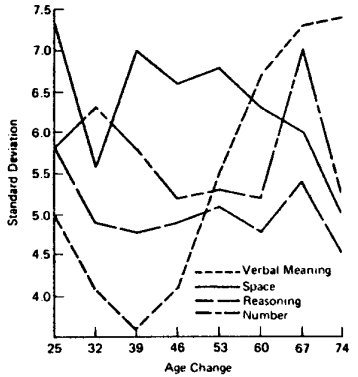

Figure 2. Standard deviations of longitudinal seven-year change scores.

Meaning, Inductive Reasoning, Number) interindividual variability in change is relatively stable during the thirties and forties and then shows an increment in the sixties. This shift in magnitude of variability is most notable for Verbal Meaning. Note that for these three abilities, interindividual differences in change peak at approximately age 67, the age period at which statistically significant decrement is first noted. For several of the abilities, there is a drop in the magnitude of interindividual variability in change in the mid seventies. For verbal ability, however, variability in change remains high. This increase in interindividual differences in intraindividual change in the sixties can have important implications for the design of instructional programs for the older adult learner.

Cohort Differences. During the last two decades there has been considerable discussion and debate within adult developmental psychology regarding cohort effects as a source of interindividual differences in intraindividual change (Botwinick and Arenberg, 1976; Horn and Donaldson, 1976; Schaie and Baltes, 1977). Although some (Botwinick, 1977; Salthouse, 1982) have sought to dismiss cohort differences as little more than variations in the "classical" pattern of intellectual aging, cohort differences do appear to have some distinctly different educational implications from age-related change. As will be elaborated on later, cohort differences may indeed be of greater practical significance than age changes in terms of social policy implications for lifelong learning.

The most comprehensive study of cohort differences in intellectual functioning has been Schaie's (1979, 1983) 21-year cohort-sequential research. Data from that study suggest that differences between cohorts in intellectual performance are equal to or may exceed the magnitude of intraindividual change when cohort effects and intraindividual change are examined over comparable time periods. Figure 3 compares performance differences between birth cohorts in terms of the proportion of performance of the cohort born in 1952; performance of the 1952 cohort is set at 100 percent.

The most common pattern indicates a positive cohort trend; that is, the performance level of earlier-born cohorts is below that of later-born cohorts when the two are compared at the same chronological age. Current elderly are significantly disadvantaged with regard to inductive reasoning ability and verbal meaning; a similar but nonsignificant trend is shown for spatial orientation. Statistically significant cohort effects occur for the 1889 to 1931 birth cohorts for inductive reasoning ability and for the 1889 to 1917 birth cohorts for verbal meaning. In contrast, word fluency shows a reverse cohort trend. Earlier-born cohorts (1889 to 1917) performed above the mean level of the 1952 cohort, whereas performance of later-birth cohorts (1924 to 1945) fell below that of the 1952 cohort. Finally, a third type of cohort trend is suggested by numerical ability. Here, a curvilinear trend is suggested, with some birth cohorts (1903 to 1924) performing at a level above that indicated for either earlier- or later-born cohorts.

Cohort effects, which reflect multidirectional patterns of change, are a dynamic form of interindividual differences, varying according to the critical life experiences of a given cohort. Most recently, there is suggestive evidence (Schaie and Hertzog, 1983) that there may be a partial reversal in the positive cohort

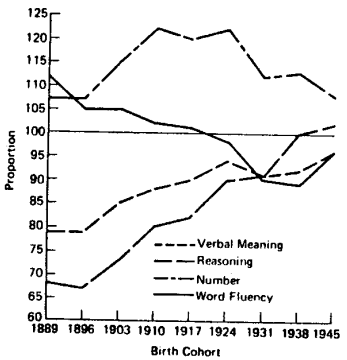

Figure 3. Performance of various cohorts as a proportion of the performance of cohort born in 1952.

trend for verbal ability in current young adult cohorts, a trend also suggested by recent reports on a decline in scores in college entrance examinations.

Health. With increasing age, the incidence of cumulative chronic disease also increases. Thus, there is a likelihood of an increasing association between health status and cognitive change. Longitudinal research indicates a very complex pattern of relationships between psychological functioning and health status (Hertzog, Schaie, and Gribbin, 1978; Siegler, 1983; Siegler, Nowlin, and Blumenthal, 1980). The health variable that has been the most thoroughly examined is circulatory disorders. Heart disease is correlated with other sources of individual differences, such as cohort and socioeconomic status. When these variables have been controlled for, circulatory disorders are found to be related to seven-year declines in intellectual functioning (Hertzog, Schaie, and Gribbin, 1978); however, heart disease accounts for only a small amount of the variance associated with cognitive change. Although heart disease has been associated with cognitive change on a composite measure of intellectual ability, it has been difficult to identify the particular cognitive abilities that are most susceptible to the effects of heart problems.

Life Style. In terms of concurrent individual difference variables associated with intellectual change, life style variables present some intriguing findings. Decline in intellectual functioning over a seven-year period in mid- to later adulthood has been significantly associated with a life style of personal disengagement and of family dissolution (Gribbin, Schaie, and Parham, 1980). In particular, older women who reported a less actively engaged life style, who had experienced some form of family dissolution (loss of spouse), and who lived in relatively inaccessible environments showed the most dramatic drop in cognitive functioning over a seven-year period.

Given their longer life expectancies and the likelihood of a lengthy period of widowhood, educational intervention programs targeted at older women appear to have particular promise. The adult education literature (Burgess, 1971; Carp, Peterson, and Roelfs, 1974) indicates that one major motivation for participation in educational programs is the desire for social interaction (to meet new people, feel a sense of belonging). Data relating life styles to cognitive change suggest that women seeking social interactions within the context of educational activities may also be particularly in need of intellectual stimulation.

Education and Socioeconomic Status. In considering the association between education and intellectual functioning, it is important to distinguish between the relation of education to current level of intellectual performance and the relation of education and long-term changes in intellectual functioning. Educational level has frequently been associated with current level of functioning on a number of cognitive measures such as problem solving, mental abilities, and learning (Birren and Morrison, 1961; Kessler, Denney, and Whitely, 1976). A significant relation has not been found, however, between education level and change (decline) in cognitive functioning (Stone and Schaie, 1980).

Education appears to play an interactive role, then, in the maintenance of intellectual functioning. In early stages in the life span, those of higher ability may seek out or be given greater educational opportunities; education serves to foster the development of skills and a knowledge base for future learning. Second, educational level is associated with certain types of life styles that foster the maintenance or decline of intellectual abilities. For example, prior level of educational attainment is the most significant predictor of participation in adult education activities in midlife (Cross, 1981; Johnstone and Riviera, 1965).

Longitudinal Research: Its Relevance and Limitations

Some may question our utilization of longitudinal-research findings for deriving educational implications, given the recent debate regarding the potential limitations of this type of research (Botwinick, 1977). The aim of edu-

cation is the facilitation of certain dimensions of *intraindividual* change via educational intervention. The central thesis of most educational theories of learning and instruction is the description and explication of variables associated with intraindividual change in the instructional context. In the assessment and evaluation of educational endeavors, the focus is on intraindividual change, occurring as a function of educational programs, and on interindividual differences in intraindividual change (e.g., comparison of the relative effectiveness of various programs).

Longitudinal research provides the only direct information on long-term intraindividual change and thus, in spite of some limitations, would appear to be the data base of choice in deriving educational implications. Likewise, cohort-sequential research is the only paradigm for deriving estimates of cohort differences; findings of such research are essential to developing a knowledge base for intervention into cohort-related obsolescence.

As longitudinal studies progress over a number of years, subjects drop out of these studies in a nonrandom order. The remaining subjects have usually been found to be more highly educated, to exhibit higher levels of intellectual performance, and to be in better health than the subjects dropping out of the study (Schaie, Labouvie, and Barrett, 1973). Thus, findings from longitudinal research are somewhat positively biased. What might this mean in terms of educational implications? Consideration of the subject sample is an important issue in deriving generalizations or implications from any research study. Since longitudinal studies typically involve much larger sample sizes—with greater care given to subject selection at the inception of the study—findings should be more reliable than those obtained from single-shot studies involving small sample sizes. Replication is the *sine qua non* of scientific research; in this regard, the consistency of findings across a number of longitudinal studies regarding the timing of significant age-related decline is noteworthy.

The positive sample bias in longitudinal research may in fact increase the relevance of the findings for adult education. Currently, only 4.5 percent of adults over age 55 participate in formal adult education activities (National Center for Education Statistics, 1980). Educational attainment is the most powerful predictor of participation in adult education. Thus, current older participants in adult education are clearly a positively biased subgroup of the elderly and appear to be biased, moreover, along the same dimensions as are longitudinal samples. Findings from longitudinal research may therefore be particularly relevant to the group of current older learners engaged in formal educational pursuits.

Some have questioned the unique contribution of longitudinal findings, suggesting that there is little qualitative difference in the findings of longitudinal and cross-sectional research (Botwinick, 1977; Salthouse, 1982). The question of whether onset of significant age-related decline begins at age 47, as suggested by cross-sectional research, or at age 67, as found in longitudinal research, appears to have been dismissed by some as a mere quantitative difference. Nevertheless, important *qualitative* differences in terms of the educational and social policy implications do exist (Riley, Abeles, and Teitelbaum, 1982). Qualitatively different educational procedures are likely to be needed in the remediation of age-related decline vs. the alleviation of cohort disadvantage. For example, very different types of educational programming might be developed for returning middle-aged women students, depending on whether those in higher education consult cross-sectional or longitudinal findings. Likewise, qualitative differences in decision making on social policy issues such as mandatory retirement, social security, and health insurance would occur if based on cross-sectional vs. longitudinal data (Riley, 1983).

EDUCATIONAL IMPLICATIONS FROM LONGITUDINAL AND SEQUENTIAL RESEARCH

Peaks and Decline in Intellectual Functioning

The allocation of educational resources to the first quarter of the life span has been partially based on the assumption that educational intervention is likely to be most beneficial during maximal levels of intellectual functioning (Cropley, 1977). Since intellectual development has long been assumed to peak in adolescence and young adulthood, secondary and higher education has been targeted on those age periods. Findings of longitudinal research, however, indicate that intellectual functioning actually peaks in midlife, and thus the thirties and forties should be considered as prime periods for learning. If development of complex problem-solving skills, such as those involved in career or family responsibilities, is assumed to profit from a maximal level of functioning on a number of requisite abilities (verbal, reasoning, etc.), then the thirties even more than the twenties appear particularly suited to higher educational pursuits (Schaie, 1977/78). When long-term data on intellectual development are considered, society's allocation of major roles and responsibilities to persons in midlife appears eminently reasonable.

These data also suggest the important role of early work experience in the continued growth of abilities. A stimulating work environment has been found to be associated with continued intellectual development, so much so that the workplace for many persons provides an important mechanism for continued learning. In fact, the largest provider of adult education in middle adulthood is industry, not higher education (Cross, 1981; see Stagner, this volume, for a more detailed discussion). The longitudinal research of Bray and Howard (1983) within an industrial setting indicates that both college and high school graduates assigned to beginning management positions showed increases in intellectual functioning through midlife. The interaction between ability functioning and complexity of the work environment has also been supported by the work of Kohn and Schooler (1979).

The differential pattern of stability and change found for specific abilities also has educational relevance. For example, most instructional procedures in adult education are primarily verbal in nature. The considerable stability, into at least the mid seventies, of verbal ability (passive vocabulary) supports both the popularity and effectiveness of printed material as an instructional medium. Studies of adult learning indicate printed material to be one of the most important and frequently used sources of information (Penland, 1979). Such printed materials are particularly relevant in self-directed learning because of their accessibility. Verbal ability has been shown to be a significant predictor of text comprehension (Taub and Long, 1976).

A cautionary statement regarding the relation of verbal ability and verbal instruction is also needed, however. Although there is considerable intraindividual stability in verbal meaning, this ability also shows the strongest negative cohort effects for current older cohorts (Schaie, 1983). Thus, older adults today may exhibit a relatively lower level of verbal proficiency (when compared with today's younger adults), although little if any age-related decline has occurred (Walmsley and Allington, 1982). These cohort effects may become most evident in verbal material involving technical terminology or involving societal shifts in language pattern usage. In assessing the readability of patient education materials for older adults, Holcomb (1979) found educational level but not age to be a significant predictor.

The timing of educational intervention has focused primarily on *optimal* developmental periods for knowledge and skill acquisition. Until the last two decades, remedial or compensatory education, even in mainstream education, has been a secondary concern. Somewhat ironically, when considered within a lifespan perspective, the terms *remedial* or *compensatory education* have typically been used to describe intervention in the first quarter of the life span (Lazar, Darlington, Murray, Royce, and Snipper, 1982). Given the limited interest in adult education, relatively little consideration has been given to remedial or compensatory educational efforts associated with age-related decline or cultural change (Hesburgh, Miller, and Wharton, 1974).

Longitudinal findings suggest that the timing of remedial efforts in later adulthood should vary by ability. The decade of the sixties appears particularly salient, since it is during this decade that significant decline first becomes apparent for several abilities. The cognitive training research, to be reviewed in

the next section, strongly suggests that intervention efforts can produce significant improvement. The data in Figure 1 suggest that even in the early eighties older adults are functioning, on average, at 75 to 80 percent of the performance level of a 25-year-old, clearly indicating a capacity to learn and profit from instruction even in late old age.

Patterns of Quantitative Change

Our brief review of longitudinal research suggests that long-term intraindividual changes in intellectual functioning involve three major change patterns: stability, modest increment, and gradual decline (Willis and Baltes, 1980). In this section, we attempt to delineate further these types of change with regard to educational concerns. Although these change patterns have typically been studied separately from one another, it is important to note that two or more of them are likely to be exhibited simultaneously in the complex behavior of a given individual in later adulthood.

Irreversible Decrement. In earlier research on intelligence, there was the implicit, if not explicit, assumption that most quantitative change in intellectual performance with age was irreversible (Schaie, 1973). Irreversible decline involves significant decrement that cannot be reversed and for which adequate compensatory mechanisms do not exist. Irreversible decline of sufficient magnitude to substantially impair behavior functioning is associated primarily with advanced biological aging, pathologies, or catastrophic illnesses or accidents. There is growing recognition that whether or not a decline is irreversible cannot be determined solely from longitudinal research on age changes but must be examined empirically through medical and/or behavioral intervention research (Smith, 1980).

Decrement with Compensation. This form of decline involves behavioral change for which compensatory mechanisms can be employed to maintain an adequate level of functioning although reversal of the deficit is not currently feasible (Schaie, 1973). Prosthetics such as eye glasses and hearing aids, even if incapable of reversing the deficit, enable an individual to function effectively. Recent advances in high technology must be considered in the further development of such mechanical prosthetics. The utility of home computers, voice synthesizers, digital alarms, or memory phones as mechanical prosthetics for the elderly suffering from sensory or cognitive loss needs to be explored (Hardiman, Holbrook, and Hedrick, 1979; Weisman, 1983).

The increasingly rich descriptive research base in cognitive aging should begin to yield important implications for the development of cognitive-behavioral as well as mechanical prosthetics. Considerable research within mainstream cognitive psychology, as well as within cognitive aging, has focused on adults' understanding and use of "compensatory" strategies that compensate for capacity limitations, for example, in memory (Perlmutter, 1978). A hallmark of cognitively sophisticated learners appears to be their facility in usage of such aids (Charness, 1981; Chi, Glaser, and Rees, 1982). Extension of this research holds promise for the identification of useful cognitive-behavioral prosthetics in cases of age-related decline in capacity, or possibly a decline in energy level that makes it more difficult to sustain high levels of performance (Robertson-Tchabo, 1980).

Disuse. A third form of performance decline may be that associated with disuse (Salthouse, 1982). Negative changes in cognitive performance may occur, not because of changes in competence or capacity, but as a result of the individual's having little opportunity or need to exercise a particular skill or knowledge area (Gardner and Monge, 1977; Murrell and Humphries, 1978). Performance declines associated with disuse are evident not only in advanced age but throughout adulthood, as any teacher can attest. It might be expected, however, that the probability of performance decline associated with disuse will increase in later adulthood, since the extent of knowledge and skill increases cumulatively across the life course and the portion that can be kept (or should be kept) in active use declines. In cases of performance decline as a function of disuse, minimal intervention efforts should suffice to reactivate the knowledge or skill.

Continued Increment. One of the most positive findings from longitudinal research is the fact that modest increments in intellectual performance continue into midlife for a number of abilities (Cunningham and Owens, 1983; Jarvik and Bank, 1983). For the ability of verbal meaning, these increments are statistically significant until the fifties. It has been suggested that those abilities that are most actively used in the tasks and responsibilities of adult living (e.g. verbal) should be the ones most likely to show continued growth (Ferguson, 1954, 1956). It is likely that from midlife onward there will be increasing individual differences in the particular abilities that show continued growth. Increasingly, such increment patterns may become a reflection of unique life styles and nonnormative life events.

Baltes, Dittman-Kohli, and Dixon (1982) have chosen to discuss the issue of continued intellectual development and old age under the term "selective optimization." Their position is that the individual comes to focus selectively on certain types of intellectual skills and pursuits with increasing age, and it is within these limited areas that continued intellectual development is most likely to occur. Facilitation of such selective optimization pursuits would appear to be a major responsibility for continuing education and adult education programming.

Interindividual Differences in Intraindividual Change: Educational Implications

Descriptive research in cognitive aging has focused on chronological age as the major variable for examining interindividual differences in intraindividual change. In spite of their limitations, cross-sectional age comparative studies predominate in the intellectual aging literature (Giambra and Arenberg, 1980; Krauss, 1980). With regard to applied concerns, however, cohort differences appear to be of greater interest and relevance. In terms of educational implications, cohort differences appear to be of equal, if not greater, concern than age-related change for three reasons: (1) In contrast to age-related change, cohort differences are of educational concern across the entire adult life course. (2) Since cohort effects are generally considered to be a function of environmental/experiential differences, it is assumed that they should be susceptible to educational intervention. (3) There is considerable suggestive evidence that early educational experiences are themselves significant contributors to such cohort effects.

Differential cohort effects are evident by age 25 in the longitudinal research literature (Schaie, 1983). If we assume that recent reports of drops in scholastic aptitude tests reflect similar cohort effects, then such generational differences are already evident by age 17, and such effects thus appear to have their origin during the early portion of the life span during which schooling plays a major socialization role (Parsons and Platt, 1968, 1972). Although these effects probably originate in childhood, their consequences are probably most debilitating in old age.

Obsolescence and Cohort Effects. One form of cohort difference of particular educational interest is that more commonly described as *obsolescence.* This term has been used to refer to job-related obsolescence, particularly with regard to professional obsolescence in high-technology industries such as engineering (Ferdinand, 1966; Shearer and Stegar, 1975). Obsolescence has typically been defined as a form of interindividual differences in intraindividual change. For example, in discussing obsolescence in the engineering profession, Siefert (1964) defines it as the difference between the knowledge and skills possessed by a new graduate of a modern engineering curriculum and the knowledge and skills possessed by the practicing engineer who may have completed his formal education a number of years before. In this context, obsolescence is not viewed primarily as reflecting individual decline but rather differences in the early educational experiences of different cohorts of professionals (i.e. interindividual differences in intraindividual change).

The sources of professional cohort differences are to be found in the rapid growth of

knowledge and change in a particular area of specialization. The term "professional half-life" has been coined to refer to the length of time from the completion of a person's professional training until at least half of the acquired professional knowledge has become obsolete (Dubin, 1972). In a sense, the half-life concept is a measure of when professional cohort differences reach a level of practical significance. Continuous professional updating, either through self-directed learning or formal educational procedures, is seen as the major mechanism for the prevention or at least remediation of professional cohort differences (Dubin, 1977; Houle, 1981). Dubin (1972) has derived estimates of the amount of time different professionals would need to spend in professional updating activities, based on rate of knowledge growth within a given discipline. Dubin's calculations suggest that, given the relatively rapid knowledge growth in our own discipline, psychologists would need to spend approximately 20 percent of their work time in professional updating!

The study of professional obsolescence has been used to illustrate the more practical implications of cohort effects as a form of interindividual differences in intraindividual change. To the extent that such cohort differences impact the effective functioning of the individual, educational intervention is strongly implicated. Longitudinal research suggests both that the magnitude of cohort effects varies by ability and that the pattern of cohort effects is dynamic and may differ across cohorts, given different life experiences.

The implications for the field of education are twofold. First, given the dynamic nature of cohort effects, it is necessary to monitor continually the course of these effects for successive cohorts. Educational programming, responding to these effects, will need to be flexible and attentive to changing patterns of cohort trends. Fortunately, there is suggestive evidence that at least some forms of cohort effects become evident early in the life span; in the case of negative cohort trends, it should thus be possible to engage in educational intervention in young adulthood so as to minimize consequences for middle and later adulthood. Unfortunately, our society's current educational response to evidence of negative cohort trends is to focus primarily on attempts to prevent their recurrence in future cohorts but to do little toward remediation of the effects in current adult cohorts who have suffered from previous negligence. A second implication for education is that the field must continue to engage in serious reflection on the historical trends within its own subdisciplines of teacher education, curriculum development, and instructional psychology so as to gain a better understanding of how changes in socialization and educational practice are reflected in the observed cohort differences.

Socio-cultural Change and the Role of Education. From a sociological perspective, Parsons has suggested that cohort differences result from changes in the structure of socialization systems (Parsons and Platt, 1972). As a society becomes increasingly complex and differentiated, the socialization process is temporally extended. As a result of the extension of the socialization process and its movement outside the home, education has become an increasingly important agent of socialization in our society. This expansion of the educational system has changed the relations among cohorts; they differ from one another because they have been socialized to different extents within the educational context. The role of education as an agent of socialization takes on particular significance, since socialization, within Parsonian theory, involves acquisition of basic values, not only acquisition of knowledge and skills. Parsons has recently suggested that a new and important stage of socialization (college education) is evolving in which higher education will be the primary agent of socialization.

COGNITIVE TRAINING RESEARCH: SHORT-TERM CHANGE

We turn now from a discussion of long-term intraindividual change to short-term change. Most research on long-term change has been descriptive, examining normative developmental change across adulthood. In contrast, study of short-term changes has primarily been experimental-manipulative, examining

modifiability or plasticity in intellectual performance as a function of some brief experimental treatment (Baltes and Willis, 1979). Just as with long-term change, study of short-term change is concerned with intraindividual change and interindividual differences in intraindividual change.

Three major questions need to be considered: (1) What intellectual abilities and/or cognitive processes are subject to modification via experimental treatments? (2) What is the range or magnitude of change in performance? (3) Under what experimental conditions does intraindividual change occur?

Abilities and Cognitive Tasks as Targets of Training

Examination of the first question is, of course, strongly influenced by the researcher's particular theoretical orientation to intellectual development (Baltes and Willis, 1982). For example, if one adopts the traditionally held view of an early peak and precipitous global decline in intellectual functioning, then experimental intervention with regard to almost any intellectual ability or process may be of interest. In contrast, if research is guided by a particular theory of intellectual development, then the target of intervention should be dictated by the theory. For example, the differential pattern of developmental change specified by the theory of fluid and crystallized intelligence (Cattell, 1971) should lead to a focus on fluid abilities as the target of intervention. A more pragmatic approach is to identify those abilities showing earliest decline within longitudinal and cohort-sequential data sets.

Magnitude (Range) of Training Effects

We now turn to the second question, that of the magnitude or range of training effects. Discussion of the range and magnitude of intraindividual improvement as a function of training involves a number of issues. In many cognitive training studies, there has been the implicit, if not explicit, assumption that training improvement primarily reflects the remediation of age-related decline. Since no training study to date has had available longitudinal data on the training subjects, however, it has not been possible to examine directly the extent to which training primarily involves the remediation of decline. Figure 1 indicates that a substantial number of elderly have not experienced significant decline, and thus training for these persons would involve acquisition of new skill levels rather than remediation. The more cautious researchers in this area have then assessed training effects by examining the range of intraindividual variability or plasticity in intellectual aging, without focusing on the specific nature of the change effected (i.e., whether the change involves remediation or acquisition of new skills).

Nature of Training Effects. Consideration of the practical implications of such training endeavors would seem to require a more detailed understanding of the specific nature of intraindividual change effected through training. Figures 1 and 3 suggest that both age-related decline and cohort effects must be considered in the assessment of intraindividual change associated with training. The matrix in Figure 4 presents in a simplified manner some of the types of intraindividual change that might occur as a function of training.

The left side of the matrix depicts forms of intraindividual change that would occur if the target of training is an ability or skill exhibiting differential cohort effects for the current elderly population. Figure 3 suggests that a given cohort may experience both positive and negative cohort effects with regard to different abilities. Both types of effects must be considered in educational programming, particularly in multicohort learning contexts. Negative cohort differences will be focused on in the discussion below.

For adults with no significant age-related decline, training improvement may be largely a function of initial lower levels of functioning associated with cohort effects (upper left-hand cell). Given that normative age-related decline does not become substantial until age 67 or older, training improvement for adults in their early sixties may primarily reflect the modifiability of negative cohort effects. If we assume that older adults who participate in adult education or in training studies are selectively bi-

ased along the same dimensions as subjects who remain in longitudinal studies, it then follows that a disproportionate number of subjects in our studies may fall into this cell of the matrix. The lower left-hand cell represents that portion of the adult population who are disadvantaged not only with regard to cohort differences but who also have experienced age-related decline. This portion of the elderly may be the most in need of educational intervention.

The middle and right-hand cells of the matrix depict forms of intraindividual change that might be exhibited if the target of intervention is an ability showing few significant cohort differences or on which there is a positive cohort effect in favor of earlier-born cohorts. This would be the case with an ability such as word fluency. Training improvement for subjects falling within the lower middle or right-hand cells should then primarily reflect remediation of age-related decline. In contrast, training improvement for subjects within the upper middle or right-hand cell of the matrix should reflect performance levels increased beyond those previously exhibited by the subject, since neither cohort differences nor age-related decline are significant for these persons. It should be noted that the matrix oversimplifies the forms of intraindividual change, particularly with regard to cohort effects. There is, of course, considerable variability regarding the extent to which specific individuals within a given age/cohort have experienced the effects associated with their birth cohort.

Empirical examination of the effectiveness of training programs in remediating age-related decline vs. cohort effects would, of course, require a subject population with prior longitudinal data on the relevant ability dimensions. To date, no cognitive training study has employed such a subject sample. Thus, at present, we can only speculate about different types of performance (learning) curves that might be associated with training for different cells of the matrix shown in Figure 4. If we assume that cohort effects originate fairly early in the life course and that the magnitude of such effects remains relatively stable across adulthood, then we might expect training improvement that is associated primarily with cohort differences to be represented by the traditional learning curve. The performance level of the subject would be relatively low (compared to more advantaged cohorts) prior to training, and steady, gradual improvement would be expected across training sessions. Indeed, findings from several training studies involving multiple practice or training sessions (Beres and Baron, 1981; Hofland, Willis, and Baltes, 1981; Taub, 1973) do reflect performance improvement approximating the traditional learning curve.

In terms of educational implications, intervention in cohort deficiencies would most likely require more lengthy, intensive training procedures than would be the case if previously acquired skills were simply being reactivated. Likewise, it would be expected that the pattern of training improvement associated with the upper right-hand cell of the matrix would also approximate the traditional learning curve. Again, training would involve increasing the subject's performance level, rather than providing remediation.

In contrast, the case illustrated in the lower

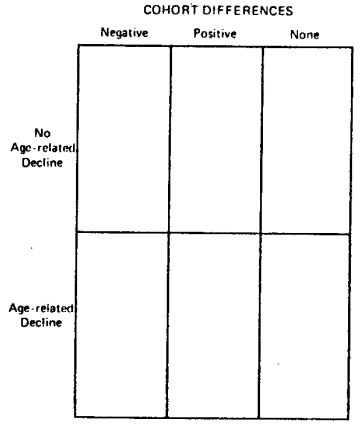

Figure 4. Types of intraindividual change as a function of training.

right-hand cell represents the purest instance of age-related decline per se. If decline is primarily a function of disuse, then training improvement might exhibit a strong linear curve, at least until the individual's prior level of functioning is approximated. If such age-related decline is largely irreversible, then little training improvement would be shown. Estimation of the performance curve associated with the lower left-hand cell is the most difficult, since remediation of age-related decline and intervention into cohort differences are both involved. Again, if age-related decline is associated with disuse, the performance curve ought to be somewhat more linear than the traditional learning curve.

Although discussion regarding the pattern and magnitude of differential forms of training improvement can only be conjectural at this time, it appears important to engage in such speculations since we believe that future research on these issues is critical to advancing our understanding of intraindividual plasticity in intellectual aging.

Earlier in this chapter we suggested that while change patterns for different abilities (i.e., stability, decrement, increment, cohort effects) have typically been discussed and examined separately from one another, two or more change patterns may be involved in complex problem solving. Consider the following hypothetical situation. Mrs. Jones, aged 65 years, has been diagnosed as diabetic. The prescribed medical treatment involves self-administered medication and compliance with some dietary restrictions, the latter requiring somewhat complex menu planning. Mrs. Jones, although sufficiently motivated to comply, is having difficulty following the prescribed treatment routine. Further discussion indicates that Mrs. Jones had misinterpreted label instructions on one medication and was having difficulty planning a daily menu, given her dietary restrictions.

What cognitive abilities and patterns of change might be implicated in designing appropriate patient education? Recent structural analyses of the primary abilities associated with reading comprehension tasks, such as interpretation of medicine bottle labels and dietary charts, suggest that inductive reasoning and, secondarily, verbal ability may be important for adequate performance on such tasks (Willis and Schaie, 1983). Recall that inductive reasoning and vocabulary are two abilities showing the strongest negative cohort effects for current elderly cohorts. Since normative decline on inductive reasoning begins in the late sixties, Mrs. Jones may also have begun to experience some decline in this ability. In contrast, normative data on vocabulary ability would suggest no significant decline. Moreover, recent research indicates that knowledge of disease processes and the purposes of medication are significantly lower for elderly patients than for younger ones, suggestive of cohort differences (Klein et al., 1982). If Mrs. Jones has significant visual impairment, frequently associated with diabetes, she may also have difficulty in seeing the print or numerals on medication labels or treatment apparatus (e.g., syringes).

Patient education efforts may then involve consideration of at least three patterns of change (stability, decrement with compensation, cohort differences). Sensory deficits may be compensated for with enlarged print and use of magnifying equipment (decrement with compensation). Improvement in menu planning skill and in the comprehension of treatment instructions may need to focus on cognitive reasoning strategies, as well as on factual knowledge of medical terms and procedures (remediation of negative cohort effects and decrement with compensation, if decline on reasoning ability has occurrred). On the other hand, Mrs. Jones' general verbal ability has probably remained quite stable and should facilitate educational efforts.

We now turn to a brief review of the empirical findings on the magnitude of intraindividual short-term change as a function of experimental-manipulative research. Three criteria can be employed in the examination of the range of short-term intraindividual change as a function of training (Willis and Baltes, 1980; Willis, Blieszner, and Baltes, 1981). First, what is the size or magnitude of the effect? Second, is there evidence of a differential pattern of training transfer across

near and far transfer tasks? Third, are training effects maintained over time? Unfortunately, the design of many training studies has not permitted a careful examination of these issues.

Limitations of Age Comparative Studies. Consideration of the first question requires that the magnitude of training effects be compared against some criterion. The criterion of comparison that is chosen, of course, depends on the question being asked. It is with regard to the criterion for assessing the magnitude of training effects that some researchers go awry, in that performance of a younger age/cohort is chosen as the criterion for examining the magnitude of training effects in an older sample. It has been argued that if age differences are due largely to environmental/experiential deficits, then the elderly should be expected to benefit more from training than a younger sample. Such a conclusion appears to reflect on the part of some of our colleagues (Birren et al., 1982; Denney, 1982; Donaldson, 1981; Salthouse, 1982) a difference of opinion or misunderstanding regarding cohort effects as they relate to the interpretation of training research.

Given the sizeable differences in performance level between current adult cohorts, there is strong evidence (see Figure 3) that many older adults functioned at a significantly lower performance level as young adults than do current young adult cohorts. This initial cohort difference is compounded both by the cumulative effects of functioning at a relatively lower performance level across young and middle adulthood, plus the possible onset of age-related decline. To demand greater training improvement for the elderly than for the young adult comparison sample is to expect that a very brief training program can remediate a significant initial cohort difference, plus the cumulative effects of this early disadvantage, plus possible aging decline. Furthermore, longitudinal data suggest that young adult samples in their twenties would be expected to exhibit considerable plasticity in their intellectual functioning, since intellectual performance on many abilities peaks, not in the twenties, but in the thirties or forties.

If age comparative training research is examined in the light of cohort effects and their potential cumulative effects on intellectual functioning, then the results of comparative training studies appear quite favorable to the older adults. The lack of a significant age × treatment interaction, which has been interpreted typically as a negative finding, provides important information regarding the considerable plasticity of intellectual functioning in later adulthood. Absence of a significant age × treatment interaction (assuming a significant main effect for training) suggests that the training gain for the older group is as great as the training gain for the younger group. A main effect for age is to be expected, given cohort differences. In such age comparative research, training improvement (magnitude of intraindividual change for the older group compared with magnitude of intraindividual change for the younger group) is the most defensible unit of comparison, given the strong cohort effects that are reflected in performance level (see Nunnally, 1982, and Schaie and Hertzog, this volume, for discussion of gain scores).

Age comparative training research has typically violated critical assumptions of quasi-experimental designs (Campbell and Stanley, 1963; Krauss, 1980). Comparisons of treatment effects are based on the assumption that the effect of all variables expected to be related to the treatment effects, except for the variable of interest (i.e., age), have been eliminated either through random assignment or statistical control procedures. Of course, age cannot be randomly assigned. Rarely have training studies focusing on age comparisons given careful consideration to comparability of subject variables such as educational level, testing experience, health and sensory impairment, all of which have been shown to be related to intellectual performance.

Some have suggested that the utility of a younger age/cohort comparison group lies not in evaluating the magnitude of training effects, but in facilitating understanding of age-related changes in cognitive processes. For example, it is well documented in learning and memory studies that younger adults more frequently employ cognitive strategies and memory mnemonics than do older adults. What does this age difference in usage of cognitive strategies suggest regarding age-related change? Have current older adult cohorts *declined* in their usage of cognitive strategies? Or, are there cohort differences in strategy usage, even when cohorts are compared at the same chronological age? Unfortunately, current longitudinal and sequential studies have been conducted within psychometric, rather than cognitive or information processing, approaches to intelligence, and there is thus only limited longitudinal data on cognitive strategy usage.

Higher intellectual performance levels, however, have been found to be strongly associated with frequency and facility of strategy usage (Chi et al., 1982; Schmitt, Murphy, and Sanders, 1981). The significantly lower intellectual performance of earlier cohorts in longitudinal research when compared to later cohorts at the same chronological age suggests, then, that earlier cohorts may have been less adept in strategy usage, even in young adulthood. Thus age differences reported for some types of cognitive processing may reflect cohort differences. Examination of the cognitive behavior of younger comparison groups in cross-sectional research can provide important information on the most efficient strategies for performing many cognitive tasks, similar to the current research on experts within mainstream psychology (Chi et al., 1982). The question of whether age differences in strategy usage reflects age-related change, however, must be addressed longitudinally.

Empirical Findings on Magnitude of Training Gain. If intraindividual change is the major concern, as we argue it should be, then training improvement needs to be compared with the individual's performance at some earlier time in development (e.g., peak performance level) or with the individual's level of performance immediately prior to training (e.g., pretest score). Since lack of longitudinal data has precluded comparison of training gain with earlier level of performance, the individual's pretest score becomes the most obvious criterion for comparison. Unfortunately, some training studies have not even included a pretest. Given the test naivete of many elderly subjects, significant improvement can occur merely as a function of pre- and posttesting. To assess the portion of improvement that can be reliably attributed to training alone, it is necessary to compare post-training performance of the treatment group with a control group randomly drawn from the same subject population that receives only pre- and posttesting.

When the magnitude of training improvement (treatment vs. control) is examined in terms of standard deviation units, several studies report effect magnitudes on the order of 0.75 to 1.00 standard deviations (Hornblum and Overton, 1976; Labouvie-Vief and Gonda, 1976; Schultz and Hoyer, 1976; Willis, Blieszner, and Baltes, 1981). Since none of the training studies have been conducted within a longitudinal design, it is not possible to make a direct comparison of the magnitude of training effects with the size of cohort differences or the magnitude of normative age-related decline. Examination of relevant data from Schaie's (1983) cohort-sequential study, however, provides some estimates. Cohort differences between the cohorts born in 1917 and 1952 for the abilities of verbal meaning and inductive reasoning showed significant effects on the order of 0.33 and 0.50 standard deviation units, respectively. Likewise, age-related decline from peak level of performance to age 67 (verbal meaning = 53 years; inductive reasoning = 46 years) was on the order of 0.23 and 0.22 standard deviation units for these two abilities. Thus, the magnitude of training improvement reported in several studies is comparable to, or greater than, the size of the cohort effect *or* to the magnitude of age-related decline as estimated from cohort-sequential data. For individuals suffering from the combined effects of a cohort disadvantage and age-related decline, however, more intensive intervention efforts than those described in current training studies may well be required.

Assessment of Training Transfer. In a number of studies, the posttest assessment battery has been limited to one or two measures of near transfer. In some cases, the same task stimuli were even used in training and post-

tests (Denney, Jones, and Krigel, 1979). Assessment of the nature and the range of training effects requires a broad transfer battery, however, one that involves not only measures predicted to show training effects (*near transfer*) but also measures hypothesized to demonstrate no training effects (*far transfer*). *A priori* predictions regarding the pattern of training transfer expected across near- and far-transfer measures should be derived either from a well-established measurement theory or on the basis of an empirical examination of the structural relationships among the measures. Unfortunately, too many studies have neglected this step, and thus assessment of training effects becomes a fishing expedition across a sea of *ad hoc* measures.

Why should both near- and far-transfer measures be included? In a well-conceived study, the researcher has formulated *a priori* hypotheses regarding the specific cognitive skills, strategies, or environmental conditions that underlie performance on the target ability or skill. The training program is then designed to foster these specific strategies or processes in the expectation of ability-specific or skill-specific treatment effects. The training should result in improvement on the target ability or skill, not just any cognitive variable.

If the researcher hypothesized *a priori* that the lower performance level of the elderly is associated with certain environmental conditions (e.g., lack of reinforcement or feedback) rather than a deficit in cognitive skills, then the treatment should focus on the optimization of such environmental conditions. Whether the treatment focuses on cognitive skill or environmental conditions, the critical issue is for the researcher to formulate *a priori* hypotheses regarding a relationship between the treatment (involving certain cognitive strategies and/or environmental conditions) and performance on a target ability/skill. The training effects may then be predicted to be specific to that target ability/skill.

Comparison of training improvement on near-transfer measures vs. far-transfer measures provides a test of the hypothesized relationships between the treatment and performance on the target ability-skill (near transfer). For the predicted relationship between treatment conditions and target ability to be confirmed, training transfer must be shown to the target-ability tasks (near-transfer), but *not* to nontargeted (far-transfer) measures. If general improvement occurs for both target-specific (near-transfer) *and* nontargeted ability tasks (far-transfer), then interpretation of the relationship between treatment condition and targeted ability becomes equivocal. General, rather than target-specific, improvement may have resulted from any number of unspecified factors (e.g., test naivete, motivation) that might influence performance on both near- and far-transfer measures, not solely the targeted (near-transfer) tasks.

Several recent reviews of training research (Birren et al., 1982; Denney, 1982; Donaldson, 1981) have suggested that the reported training effects are quite limited, since training improvement was shown only for the targeted ability tasks and no transfer was shown to far-transfer ability measures. However, findings of target-specific (near) transfer are actually in line with the author's predictions that training effects would occur *only* for the target ability to be trained (Baltes and Willis, 1982).

In our program of training research (Baltes and Willis, 1982; Blieszner, Willis, and Baltes, 1981; Willis, Blieszner, and Baltes, 1981; Willis, Cornelius, and Baltes, 1983), we have repeatedly demonstrated significant training effects for several measures of the target ability (near transfer), as predicted; far-transfer effects have always been minimal. This pattern of differential transfer effects has also been demonstrated in those other training studies that have included a broad transfer battery (e.g., Baltes and Dittman-Kohli, 1983; Hornblum and Overton, 1976; Schultz and Hoyer, 1976).

The third criterion for examining the magnitude of treatment effects focuses on the maintenance of training improvement over time. Temporal durability of effects is important both for theoretical and practical reasons. From a theoretical perspective, if it is argued that training impacts the target ability/skill rather than some nonability performance factors (e.g., anxiety, test sophistication), then maintenance of the improved level of performance over time is critical.

From a more applied educational perspective, the utility of training is greatly diminished unless proficiency is maintained over time. Relatively few training studies to date have examined the maintenance issue. If future training research is to have practical implications for adult education and lifelong learning, this will be a critical issue to examine. Of the few studies that have examined maintenance effects (Blieszner, Willis, and Baltes, 1981; Hornblum and Overton, 1976; Labouvie-Vief and Gonda, 1976; Willis, Blieszner, and Baltes, 1981), most have reported significant near-transfer effects from two weeks to six months following training. Sanders and Sanders (1978) report significant maintenance one year after training.

Experimental Conditions and Training Effects

We turn now to the third question raised with regard to the study of short-term intraindividual change: Under what experimental conditions can significant short-term intraindividual change be observed? It may be useful to organize our discussion with regard to the model of learning, adapted from Jenkins (1979) and Smith (1980), that is shown in Figure 5. At first glance, the model appears quite simple, but it becomes more complex upon further consideration (Brown, 1982). The diagram represents the learner-in-context; in this case, the training context. A minimum of four factors need to be considered. We will begin by considering each factor independently. Then we will speculate on some two- or possibly three-way interactions.

Learner Characteristics. Older adult learners vary tremendously in the factual knowledge and repertory of relevant skills/strategies they bring to the training context; these learner characteristics, of course, influence their performance during training. Prior training research, following in the tradition of descriptive studies (see Krauss, 1980), has tended to treat within-age/cohort interindividual differences as error variance to be statistically controlled or has restricted the examination of learner characteristics to demographic variables, such as age or educational level. Examination of the full range of possible intraindividual change, however, will necessitate consideration of the potential interactions between learner characteristics and various forms of training.

At least three types of learner characteristics need to be examined: (1) *a priori* cognitive knowledge, abilities, and strategies that are

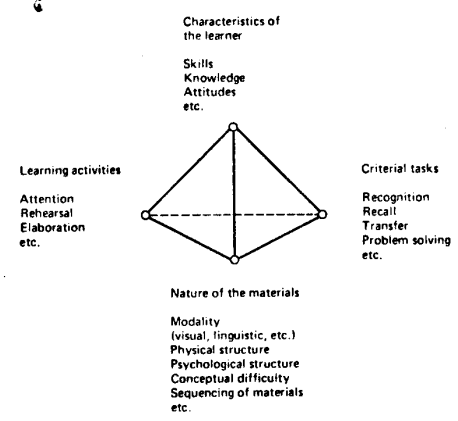

Figure 5. Model of learner-in-context.

directly related to the training task; (2) metacognition, or self-knowledge of ability and relevant skills; and (3) noncognitive variables such as attitudes, beliefs, or cognitive styles. The subject's *a priori* familiarity with the criterion task or factual knowledge about that type of problem is a learner characteristic that has frequently been associated with performance proficiency. For example, Hoyer and Plude (1980) suggest that the degree of the learner's *a priori* familiarity with the target task may be related to utilization of automatic vs. effortful processes. Likewise, *a priori* knowledge has been related to the depth of semantic processing and to the complexity of the organizational strategies utilized. The range of interindividual differences in *a priori* knowledge regarding the criterion task is likely to be greater in adulthood than at any other age period. Such a learner characteristic is highly salient in applied educational endeavors (Robertson-Tchabo, 1980).

One noteworthy attempt to incorporate learner characteristics into the design of training research was undertaken by Gonda (1981). This study examined the interaction between locus of control and the degree of directiveness in the instruction given. It was hypothesized and confirmed that subjects exhibiting an external locus of control would profit more from a highly structured instructional setting than would learners with a higher internal locus of control. Unfortunately, the study is flawed, since locus of control is correlated with level of performance on the target cognitive task. Nevertheless, the study provides a useful example of including learner characteristics in the design of training research.

Learning Activities. This factor in the model deals with the cognitive activities or behaviors the learner is expected to engage in during training. Such activities are assumed to be related to, or to underlie, proficiency on criterion tasks. It is with respect to this factor that the descriptive research within cognitive aging is most relevant. A major thrust of experimental research during the last decade has been the examination of the strategies and processes that are related to successful performance on a number of cognitive tasks as well as of the older adult's limitations in employing these strategies (Giambra and Arenberg, 1980; Hartley, Harker, and Walsh, 1980; Hoyer and Plude, 1980; Salthouse, 1982).

An important next step in educational research will be the incorporation of this knowledge regarding salient strategies into the design of educational programs. A number of studies suggest that the older adult has knowledge of such strategies as mnemonic aids (Perlmutter, 1978, 1980) and also can often successfully employ such strategies when instructed to do so in a specific context (Robertson-Tchabo, Hausman, and Arenberg, 1976). Many older adults, however, exhibit only a limited spontaneous usage of such strategies. Thus, future training efforts may increasingly need to focus on executive processes that train the older adult to determine the suitable contexts for using such skills.

Training studies have differed widely in the degree to which the treatment focuses on specific learning activities. In one group of training studies, specific skills or strategies were identified as being critical to performance on the criterion task, and training activities focused directly on increasing subjects' strategy usage. In a number of studies, Denney (1982) has successfully trained subjects' usage of constraint-seeking questions via modeling procedures. Several studies (Robertson-Tchabo et al., 1976; Schmitt et al., 1981) have demonstrated significant improvement in free recall tasks by training older adults in categorical rehearsal or imagery strategies. Likewise, training on various types of rule eduction strategies has been shown to significantly improve older adults' performance on a variety of concept-formation and complex problem-solving tasks (Labouvie-Vief and Gonda, 1976; Sterns and Sanders, 1980; Willis, Blieszner, and Baltes, 1981).

Yet another group of studies is of interest because of their focus on the subjects' activation of their *own* learning activities rather than strategies determined by the researcher (Beres and Baron, 1981; Grant, Storandt, and Botwinick, 1978; Hofland, Willis, and Baltes, 1981; Hornblum and Overton, 1976; Labouvie-Vief and Gonda, 1976). These studies have typically provided the subject with the opportunity to practice on a number of instances of a particular type of task or problem, with or without feedback regarding the correctness of their responses.

Most of these studies have reported significant improvement, suggesting that if given a number of practice trials, older adults are spontaneously able to activate learning strategies related to performance improvement. Significant improvement associated with practice has been reported for tasks as varied as memory digit span (Taub and Long, 1976), digit symbol substitution (Beres and Baron, 1981; Grant, Storandt, and Botwinick, 1978), area conservation (Hornblum and Overton, 1976), inductive reasoning (Blieszner, Willis, and Baltes, 1981; Labouvie-Vief and Gonda, 1976), concept formation (Sanders et al., 1975), and forward visual masking (Coyne, 1981). The few studies that have included near- and far-transfer measures have shown improvement only on near-transfer tasks, suggesting that ability-specific rather than nonability-specific performance factors accounted for the improvement (Hofland, Willis, and Baltes, 1981; Hornblum and Overton, 1976).

There is a somewhat confusing discrepancy between these practice studies that suggest that older adults are capable of spontaneously generating strategies resulting in improved performance and studies in the experimental literature that frequently report the absence of strategy usage. Research by Hultsch (1974) on the "learning to learn" phenomenon, which examined free recall over multitrials, suggests one possible interpretation. In contrast to younger adults who exhibited positive transfer at all stages of learning, older adults exhibited a pattern of negative transfer in the early stages of learning, followed by positive transfer during the later stages of learning.

It is possible that multiple practice trials are particularly conducive to facilitating older adults' spontaneous generation of appropriate learning activities and that experimental studies, which usually provide less opportunity for practice, thus present a restrictive picture of older adults' capabilities. Hartley, Harker, and Walsh (1980, p. 249) have recently echoed this concern:

> Most of our accumulated knowledge about the adult development of learning and memory grows out of investigations that collect small samples of behavior from large samples of subjects. The differences these investigations report may be statistically reliable, but their generality across larger samples of behavior (e.g. extended practice on the same task) may be questionable. An intuition shared by many of us is that it is easier to learn new information about a topic and retain it longer as our knowledge about the topic increases.

Materials and Environmental Conditions. The third factor in the model to be considered focuses on the nature of the training materials and other features of the training context. Experimental studies suggest that acquisition and retrieval can be influenced by a number of features of the task stimuli, including the organization and structure of the material, the utilization of examples, the abstract vs. concrete nature of the content, and the redundancy of information. Thus far, it is unclear to what extent training studies have taken into account these findings in the design of training materials. Descriptions of training procedures and stimuli used in training materials are currently quite abbreviated in the literature.

Another aspect of the materials and conditions factor focuses on those nonability-specific features of the learning environment that may affect performance. A number of variables have been examined, including monetary and social reinforcement (Denney, 1980; Sanders et al., 1975), anxiety reduction (Labouvie-Vief and Gonda, 1976), and prior performance success (Denney, 1980). Likewise, Storandt and associates have examined the effect of a number of noncognitive variables on cognitive task performance (Storandt, 1977; Storandt and Futterman, 1982). In general, these studies have not reported the significant improvement on cognitive tasks that has been shown when cognitive strategy training or practice was the focus of treatment. It cannot be concluded on the basis of these studies that noncognitive factors play no role in older adults' performance on cognitive tasks. Several of these variables, when combined with cognitive training, have led to improved performance (Willis and Schaie, 1981).

Criterion Task. The final factor in the model deals with the types of cognitive behaviors the learner will be expected to exhibit as a result of training. These behaviors are assessed at posttest by means of one or more outcome

measures. We have suggested that criterion tasks should include both near- and far-transfer measures in order to examine adequately what specific changes in the learner's behavior can be attributed to training. Note that the criterion task in Figure 5 is defined not by test name, but by the cognitive behaviors that the criterion task is expected to assess. The learner's performance on a particular criterion task reflects not only the cognitive behaviors of interest but also indicates task-specific measurement variance. Given that any one criterion task reflects multiple sources of variance, the reliability of assessing the desired cognitive behaviors is increased if multiple measures assumed to tap those behaviors are included at posttest.

Interactions among Model Factors. It is the interaction among the model factors that will provide the most useful information regarding the range of intraindividual plasticity in aging and the conditions under which such plasticity can be achieved. Unfortunately, most training research to date has not focused on such interactions. We will briefly illustrate two types of interactions that could provide important information. Given the increasing range of interindividual differences in later adulthood, the learner characteristics × learning activities interaction should be of particular interest. For example, different forms of learning activities should be more useful for the older adult suffering from a cohort disadvantage than for the older adult whose performance has dropped as a function of disuse. As we have suggested previously, more intensive training intervention may be required in the alleviation of cohort disadvantage than in the remediation of decline associated with disuse.

A second example illustrates a triple interaction (learner characteristics × learning activities × criterion task). It is probable that the breadth of training transfer (criterion task) achieved may be a function of the learner's prior knowledge level and the intensity of the learning activities (e.g., self-directed practice vs. strategy instruction). The more able learner should achieve considerable transfer with less intensive learning activities, whereas strategy instruction may be required for the less able learner to demonstrate training transfer.

THE ADULT LEARNER

We turn now to the final section of this chapter. We will begin by considering the personal and motivational factors that may be associated with a lifelong learning orientation. Although achievement motivation theory has traditionally been closely associated with research on learning and academic success in childhood, recent extensions of the theory focus more specifically on achievement-related concerns in adulthood. We will therefore discuss those studies in the survey literature that evaluate self-reported reasons for participation in adult education activities. Finally, we will consider the question of the potential goals of the adult learner.

Personal and Motivational Factors

There is suggestive evidence that adults in our society are less satisfied with the quality of their intellectual functioning than with some other aspects of their lives. In 1975 Flanagan and Russ-Eft (1976) followed up a representative sample of Project TALENT subjects first studied as high school students in 1960. These subjects were now in their early thirties. Subjects were interviewed on the quality of their life in 15 areas. They were asked both how important a given area was to them and how satisfied they were with their current status. On the issue of physical and mental health, 98 percent considered it an important area to them, and 86 percent were satisfied with their status. However, for the area of "development and use of your mind through learning, attending school, improving your understanding or acquiring additional knowledge," 83 percent considered the area important, but only 54 percent were satisfied with their status. The disparity between value and satisfaction was greater here than for any other area.

Personal Characteristics. What are the personal characteristics of those who engage in adult learning activities and why do they seek out those pursuits? We will focus our survey of the adult education literature primarily on education in formal, organized learning contexts, since this form of education has been better documented. Some consideration will also be given to learning activities described as "self-directed" (Tough, 1971), since this form of learning may be of particular relevance in later adulthood. Organized adult learning activities may be conducted for credit, but usually are not; they are offered by continuing education and extension divisions, industry, community agencies, and so on. They often involve class-like formats with groups of learners but can also include tutorials and correspondence study. Estimates of participation rates in this form of adult education vary from 12 to 30 percent of the adult population. Self-directed learning pursuits are typically self-planned, sustained efforts to learn knowledge or skills (Tough, 1971). It is estimated that 79 to 98 percent of the adult population engage in such activities (Penland, 1979).

Adults involved in organized adult education activities are more likely to be in young or middle adulthood and to be above average in educational level and family income. Those employed or seeking employment are more likely to be involved than those staying at home. A college graduate is more than twice as likely to be engaged in adult education as a high-school graduate. A high-school graduate is more than twice as likely to be involved as a nongraduate (Carp et al., 1974). The participation rate of adults 55 years of age and older is 4.5 percent, compared with 12 percent for all adults (Boaz, 1978). Interest and participation in education begin to decline from the early 30's through the 40's and drop significantly after age 55.

The lower participation rate of current older cohorts is particularly associated with educational level. These cohorts have a median educational level of 9 years, compared with a median of 12 years for the total adult population. High-school graduation appears to be a particularly significant benchmark for participation in adult education. The participation rate for those completing two years of high school is 4.1 percent (comparable to the elderly's participation rate); for high-school graduates, participation increases to 10.9 percent (Anderson and Darkenwald, 1979). The low participation rate of the current elderly may reflect in part a cohort effect. If prior educational attainment continues to be the most significant predictor of continuing education participation, then as the educational level of future elder cohorts rises, their participation in adult education should increase dramatically (Birren and Woodruff, 1973; Hiemstra, 1976).

In contrast to the low participation rates of older cohorts in formal adult education, there is some suggestive evidence that older adults are engaging in self-directed learning. Hiemstra (1976) studied the learning activities of 200 persons over age 55 and found that the average person reported spending approximately 325 hours each year in some form of learning activity; over 50 percent of these activities were self-directed. Penland's (1979) study of self-directed learning indicated that most learners focused on practical, problem-centered topics (e.g. health, home repairs, hobbies/crafts).

Self-Reports and Adult Education Participation. Numerous surveys have examined the self-reports of adults on their reasons for participation in adult education. Most of these studies have yielded descriptive data, but attempts to utilize this data for hypothesis testing or to extend psychological theories of motivation have been meager. Burgess (1971) factor analyzed the responses of a large number of adults regarding their reasons for participation in adult education. He found that seven factors could be described as basic learning orientations: (1) desire to know (knowing for the sake of knowing), (2) desire to reach a personal goal (often career-oriented), (3) desire to reach a social goal, (4) desire to reach a religious goal, (5) desire to take part in social activity, (6) desire to escape an unpleasant/tedious task, and (7) desire to comply with formal requirements of an employer or social organization. Burgess then attempted to categorize the original protocols according to these orientations. Over half of the sample had two or more dominant orientations. One-

third of the sample could be classified according to a single orientation.

Burgess' learning orientations were employed in one of the more recent comprehensive national surveys of participation in organized adult learning conducted in 1972 by the Educational Testing Service (Carp et al., 1974). Seventy-seven percent of the sample indicated a desire to know more about some topic (would-be learners) whereas only 31 percent indicated that they had participated in an educational activity during the past 12 months (learners). One-third or more of the learners gave reasons for educational participation focusing on knowledge, personal goals (primarily career-related goals), and complying with a formal request of an employer. Would-be learners reported similar reasons for wanting to participate (Carp et al., 1974).

Relatively little research has been conducted on older adults' reasons for participation in formal education. One study by Daniel, Templin, and Shearon (1977) examined the self-reported reasons of two groups of older adults enrolled in community colleges, either for credit or noncredit. The three top-ranked reasons given by those enrolled for credit were (1) to contribute to society, (2) to become more cultured, and (3) to earn more money. Younger students in credit courses emphasized getting a job, obtaining a general education, and earning money. Older adults enrolled in noncredit courses gave as reasons the learning of interesting things, meeting interesting people, and contributing to society. The reasons of younger students enrolled in noncredit courses also cited learning interesting things but were concerned with earning money and getting a job. One of the major findings of this type of survey research is that learners have multiple reasons for participating in educational activities. For example, "would-be learners" gave an average of 4.6 reasons in the ETS study. Such citations of multiple reasons for participating in adult education call into question the utility of learner typologies that emphasize only one motive for a given individual. Moreover, one cannot assume that all individuals reporting an interest in the same content area have similar motivational reasons for studying it. The ETS study (Carp et al., 1974) examined desired content areas for study and motivational reasons separately. A great diversity of motivational reasons were cited with regard to each content area.

Consideration of motivation and adult learning from a sociological perspective is also instructive (Brim and Wheeler, 1966; Parsons and Platt, 1972). As we discussed earlier, sociologists have suggested that socialization in childhood is not adequate for the tasks of adulthood and that further socialization in adulthood is thus required. Adult socialization, however, is conceived to be qualitatively different from earlier socialization. Brim and Wheeler (1966) suggest that the purposes of socialization are to provide the individual with knowledge of what is expected of him, with the ability to meet role requirements, and with motivation (the desire to practice the behavior and pursue the appropriate means). The most important change in the content of socialization from childhood to adulthood is the shift from concern with values and motives to a concern with ability, knowledge, and overt behavior. Socialization after childhood is less concerned with attempts to influence motivation of a fundamental kind or to influence basic values.

Rosow (Brim and Wheeler, 1966) questions whether adult socialization should try to reshape motivation for certain types of performance or, the limitations on the control of conditions for learning in adulthood being what they are, should be content to deal with overt behavior only. Society may need to accept conforming behavior as evidence of satisfactory adult socialization, foregoing any concern with value systems. An issue, then, for adult education is whether to work within the adult's existing motivational system—the most commonly accepted approach—or to consider resocialization of motives *per se.* There is considerable discussion in sociology about the possible extension of the initial period of socialization that is concerned with establishment of values and motives into young adulthood (Parsons and Platt, 1972). Can socialization with regard to basic motives be extended across the total life course?

Achievement Motivation and the Adult Learner. Recent extensions of achievement motivation theory by Raynor (Atkinson and Raynor, 1974; Raynor and Rubin, 1971) suggest interesting applications of it to issues related to mid and late career striving and to motivation for continued professional updating as opposed to obsolescence. A critical addition to the theory focuses on the relation of future orientation and motivation. Raynor suggests that individual differences in future orientation interact with individual differences in achievement motivation to determine the strength of motivation sustaining the immediate activity. Career paths are distinguished insofar as they involve either contingent or noncontingent future orientation. Within a contingent career path, success in the immediate activity (or career stage) guarantees opportunity to strive for future success, whereas failure in the immediate activity guarantees future failure because of a loss of opportunity to continue on the career path. The anticipation that success in a contingent career path involves movement to higher levels of knowledge and skill, with concomitant extrinsic rewards, is viewed as the single greatest motivational impetus for career striving.

Another important distinction in the theory is between closed and open contingent career paths. A closed contingent career path involves a finite number of steps along the way, with a final or ultimate career goal in view. If retirement is viewed as a final career goal, then most persons in late career stages may function on a closed career path. As Raynor notes, however, the individual's *view* of the path (contingent vs. noncontingent, closed vs. open) is the important psychological variable, not the objective description by an outsider.

The number of remaining steps to the final goal in a closed contingent career path should influence the strength of motivation for the immediate activity. Raynor suggests that there are two independent gradients of motivation (achievement and extrinsic), which operate in opposite directions across career stages. In later stages of a closed contingent career path, achievement motivation should decrease and extrinsic motivation should increase. In contrast, within an open contingent career path, achievement motivation is not predicted to decrease, since additional possibilities for continued career striving become apparent as one moves along the career path. Since learning has traditionally been associated with high levels of achievement motivation, continued professional updating would appear most likely when one perceives one's career as following an open contingent career path. There should be a net rise in motivation since both its achievement and extrinsic components are expected to increase. This theory suggests that simple predictions of an increment or decrement in motivation across career stages is not adequate since multiple types of motivation with different gradients across career stages must be considered. Also critical to the theory are the individual's perceptions of the qualitative dimensions of the career path.

The concepts of contingency and openness may also be applicable to lifelong learning in a broader sense. Willingness or interest in engaging in continued learning activities may be related to the individual's perception of the degree to which attainment of desired goals are contingent on further learning. Furthermore, when the focus of study is a narrow, restricted area of content or skills, motivation for learning may best be conceptualized as reflecting a closed contingent path. In contrast, if the focus is on "learning for the sake of learning" or on a topic (e.g., hobby) that has no ultimate goal, then motivation for learning may reflect an open path and achievement motivation may remain high.

Goals of the Adult Learner

There has been comparatively little empirical research on the learning or educational goals of the older adult. Daniel, Templin, and Shearon (1977) found that older adults enrolled in a community college program cited both the desire to learn and engage in self-improvement and the desire to satisfy sociocultural needs (to meet people and to contribute to society) as primary motivational factors. Two other studies (Knowlton, 1977; Romaniuk and Romaniuk, 1982) were conducted

with *elderhostel* participants and support the previous findings that older adults are interested in learning for the sake of learning and for seeking new challenges.

The limited research suggests five possible goals for the older adult learner (Schaie and Quayhagen, 1979; Willis and Schaie, 1981). Education may first be sought by adult learners to help them comprehend changes in their body and behavior that reflect maturation and aging. Second, the mature learner may need help in understanding the rapid technological and cultural change characteristic of contemporary societies. A third objective may be the development of skills for combatting the personal consequences of sociocultural change and obsolescence. Fourth, the adult learner may seek to acquire new vocational skills, possibly an education for a second career. Finally, the older adult may find education to be a means of developing satisfactory and meaningful retirement roles.

Education as a Means of Comprehending One's Own Aging. Beginning with middle age, there is a substantial need to seek information on what is known about biological and psychological changes in adulthood (Klein, German, McPhee, Smith, and Levine, 1982), particularly those changes that relate to memory, learning, and problem solving. The human aging process is frequently taken for granted as something that one learns to live with and that does not require special attention until there are significant physiological or psychological problems. The cognitive aging literature suggests that many older adults, whether as a result of cohort differences, low levels of education, or age-related decline, do not spontaneously employ cognitive strategies effective in problem solving or memory tasks; they can nevertheless be trained to employ such strategies with minimal intervention efforts.

Education as a Means of Comprehending Socio-cultural Change. Rapid technological and socio-cultural change has rendered older cohorts particularly vulnerable to the threat of obsolescence. The first step in combatting such threats is to provide them with educational opportunities for improving their understanding of the social and technological upheavals they are forced to confront. Rapid change can be very threatening, particularly when it suggests a loss of personal control. A traditional objective of adult education dedicated to continuing or lifelong education has been to interpret to adults past the stage of formal education those aspects of social and technological transitions that are likely to affect both their personal behavior and the course of societies.

A Means of Combatting Technological and Socio-cultural Obsolescence. It is quite evident that the educational level attained by most older persons in their youth often no longer suffices to enable them to cope many decades later. Adult education can be instrumental in overcoming generational differences in both knowledge and relevant skills. Whether or not there will be a need for another period of "compulsory" education in the adult years may be of concern to future social policy planners. At present, it is advantageous not only for the individual but also for society to provide educational opportunities that can help its older members maintain an independent life style and cope successfully as community dwellers with a changing environment.

Second Career Education. Past traditions have required that individuals make their career choice quite early, prepare for that choice, and then maintain their career throughout life. This pattern has changed drastically, partially as a function of technological change. Technological specialization increases the number of different occupations and reduces the life expectancy of any one occupation. Most workers today are engaged in specialized jobs that did not exist a generation ago. Therefore, the older adult who wishes to remain in the work force is increasingly likely to require retraining for a second or third career (Lieberman and Lieberman, 1983).

Education as a Source of Generating Satisfactory Retirement Roles. A final objective of the adult learner may be to cope with the problems posed by giving up a work-oriented life pattern for one that is predominantly directed towards leisure activities. Education with this in mind, as in second-career education, must focus on the development or honing of relevant skills, but with the difference that personal satisfaction rather than economic gain is the primary learning incentive. As part of this process, educational programs should be developed that focus on self-discovery and the detailed examination of individual expectations, potentials, and resources.

Leisure-oriented skills, however, need not be solely directed to the satisfaction of personal needs. Many societal roles are not filled adequately by professionals, and one of the most promising retirement roles may well be the greater involvement of the older person in significant volunteer roles of a quasi-professional nature. Opportunities for such roles exist particularly in the human services fields and often in service to other less advantaged older persons. Effective and satisfying involvement in such roles, however, usually requires the acquisition of new skills and information, as well as the help of appropriate placement services (Seguin and O'Brien, 1976).

A particular problem during the retirement years is the imbalance of life expectancy between men and women, resulting in the high probability of widowhood for most elderly women. Special educational opportunities should therefore be provided for widows to help them develop or redevelop skills for independent living outside the traditional family unit, for the adequate management of personal economic resources, and for the development of new interpersonal relationships.

SUMMARY

In this chapter we have attempted to review a portion of the relevant literature on adult intellectual development for the purpose of deriving educational implications that apply to the older adult learner. Longitudinal research on intraindividual change in intellectual functioning presents a fairly positive picture of the continued learning potential of the adult throughout most of the life span.

Research on cohort differences indicates, however, that the older adult may be particularly disadvantaged intellectually as a function of negative cohort trends. Intergenerational differences in level of intellectual functioning become particularly salient in periods of rapid cultural and technological change. The combination of significant cohort differences, occurring early in the life span, and the possible onset of age-related change in later adulthood may put many elderly at double risk with regard to effective cognitive functioning. We have therefore suggested that education targeted at the alleviation of cohort effects may be particularly relevant with increasing age.

The growing literature on cognitive training research in later adulthood suggests that the elderly can profit from a variety of instructional procedures. The applicability of training research to the design of gerontological educational programming requires that such research focus on intraindividual change and interindividual differences in change. Of particular importance in future experimental manipulative research will be a greater concern with interindividual differences in learner characteristics and the inclusion of individual difference variables in the design of training procedures.

The research literature in adult developmental psychology demonstrates that older adults have a substantial learning potential and presents evidence of a special need for continuing educational opportunities in later life. It is our hope that this chapter has provided a convincing rationale for the establishment of an educational psychology applicable to the adult learner.

REFERENCES

Anderson, R., and Darkenwald, G. 1979. *Participation and Persistence in American Adult Education.* New York: College Board.

Atkinson, J. W., and Raynor, J. O. 1974. *Motivation and Achievement.* Washington, D.C.: Winston.

Baltes, P. B., and Baltes, M. M. 1980. Plasticity and variability in psychological aging: Methodological and theoretical issues. In *Determining the Effects of Aging on the Central Nervous System,* ed. G. Gurski. Berlin: Schering.

Baltes, P. B., and Danish, S. J. 1980. Intervention in life-span development and aging: Issues and concepts. In *Life-Span Developmental Psychology: Intervention,*

eds. R. E. Turner and H. W. Reese. New York: Academic Press.

Baltes, P. B., and Dittmann-Kohli, F. 1983. *Cross-Cultural Replication and Multiple-Ability Extension of Cognitive Training Research in Aging.* Unpublished manuscript, Max Planck Institute for Human Development and Education, Berlin, Germany.

Baltes, P. B.; Dittmann-Kohli, F.; and Dixon, R. A. 1982. *Intellectual Development During Adulthood: General Propositions Towards Theory and a Dual-Process Conception.* Paper given at the SSRC Conference on Life-course Human Development, Berlin, Germany.

Baltes, P. B., and Labouvie, G. V. 1973. Adult development in intellectual performance: Description, explanation, and modification. In *The Psychology of Adult Development and Aging,* eds. C. Eisdorfer and M. P. Lawton. Washington, D.C.: American Psychological Association.

Baltes, P. B., and Willis, S. L. 1977. Toward psychological theories of aging and development. In *Handbook of the Psychology of Aging,* eds. J. E. Birren and K. W. Schaie. New York: Van Nostrand Reinhold.

Baltes, P. B., and Willis, S. L. 1979. Life-span developmental psychology, cognitive functioning, and social policy. In *Aging from Birth to Death,* ed. M. W. Riley. Boulder, CO: Westview Press.

Baltes, P. B., and Willis, S. L. 1982. Enhancement (plasticity) of intellectual functioning in old age: Penn State's Adult Development and Enrichment Project (ADEPT). In *Aging and Cognitive Process,* eds. F. I. M. Craik and S. E. Trehub. New York: Plenum Press.

Beres, C., and Baron, A. 1981. Improved digit substitution by older women as a result of extended practice. *Journal of Gerontology* 36: 591–597.

Birren, J. E.; Cunningham, W. R.; and Yamamoto, K. 1982. Psychology of adult development and aging. *Annual Review of Psychology* 34: 543–575.

Birren, J. E., and Morrison, D. 1961. Analysis of the WAIS subtests in relation to age and education. *Journal of Gerontology* 16: 363–369.

Birren, J. E., and Woodruff, D. W. 1973. Human development over the life span through education. In *Life-span Developmental Psychology: Personality and Socialization,* eds. P. B. Baltes and K. W. Schaie. New York: Academic Press.

Blieszner, R.; Willis, S. L.; and Baltes, P. B. 1981. Training research in aging on the fluid ability of inductive reasoning. *Journal of Applied Developmental Psychology* 2: 247–265.

Boaz, R. 1978. *Participation in Adult Education. Final Report 1975.* Washington, D.C.: National Center for Educational Statistics.

Botwinick, J. 1977. Intellectual abilities. In *Handbook of the Psychology of Aging,* eds. J. E. Birren and K. W. Schaie. New York: Van Nostrand Reinhold.

Botwinick, J., and Arenberg, D. 1976. Disparate time spans in sequential studies of aging. *Experimental Aging Research* 2: 55–61.

Bray, D. W., and Howard, A. 1983. The AT&T longitudinal studies of managers. In *Longitudinal Studies of Adult Psychological Development,* ed. K. W. Schaie. New York: Guilford Press.

Brim, O., and Wheeler, S. 1966. *Socialization After Childhood: Two Essays.* New York: Wiley.

Brown, A. L. 1982. Learning and development: The problems of compatibility, access, and induction. *Human Development* 25: 89–115.

Burgess, P. 1971. Reasons for adult participation in group educational activities. *Adult Education* 22: 3–29.

Campbell, D. T., and Stanley, J. C. 1963. *Experimental and Quasi-Experimental Designs for Research.* Chicago: Rand McNally.

Carp, A.; Peterson, R.; and Roelfs, P. 1974. Adult learning interests and experiences. In *Planning Non-Traditional Programs: An Analysis of the Issues of Postsecondary Education,* eds. K. P. Cross and J. R. Valley. San Francisco: Jossey-Bass.

Cattell, R. B. 1971 *Abilities: Structure, Growth and Action.* New York: Houghton-Mifflin.

Charness, N. 1981. Visual short-term memory and aging in chess players. *Journal of Gerontology* 36: 615–619.

Chi, M; Glaser, R.; and Rees, E. 1982. Expertise in problem solving In *Advances in the Psychology of Human Intelligence,* vol. 1, ed. R. Sternberg. Hillsdale, NJ: Erlbaum.

Coyne, A. C. 1981. Age differences and practice in forward visual masking. *Journal of Gerontology* 36: 730–732.

Cropley, A. J. 1977. *Lifelong Education: A Psychological Analysis.* New York: Pergamon.

Cross, K. P. 1981. *Adults as Learners.* San Francisco: Jossey-Bass.

Cunningham, W. R., and Owens, W. A. Jr. 1983. The Iowa State study of the adult development of intellectual abilities. In *Longitudinal Studies of Adult Psychological Development,* ed. K. W. Schaie. New York: Guilford Press.

Daniel, D. E.; Templin, R. G.; and Shearon, R. W. 1977. The value orientation of older adults towards education. *Educational Gerontology* 2: 33–42.

Dave, R. H., ed. 1976. *Foundations of Lifelong Education.* Oxford: Pergamon Press.

Denney, N. W. 1980. The effect of manipulation of peripheral, noncognitive variables on the problem-solving performance of the elderly. *Human Development* 23: 268–277.

Denney, N. W. 1982. Aging and cognitive changes. In *Handbook of Developmental Psychology,* ed. B. B. Wolman. Englewood Cliffs, NJ: Prentice-Hall.

Denney, N. W., and Denney, D. 1974. Modeling effects on the questioning strategies of the elderly. *Developmental Psychology* 10: 400–404.

Denney, N. W.; Jones, F.; and Krigel, S. 1979. Modifying the questioning strategies of young children and elderly adults. *Human Development* 22: 23–36.

Donaldson, G. 1981. Letter to the editor. *Journal of Gerontology* 36: 634–636.

Dubin, S. 1972. Obsolescence or lifelong education: A choice for the professional. *American Psychologist* 17: 486–498.

Dubin, S. 1977. *A Learning Model for Updating Older Technical and Professional Persons.* Paper presented at meeting of the American Psychological Association, San Francisco.

Eichorn, D. H.; Clausen, J. A.; Haan, N.; Honzik, M. P.; and Mussen, P., eds. 1981. *Present and Past in Middle Life.* New York: Academic Press.

Ferdinand, F. 1966. On the obsolescence of scientists and engineers. *American Scientist* 54: 45–56.

Ferguson, G. A. 1954. On learning and human ability. *Canadian Journal of Psychology* 8: 95–112.

Ferguson, G. A. 1956. On transfer and the abilities of man. *Canadian Journal of Psychology* 10: 121–131.

Flanagan, J. C., and Russ-Eft, D. 1976. *An Empirical Study Aid in Formulating Educational Goals.* Palo Alto, CA: American Institutes for Research.

Flavell, J. 1970. Cognitive changes in adulthood. In *Life-Span Developmental Psychology: Research and Theory,* eds. L. R. Goulet and P. B. Baltes. New York: Academic Press.

Gardner, E. F., and Monge, R. H. 1977. Adult age differences in cognitive abilities and educational background. *Experimental Aging Research* 3: 337–383.

Giambra, L., and Arenberg, D. 1980. Problem solving, concept learning and aging. In *Aging in the 1980s,* ed. L. Poon. Washington, D.C.: American Psychological Association.

Goulet, L. R. 1973. The interfaces of acquisition: Models and methods for studying the active, developing organism. In *Life-Span Developmental Psychology: Methodological Issues,* eds. J. R. Nesselroade and H. W. Reese. New York: Academic Press.

Grant, E.; Storandt, M.; and Botwinick, J. 1978. Incentive and practice in the psychomotor performance of the elderly. *Journal of Gerontology* 33: 413–415.

Gribbin, K.; Schaie, K. W.; and Parham, I. A. 1980. Complexity of lifestyle and maintenance of intellectual abilities. *Journal of Social Issues* 36: 47–61.

Hardiman, C.; Holbrook, A.; and Hedrick, D. 1979. Nonverbal communication systems for the severely handicapped geriatric patients. *Gerontologist* 19: 96–101.

Hartley, J.; Harker, J.; and Walsh, D. 1980. Contemporary issues and new directions in adult development of learning and memory. In *Aging in the 1980s,* ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Hertzog, C.; Schaie, K. W.; and Gribbin, K. 1978. Cardiovascular disease and changes in intellectual functioning from middle to old age. *Journal of Gerontology* 33: 872–883.

Hesburgh, T.; Miller, P.; and Wharton, C. 1974. *Patterns for Lifelong Learning.* San Francisco: Jossey-Bass.

Hiemstra, R. 1976. *Lifelong Learning.* Lincoln, NE: Professional Educators Publications.

Hofland, B. F.; Willis, S. L.; and Baltes, P. B. 1981. Fluid intelligence performance in the elderly: Intraindividual variability and conditions of assessment. *Journal of Educational Psychology* 73: 573–586.

Holcomb, C. A. 1979. The Cloze Procedure and older adults: Effects of age and schooling. *Educational Gerontology* 4: 279–295.

Horn, J. L., and Donaldson, G. 1976. On the myth of intellectual decline in adulthood. *American Psychologist* 31: 701–719.

Hornblum, J. N., and Overton, W. F. 1976. Area and volume conservation among the elderly: Assessment and training. *Developmental Psychology* 12: 68–74.

Houle, C. O. 1981. *Continuing Learning in the Professions.* San Francisco: Jossey-Bass.

Hoyer, W. J. 1974. Aging as intraindividual change. *Developmental Psychology* 10: 821–826.

Hoyer, W. J., and Plude, D. J. 1980. Attentional and perceptual processes in the study of cognitive aging. In *Aging in the 1980s,* ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Hultsch, D. F. 1974. Learning to learn in adulthood. *Journal of Gerontology* 29: 302–308.

Jarvik, L. F., and Banks, L. 1983. Aging twins: Longitudinal psychometric data. In *Longitudinal Studies of Adult Psychological Development,* ed. K. W. Schaie. New York: Guilford Press.

Jenkins, J. 1979. Four points to remember: A tetrahedral model of memory experiments. In *Levels of Processing in Human Memory,* eds. L. Cermak and F. I. M. Craik. Hillsdale, NJ: Lawrence Erlbaum.

Johnstone, J., and Riviera, R. 1965. *Volunteers for Learning.* Chicago: Aldine.

Kessler, M. S.; Denney, N. W.; and Whitely, S. 1976. Factors influencing problem solving in middle-aged and elderly adults. *Human Development* 19: 310–320.

Klein, L.; German, P.; McPhee, S.; Smith, C.; and Levine, D. 1982. Aging and its relationship to health knowledge and medication compliance. *Gerontologist* 22: 384–387.

Knowlton, M. P. 1977. Liberal arts: The Edlerhostel plan for survival. *Educational Gerontology* 2: 87–93.

Kohn, M. L., and Schooler, C. 1979. The reciprocal effects of the substantive complexity of work and intellectual flexibility: A longitudinal assessment. In *Aging from Birth to Death,* ed. M. W. Riley. Boulder, CO: Westview Press.

Krauss, I. 1980. Between and within-group comparisons in aging research. In *Aging in the 1980s,* ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Labouvie-Vief, G. 1977. Adult cognitive development: In search of alternative interpretations. *Merrill Palmer Quarterly* 23: 227–263.

Labouvie-Vief, G., and Gonda, J. N. 1976. Cognitive strategy training and intellectual performance in the elderly. *Journal of Gerontology* 31: 327–332.

Labouvie-Vief, G., and Schell, D. 1982. Learning and memory in later life. In *Handbook of Developmental Psychology,* ed. B. B. Wolman. Englewood Cliffs, NJ: Prentice-Hall.

Lazar, I.; Darlington, R.; Murray, H.; Royce, J.; and Snipper, A. 1982. Lasting effects of early education. *Monographs of the Society for Research in Child Development,* Serial No. 195.

Lieberman, L., and Lieberman, L. 1983. Second careers in art and craft fairs. *Gerontologist* 23: 266–272.

Murrell, K. F. H., and Humphries, S. 1978. Age, experience, and short-term memory. In *Practical Aspects of*

Memory. eds. M. M. Gruneberg, P. E. Morris, and R. N. Sykes. London: Academic Press.

National Center for Education Statistics. 1980. *Preliminary Data, Participation in Adult Education, 1978*. Washington, D.C.: Office of Education, U.S. Department of Health, Education and Welfare.

Nesselroade, J. R., and Baltes, P. B., eds. 1979. *Longitudinal Research in the Study of Behavior and Development*. New York: Academic Press.

Nunnally, J. 1982. The study of human change: Measurement, research strategies, and methods of analysis. In *Handbook of Developmental Psychology*, ed. B. B. Wolman. Englewood Cliffs, NJ: Prentice-Hall.

Overton, W. F., and Newman, J. 1981. *Life-Span Cognitive Intervention Research: A Competence-Activation/Utilization Approach*. Paper presented at the meeting of the International Society for the Study of Behavioral Development, Toronto, Canada.

Parsons, T., and Platt, G. 1968. Considerations on the American academic system. *Minerva* 497–523.

Parsons, T., and Platt, G. 1972. Higher education and changing socialization. In *Aging and Society: A Sociology of Age Stratification*, eds. M. W. Riley, A. Foner et al. New York: Russell Sage Foundation.

Penland, P. 1979. Self initiated learning. *Adult Education* 29: 170–179.

Perlmutter, M. 1978. What is memory aging the aging of? *Developmental Psychology* 14: 330–345.

Perlmutter, M. 1980. An apparent paradox about memory aging. In *New Directions in Memory and Aging*, eds. L. Poon, J. Fozard, L. Cermak, D. Arenberg, and L. Thompson. Hillsdale, NJ: Erlbaum.

Raynor, J. O., and Rubin, I. S. 1971. Effects of achievement motivation and future orientation on level of performance. *Journal of Personality and Social Psychology* 17: 36–41.

Riley, M. W. 1983. Aging, health and social change, an overview. In *Perspectives on Behavioral Medicine Vol. 4: Behavioral and Psychosocial Dimensions of Aging*, eds. M. W. Riley, A. S. Baum, and J. D. Matarazzo. New York: Academic Press.

Riley, M. W.; Abeles, R. P.; and Teitelbaum, M. S., eds. 1982. *Aging from Birth to Death: Sociotemporal Perspectives*. Boulder, CO: Westview Press.

Robertson-Tchabo, E. A. 1980. Cognitive skill and training for the elderly: Why should "old dogs" acquire new tricks. In *New Directions in Memory and Aging*, eds. L. Poon, J. Fozard, L. Cermak, D. Arenberg, and L. Thompson. Hillsdale, NJ: Erlbaum.

Robertson-Tchabo, E. A.; Hausman, C. P.; and Arenberg, D. 1976. A classical mnemonic for older learners: A trip that works! *Educational Gerontology* 1: 215–226.

Romaniuk, J., and Romaniuk, M. 1982. Participation motives of older adults in higher education: The Elderhostel experience. *Gerontologist* 22: 364–368.

Salthouse, T. A. 1982. *Adult Cognition*. New York: Springer-Verlag.

Sanders, J. C.; Sterns, H. L.; Smith, M.; and Sanders, R. E. 1975. Modification of concept identification performance in older adults. *Developmental Psychology* 11: 824–829.

Sanders, R. E., and Sanders, J. C. 1978. Long-term durability and transfer of enhanced conceptual performance in the elderly. *Journal of Gerontology* 33: 408–412.

Schaie, K. W. 1973. Methodological problems in descriptive developmental research on adulthood and aging. In *Life-Span Developmental Psychology: Methodological Issues*, eds. J. R. Nesselroade and H. W. Reese. New York: Academic Press.

Schaie, K. W. 1977/78. Toward a stage theory of adult cognitive development. *Journal of Aging and Human Development* 8: 129–138.

Schaie, K. W. 1979. The primary mental abilities in adulthood: An exploration in the development of psychometric intelligence. In *Life-Span Development and Behavior*, vol. 2, eds. P. B. Baltes and O. G. Brim, Jr. New York: Academic Press.

Schaie, K. W. 1980. *Intraindividual Change in Intellectual Abilities: Normative Considerations*. Paper presented at annual meeting of the Gerontological Society, San Diego.

Schaie, K. W. 1983. The Seattle Longitudinal Study: A twenty-one year investigation of psychometric intelligence. In *Longitudinal Studies of Adult Psychological Development*, ed. K. W. Schaie. New York: Guilford Press.

Schaie, K. W., and Baltes, P. B. 1977. Some faith helps to see the forest: A final comment on the Horn and Donaldson myth of the Baltes-Schaie position on adult intelligence. *American Psychologist* 32: 1118–1120.

Schaie, K. W., and Hertzog, C. 1982. Longitudinal methods. In *Handbook of Developmental Psychology*, ed. B. B. Wolman. Englewood Cliffs, NJ: Prentice-Hall.

Schaie, K. W., and Hertzog, C. 1983. Fourteen-year cohort-sequential studies of adult intelligence. *Developmental Psychology* 19: 531–543.

Schaie, K. W.; Labouvie, G. V.; and Barrett, T. J. 1973. Selective attrition effects in a fourteen-year study of adult intelligence. *Journal of Gerontology* 28: 328–334.

Schaie, K. W., and Quayhagen, M. 1979. Life-span educational psychology: Adulthood and old age. In *Probleme und Perpektiven der Pädagogischen Psychologie*, eds. J. Brandstätter, G., Reinert, and K. A. Schneewind. Stuttgart: Klett.

Schaie, K. W., and Willis, S. L. 1978. Life-span development: Implications for education. *Review of Research in Education* 6: 120–156.

Schaie, K. W., and Willis, S. L. 1982. Life-span development. In *Encyclopedia of Educational Research*, ed. H. E. Mitzel. 5th ed. New York: MacMillan.

Schmitt, F.; Murphy, M.; and Sanders, R. E. 1981. Training older adult free recall rehearsal strategies. *Journal of Gerontology* 36: 329–337.

Schultz, N. R., and Hoyer, W. J. 1976. Feedback effects on spatial egocentrism in old age. *Journal of Gerontology* 31: 72–75.

Seguin, M. M., and O'Brien, B. 1976. *Releasing the Potential of the Older Volunteer*. Los Angeles: University of Southern California Press.

Shearer, R., and Stegar, J. 1975. Manpower obsolescence: A new definition and empirical investigation of personal variables. *Academy of Management Journal* 18(2): 263–275.

Siefert, W. W. 1964. The prevention and cure of obsolescence in scientific and technical personnel. *Research Management* 7: 143–154.

Siegler, I. C. 1983. Psychological aspects of the Duke Longitudinal Studies. In *Longitudinal Studies of Adult Psychological Development*, ed. K. W. Schaie. New York: Guilford Press.

Siegler, I. C.; Nowlin, J. B.; and Blumenthal, J. A. 1980. Health and behavior: Methodological considerations for adult development and aging. In *Aging in the 1980s*, ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Smith, A. 1980. Cognitive issues: Advances in the cognitive psychology of aging. In *Aging in the 1980s*, ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Sterns, H. L., and Sanders, R. E. 1980. Training and education in the elderly. In *Life-Span Developmental Psychology: Intervention*, eds. R. E. Turner and H. W. Reese. New York: Academic Press.

Stone, V., and Schaie, K. W. 1980. *Intelligence, Life Stress and Health: A LISREL Analysis*. Paper presented at annual meeting of the Gerontological Society, San Diego.

Storandt, M. 1977. Age, ability level, and method of administering and scoring the WAIS. *Journal of Gerontology* 32: 175–178.

Storandt, M., and Futterman, A. 1982. Stimulus size and performance on two subtests of the Wechsler Adult Intelligence Scale by younger and older adults. *Journal of Gerontology* 37: 602–603.

Taub, H. A. 1973. Memory span, practice and aging. *Journal of Gerontology* 28: 335–358.

Taub, H. A., and Long, M. K. 1976. The effects of practice on short-term memory of young and old subjects. *Journal of Gerontology* 27: 494–499.

Thomae, H., ed. 1976. *Patterns of Aging: Findings from the Bonn Longitudinal Study of Aging*. Basel: Karger.

Thurstone, L. L. 1938. *Primary Mental Abilities*. Chicago: University of Chicago Press.

Tough, A. 1971. *The Adult's Learning Projects*. Toronto: Ontario Institute for Studies in Education.

Walmsley, S., and Allington, R. 1982. Reading abilities of elderly persons in relation to the difficulty of essential documents. *Gerontologist* 22: 36–38.

Weisman, S. 1983. Computer games for the frail elderly. *Gerontologist* 23: 361–363.

Willis, S. L., and Baltes, P. B. 1980. Intelligence in adulthood and aging: Contemporary issues. In *Aging in the 1980s*, ed. L. W. Poon. Washington, D.C.: American Psychological Association.

Willis, S. L.; Blieszner, R.; and Baltes, P. B. 1981. Intellectual training research in aging: Modification of performance on the fluid ability of figural relations. *Journal of Educational Psychology* 73: 41–50.

Willis, S. L.; Cornelius, S. W.; and Baltes, P. B. 1983. Training research in aging: Attentional processes. *Journal of Educational Psychology* 75: 257–270.

Willis, S. L., and Schaie, K. W. 1981. Maintenance and decline of adult mental abilities: II. Susceptibility to experimental manipulation. In *Adult Learning and Development*, eds. F. Grote and R. Feringer. Bellingham, WA: Western Washington University.

Willis, S. L., and Schaie, K. W. 1983. *Ability Correlates of Real Life Tasks in Young and Later Adulthood*. Paper presented at the biennial meeting of the Society for Research in Child Development, Detroit.