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K. Warner Schaie
Pennsylvania State University, USA

This essay considers progress in understanding adult development in the study of behaviour during the 20th century. It describes the influence of methodological advances including paradigmatic shifts from cross-sectional to longitudinal studies, advances in measurement, the impact of confirmatory factor analysis, and consideration of age as the dependent variable. A theoretical framework for understanding adult cognitive development is presented. Different types of longitudinal studies, the issue of structural invariance across age, sources of individual differences and the impact of cohort differences are discussed. Finally projections are made for future research.

The purpose of this essay is to consider how our understanding of adult development in the study of behaviour has progressed over the course of the 20th century. When I agreed to undertake this task I began to think on how my own views of adult development had developed over the past 50 years, and I therefore tried to identify those critical factors that contributed to my current understanding of the influences that affect adult development. It became clear to me very quickly that these conceptions had largely been shaped by being engaged throughout my career in the pursuit of a set of large-scale longitudinal studies. These studies were designed to systematically identify the influences that differentiate between the lucky individuals who age successfully (cf. Rowe & Kahn, 1987) and those who are exposed to a variety of hazards likely to lead to early decline and low levels of functioning in the final part of their lives (cf. Schaie, 1989, 1996b,c). This thinking led me to organise the essay largely in terms of what we have learned from longitudinal studies, primarily those of cognition and personality.

Over the course of the 20th century many relevant lessons learned from the social and biological sciences have required behavioural sciences to become less parochial and more comfortable in considering the convergence of scientific findings from adjacent disciplines. To commence this somewhat personal account of the recent history of the developmental psychology of ageing I will therefore provide a theoretical framework that represents my recognition (and all that I have learned from colleagues in interdisciplinary settings) that behavioural change can only be understood (and predicted for that matter) by examining behavioural change in the context of societal change (cf. Riley, Foner, & Riley, 1999). The model also gives due recognition to lasting heritable influences (cf. Schaie, Plomin, Willis, Gruber-Baldini, & Dutta, 1992), as well as to the obvious age-related changes in the efficiency of the physiological infrastructure (Cristofalo, Tresini, Francis, & Volker, 1999).

The first half of the 20th century

The field of adult development and ageing developed quite slowly during the first half of the 20th century. A comprehensive overview of early gerontology can be found in Cowdry's *Problems of Aging* (1939). This volume was quite light on psychological content and even Birren's monumental *Handbook of Aging and the Individual* published in 1959, still confined psychological ageing to no more than about half of this single volume account.

An early seminal influence for the psychology of ageing was a quasi-autobiographical account of the last part of his life by one of the founders of American developmental psychology. G. Stanley Hall (1922). But attention to the psychological development of adults was also fostered by the need of the military during World War I to classify and assign large numbers of young and middle-aged draftees to emerging speciality roles. This need led to an extension of the mental testing movement begun by the work of Binet and Simon (1905) with children, to the construction of tests suitable for adults (Yerkes, 1921). The availability of assessment instruments such as the Army Alpha test led to an interest in age-comparative studies (e.g., Jones & Conrad, 1933; Miles, 1931). Emergence of the field of clinical psychology incurred further development of tests specifically tailored for work with adults (Wechsler, 1939) and continued the interest in studying adult age differences. An active research programme on human ageing was begun under the direction of Nathan Shock at the National Institutes of Health (USA) with psychological research being initiated by James Birren in 1947. About the same time, the Nuffield Unit for Research on Ageing was established at the University of Cambridge (Welford, 1951). Research on ageing also began during the 1950s at the University of Bonn in Germany (Schmitz-Scherzer & Thomae, 1983). The Division on Adult Development and Aging of the American Psychological Association was founded in 1945. But

Correspondence should be addressed to Dr K. Warner Schaie, Pennsylvania State University, 105 Henderson South, University Park, PA 16802, USA

formal recognition of ageing as a major research field probably occurred only when the National Institute on Aging was established in 1975.

Because I intend to limit my essay to the influence of longitudinal work on understanding adult development, I will deal primarily with work that occurred in the second half of the 20th century. More detailed accounts of the psychological aspects of adult development during the first half of the 20th century can be found in Birren (1961), Birren and Birren (1990), Birren and Schroots (in press), Jones (1959), and Riegel (1977).

The influence of methodological advances

I would be remiss if I were not to call attention to the influence of methodological advances in shaping our understanding of adult development (cf. Schaie, 1988, 1992). These advances have resulted in several paradigmatic shifts that have markedly changed the face of research on adult developments. The advances I will discuss here include first the shift from the dominance of cross-sectional data collections to the recognition of the importance of longitudinal designs. Second, there have been significant advances in the measurement of change, so essential to studies of development and ageing. Third, there has been a change from data-driven exploratory factor analysis to hypothesis-testing confirmatory factor analysis that has been particularly relevant to the study of developmental phenomena. Fourth, there has been a conceptual shift of treating age as the dependent rather than the independent variable, and finally there have been increasing efforts to study development by means of growth curves.

The paradigmatic shift from cross-sectional studies of age differences in the study of human development to longitudinal ones was extremely important. This shift, of course, included the understanding of the fact that the elicitation of antecedent-consequent relationships in the study of development clearly requires following the same individuals over time (Mason, Mason, Winsborough, & Poole, 1973; Ryder, 1965; Schaie, 1965, 1977). This understanding was precipitated to some extent by the follow-up of members of longitudinal studies that began in early childhood or late adolescence when they reached early adulthood or middle age (e.g., The Berkeley Growth and Guidance studies, Barley & Oden, 1955; Eichorn, Clausen, Haan, Honzik, & Mussen, 1981; or the Iowa State ROTC follow-up studies, Owens, 1953, 1966). Failure to replicate the decline in function from young adulthood into middle age inferred from cross-sectional data (e.g., Jones & Conrad, 1933) necessitated coming to grips with the contrasting inferences to be drawn from cross-sectional and longitudinal data.

The second methodological advance that resulted in a major impact on the study of adult development actually occurred in the field of measurement; specifically following some heated debates and increasing sophistication in the understanding of the measurement of change. This debate began early on with the recognition that measurement imperfections (i.e., deviations of observed scores from true scores) were likely to cumulate in gain (or loss) scores comparing multiple measurements of the same individuals (Thorndike, 1924). This issue was further developed by Lord (1956), and the debate became more heated in the 1960s when many developmentalists despaired at being able to assess change adequately (cf. Cronbach & Furby, 1970; Harris, 1963). Since studies of adult development require the test of hypotheses about directional changes, difference scores have always played an important role. Fortunately, it was soon recognised that a major problem occurs in two-point studies, leading to the advocation of multiple occasion studies (Nesselroade, Stigler, & Baltes, 1980; Rogosa, Brandt, & Zimowsky, 1982; Willett, 1989) and of growth curve modelling (see later).

A third paradigmatic shift was facilitated by the introduction of formal methods of confirmatory factor analysis and structural equations modelling. Earlier methods of exploratory factor analysis have always been utilised in studies of adult development to determine latent constructs from observed variables. But, even more important, has been the use of factor analysis for the purpose of determining whether psychological constructs change across samples of different ages or within the same samples over time (cf. Reinert, 1970). Early approaches to the study of multiple groups can be found in the writings of Thurstone (1947), Guttman (1952), and in work in the Cattell laboratory (e.g., Cattell & Cattell, 1955). However, it was not until the advent of high speed computers that algorithms could be developed that were applicable to more than a minimal number of variables (Jöreskog, 1971; Sörbom & Jöreskog, 1978). Confirmatory factor analysis makes it possible to assess systematically the invariance (stability) of the regression of the latent constructs, which are of primary interest to science, upon the observed variables. In studies of adult development, such invariance is a singular prerequisite for the comparison of individuals and groups over long periods of time, or the comparison of groups of different individuals who differ in salient characteristics. Confirmatory factor analysis, for example, can be used to test hypotheses about the differentiation and dedifferentiation of psychological domains across the adult lifespan (Baltes & Lindenberger, 1997; Reinert, 1970; Schaie, Maitland, Willis, & Intrieri, 1998).

A fourth important methodological development involved the paradigmatic shift of considering chronological age as a dependent rather than an independent variable. First introduced conceptually by Wohlwill (1973), behavioural scientists soon began to realise that the study of age or duration time as a dependent variable could be operationalised via methods of survival or event-time analysis (Allison, 1984; Schaie, 1989; Singer & Willett, 1991). This approach is important in both cognitive and health psychology, because the prediction of morbidity and mortality by means of earlier behavioural characteristics requires not only the definition of end-points but also the timing (respectively age) at which such end-points are most likely to occur (e.g., Bosworth, Schaie, Willis, & Siegler, 1999).

As longitudinal studies have been conducted for longer periods of time with multiple measurements, it is now possible to apply powerful methods of growth curve modelling (LGM) that allow separating patterns of individual change over time from the group averages that had previously represented the primary focus of inquiry. These methods also allow incorporating covariates and predictors of different forms of development. Multivariate growth curve methods were first introduced by Tucker (1958). Again, intensive development required the advent of more powerful computational resources, leading to modern methods of multilevel modelling (Bryk & Raudenbush, 1987; Rogosa & Willett, 1985; Rudinger & Rietz, in press; Willett & Sayer, 1994). LGM models are of particular interest in the study of adult development, because differences in

genetic predisposition and environmental exposure may result in ageing patterns that differ markedly for subsets of the population as well as for groups of individuals with either very favourable or unfavourable life experiences.

A theoretical framework for understanding adult cognitive development

An understanding of development from early adulthood to old age must include embedding what we know about development within the context of changing environmental influences and changes in individuals' physiological infrastructure. Figure 1 displays a schematic of how these influences might operate over the adult life course in the case of cognition. The schematic contains two end-points: first we are concerned with the lifelong influences that affect the level of late life cognitive functioning. But a secondary end-point is represented by the status of the cortex at life's end that would describe the infrastructure relevant to the maintenance of cognitive functioning that can only be determined post-mortem. In this conceptual path model, rectangles are used to identify those individual indicators that are observed directly, whereas ovals are used to indicate the latent constructs which would be inferred from measurement models for sets of observed variables.

The astute reader will immediately argue that the arrows in Figure 1, other than those directed towards the end-points, that represent the interplay of the various causal influences may be too simplistic. Indeed, we could have posited several reciprocal relationships. However, I have tried to keep the model as simple as possible, because I intend to use it primarily for its heuristic value, rather than fitting the model to specific sets of data. However, I would like to indicate that all of the causal paths specified in the model were suggested by empirical investigations in my own laboratory or the work of other cognitive developmentalists.

Let me now try to explicate some of the attributes of the heuristic model. The initial bases for adult cognitive functioning must, of course, be attributed to both heritable (genetic) influences as well as early environmental influences typically experienced within the home of the biological parents. Although some of the behaviour genetic literature suggests that much of the early environmental variance is nonshared (e.g., Plomin & Daniels, 1987), there is recent retrospective evidence that there may indeed be some early shared environmental influences on later cognitive performance (Schaie & Zuo, 2000). Both genetic and early environmental factors are thought to influence midlife cognitive functioning. The early environmental influences will, of course, also exert influences in midlife social status (Nguyen, 2000). By contrast, virtually no correlations have been found between retrospective accounts of family environment in the family of origin, and environment in the current family (Schaie & Willis, 1995). However, the current family environment does seem to influence midlife cognitive performance. Genetic factors are also likely to be implicated in the rate of cognitive decline in adulthood. Thus far the best-studied gene in this context is the Apo-E gene, one of whose alleles is thought to be a risk factor for Alzheimer's disease. Apo-E status is therefore added as a factor; the expression of the gene is probably not at issue prior to midlife.

We are now ready to specify the causal influences that determine level of cognitive function in late life as well as cortical status at autopsy. The direct influences to be implicated in addition to genes whose expression is turned on in late life, most likely originate in midlife. They include level of cognitive functioning in midlife, midlife lifestyles, and the incidence and severity of chronic disease. But there are indirect influences attributable to the effects of midlife cognitive function and lifestyles on chronic disease, as well as shared family influences on midlife cognition and of social status on midlife lifestyles.

Although some of these paths represent concurrent observations that would allow alternative paths (respectively, reciprocal causal paths), most of the paths specified by the model represent antecedent-consequent relationships which require longitudinal data for their estimation and understanding. I will therefore now turn to what has been learned about adult cognitive development through longitudinal studies.

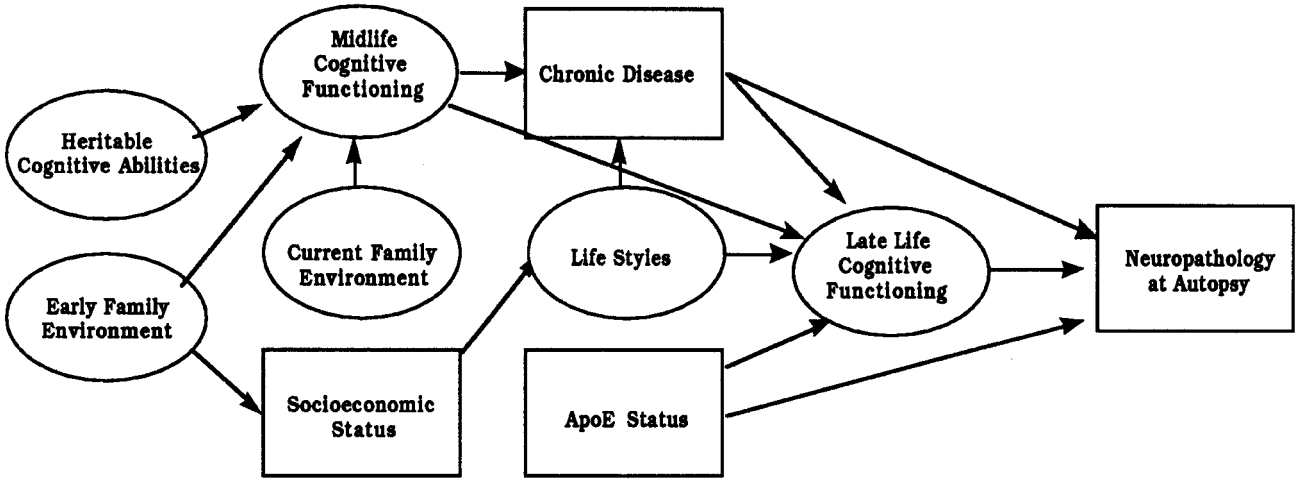


Figure 1. A conceptual model for influences affecting late life psychological functioning in the sample case of cognition.

Longitudinal studies of adult development

From the very beginning of empirical inquiry on development beyond adolescence substantive concerns were limited primarily to the areas of intellectual development and personality traits. Investigators interested in the age-related aspects of learning and memory largely adopted the paradigms popular in early experimental child psychology and thus limited themselves to age-comparative studies of young and old adults. Only recently, have we seen an interest in this area in studies that would investigate the developmental mechanisms by use of longitudinal paradigms (see Salthouse, 1999).

Cross-sectional studies predominated until the late 1930s and clouded our understanding of adult development due to the confusion of age-related development with secular changes expressed as cohort effects. For example, successive studies of adult age differences in intelligence reported asymptotic peak performance to occur at ever later ages. Thus, Terman (1916) in his standardisation of the Stanford–Binet thought that intelligence peaked at age 16, and Yerkes' (1921) estimate of World War I soldiers was even lower at age 13. By 1939, Wechsler's standardisation sample peaked between 18 and 24 years, similar to the top ages found by Jones and Conrad (1933).

Types of longitudinal studies

The initial longitudinal studies that informed our understanding of adult development were of two types. First, there were studies that began with a focus on early childhood and child-rearing practices, but whose participants were followed into adulthood. A prime example of such a study is the follow-up of the Berkeley Growth and Guidance studies (Bayley & Oden, 1955; Eichorn et al., 1981). A second group of studies traced participants who had been assessed as young adults as part of their college experience and were reassessed in midlife or later. One example of such studies is Owens (1953, 1966) follow-up of persons in their fifties who had first been assessed as ROTC members during World War I.

Contrast between cross-sectional and longitudinal studies

The earlier cross-sectional studies (e.g., Jones & Conrad, 1933) placed peak performance in intelligence and other positive psychological attributes in late adolescence or early young adulthood with linear decline occurring thereafter. By contrast, the longitudinal follow-up studies suggested that psychological growth continued generally into early midlife and for some variables (notably the verbal abilities) at least into the fifties. My own early work (Schaie, 1958) with cross-sectional data on mental abilities and rigidity-flexibility in adults over the age range from the twenties to the sixties suggested that, although peak performance now occurred in the twenties and thirties, linear decline still prevailed thereafter. I vividly remember a conversation with Harold Jones in 1959 or so, trying to understand the differences between the cross-sectional and longitudinal findings. His suggestion was that we were dealing with noncomparable samples and different measurement variables as well as the attrition effects in longitudinal studies. These were all points well taken, but I felt that there was something more fundamental at stake.

The Seattle Longitudinal Study

I soon became convinced that the cross-sectional versus longitudinal issue needed to be confronted directly by following a structured cross-sectional sample over most of the adult lifespan. I therefore designed a study that converted my original cross-sectional study into a series of short-term longitudinal studies of mental abilities each extending over a simultaneous seven-year period (Schaie & Strother, 1968). My replicated cross-sectional findings were quite similar to the original findings, but the longitudinal data showed later ages of peak performance, maintenance of average functions on most abilities until the sixties, and only modest decline through the seventies. Further extensions of these studies (with some longitudinal data over as long as 42 years) over the past several decades, have consistently replicated these findings, with dramatic declines not experienced until the eighties are reached (Schaie, 1983, 1996b; Schaie & Hertzog, 1986; Schaie & Lavouvie-Vief, 1974). I will come back to other matters learned from this study later on, but first must dwell a bit on other longitudinal approaches to the study of ageing.

Lifespan oriented studies

The early work on adult development was pretty much oriented within the context of a lifespan development framework (cf. Baltes, 1987, 1997), but the burgeoning field of geropsychology soon divided into at least two rather different orientations. Some of us remained committed to the notion that an understanding of the ageing process required the careful charting of human development at least across the entire adult lifespan, if not beginning our enquiries in childhood. This orientation, which I share, holds that what is of primary interest is the understanding of the mechanisms that contribute to the behavioural differences between youth and old age within a process that extends across the lifespan. Most of the studies mentioned earlier illustrate this type of approach.

Studies originating in late life

The second orientation, sometimes labelled the ''clinker method'' (after the residue that remains when charcoal is produced), considers the characteristics of the elderly to be of primary interest, and would investigate the ageing process only from that period of life when a categorical transformation, such as leaving the world of work, or family dissolution due to death of a spouse has begun. Representative longitudinal studies of the second orientations therefore began at an advanced age. Several of these types of studies began during the 1960s and 1970s when the subjects were in their sixties.

Perhaps the most prominent of studies begun in late life has been the Duke Longitudinal Study (Palmore, Busse, Maddox, Nowlin, & Siegler, 1985). But many others can be found in the literature conducted in a variety of industrial societies (e.g., Canada: Hultsch, Hertzog, Dixon, & Small, 1998; Germany: Schmitz-Scherzer & Thomae, 1983; Rott, 1993; Israel: Shanan, 1993; Sweden: Svensson, Dehlin, Hagberg, & Samuelsson, 1993; United Kingdom: Rabbitt, 1993). Other more recent studies have focused on following those in very late life (e.g., Baltes & Mayer, 1999; Poon, Sweeney, Clayton, & Merriam, 1992).

These studies generally find smaller decrements than would be suggested by cross-sectional data, only small average decline

in the sixties, with increasingly steep decrements for each successive age decade. There is also a strong suggestion that decline accelerates as a precursor of eventual death (Berg, 1996; Bosworth et al., 1999). But most importantly, all of the studies call attention to vast individual differences in rate of change occurring for individuals of all levels of early psychological functioning and socioeconomic status. Thus, although the frequency of individuals who show some decline increases at a near logarithmic rate once the sixties are passed, there are still rare individuals to be found even in their mid eighties who function exceedingly well. What many of these studies also suggest is that there may be an individualised pattern of developmental trajectories (cf. Magnusson, 1998). For example, in the case of mental abilities, most individuals by the time they reach the sixties will have experienced a significant drop in one of their abilities, but that ability will be specific to the individual (Schaie, 1989). Indeed, it is only from the longitudinal study of adult development that it is possible to enquire into possible mechanisms and/or causes of these vast individual differences in developmental progressions through adulthood.

Structural invariance of constructs across age

One of the bothersome problems in studies of adult development has been the ever-present question whether we are not comparing apples and oranges when we do age-comparative work. The experimental ageing literature is replete with studies that compare college studies with senior volunteers. Fashionable also have been the so-called Brinley plots, in which mean performance of young adults and older persons across tasks of varying difficulty have been charted in order to obtain ratios that define the extent of the disadvantage of the older group (e.g., Cerella, 1990). All this work is based on the assumption that the constructs studied (and technically the regression of the constructs on the marker variables used to measure them) remain invariant across the different groups or, in longitudinal studies, within groups (cf. Meredith, 1993).

The advent of confirmatory factor analysis has made a formal test of structural invariance across age practicable, and there have been a number of recent studies that have applied these methodologies to problems in adult development. The limited literature thus far available gives some reassurance, but also grounds for caution. Although good invariance has been demonstrated across much of midlife, there are significant structural differences between young and old adults, as well as between elderly men and women (e.g., Maitland, Intrieri, Schaie, & Willis, 2000; Schaie et al., 1998). However, there are selected marker variables that seem to be remarkably stable across the entire age range, which therefore deserve special attention. These marker variables include unspeeded measures of vocabulary (ETS Advanced Vocabulary), as well as selected markers of inductive reasoning (PMA Letter Series), spatial orientation (STAMAT Object Rotations), and numeric ability (ETS Subtraction and Multiplication).

Sources of individual differences

The differences in individual trajectories and patterns of decline invite investigations of potential causes of unfavourable or successful ageing. Although some of these influences can be represented by psychological constructs, others must clearly be sought in the physiological infrastructure underlying effective behaviour, as well as the sociodemographic factors that will either benefit or constrain individual development. The development impact of all of these influences can, of course, only be assessed by means of longitudinal data.

Not all individuals decline in lock-step. Although linear or quadratic forms of decline may be detectable for large groups, individual decline appears to occur far more frequently in a stair-step fashion. Individuals will have unfavourable experiences, to which they respond with a modest decline in cognitive functioning, and then tend to stabilise for some time, perhaps repeating this pattern several times prior to their demise.

Genetic influences

Certainly, genetic endowment will account for a substantial portion of individual differences. For example, evidence of heritability of adult intelligence has been provided from both twin studies (e.g., Finkel, Pedersen, McGue, & McClearn, 1995) and family studies (e.g., Schaie et al., 1992). Similarly, genetic variance has been identified for a variety of personality traits as well as their stability in adulthood (e.g., Pedersen & Reynolds, 1998). Nevertheless, in most populations sampled, heritability explains on average at most 25% of cognitive abilities and less in the realm of personality. Hence, there are many other important sources of individual differences in psychological ageing that have been implicated.

Chronic disease

The onset of intellectual decline seems to be markedly affected by the presence or absence of several chronic diseases. Most reliably identified as such influences thus far are cardiovascular disease, diabetes, neoplasms, and arthritis. All of these diseases are risk factors for the occurrence of early cognitive decline, as is a low level of overall health. Persons functioning at high cognitive levels are also more likely to seek earlier and more competent medical intervention in the disabling conditions of late life, and they are more likely to comply more effectively with preventive and ameliorative regimens that tend to stabilise their psychological infrastructure. They are also less likely to engage in high risk lifestyles and to respond more readily to professional advice that maximises their chances for survival and reduction of morbidity (e.g., Bosworth & Schaie, 1999).

Environmental circumstances

Other candidates of circumstances that might account for individual differences in cognitive ageing, for example, have been all those aspects of the environment that are likely to enhance intellectual stimulation (cf. Schaie & O'Hanlon, 1990). Considerable evidence suggests that the onset of intellectual decline is postponed for individuals who live in favourable environmental circumstances, as would be the case for those persons characterised by a high socioeconomic status. These circumstances include above-average education, histories of occupational pursuits that involve high complexity and low routine, and the maintenance of intact families. Likewise, risk of cognitive decline is lower for persons with substantial involvement in activities typically available in complex and intellectually stimulating environments. Such

activities include extensive reading, travel, attendance at cultural events, pursuit of continuing education activities, and participation in clubs and professional associations (Arbuckle, Gold, Andres, & Schwartzman, 1992; Gribbin, Schaie, & Parham, 1980).

Intact families, our most important individual support system, also reduce risk of cognitive decline. In addition, it has been found that cognitive decline is less severe for those married to a spouse with high cognitive status, with the lower-functioning spouse at the beginning of a marriage tending to increase his/her levels *vis-à-vis* the higher-functioning spouse (Gruber-Baldini, Schaie, & Willis, 1995).

Psychological characteristics

Cognitive styles. Associated also with differential intellectual ageing have been individual differences in the cognitive style of rigidity-flexibility. It can now be concluded that an individual's self-report of a flexible personality style at *midlife*, as well as flexible performance on objective measures of motor-cognitive perseveration tasks, is predictive of a reduction in the risk of cognitive decline. It seems that the availability of a more flexible response style is useful when one must cope with the vicissitudes of advanced age.

Perceptual and response speed. Ageing effects on many cognitive abilities tend to be confounded with the perceptual and response speed required to process the tasks used to measure these abilities. Thus, individuals who remain at high levels of perceptual speed are also at an advantage with respect to the maintenance of such other abilities.

Life satisfaction. Finally, those individuals who rate themselves as being satisfied with their accomplishments in midlife or early old age seem to be at an advantage when assessed at a later age. Also, individuals who overestimate the rate of their cognitive decline might well be engaging in self-fulfilling prophecies if they reduce their active participation in life to compensate for decline that is perceived by the individual but has not actually occurred.

Developmental interventions

Once we understand some of the factors that influence individual differences in adult development, we are then challenged as scientists to attempt obtaining experimental control by means of targeted interventions. Although investigators in child development might be interested in accelerating normal development of children's competencies, adult developmentalists' primary goal is to postpone functional decline or compensate for cohort differences (see later).

An essential feature of the design of interventions with older adults is the need to determine whether the individual has declined from a previously attained higher level or whether he/she is simply functioning at a low level that represents that person's developmental asymptote. If longitudinal data are available, it becomes possible to determine not only whether an intervention has resulted in improved levels of function, but also to determine whether remediation or new learning has occurred. And, again, only longitudinal studies can inform us whether or not developmental interventions have had long-lasting effects (cf., Willis & Nesselroade, 1990; Willis & Schaie, 1994).

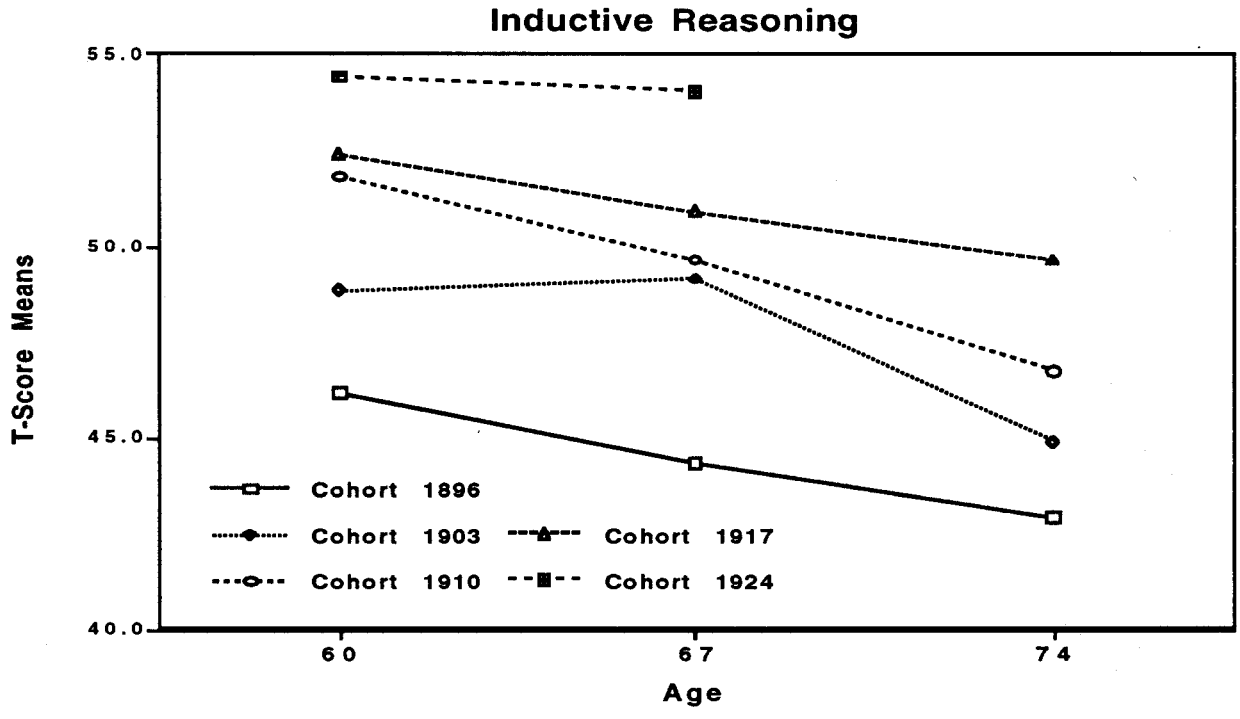
The impact of generational differences

One of the major contributions made by developmentalists interested in adulthood has been the attention given to generational (or cohort) differences in psychological characteristics, including shifts in the rate of developmental change across successive cohorts. What is at issue here is that we cannot be certain that once we have explicated developmental mechanism and life course trajectories that these will stay put. As Riley (Riley et al., 1999) vividly portrays, changing societies change the life course of individuals, who in turn during their lives modify the formative nature of society. The cohort issue has long been of central concern in sociology and demography. In developmental psychology, cohort was first seen as a confound that created unwelcome discrepancies between cross-sectional and longitudinal findings. Hence, initial concerns with attempts to control for what were perceived to be ''experimental artefacts''.

Cohort variance in studies of infancy and childhood may indeed be no more than a minor disturbance unlikely to overshadow or hide universal developmental laws. By contrast, cohort variance often assumes a substantively meaningful role in the study of adult development. Individual differences in adulthood, prior to advanced old age, are largely moderated by environmental context (see earlier). We therefore need to understand how successive cohorts differ from one another (Schaie, 1996a; Willis, 1989). Examples of major contexts that differ dramatically for successive generations are level of educational attainment, adoption of healthy lifestyles with respect to exercise and diet, and major advances in health care that contribute to the extension of life and functionality. The increase in societal support during early old age has resulted in compensatory behaviours that optimise selective psychological functions (cf. Baltes & Carstensen, 1996). The increased functionality, however, also expands demands by society on the individual's development.

An example of this interplay can be seen in the current discussions on delaying eligibility for social security payments in the United States. It is argued that individuals both live longer and remain functional to later ages than in the past. Facing the developmental psychologist, is the question as to what assumptions need to be made to buttress these contentions. I would argue that two assumptions are required. First, it is necessary to show that older individuals function at higher levels today than in earlier eras, and second, evidence is needed that the rate of declining competence has slowed for successive cohorts. Figure 2 shows some relevant data from the Seattle Longitudinal Study bearing on these questions.

What should be noted in Figure 2 is the pattern of increased levels of performance on two important dimensions of cognitive competence (Inductive Reasoning and Spatial Ability) for successive cohorts over the age range from 60 to 74. This, of course, is the age span during which most individuals could typically be expected to retire, and the data support the assumption that performance over this age range has indeed risen. On the other hand, there is little support for the second assumption of changes in rates of ageing. The data suggest that the rate of change from age 60 to age 74 has not



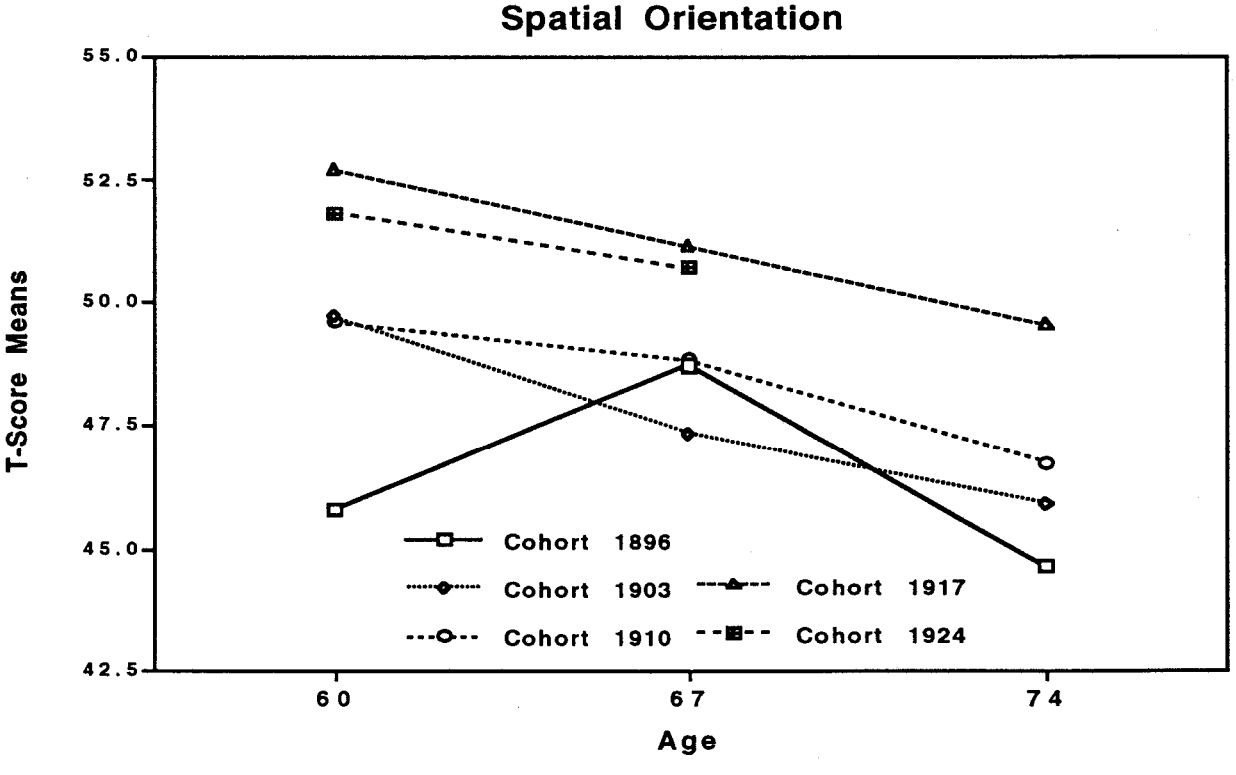


Figure 2. Changes in level and rate of ageing across five cohorts for the mental abilities of Inductive Reasoning and Spatial Orientation.

changed markedly over what represents an almost 30-year period of time.

Future implications

The study of adult psychological development is increasingly informed by relevant neighbouring disciplines that investigate the genetic basis, physiological infrastructure, and societal context of the developing individual. Hence, I would predict that the study, over the life course, of single psychological variables that was common in the first two-thirds of the 20th century will be largely displaced by multivariate multidisciplinary efforts. Indeed, most of the more recent longitudinal studies of adults already display these characteristics (e.g., Baltes & Mayer, 1999). Cross-sectional investigations will continue to have a role as exploratory pilot studies or as the first stages of prospective longitudinal studies. Given the willingness of public agencies to invest in more comprehensive investigations we are likely to see more programmatic long-range investigation that may frequently include experimental paradigms and, in particular, interventions designed to modify rate of development.

With our increasing sophistication in psychological measurement, we will take advantage of the work on structural invariance to develop better scales. The introduction of item response theory to educational measurement was instrumental in improving the precision of measurement scales and their applicability to populations at different stages across the range of human talent. But item response theory remains essentially a univariate procedure, and its proponents have not yet dealt with matters such as changes in item differences across age and time. Once we have used confirmatory factor analyses to identify those robust marker variables that do well in measuring behaviour across the entire adult lifespan we must then return to improving the measurement characteristics of those scales that we will continue to use.

We are beginning to develop common archives that will make available to our colleagues large datasets from many different populations and covering a wide range of psychological attributes. This development calls even more urgently for the development of ''gold standards'' for a core set of measures. Such measures can then be used to link disparate datasets and provide the basis for substantively meaningful meta-analyses.

I would also predict that the investigation of adult development will increasingly turn to the identification of mechanisms and processes that underlie developmental interventions and that will be relevant to public policy questions. Many of the mechanisms that may lead from full functionality to increasing impairment are likely to become first measurable in midlife (cf. Willis & Reid, 1999). Paradoxically, such investigations may rekindle interest in age-comparative and short-term longitudinal studies, so as to be able to respond to societal problems of an immediate nature. However, age-comparative studies of this nature will not use the young/old comparison paradigms currently so common in the experimental literature. Rather, they must introduce designs that compare groups differing modestly in age; hence, making it possible to control or match for other individual difference variables. We should thus see more studies comparing different segments of midlife and of old age, rather than investigations attempting to cover broad age slices.

Recent theorising on losses and gains in advanced old age (cf. Baltes, 1997), suggests that we have been successful in identifying and introducing behavioural and environmental compensations for the increasing physiological frailness all of us can expect as we age; these seem to work well in early old age. We have been far less successful in dealing with the needs of the very old, where the compensatory methods that may work well at retirement no longer suffice. Some would argue that the only solution here is to find ways to enhance the spiritual experience and psychological accommodation of the very old to the reality of end-of-life losses. Nevertheless, my inveterate optimism would argue that even here other possibilities for successful interventions may still lie ahead. Hence, studies of the very old, including investigation of behavioural and environmental prostheses, would seem to be part of the need for a strong applied psychology of adult development, one that will find ways to enhance the quality of our existence towards the very end of human existence.

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