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講演録

Adult Cognitive Development from a Lifespan Developmental Perspective[1]

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Abstract: A fairly concise lifespan perspective is presented on what some would call normal cognitive aging. The currently most useful theoretical frameworks that include statements about cognitive development from young adulthood to advanced old age are outlined. Psychologists are reminded that they must never confuse age differences that may largely represent cohort differences associated with rapidly changing environmental circumstances, with age changes that occur within individuals over their life course.

A distinction is next made between normal and pathological aging, as is characterized by very different aging trajectories that distinguish individuals who follow average trajectories, those who decline early, those who develop neuro- or psycho-pathologies, and those favored few "super-aged" who remain fully functional until shortly before their death.

Because changes in intellectual competence represent a central topic in the psychology of aging, examples of substantive data for such changes are then presented through adulthood. Little cognitive decline not associated with pathological processes is found prior to the decade of the 60s, but some genetically and environmentally disadvantaged individuals show decline in the late 40s or early 50s. Age difference data and differential cohort paths are also presented for different abilities over the past 70 years.

Finally, I reflect on the topic of ageism in the psychology of aging and suggest that the major influence for much professional stereotyping of the elderly may be found in the assumption of universal cognitive decline and movement towards negative personality traits with increasing age. I show data that suggest such decline is not universal although larger proportions of older persons show decline for each successive decade after the 60s are reached.

Key Words: Age-cohort-period model, Ageism, Cross-sectional age differences, Co-constructive perspective, Generational differences, Lifespan perspective, Lifespan theories of cognitive aging, Longitudinal age changes, Normative Changes in Intelligence, Seattle Longitudinal Study, Stage theory of cognition, Successful, normal and pathological aging.

In this article I will summarize some of the major theoretical and methodological issues in studying adult cognitive development from a lifespan perspective. I will then review the normative cognitive changes that occur across adulthood. Finally, I discuss some issues related to ageism in the psychology of aging which has led to the frequently voiced, but invalid assumption of inevitable cognitive decline in old age.

Theoretical and Methodological Issues

Before summarizing the substantive literature on normal cognitive aging, it is necessary to indicate some of the theoretical formulations that have informed this literature, describe the paradigm shift introduced by the specification of the age-cohort-period model, and to distinguish between successful, normal and pathological aging.

Lifespan theories of psychological aging

There have been few comprehensive theories of psychological development that have fully covered the period of adulthood (Schaie & Willis, 1999, Willis, Martin

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& Schaie, 2009). The broadest approaches have been those of Eric Erikson (1982; Erikson, Erikson, & Kivnick, 1986), and of Paul Baltes (1993). Baltes' selection, optimization and compensation (SOC) theory represents a dialectical life-span approach. Psychological gains and losses occur at every life stage, but in old age losses far exceed the gains. Baltes considers evolutionary development incomplete for the very last stage of life, during which societal supports no longer fully compensate for declines in physiological infrastructure and losses in behavioral functionality (see Baltes, 1987; Baltes & Smith, 1999; Baltes, Staudinger, & Lindenberger, 1999). Selection, optimization and compensation, however, can also be seen as strategies of life management, and thus may be indicators of successful aging (Baltes & Freund, 2003). For a fuller exposition of SOC theory and review of relevant empirical studies, see Riedinger, Li, and Lindenberger (2006). The SOC theory has recently been expanded to a co-constructionist biosocial theory (Baltes & Smith, 2004; Willis & Schaie, 2006; see below). Theoretical models limited to the domain of cognition have also been proposed by Schaie and Willis (Schaie, 1977-78; Schaie & Wilis, 2000; Willis & Schaie, 2006; Willis, Martin & Schaie. 2009), and by Sternberg (1985). I will here describe more fully, as examples, the Eriksonian, and the Schaie and Willis stage theories, as well as the more recent co-constructive theory.

Erikson's stage model. Traditional psychodynamic treatments of the lifespan have been restricted primarily to the development of both normal and abnormal personality characteristics. With the exception of some ego psychologists (e.g., Loevinger, 1976), however, Erik Erikson remains the primary theorist coming from a psychoanalytic background who has consistently pursued a lifespan approach. Although Erikson's most famous concept, the identity crisis, is placed in adolescence, the turmoil of deciding "who you are" continues in adulthood, and identity crises often recur throughout life, even in old age (Erikson, 1976). Moreover, Erikson (1982) takes the position that "human development is dominated by dramatic shifts in emphasis."

In his latest writing, Erikson (influenced by his wife Joan) redistributed the emphasis on the various life stages more equitably. He argued that the question of greatest priority in the study of ego development is "how, on the basis of a unique life cycle and a unique complex of psychosocial dynamics, each individual struggles to reconcile earlier themes in order to bring into balance a lifelong sense of trustworthy wholeness and an opposing sense of bleak fragmentation" (Davidson, 1995; Erikson, E., Erikson, J., & Kivnik, 1986; Goleman, 1988).

The *intimacy crisis* is the primary psychosocial issue in the young adult's thoughts and feelings about marriage and family. However, recent writers suggest that this crisis must be preceded by identity consolidation which is also thought to occur in young adulthood (cf. Pals, 1999).

The primary issue of middle age, according to Erikson, is *generativity versus stagnation* (see McAdams & de St. Aubin, 1998; Snarey, Son, Kuehne, Hauser, & Vaillant, 1987). Broadly conceived, *generativity* includes the education of one's children, productivity and creativity in one's work, and a continuing revitalization of one's spirit that allows for fresh and active participation in all facets of life. Manifestations of the generativity crisis in midlife are career problems, marital difficulties, and widely scattered attempts at "self-improvement."

Successful resolution of the generativity crisis involves the human virtues of caring, giving, and teaching, in the home, on the job, and in life in general. In Erikson's view of ego development, the final years of life mark the time of the *integrity versus despair crisis*, when individuals look back over their lives (Haight, Coleman, & Lord, 1994) and decide that they were well ordered and meaningful (integrated) or unproductive and meaningless (resulting in despair).

Those who despair approach the end of life with the feeling that death will be one more frustration in a series of failures. In contrast, the people with integrity accept their lives (including their deaths) as important and on the whole satisfying. In a sense, ego integrity is the end result of the life-long search for ego identity, a recognition that one has coped reasonably successfully with the demands of both the id and society (Erikson, 1979, 1982; Whitbourne, 1996). Once old age is reached it may be most advantageous for the person to rigidly maintain this identity (Tucker & Desmond, 1998).

The final stage of life includes an exploration of personal grounds for faith. Erikson points out that the aged share with infants what he calls the "numinous" or the experience of the "ultimate other." This experience was provided for the infant by its mother. By contrast, the experience of ultimate confidence is provided for the older person by the confirmation of the distinctiveness of their integrated life and by its impending transcendence (Erikson, 1984).

A formal investigation of the progression through the Eriksonian stages from young adulthood into midlife has

been conducted by administering an inventory of psychosocial development to three cohorts of college students, followed up after 11 and 22 years (Whitbourne, Zuschlag, Elliot, & Waterman, 1992). This study showed not only inner psychological changes as postulated by Erikson, but also showed effects of exposure to particular historical, cultural, and social realities of the environment.

As higher stages were attained, there also seemed further resolution of the earlier stages of development, suggesting a process of continuous reorganization, beyond the stage-specific issues confronted by the individual. In addition, this study raises the possibility that the sequencing of stages may not be unidirectional, and it further suggests cohort differences that implied less favorable resolution of ego integrity versus despair over the decade of the 1980s (Whitbourne & Connolly, 1999).

Schaie and Willis' stage theory of cognition. This theory uses findings from research on adult intellectual development to formulate eight adult stages. It is argued that while Piaget's childhood stages describe increasing efficiency in the acquisition of new information, it is quite doubtful that adults progress beyond the powerful methods of science (formal operations) in their quest for knowledge. Therefore, if one is to propose adult stages, they should not be further stages of acquisition; but, instead, such stages should reflect different uses of intellect. (See Figure 1 for a depiction of the Schaie-Willis stages).

In young adulthood, for example, people typically switch their focus from the acquisition to the application of knowledge, as they use what they know to pursue careers and develop their families. This is called the *achieving* stage. It represents most prominently the application of intelligence in situations that have profound consequences for achieving long-term goals. The kind of intelligence exhibited in such situations is similar to that employed in educational tasks, but it requires careful attention to the possible consequences of the problem-solving process.

Young adults who have mastered the cognitive skills required for monitoring their own behavior and, as a consequence, have attained a certain degree of personal independence will next move into a stage that requires the application of cognitive skills in situations involving social responsibility. Typically, the *responsible* stage occurs when a family is established and the needs of spouse and offspring must be met. Similar extensions of adult cognitive skills are required as responsibilities for others are acquired on the job and in the community.

Some individuals' responsibilities become exceedingly complex. Such individuals – presidents of business firms, deans of academic institutions, officials of churches, and a number of other positions – need to understand the structure and the dynamic forces of organizations. They must monitor organizational activities not only on a temporal dimension (past, present, and future), but also up and down the hierarchy that defines the organization. They need to know not only the future plans of the organization, but also whether policy decisions are being adequately translated into action at lower levels of responsibility. Attainment of the *executive* stage, as a variation on the responsibility stage, depends on exposure to opportunities that allow the development and practice of the relevant skills (Avolio, 1991; Smith, Staudinger, & Baltes, 1994).

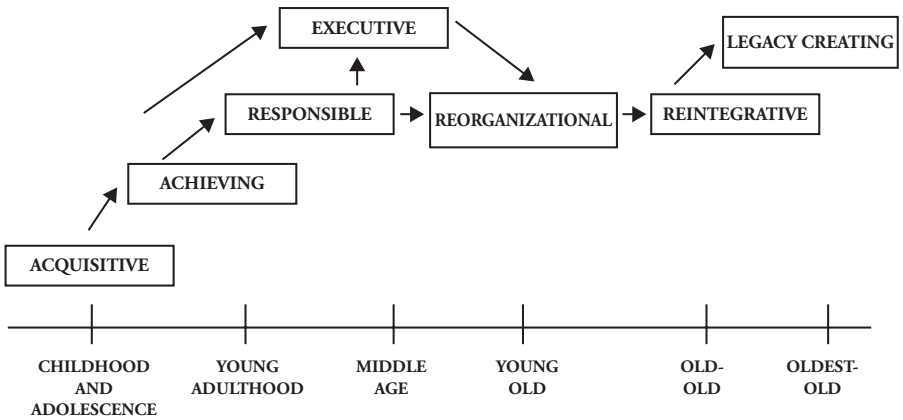

Figure 1. The Schaie-Willis stage theory model of adult cognitive development (From Schaie & Willis, 2000).

In the later years of life, beyond the age of 60 or 65, the need to acquire knowledge declines even more and executive monitoring is less important because frequently the individual has retired from the position that required such an application of intelligence. This stage, *reintegration*, corresponds in its position in the life course to Erikson's stage of ego integrity. The information that elderly people acquire and the knowledge they apply becomes a function of their interests, attitudes, and values. It requires, in fact, the *reintegration* of all of these. The elderly are less likely to "waste time" on tasks that are meaningless to them. They are unlikely to expend much effort to solve a problem unless that problem is one that they face frequently in their lives. This stage frequently includes a selective reduction of interpersonal networks in the interest of reintegrating one's concern in a more self-directed and supportive manner (cf. Carstensen, 1993; Carstensen, Gross, & Fung, 1997).

In addition, efforts must be directed towards planning how one's resources will last for the remaining 15 to 30 years of post-retirement life that are now characteristic for most individuals in industrialized societies. These efforts include active planning for that time when dependence upon others may be required to maintain a high quality of life in the face of increasing frailty. Such efforts may involve changes in one's housing arrangements, or even one's place of residence, as well as making certain of the eventual availability of both familial and extra-familial support systems. The activities involved in this context include making or changing one's will, drawing up advanced medical directives and durable powers of attorney, as well as creating trusts or other financial arrangements that will protect resources for use during the final years of life or for the needs of other family members.

Although some of these activities involve the same cognitive characteristics of the responsible stage, these objectives involved are far more centered upon current and future needs of the individual rather than the needs of their family or of an organizational entity. Efforts must now be initiated to reorganize one's time and resources to substitute a meaningful environment, often found in leisure activities, volunteerism, and involvement with a larger kinship network. Eventually, however, activities are also engaged in to maximize quality of life during the final years, often with the additional objective of not becoming a burden for the next generation. The unique objective of these demands upon the individual represent an almost universal process occurring at least in the industrialized societies, and designation of a separate *reorganizational* stage is therefore warranted.

The skills required for the reorganizational stage require the maintenance of reasonably high levels of cognitive competence. In addition, maintenance of flexible cognitive styles are needed to be able to restructure the context and content of life after retirement, to relinquish control of resources to others and to accept the partial surrender of one's independence (Schaie, 1984; 2005).

Many older persons reach advanced old age in relative comfort and often with a clear mind albeit a frail body. Once the reintegrative efforts described above have been successfully completed, yet one other stage is frequently observed. This last stage is concerned with cognitive activities by many of the very old that occur in anticipation of the end of their life. This is a *legacy-creating* stage that is part of the cognitive development of many, if not all, older persons. This stage often begins by the self- or therapist-induced effort to conduct a life review (Butler, Lewis, & Sunderland, 1998). For the highly literate and those successful in public or professional life this will often include writing or revising an autobiography (Birren, Kenyon, Ruth, Schroots, & Swensson, 1995; Birren & Schroots, 2006).

There are also many other more mundane legacies to be left. Women, in particular, often wish to put their remaining effects in order, and often distribute many of their prized possessions to friends and relatives, or create elaborate instructions for distributing them. It is not uncommon for many very old people to make a renewed effort at providing an oral history or to explain family pictures and heirloom to the next generation. Last, but not least, directions may be given for funeral arrangements, occasionally including donation of one's body for scientific research, and there may be a final revision of one's will.

The co-constructive perspective. Both neuro-biological and socio-cultural influences on development have long been recognized. Co-evolutionary theorists (Dunham, 1991; Tomasello, 1999) suggest that both biological and cultural evolution has occurred and that recent, cohort-related advances in human development in domains such as intelligence can be attributed largely to cumulative cultural evolution. Cultural activities impact the environment, thereby influencing mechanisms such as selection processes; and thus allow humans to co-direct their own evolution (Cavalli-Sforza & Feldman, 1981; Dunham, 1991). Baltes' and his colleagues (1997; Li, 2003; Li & Freund, 2005) co-constructionist approach

imposes a lifespan developmental perspective on co-evolutionary theory and provides principles regarding the timing of the varying contributions of neuro-biology and culture at different developmental periods and across different domains of functioning. Three principles are proposed regarding the relative contributions of biology and culture influences across the lifespan:

1. Beneficial effects of the evolutionary selection process occur primarily in early life and are less likely to optimize development in the later half of life.

2. Further advances in human development depend on ever increasing cultural resources. From a historical perspective, increases in cultural resources have occurred via cumulative cultural evolution and have resulted in humans reaching higher levels of functioning. At the individual level, increasing cultural resources are required at older ages for further development to occur or to prevent age-related losses.

3. The efficacy of increasing cultural resources is diminished in old age, due to decline in neurobiological functions.

Li (2003) proposes a triarchic view of culture involving three aspects of culture that are related to the co-constructionist perspective: resource, process, and developmental relevancy. Culture as social resources involves the knowledge, values, and material artifacts accumulated by a society and transmitted to future generations; these resources continue to develop and change through cumulative cultural evolution (Tomasello, 1999). Expanding upon Li's triarchic view of cultural domains, Willis and Schaie (2006) view accumulated cultural resources as being represented by structural variables such as educational level, occupational status, and ability level. These variables reflect the individual's acquisition and accumulation of cultural knowledge and skills primarily during the first half of adulthood.

Culture as ongoing social process involves the routines, habits, and performances of the individual in daily life that take place in the individual's proximal developmental context and that are shaped by the momentarily shared social reality (Li, 2003). The third component of developmental relevancy suggests that the impact of particular cultural resources and processes on an individual is partially determined by the individual's developmental stage, which has also termed the "developmental niche" (Gauvain, 1998; Super & Harkness, 1986).

The co-constructive perspective is particularly useful in understanding the interplay risk and protective factors that influence cognitive aging. These aspects will be discussed later as an introduction to the issues of normal cognitive aging and intelligence.

The age-cohort-period model

Early students of normal and pathological aging thought that the comparison of groups of individuals at different ages (cross-sectional data) could be used to predict and understand age changes within the same individuals (longitudinal data). A paradigm shift occurred when it was shown that such inference was not possible except under very unusual circumstances (Ryder, 1965; Schaie, 1965, 2009).

The Model. The Age-Cohort-Period model specifies that any age-related or time-dependent behavior can be assigned three temporal characteristics, such that

$$b\,(\text{Behavior}) = f\,(A + C + P),$$

where the behavior b is observed at the chronological age A, for individuals over the calendar period P *who* have entered the environment as members of cohort C. Just as is true for the relation among the physical variables of volume, pressure and temperature, here also the third component can always be stated as a function of the other two components. Thus, $A = C + P$, $C = A + P$, and $P = A + C$. However, each of the three components may be of primary interest for some scientific questions in the developmental sciences, and one may therefore want to be able to estimate the specific contribution attributable to each component. In the behavioral sciences, in particular, we typically want to differentiate effects that change across *age* (intra-individual change) from those effects that differ across *cohorts* or generations (inter-individual differences).

Data Collection Strategies. Empirical studies in the developmental sciences involve age and/or cohort comparisons either at one point in time or at successive time intervals. Traditional strategies used for this purpose are represented by cross-sectional, longitudinal, and time-lag designs (also see Schaie, 1977).

The *cross-sectional* strategy investigates the hypothesis that there are differences in one or more characteristics for samples drawn from different cohorts but measured at the same point in time. This strategy is most appropriate for the study of inter-individual differences. Age differences in behavior at a particular point in historical time may be relevant for policy decisions that lead to differential societal responses regardless of the antecedent conditions responsible for the age differences. Age differences detected in a cross sectional data set, however, are inextricably confounded with

cohort differences. Since cross-sectional sub-samples are measured only once, no information is available on intra-individual change. Unless there is independent evidence to suggest that older cohorts performed at the same level as younger cohorts at equivalent ages, it would be most parsimonious to assume, at least in comparisons of adult samples, that cross-sectional age differences represent estimates of cohort differences, that may be either inflated or reduced by maturational changes occurring over a specified age range.

The *longitudinal* strategy investigates whether age-related changes have occurred within the same population cohort measured on two or more occasions. This strategy is appropriate when the investigator wishes to predict age differentiation in behavior that occurs over time. But longitudinal data do not always provide unambiguous estimates of intra-individual change. A single-cohort longitudinal study confounds age-related (maturational) change with period effects that are specific to the particular historical period over which the behavior is monitored. The period effects could either mask or grossly inflate estimates of maturational changes

The *time-lag strategy* compares two or more samples of individuals drawn from successive cohorts at successive points in time at the same chronological age. The hypothesis tested is whether there are differences in a given behavior for samples of equal age but drawn at different points in time. This strategy is of particular interest to social and educational psychologists. It is particularly appropriate when one wishes to study performance of individuals of similar age in successive cohorts (e.g., comparing baby boomers with the preceding generation). The simple time-lag design confounds cohort effect with period effects and may provide inflated or reduced cohort estimates depending on whether the temporal interval between the cohorts represents a period of favorable or adverse environmental influences.

Sequential Strategies. Several alternative sequential strategies are available that might differentiate effects of maturational characteristic for a particular developmental period from the attainment of different levels of functioning attributable to differences in socialization and/or other life experiences characteristic for successive generation by assessing the behavior of more than one cohort over a given age range (Schaie, 1977; Schaie & Willis, 2002, ch. 5).

The term "sequential" implies that the sampling strategy used to study generational differences must include the acquisition of a sequence of samples taken across several measurement occasions. Perhaps the most widely used sequential strategy is the *cross-sequential* design, in which two or more cohorts are followed an identical time period. This approach permits the direct comparison of longitudinal and cross-sectional data (provided that the calendar time ranges are similar for age and cohort). The advantage of this approach is that only two points in time are needed; hence the early appearance in the literature of studies using this design. For purposes of studying generational differences, however, this approach represents a "model misspecification" because it does not allow comparing each cohort over the same age range.

Geropsychologists and other developmental scientists often find the *cohort-sequential* design of greatest interest because it explicitly differentiates intra-individual age changes that occur within a generation from inter-individual differences between generations. This design also permits a check of the consistency of age functions over successive generations, thereby offering greater external validity than would be provided by a single-cohort longitudinal design. A cohort-sequential study consists of two or more generations (however defined) being followed over two or more similar age levels. The minimum design for such a study involves three measurement points, allowing each of two cohorts to be followed over the same age range.

For clinical purposes, cross-sectional age difference data must generally be interpreted as population differences that reflect secular changes. Such data are not directly relevant for the detection of abnormal changes in individual behavior. Longitudinal data are needed therefore to evaluate the meaningfulness of intra-individual changes that might herald the onset of pathology.

Successful, normal and pathological aging

It is readily apparent that there are vast individual differences in patterns of psychological changes from young adulthood through old age. Scrutiny of a variety of longitudinal studies of psychological aging (cf. Schaie & Hofer, 2001) suggest that four major patterns will describe most of the observed aging trajectories, although further sub-types could, of course, be considered (Schaie, 2006). These patterns would classify individuals into those who age successfully (the super-normals), those who age normally, those who develop mild cognitive impairment, and finally those who become clinically diagnosable as suffering from

dementia.

The most common pattern is what we could denote as the *normal aging* of psychological functions. This pattern is characterized by most individuals reaching an asymptote in early midlife, maintaining a plateau until the late fifties or early sixties, and then showing modest decline on most cognitive abilities through the early eighties, with more marked decline in the years prior to death (cf. Bosworth, Schaie, & Willis, 1999). They also tend to become more rigid and show some changes on personality traits in undesirable directions (Schaie, Willis, & Caskie, 2004). Among those whose cognitive aging can be described as normal, we can distinguish two sub-groups. The first include those individuals who reach a relatively high level of cognitive functioning and who even if they become physically frail can remain independent until close to their demise. The second group who only reach a modest asymptote in cognitive development, on the other hand, may in old age require greater support and be more likely to experience a period of institutional care.

A small sub-group of adults experience what is often described as *successful aging* (Fillit et al., 2002; Rowe & Kahn, 1987). Members of this group are often genetically and socio-economically advantaged, they tend to continue cognitive development later than most and typically reach their cognitive asymptotes in late midlife. While they too show some very modest decline on highly speeded tasks, they are likely to maintain their overall level of cognitive functioning until shortly before their demise. They are also likely to be less neurotic and more open to experience than most of their age peers. They are the fortunate individuals whose active life expectancy comes very close to their actual life expectancy.

The third pattern, *mild cognitive impairment* (MCI; Petersen, Smith, Waring, Ivnik, Tangalos, & Kokmen, 1999), includes that group of individuals who, in early old age, experience greater than normative cognitive declines. Various definitions, mostly statistical, have been advanced to assign membership to this group. Some have argued for a criterion of 1 *SD* of performance compared to the young adult average, while others have proposed a rating of 0.5 on a clinical dementia rating scale, where 0 is normal and 1.0 is probable dementia. Earlier on, the identification of MCI required the presence of memory loss, in particular. However, more recently the diagnosis has been extended to decline in other cognitive abilities. There has also been controversy on the question whether individuals with the diagnosis of MCI inevitably progress to dementia, or whether this group of individuals represents a unique entity; perhaps one could denote them as the *unsuccessful aging* (cf. Petersen, 2003).

The final pattern includes those individuals who in early or advanced old age are diagnosed as suffering from *dementia*. Regardless of the specific cause of the dementia these individuals have in common dramatic impairment in cognitive functioning. However, the pattern of cognitive change, particularly in those whose diagnosis at post mortem turns out to be Alzheimer's disease, is very different from the normally aging. When followed longitudinally, at least some of these individuals show earlier decline, perhaps starting in midlife.

Normative Changes in Intelligence

The study of normal age changes in intelligence has long been informed by Cattell's (1963) theory of fluid and crystallized intelligence. Fluid abilities are sometimes also referred to as the mechanics and crystallized abilities as the pragmatics of intelligence (Baltes, Staudinger, & Lindenberger, 1999). It has been proposed that the fluid abilities show a relatively early peak in young adulthood with subsequent linear decline, while crystallized abilities which depend on acculturation and information maintenance tend to peak in midlife and maintain a fairly high level until close to death (Bosworth, Schaie, & Willis, 1999). We will describe first a co-constructionist model that links differential impact of neuro-biological and socio-cultural factors to normative changes and cohort differences in cognitive abilities. We will then provide examples of cross-sectional age differences and longitudinal age changes in normal populations, and will offer a possible algorism approach to determine whether a given individual is aging at a slower or faster rate than his/her age-cohort peers.

The co-constructionist model

Those studying cognition from a broad co-evolutionary perspective propose that advances in cognition as would be represented in cohort and generational effects are primarily due to an accumulation of cultural resources and knowledge across time. This perspective has been largely non-developmental. It is concerned primarily with secular trends in *level* of cognitive performance, but with little consideration of how culture impacts developmental change. Dickens and Flynn (2001) have proposed that individuals' environment is largely matched to their IQ

level. Through a multiplier effect, an individual with a higher IQ either seeks or is selected for a more stimulating environment, leading to further increases in IQ. The impact of small environmental changes could result in significant IQ gain due to the multiplier effect. By a similar process, a social multiplier effect can occur if intellect increases by a small amount for many persons in a society and leads across time to further reciprocal interactions between ability and environment. Increase in a person's IQ is thus influenced not only by their environment but also by the social multiplier effects occurring for others with whom they have contact. The question remains of what determines the domain of development or cognition that is impacted by culture and environment. Drawing upon Darwin's work, Flynn suggests that an X Factor may determine those aspects of development that are impacted by the environment (Dickens & Flynn, 2001). The X Factor need not be inherently related to the developmental domain impacted. For example, introduction of specific programming on television (e.g., Olympics) might increase public attention and participation in a given sport, which then led to increased physical fitness. The X factor, or period effect, here is television or specific TV programming.

In a related co-evolutionary approach, Tomasello and others (Dawkins, 1989; Dunham, 1991; Tomasello, 1999) have proposed mechanisms for social transmission of cultural knowledge. Humans have evolved forms of social cognition unique to humans, which have enabled them not only to create new knowledge and skills but more importantly to preserve and socially transmit these cultural resources to the next cohort/generation. Cultural learning thus involves both social transmission of cultural knowledge and resources developed by one person, and also sociogenesis or collaborative learning and knowledge creation

Expanding upon Li's triarchic view of cultural domains, accumulated cultural resources can be viewed as structural variables such as educational level, occupational status, and ability level. These variables reflect the individual's prior acquisition and accumulation of cultural knowledge and skills. In contrast, the second component of the triarchic view of culture focuses on current activities, habits, and beliefs of the individual that are shaped by concurrent social dynamics and processes. The individual's current activities in domains, such as health behaviors, cognitive engagement, and the complexity of one's work tasks are viewed as aspects of social dynamics that impact cognitive functioning and cohort differences in cognition. The neuro-biological influences of particular relevance to intelligence are thought to be the domains of chronic diseases and of biomarkers

Secular Cohort Trends in Cognition. For several decades, there has been an intensive debate on the nature and directionality of cohort differences in cognition. Cross-sectional data from several Western societies indicate the occurrence of "massive IQ gains on the order of 5 to 25 points in a single generation" (Flynn, 1987, p. 171; 1999). The "Flynn effect" has been documented primarily for post War II cohorts born in the 1950's. This massive cohort gain has been documented most clearly for fluid abilities, rather than crystallized abilities. Relatively little rationale has been offered for why fluid rather than crystallized abilities would show these positive trends for Post War II cohorts. But see Schaie (2008) and, Schaie, Willis and Panek (2005) for a discussion of societal changes that may account for these cohort trends. In contrast, cross-sectional reports on college admission tests indicate negative cohort trends for certain birth cohorts of young adults (Wilson & Gove, 1999). Likewise, Alwin (1991; Alwin & McCammon, 2001) and Glenn (1994) reported negative cohort trends in verbal ability.

In order to examine cohort-related shifts in the domains of intelligence impacted by culture, an extensive database of multiple cohorts studied over the same developmental ages is needed, such as is present in the SLS (Schaie 2005). Studies, such as Flynn's, highlight some of the serious limitations in prior cohort studies of cognition – focusing only on *level*, rather than developmental change in cognitive functioning, on a limited number of cohorts, over a single age period, and with no consideration of cohort-related differences in trajectory patterns (cf. Schaie, Willis & Pennak, 2005).

Generational Differences in Cognition. Studies of secular trends in cognition have focused almost exclusively on unrelated cohorts. The study of biologically related generations is important for several reasons. First, comparison of cohort versus generational data permit examination of whether a similar increase in prevalence of positive developmental trajectories hypothesized to occur across cohorts is also found across generations. More importantly, the comparison of the relative impact of neuro-biological versus socio-cultural influences, in biologically related individuals vs. cohorts, would inform the relative potency of cultural and genetic influences on intelligence at various developmental periods. For example, the co-

constructionist perspective posits that the influence of neuro-biological factors increases in old age and exceeds the impact of cumulative cultural influences. A more stringent test of the increased impact of neuro-biological factors in old age should be the study of successive family generations in contrast to successive unrelated cohorts, given the shared genetic and environment across generations. The increased influence of neuro-biological factors in old age is based in part on the assumption among evolutionary theorists that positive selection effects are most clearly manifest early in the lifespan and that the expression of deleterious genes in old age has been less constrained by the evolutionary process (Finch & Kirkwood, 2000).

Timing of Impact of Socio-cultural and Neuro-biological Influences. Based on co-constructionist and dual intelligence approaches, socio-cultural and neuro-biological influences vary in the timing of their impact in the early (Figure 2) and later half of adulthood (Figure 3). Accumulated cultural resources are represented by structural variables such as educational level, occupational status, and ability level, which are acquired and accumulated primarily during the first half of adulthood. Social processes impact current activities, habits, and beliefs of the individual, represented by activities in domains such as health behaviors, cognitive engagement, and the complexity of one's work tasks. Neuro-biological influences are represented by the two domains of chronic diseases and of biomarkers, shown in the literature to impact cognitive functioning.

Both fluid and crystallized intelligence are impacted during the first half of adulthood (Figure 2), by cultural resources (e.g., education, occupation) that are accumulated during the early part of adulthood. The accumulated resources influence development of concurrent cultural activities (e.g., cognitive engagement). Recent research indicates that biomarkers such as Apo-E 4 impact particularly fluid ability throughout childhood and adulthood. These biomarkers (e.g., c-reactive protein) also influence the preclinical phase of chronic disease early in adulthood.

According to the Dual Intelligence model, fluid intelligence underlies the development of crystallized intelligence. In the second half of adulthood (Figure 3), the accumulated resources such as educational level are established and cognitive functioning, particularly crystallized intelligence, is maintained through current culture-based activities (e.g., cognitive engagement). Maintenance of fluid intelligence is impacted by onset of the clinical phase of selected chronic disease (e.g., hypertension, cardiovascular disease) with the major influence on fluid intelligence. Selected biomarkers (e.g., Apo-E, c-reactive protein) mediate the onset and severity of selected chronic diseases. According to the Dual Intelligence model, crystallized strategies and compensatory mechanisms maintain and compensate for fluid intelligence losses. Solid paths represent stronger influences; dotted lines, weaker influences.

Cross-sectional age differences and longitudinal age changes

Although an omnibus IQ measure, derived from intelligence tests such as the WAIS, might provide a reasonable estimate of overall cognitive functioning, it must be recognized that such an index would not reflect both normal and abnormal changes of the component abilities underlying the overall measure. It is important to note, that different mental abilities have different life courses, both with respect to the age at which average asymptote is reached and the onset of statistically

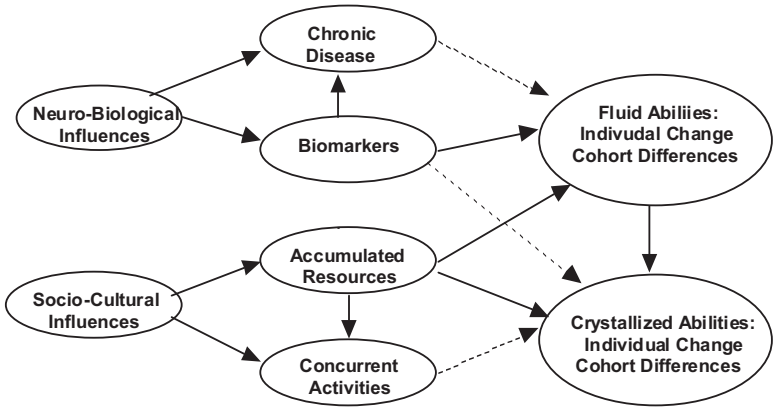

Figure 2. Theoretical models for cognitive changes from young adulthood to midlife

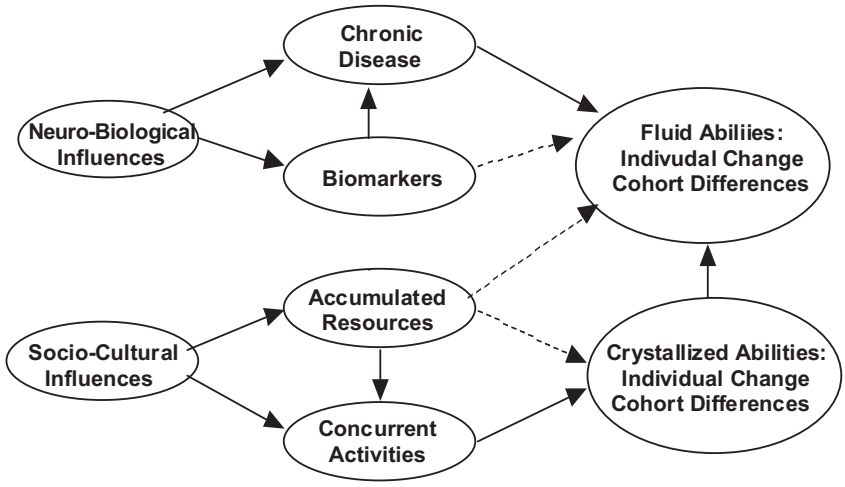

Figure 3. Theoretical model for cognitive changes from midlife to old age

significant average decline. Similarly, age differences represented by cross-sectional data will be affected by socio-cultural and neuro-biological influences that differ for successive cohorts for specific abilities.

I will illustrate these age- and time-related patterns with examples from my longitudinal data gathered over the past five decades in the context of the Seattle Longitudinal Study (SLS; Schaie, 2005). This study has collected data on five cognitive abilities from the 20s to the 80s, in seven-year intervals, and over seven successive cohorts sampled from the same HMO population of community-dwelling normal adults residing in western Washington State.

Figure 4 provides an example of the shift of cross-sectional patterns over time, with part (a) of the figure showing average data collected in 1970 and part (b) shows similar data collected in 1998. It will be noted immediately that over this 28-year period, age differences between the youngest and oldest group have lessened markedly. Performance levels have increased overall for all abilities, except number skills, which have dropped. Also noteworthy are differential peak performance ages. These occur in young adulthood for Reasoning, Spatial Orientation and Word Fluency, but only in late midlife for the Verbal and Number abilities.

Longitudinal patterns are depicted in Figure 5. The data underlying this graphic are based on cumulated intra-individual change over a 7-year period for all individuals with two-point data over a particular 7-year interval from age 25 to age 88, regardless of cohort membership. They are then centered on the average observed level at age 53, the average age of our study participants when tested. In contrast to the cross-sectional data, asymptotic performance is reached for

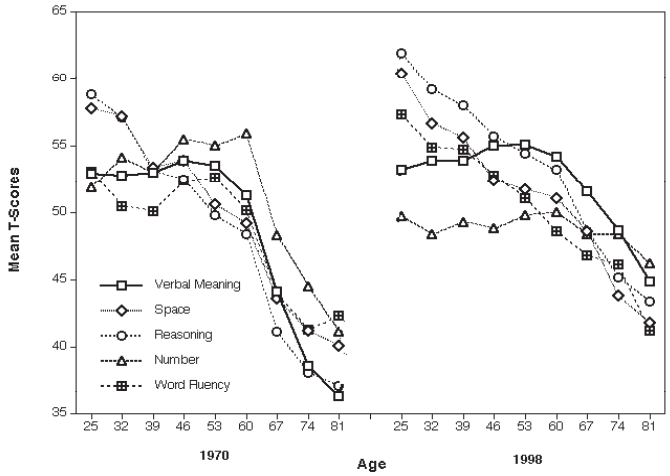

Figure 4. Cross-sectional age differences for 5 mental abilities in 1970 and 1998

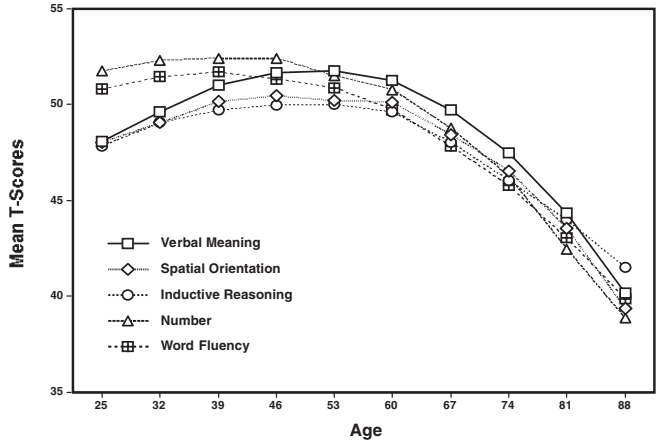

Figure 5. Longitudinal age changes for 5 mental abilities (from Schaie, 2005; p. 116)

Word Fluency age 39; for Number and Spatial Orientation at age 46; and for Inductive Reasoning and Verbal ability not until age 53. Except for Number, no statistically significant average decline is observed until the late 60s are reached. Thereafter average decline accelerates into the 80s.

What accounts for the differences between the cross-sectional data and the longitudinal data? As discussed above, in the section on the age-cohort period model, the cross-sectional data confound age and cohort differences. Hence, the steeper age differences hid the fact that there has been marked gain in asymptotic performance level for most abilities over successive cohorts. On the other hand, the apparent stability of Number skill until old age in the cross-sectional data hides the fact of negative cohort differences for this ability, probably due to changes in educational practice.

Figure 6 shows cumulative cohort differences for the five mental abilities displayed in the previous graphs, as well as a cohort gradient for an omnibus index of mental abilities. The latter indicates a generally positive pattern across cohort born from 1889 to 1973. However, cohort gradients for the separate abilities deviate markedly. Thus, almost linear gains were observed across cohorts for Inductive Reasoning and Spatial Orientation. Verbal ability attained a peak for the 1952 cohort and declined slightly thereafter. Number ability attained a peak in 1924 and has declined since then, while Word Fluency declined until 1938, but has returned to the level of the oldest cohort.

Ageism in the Psychology of Aging

From a lifespan perspective, many of the statements made by psychologists about normal development in

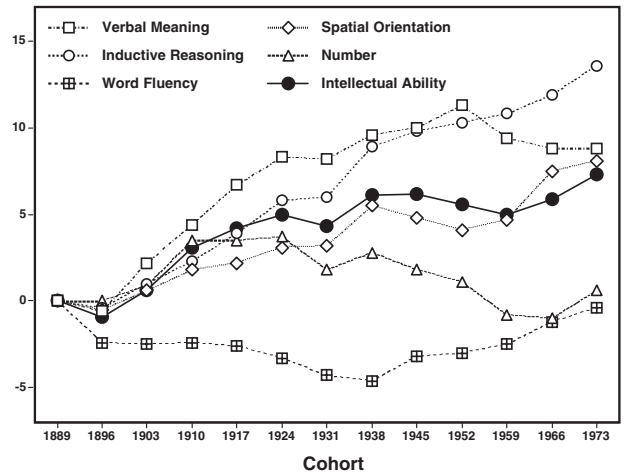

Figure 6. Cumulative cohort differences for 5 mental abilities and an overall index of intellectual ability (from Schaie, 2005; p.137).

the last third of life have been clouded by what can only be described as buying into common societal stereotypes that we now call ageism (Hummert, 1999; Schaie, 1988). Such ageism seems to be informed by the assumption of universal declines in cognitive competence and the development of other undesirable psychological characteristics with advanced age. They have also been informed by clinicians' experiences in encountering primarily older clients with psychological problems rather than the large number of elderly whom we would describe as aging successfully. In a rapidly changing society we also continue to confuse differences between old and young that are a function of greater educational and other opportunity structures for the younger cohorts with age-related changes (see methods section above). This confusion leads to language in the scientific literature that interprets age differences that reflect complex population differences as "aging decline" (Schaie 1993).

Negative stereotypes about the elderly are ubiquitous with respect to many domains of behavior and perceived attributes (Hess, 2006), even though some exceptions are found in attributed wisdom and altruistic behavior (cf. Pasupathi & Löckenhoff, 2002). Perhaps one of the most serious assumptions made by many psychologists is that of universal cognitive decline. While it is true that the proportion of individuals who show cognitive decline increases with each decade after the 60s are reached, it is equally true the many individuals do not show such decline until close to their demise, and that some fortunate few, in fact, show selective ability gains from midlife into old age. Figure 7 shows data from the Seattle Longitudinal Study to document this point (Schaie, 2005).

Pathology as normative aging

Another major source of ageism among psychologists and members of the health- and health related professions in general, has been the assumption that age-related cognitive losses as well as other behavioral deficits inevitably accompany the aging process. Although there is some controversy over the possibility of disease-free aging, it is still important to distinguish between biological changes that occur in many individuals with increasing age and the presence of specific physiological or psychological pathologies that may not be age-related even though they occur with greater frequency at advanced ages (cf. Solomon, 1999). The fact remains that chronic diseases associated with aging often have their origin in genetic predispositions and may therefore become clinically relevant over a wide age range. While cognitive decline affects significant portions of the elderly population, its symptomatology is often confused with that associated with sensory or metabolic disturbances. Indeed, there is no compelling reason to believe that selective age-related ability declines will inevitably lead to dementia, nor that they cannot be addressed by cognitive training or psychotherapy in many individuals (cf. Willis, 1996).

Summary and Conclusions

I have attempted to provide a fairly concise lifespan perspective on what some would call normal cognitive aging. To do so, I began by outlining what seem to be the most useful currently available theoretical frameworks that include statements about cognitive development from young adulthood to advanced old age. I then remind us that psychologists must never confuse aged differences, that may largely represent cohort differences associated with rapidly changing environmental

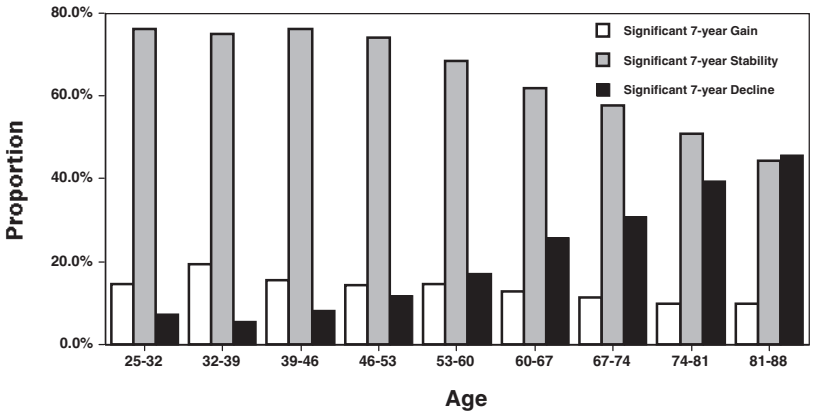

Figure 7. Proportions of study participants showing significant gain, loss or stability over 7 years

circumstances, with age changes that occur within individuals over their life course.

As part of this analysis I continue to emphasize the wide range of individual differences in level of functioning at any adult stage. I distinguish between normal and pathological aging, as is characterized by very different aging trajectories that distinguish individuals who follow average trajectories, those who decline early, those who develop neuro- or psycho-pathologies, and those favored few "super-aged" who remain fully functional until shortly before their demise.

Because changes in intellectual competence represent such a central topic in the psychology of aging, I then present examples of substantive data, for such changes through adulthood. Clearly, there is little cognitive decline not associated with pathological processes prior to the decade of the 60s, but some genetically and environmentally disadvantaged individuals show decline in the late 40s or early 50s, which may be indicators of eventual risk of dementia occurring in late adulthood. I also present age difference data and relate them to differential cohort paths for different abilities over the past 70 years.

Finally, I reflect on the topic of ageism in the psychology of aging and suggest that the major influence for much professional stereotyping may be found in the assumption of universal cognitive decline and movement towards negative personality traits with increasing age. I show data that suggest such decline is not universal although larger proportions of older persons show decline for each successive decade after the 60s are reached. I also suggest that negative professional stereotypes are formed in part by the fact that health services providers see primarily older people with problems that may or may not be age-related, but have only infrequent contact with the many elderly who age successfully.

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