

## 16 The impact of longitudinal studies on understanding development from young adulthood to old age

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### INTRODUCTION

The purpose of this chapter is to review progress in our understanding of adult development in the study of behaviour over the past half-century. It became clear to me very quickly that my own perceptions of this progress have largely been shaped by my involvement in the pursuit of large-scale longitudinal studies. These studies were mostly 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 that can lead to early decline and inadequate functioning in the final part of their lives (cf. Schaie, 1989, 1996b, c; Schaie & Willis, 2002). What follows, then, will heavily lean on what I have learned from longitudinal studies, primarily those of cognition and personality.

Over the course of the last century many relevant lessons learned from the social and biological sciences have required behavioural scientists to become less parochial and more comfortable in considering the convergence of scientific findings from adjacent disciplines. I will begin this assessment of the recent history of the developmental psychology of ageing by summarising relevant early developments of a substantive and methodological nature. I will then provide a theoretical framework that represents my understanding that behavioural change can only be understood (and predicted, for that matter) by being examined 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).

Then follows a more detailed discussion of what we have learned from longitudinal studies. I will therefore, by necessity, deal primarily with work that occurred in the second half of the century. More detailed accounts of the psychological aspects of adult development during the first half of the century can be found in Birren (1961), Birren and Birren (1990), Birren and Schroots (2001), Jones (1959), and Riegel (1977). Finally, I will do

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some prognostication of what research directions we might expect in the proximal future.

### THE FIRST HALF OF THE CENTURY

The study of adult development and ageing developed quite slowly during the first half of the twentieth 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 specialty 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 NIH 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 formal recognition of ageing as a major research field probably occurred only when the National Institute on Aging was established in 1975.

### THE INFLUENCE OF METHODOLOGICAL ADVANCES

Attention needs to be called to the role 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 to be discussed here include first of all 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 shift 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 toward treating age as the dependent rather than the independent variable, and finally there have been increasing efforts to study development by means of methods of latent growth curves.

The paradigmatic shift from the predominance of cross-sectional studies of age differences in the study of human development to the emphasis on the need for longitudinal data was motivated by a number of critical issues facing developmental researchers. The major issue, of course, was the growing understanding of the fact that, if antecedent-consequent relationships are to be elicited in the study of development, then one must follow the same individuals over time (Mason, Mason, Winsborough, & Poole, 1973; Ryder, 1965; Schaie, 1965, 1977; Schaie & Caskie, 2001). 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 their participants reached early adulthood or middle age (e.g., the Berkeley Growth and Guidance studies; Bayley & 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 confounding inferences to be drawn from cross-sectional and longitudinal data.

The second methodological advance that had major impact on the study of adult development actually occurred in the field of measurement—specifically following some heated debates and increasing sophistication in our 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). Because studies of adult development require tests of hypotheses about directional change, difference scores have always played an important role. Fortunately, it was soon recognised that the major problem is usually confined to two-point studies, leading to the advocacy 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 were utilised in studies of adult development to determine latent constructs from observed variables. But an even more important use of factor analysis has been its application to the determination of change in psychological constructs across samples of different age or within the same sample over time (cf. Reinert, 1970). Early approaches to the study of multiple groups can be found in the writing 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; Maitland, Intrieri, Schaie, & Willis, 2000; Reinert, 1970; Schaie, Maitland, Willis, & Intrieri, 1998).

A fourth important methodological development involved the paradigmatic shift from considering chronological age as a dependent rather than as 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 endpoints but also the timing (respectively age) at which such endpoints 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 enquiry. 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 currently popular approaches of multilevel modelling (cf. Bryk & Raudenbush, 1987; Rogosa & Willett, 1985; Rudinger & Rietz,

2001; 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 16.1 displays a schematic that specifies my view of how these influences might operate over the adult life course in the special case of cognition. The schematic contains two endpoints: one important for applied issues, the other of greater concern to basic science. The first endpoint is concerned with the lifelong influences that affect the level of late-life cognitive functioning so essential for maintaining independence and a life characterised by high quality. The second endpoint represents the status of the cortex at life's end and is descriptive of infrastructure relevant to the maintenance of cognitive functioning that can only be determined at post mortem. In this conceptual path model, as is conventional, rectangles are used to identify those individual indicators that are observed directly whereas ovals are used to indicate the latent constructs that would be inferred from measurement models for sets of observed variables.

It could, of course, be argued that the arrows in Figure 16.1, other than those directed towards the endpoints, which represent the interplay of the various causal influences, may be overly simplistic. Indeed, I could have posited several reciprocal relationships. However, I have tried to keep the model as simple as possible, because it is intended primarily for its heuristic value. More complex models may indeed be needed if the model were to be fitted to specific sets of data. However, I would like to assure the reader that all of the causal paths specified in the model can be supported by the results of empirical investigations in my own laboratory or those of other cognitive developmentalists.

Some more details may be in order with respect to 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 upon later cognitive performance (Schaie & Zuo, 2001). Both generic and early



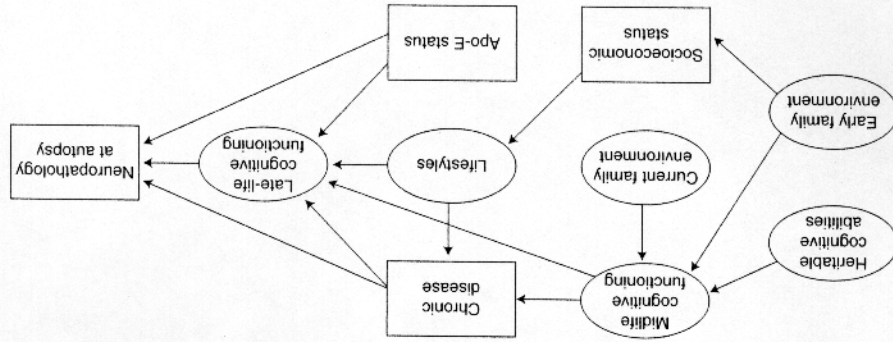
environmental factors are thought to influence midlife cognitive functioning. The early environmental influences will, of course, also exert influences on midlife social status (Nguyen, 2000). By contrast, virtually no correlations have been found between retrospective accounts of family environment in the family of origin, and that in the current family (Schaité & 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.

Given these considerations, the causal influences can now be specified 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, are most likely to 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 upon chronic disease, as well as shared family influences on midlife cognition and of social status upon midlife lifestyles (cf. Willis & Reid, 1999).

Some of these paths represent concurrent observations that would allow alternative (respectively reciprocal) causal paths, but most of the paths specified by the model represent antecedent-consequent relationships which require longitudinal data for their estimation and understanding. This leads me to turn next to a brief account of what has been learned about adult cognitive development through longitudinal studies.

### LONGITUDINAL STUDIES OF ADULT DEVELOPMENT

It is interesting to note that from the very beginning of empirical enquiry 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). But for the areas of intellectual development, and cognition as well, 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's (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 (1937). In my first cross-sectional study (Schaie, 1958), the peak ages had moved up to the late twenties and early thirties.

### Types of longitudinal studies

The initial longitudinal studies that have 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 reassessed in midlife or later. An 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) had placed peak performance in intelligence and other positive psychological attributes in late adolescence or early young adulthood, with linear decline 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 peak performance now occurred in the twenties and thirties, but linear decline still prevailed thereafter.

### 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 covering most of the adult lifespan over time. 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 7-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 function 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 & Labouvie-Vief, 1974). I will come back to other matters learned from this study later on, but first must dwell a little 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 as their primary interest, and would investigate the ageing process only from that period of life when a categorical transformation, such as leaving the work of world, or family dissolution due to death of a spouse, has begun. Representative longitudinal studies of the second orientation therefore began at an advanced age. Several of these types of studies began in the age decades of the sixties during the 1960s and 1970s.

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 & Thoma, 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 less decrement than would be suggested by cross-sectional data, only small average decline in the sixties, with

increasingly steep decrement 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 while 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 who function exceedingly well even in the mid-eighties. 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, by the time they reach the sixties most individuals 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. For a more detailed review of longitudinal studies of adults now in progress, as well as classic studies now completed, see Schaie and Hofer (2001).

#### STRUCTURAL INVARIANCE OF CONSTRUCTS ACROSS AGE

A bothersome problem in studies of adult development has been the ever-present question of whether apples and oranges are being compared in age-comparative studies. The experimental ageing literature is replete with reports of studies in which college students are compared 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 formal tests of structural invariance across different groups and over time 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 provides some reassurance, but also gives 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 et al., 2000; Schaie et al., 1998). However, there are selected marker variables that do seem to be remarkably stable across the entire age range, which

therefore deserve special attention. These marker variables include unsped 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

Individual differences in trajectories and patterns of decline invite investigations of influences that can be identified as 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 developmental impact of all of these influences can, of course, only be assessed when relevant longitudinal data are available.

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 physiological 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

Candidates for 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). There is considerable evidence to suggest 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 or her level *vis-a-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 it 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 life's accomplishment 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 to obtain experimental control by means of targeted interventions. Whereas 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 the older adult 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 & Schate, 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 rest 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 life course modify the formative nature of society. The cohort issue has long been of central concern in sociology and demography. In developmental psychology the cohort was first seen as a confound that created the unwelcome discrepancies between cross-sectional and longitudinal findings. Hence, initial concerns were 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. It is therefore important to understand how successive cohorts differ from one another (Schaitte, 1996a; Willis, 1989). Examples of major contexts that differ dramatically for successive generations can be found in the increased level of educational attainment, the adoption of healthy lifestyles with respect to exercise and diet, and major advances in healthcare 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 upon the individual's development.

Societal implications of this interplay can be seen in the current discussions in the United States on the need to postpone to later ages the eligibility for social security payments. It is argued that individuals now live longer and remain functional to later ages than was the case in the past. The developmental psychologist, when asked to apply expertise to this issue, is faced with the question as to what assumptions must be made to support these contentions. I would argue that two assumptions are required. First, it is necessary to show that older individuals today function at higher levels than their previous age peers, and second, evidence is needed that the rate of declining competence has slowed for successive cohorts. Figure 16.2 shows some relevant data from the Seattle Longitudinal Study bearing on these questions.

What should be noted in Figure 16.2 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 changed markedly over what represents an almost 30-year period of time.

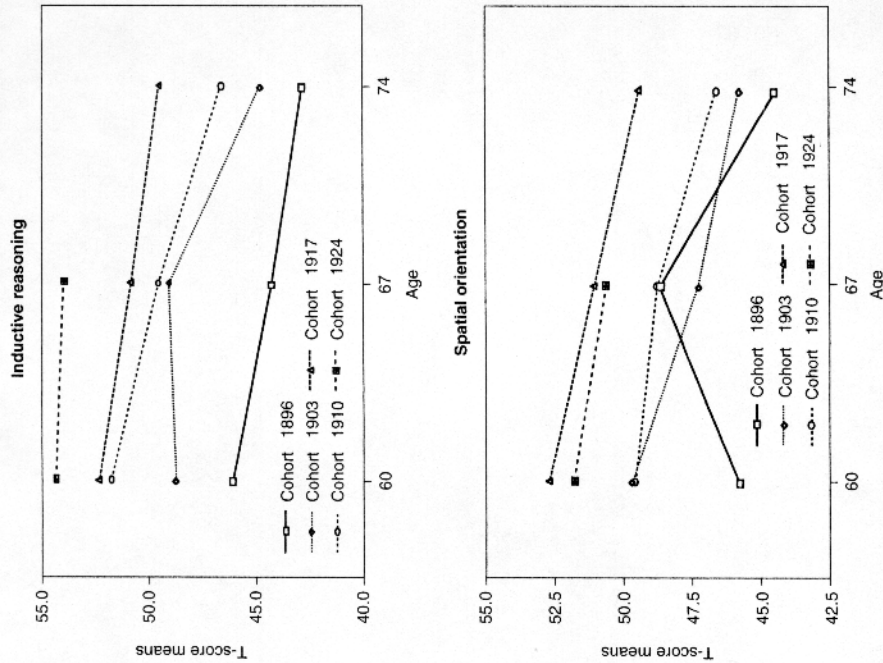


Figure 16.2 Changes in level and rate of ageing across five cohorts for the mental abilities of inductive reasoning and spatial orientation.

## 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 of the life course of single

psychological variables that was common in the first two-thirds of the past 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 stage of a prospective longitudinal study. 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 of 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 data sets 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 data sets 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 measurable first in midlife (cf. Willis & Reid, 1999). Paradoxically, such investigations may rekindle interest in age-comparative and short-term longitudinal studies 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 in age modestly—hence, making it possible to control or match for other individual difference variables. Hence, we should see more studies comparing different segments of midlife and of old age, rather than 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 that 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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