

Reprint

LIFE-SPAN THEORY IN DEVELOPMENTAL PSYCHOLOGY

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CHAPTER 18

Life-Span Theory in Developmental Psychology

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Life-span developmental psychology deals with the study of individual development (ontogenesis) from conception into old age (P. Baltes & Goulet, 1970; P. Baltes & Reese, 1984; Dixon & Lerner, 1988; Neugarten, 1969). A core assumption of life-span developmental psychology is that development is not completed at adulthood (maturity). Rather, the basic premise of life-span developmental psychology is that ontogenesis extends across the entire life course and that lifelong adaptive processes are involved. A further premise is that the concept of development can be

used to organize the evidence about lifelong adaptive processes, although it is necessary to reformulate the traditional concept of development (D. Harris, 1957; Wohlwill, 1973) for this purpose.

Sequencing in the life span gives temporal priority to earlier times and events in life. Aside from this temporal order of any developmental process, however, life-span developmental researchers expect each age period of the life span (e.g., infancy, childhood, adolescence, adulthood, old age) to have its own developmental agenda; and to make

some unique contribution to the organization of the past, present, and future in ontogenetic development. Moreover, life-span developmental scholars, if they focus on processes and mechanisms of mind and behavior (such as identity of self or working memory) rather than age, proceed from the assumption that these processes and mechanisms express manifestations of developmental continuity and change across the entire life span.

Psychology deals with the scientific study of mind and behavior, including practical applications that can be derived from such scientific inquiry. Within this substantive territory of psychology, the objective of life-span psychology is: (a) To offer an organized account of the overall structure and sequence of development across the life span; (b) to identify the interconnections between earlier and later developmental events and processes; (c) to delineate the factors and mechanisms which are the foundation of life-span development; and (d) to specify the biological and environmental opportunities and constraints which shape life-span development of individuals. With such information, life-span developmentalists further aspire to determine the range of possible development of individuals, to empower them to live their lives as desirably (and effectively) as possible, and to help them avoid dysfunctional and undesirable behavioral outcomes.

To this end, life-span researchers have focused on searching for models and definitions of successful (effective) development. One general approach to this topic has been to define successful development as the maximization of gains and the minimization of losses (M. Baltes & Carstensen, in press; P. Baltes, 1987; Baltes & Baltes, 1990b; Brandtstädter & Wentura, 1995; Marsiske, Lang, Baltes, & Baltes, 1995). Such an approach is consistent with the postulate that there is no development (ontogenetic change) without a loss, as there is no loss without a gain (P. Baltes, 1987; P. Baltes, Reese, & Lipsitt, 1980; Labouvie-Vief, 1982). What is considered as a gain in ontogenetic change and what is a loss, is a topic of theoretical as well as empirical inquiry. Suffice it at this point to mention that the nature of what is considered a gain and what a loss changes with age, involves objective in addition to subjective criteria, and is conditioned by theoretical predilection, cultural context, as well as historical time.

We offer one more introductory observation on the objectives of life-span developmental psychology which it shares with other developmental specialties. Methodologically

speaking, the study of ontogenesis is inherently a matter of general and differential psychology (P. Baltes, Reese, & Nesselroade, 1988; Kreppner, 1992; R. Lerner, 1986; Weinert & Perner, 1996). Thus, life-span research and theory is intended to generate knowledge about three components of individual development: (a) Commonalities (regularities) in development; (b) inter-individual differences in development, and; (c) intra-individual plasticity in development (Anastasi, 1970; P. Baltes et al., 1980; R. Lerner, 1984; Nesselroade, 1991a, 1991b). Joint attention to each of these components of individual variability and intra-individual potential, and specification of their age-related interplays, are the conceptual and methodological foundations of the developmental enterprise. Recognizing the methodological significance of the distinction among, and subsequent theoretical integration of, commonalities in development, inter-individual differences in development, and intra-individual plasticity has been a continuing theme in life-span research and theory since its inception (Stern, 1911; Tetens, 1777).

What about the status and location of life-span developmental psychology within the territory of developmental psychology? Is life-span developmental psychology a special developmental psychology, is it the overall integrative developmental conception of ontogenesis, or is it simply one of the many orientations to the study of development (P. Baltes, 1987)? Perhaps most scholars view life-span developmental psychology as one of the specializations in the field of developmental psychology, namely, that specialization which seeks to understand the full age spectrum of ontogenesis. In this case, the lens of life-span developmental psychologists is focused on the entire life course with less consideration for the details of age-related specificities.

Life-span theory, however, can also be seen as the coordinated integration of various age-based developmental specializations into one overarching, cumulative framework of ontogenesis. Using such a life span-coordinating lens, one could argue that, if there is a general theory of ontogenetic development, it needs to be a theory that takes into account that ontogenesis extends from conception into old age. Thus, even if one is primarily interested in the study of infants and infant development, part of one's intellectual agenda requires attention to life-span development (Brim, 1976; Lipsitt, 1982; Thompson, 1988). One example relevant for infancy researchers is the interest in the sequelae of infancy, in the search for its long-term consequences. Another example is the developmental context of

infancy, which includes adults as socialization agents who themselves develop. Thus, to understand infant-adult interaction, it is important to recognize that adults are not fixed personages but that they are themselves subject to developmental goals and challenges (Hetherington, Lerner, & Perlmuter, 1988; see also, Elder, this Volume).

What about the organizational frame of life-span theory? On a strategic level, there are two ways to construct life-span theory: *Person-centered (holistic)* or *function-centered*. The holistic approach proceeds from consideration of the person as a system and attempts to generate a knowledge base about life-span development by describing and connecting age periods or states of development into one overall, sequential pattern of lifetime individual development (see also, Magnusson & Stattin, Ch. 12, this Volume; Thelen & Smith, Ch. 10, this Volume). An example would be Erikson's (1959) theory of eight life-span stages. Often, this holistic approach to the life span is identified with *life-course psychology* (Bühler, 1933; see also, Elder, 1994, Ch. 16, this Volume).

The second way to construct life-span theory is to focus on a category of behavior or a function (such as perception, information processing, action control, identity, personality traits, etc.) and to characterize the life-span changes in the mechanisms and processes associated with the category of behaviors selected. An example would be the life-span comparative study of the developmental organization, operation, and transformation of working memory or fluid intelligence (Salthouse, 1991c).

To incorporate both approaches to life-span ontogenesis, the holistic person-centered and the function-centered one, the concept of *life-span developmental psychology* (P. Baltes & Goulet, 1970) was advanced. From our point of view, then, life-course psychology is a special case of life-span developmental psychology. However, this distinction between life-course and life-span developmental psychology should not be seen as categorically exclusive. It's more a matter of pragmatics and scientific history. In the history of the field, scholars closer to the social sciences, the biographical study of lives, and personality psychology have come to use the term life-course development (e.g., Bertaux & Kohli, 1984; Bühler, 1933; Caspi, 1987; Clausen, 1986; Elder, 1994; Mayer, 1986). Scholars closer to psychology, with its traditional interest in mechanisms and processes as well as the decomposition of mind and behavior into its component elements, seem to

prefer life-span developmental psychology, the term chosen when the West Virginia Conference Series on the field was initiated (Goulet & P. Baltes, 1970).

HISTORICAL INTRODUCTION

While this section may seem to speak more about the past than the present, it is important to recognize that present theoretical preferences are in part the direct result of historical contexts of science and cultural scenarios rather than of carefully elaborated theoretical arguments. And some of the current issues surrounding life-span developmental psychology and its location in the larger field of developmental psychology are difficult to appreciate unless they are seen in their historical and societal contexts (R. Lerner, 1983; Reinert, 1979; Riegel, 1973a, 1973b). For instance, how is it that, especially in North America, life-span developmental psychology is a relatively recent advent? Historically speaking, this is surprising because the life-span view of human development is not new at all but can be traced to the very origins of developmental psychology as several reviews have demonstrated (P. Baltes, 1979a, 1983; P. Baltes & Goulet, 1970; Groffmann, 1970; Hofstätter, 1938; Lehr, 1980; Reinert, 1979).

Many German developmental historians, for instance, consider Johann Nikolaus Tetens as the founder of the field of developmental psychology (Müller-Brettel & Dixon, 1990; Reinert, 1979). To Anglo-American developmentalists, however, Tetens is a relatively unknown figure. When Tetens published his two-volume monumental work on human nature and its development (*Menschliche Natur und ihre Entwicklung*) more than 200 years ago, in 1777, the scope of this first major opus covered the entire life span from birth into old age (see also, Carus, 1808, for another early contribution to the field of developmental psychology). The length and intellectual effort which Tetens devoted to all age periods of the life course was about the same. In addition, as elaborated at length by Reinert (1979) and also by P. Baltes (1979a, 1983), the content and theoretical orientation of this historical classic by Tetens included many of the current-day signatures of what has come to be known as the life-span developmental theoretical orientation. For instance, development was not only elaborated as a life-long process by Tetens, but also as a process which entails gains and losses, a process embedded

in and constituted by sociocultural conditions, and as a process which is continuously refined and optimized (*vervollkommnet*) by societal change and historical transformations (see Table 18.1).

The second major early work on human development, written some 150 years ago by the Belgian Adolphe Quetelet (1835, translated in 1842 into English), continued in a similar tradition. His treatment of human qualities and abilities was entirely life-span in orientation, and because of his analysis of the dynamics between individual and historical development, Quetelet prefigured major developments in developmental methodology (P. Baltes, 1983). For instance, he anticipated the distinction between cross-sectional and longitudinal study designs as well as the need to conduct successions of age studies in order to disentangle effects of age from those of secular change and historical period (P. Baltes, 1968; Schaie, 1965; Schaie & P. Baltes, 1975).

The 1777 work of Johann Nikolaus Tetens was never translated into English. This is unfortunate because reading Tetens' deep insights into the interplay among individual, contextual, and historical factors is a humbling experience. Equally impressive are his many concrete everyday examples and analyses of phenomena of human development (for instance, in the area of memory functioning), which make clear that ontogenetic development is not simply a matter of growth but the outcome of complex and multilinear processes of adaptive transformation. Because of these consistencies between the early work of Tetens and Quetelet and modern research in life-span development, life-span

researchers like to argue that these are examples of why and how a life-span orientation spawns a particular theoretical and methodological manner of looking at human development (P. Baltes, 1987; P. Baltes et al., 1980).

Indeed, inspecting and comparing the largely forgotten Tetens (or other early heralds of developmental psychology such as F. A. Carus and Quetelet) with modern life-span theory suggests that there is a conceptual orientation toward a science of ontogenesis that emerges when considering the entire life span rather than focusing on its onset, such as on infancy or childhood. As we know from other scholarly endeavors, the point of departure can make a difference in what one finds along the way. As a result, the relative emphasis on particular age periods in the study of development has resulted in variations in theory and research. For example, how the topical and institutional territory of developmental psychology is charted today differs considerably, for instance, between German- and English-speaking countries. In German-speaking countries, developmental psychology is institutionalized in textbooks and scientific organizations as a field that covers the entire life span. Thus, for German-speaking psychologists (P. Baltes, 1983; Bühler, 1933; Grossmann, 1996; Lehr, 1980; Oerter & Montada, 1995; Thomae, 1959, 1979; Weinert, 1994a), developmental psychology never became almost synonymous with child psychology, as seems to be true for many North American developmental psychologists.

There are several reasons why German developmental psychology never lost its integrative concern for ontogenesis as life-long development. It is difficult to trace historical lines and identify major reasons for such country differences, but among them could be the disciplinary foundations from which developmental psychology arose and was nurtured. In German-speaking countries, for instance, philosophy, in addition to biology, was a major springboard. Note that at the time of the publication of Tetens' work in 1777, there was no established field of psychology as an empirical science, nor was there a science of ontogenesis grounded in the field of genetics and evolutionary biology. One dominant approach to human development, at least in continental Europe of that time, was shaped by the humanities and philosophy, and within philosophy by the tradition of the philosophy of idealism. This philosophical tradition included a strong concern for questions of optimality in human development and the role of education (*Bildung*).

Table 18.1 Table of Contents of Tetens (1777), Vol. 2: *On the Perfectability and Development of Man*

Chapter	Title
1	On the perfectability of human psyche (<i>Seelennatur</i>) and its development in general
2	On the development of the human body
3	On the analogy between the development of the psyche (mind) and the development of the body
4	On the differences between men (humans) in their development
5	On the limits of development and the decline of psychological abilities
6	On the progressive development of the human species
7	On the relationship between optimization (<i>Vervollkommnung</i>) of man and his life contentment (<i>Glückseligkeit</i>)

Because of this close tie to philosophy and the humanities, human development in Germany was widely understood to reflect factors of education and socialization. In addition, there was also a focus on the topic of human development beyond early adulthood (Groffmann, 1970; Reinert, 1979). The widespread knowledge and discussion of essays on old age, such as the ancient texts of Cicero (44 B.C., 1744) or the then contemporary text of Grimm (1860), are examples of this 19th-century interest among German scholars in issues of development beyond early adulthood. According to these traditions, fueled primarily by philosophy and the humanities, a widely held position among German scholars was that it was within the medium of "culture" that individuals "developed." With very little biological science on "maturity" or "growth" at that time, there was no reason to assume that development should be identified with physical growth and, therefore, should stop at adolescence or early adulthood. One could argue that this productive interplay between the humanities and developmental psychology in Germany continues into the present, for instance, regarding such topics as collective-societal memory (J. Assmann, 1992) and wisdom (A. Assmann, 1994).

In contrast, the *Zeitgeist* in North America and also in some other European countries, such as England, was different when developmental psychology emerged as a specialty, around the turn of the century (1900). At that time, the newly developed fields of genetics and biological evolution (such as Darwinism) were in the forefront of ontogenetic thinking. From biology, with its maturation-based concept of growth, may have sprung the dominant American emphasis in developmental psychology on child psychology and child development. In North America, at least until the advent of social-learning and operant psychology-based theory in the 1960s (Bandura & Walters, 1963; Bijou & Baer, 1961; Reese & Lipsitt, 1970), biological conceptions of "growth" and "maturation" (D. Harris, 1957) led the organization and intellectual agenda in ideas about development.

Not surprisingly, therefore, in combination with other political and social forces, children became the primary focus of attention in North American developmental psychology. In fact, in North America the focus on childhood was so pervasive that historical accounts of developmental psychology published in the centennial birth year of American psychology (Parke, Ornstein, Rieser, & Zahn-Waxler,

1991) were entirely devoted to child and adolescent development. No mention was made of the major historical life-span scholars such as Tetens, Charlotte Bühler, or Sidney Pressey. Even Sheldon White, the author of the article on G. Stanley Hall, one of the American founders of developmental psychology who late in his career turned to adulthood and old age to complete his agenda of developmental studies (Hall, 1922), ignored this opportunity to treat ontogenesis as a life-long phenomenon. White (1992) mentioned the fact of Hall's late-life publication, but did not elaborate.

Before the life-span view of ontogenesis entered the field of developmental psychology more forcefully in North-American circles in the 1960s and 1970s (Brim & Wheeler, 1996; Erikson, 1959; Goulet & Baltes, 1970; Havighurst, 1948; Neugarten, 1969), several earlier contributions attempted to broaden developmental psychology toward a consideration of the entire life span (e.g., Hollingworth, 1927; Pressey, Janney, & Kuhlen, 1939; Sanford, 1902). In our view, these early American publications on themes of life-span development resulted not so much in redirecting developmental psychology from child psychology, but in setting the foundation for the emergence of the field of aging (gerontology). Indeed, many of the active life-span psychologists who promoted life-span thinking were closely affiliated with efforts to build a psychological science of aging (Birren, 1959; Birren & Schaie, 1996; Goulet & Baltes, 1970; Havighurst, 1948, 1973; Kuhlen, 1963; Neugarten, 1969; Riegel, 1958; Schaie, 1970; Thomae, 1959, 1979; Welford & Birren, 1965).

As a consequence, in American psychology there evolved a strong bifurcation between child developmentalists and adult developmentalists or gerontologists. One indication of this bifurcation was the creation of two relatively independent divisions concerned with ontogenesis within the American Psychological Association (Division 7: Developmental Psychology; Division 20: Maturity and Old Age, later renamed into Adult Development and Aging). This divide was also reflected in APA publications. Whereas the first developmental journal of the American Psychological Association, *Developmental Psychology*, started in 1969 as a life-span developmental publication, the introduction of *Psychology of Aging* in 1986 marked a departure from such a life-span integrative posture and regenerated separatism. In the interdisciplinary science of ontogenesis, too, age-specific organizations and journals were created, such as

the journal of *Child Development* by the Society for Research in Child Development and the *Journal of Gerontology* by the Gerontological Society of America, resulting in further age segmentation.

On the one hand, the creation of a multitude of organizations and journals heralded the arrival of a comprehensive behavioral science of ontogenesis. On the other hand, for life-span developmental scholars, these age-specific creations were unfortunate events because they did not promote an integrative effort at constructing life-span theory. The only institutional exception to this trend was the formation of the *International Society for the Study of Behavioral Development* in 1969, which defined as its substantive territory the study of development at all stages of the life span. The German Hans Thomaе was the leader in creating this society.

That a life-span approach became more prominent during the recent decades was dependent on several other factors and historical trends. A major factor was a concurrent concern with issues of life-span development in neighboring social-science disciplines, especially sociology. In sociology, *life-course sociology* took hold as a powerful intellectual force (Brim & Wheeler, 1966; Clausen, 1986; Elder, 1985, 1994; Featherman, 1983; Kohli, 1978; Neugarten, 1969; Riley, 1987; Riley, Johnson, & Foner, 1972; Sorenson, Weinert, & Sherrod, 1986).

Within psychology, three conditions nurtured the burgeoning of interest in life-span development (P. Baltes, 1987). First, demographically speaking, there was the fact that the population as a whole was "aging." In order to be responsive to issues of social policy and modernity, developmental psychologists were challenged to generate knowledge relevant to the lives of the fastest growing segment of the population, the group of older adults (Eisdorfer & Lawton, 1973). Meanwhile, this historical change in the demographic context of human development has been fully reflected in the organization of the American Psychological Association. Perhaps surprising to child developmentalists, the Division (20) devoted to adult development and aging has grown larger than Division 7, called developmental psychology but which, when using the focus of the work of the scholars elected to its presidency, or the scope of its primary journal as indicators, is more or less entirely devoted to the topic of development from infancy through adolescence.

The second related historical event of life-span work in the study of ontogenesis was the concurrent emergence of gerontology (aging research) as a field of specialization, with its search for the life-long precursors of aging (Birren, 1959; Birren & Schaie, 1996; Cowdry, 1939). The Gerontological Society of America, for instance, is larger than its counterpart organization, the Society for Research in Child Development. In fact, linking the study of gerontology to the study of life-span development is a critical task of current developmental theory. Are theories of development the same as theories of aging? Do we need different conceptions of ontogenesis to characterize development and aging (Welford & Birren, 1965)? For instance, does one approach deal with phenomena of growth, and the other with decline?

A third factor, and a major source of rapprochement between child developmentalists and adult developmentalists, was the "aging" of the participants and of the researchers in the several classical longitudinal studies on child development begun in the 1920s and 1930s (Caspi & Elder, 1988; Grossmann, 1996; Kagan, 1964; Kagan & Moss, 1962; Sears & Barbee, 1977; Thomaе, 1959). What are the effects of child development on later life? Which childhood developmental factors are positive or risk-prone for later healthy development? These were questions that were increasingly pursued beginning in the 1970s as the children of the classical longitudinal studies reached early adulthood and midlife (P. Baltes, 1976; Eichorn, Clausen, Haan, Honzik, & Mussen, 1981; Elder, 1974). Some of these studies have even provided a basis for a better understanding of processes in the last phases of life (Block, 1971, 1981, 1993; Elder, 1985, 1986, 1994; Holahan, Sears, & Cronbach, 1995; Sears & Barbee, 1977).

Out of these developments has emerged new territory in developmental scholarship. The need for better collaboration among all age specialties of developmental scholarship, including child development, has become an imperative of current-day research in developmental psychology (Hetherington et al., 1988; Lipsitt, 1982; Rutter & Rutter, 1993; Thompson, 1988). But for good life-span theory to evolve, it takes more than courtship and mutual recognition. It takes a new effort and serious exploration of theory that—in the tradition of Tetens (1777)—has in its *primary* substantive focus the structure, sequence, and dynamics of the entire life course.

TOWARD PSYCHOLOGICAL THEORIES OF LIFE-SPAN DEVELOPMENT: FIVE LEVELS OF ANALYSIS

We will approach psychological theories of life-span development in five sequential but interrelated steps. Each step will bring us closer to specific psychological theories of life-span development. As shown in Table 18.2, we move from the distal and general to the more proximal and specific in our treatment of life-span ontogenesis. This movement also implies a movement from the metatheoretical to the more empirical.

Specifically, we consider five levels of analysis. Level 1, the most distal and general one, makes explicit the cornerstones and "norms of reaction" or "potentialities" (Brent, 1978a, 1978b; R. Lerner, 1986; Schneirla, 1957; see also, Gottlieb, Wahlsten, & Lickliter, this Volume) of life-span ontogenesis. With this approach, which is also consistent with the levels of integration notion of Schneirla, we obtain information on what we can expect about the general scope and shape of life-span development based on evolutionary, historical, and interdisciplinary views dealing with the interplay between biology and culture during ontogenesis (Asendorpf, 1996; P. Baltes & Graf, 1996).

Levels 2 and 3 bring us closer and closer to psychological theories of individual development. On these levels of analysis, while keeping the initial overall framework in mind, we shall describe, using an increasingly more fine-grained level

of analysis, specific conceptions of life-span developmental psychology. We begin with a general view on the overall form of gains and losses across the life span (Level 2) followed by the description of a family of metatheoretical perspectives (Level 3). We argue that this family of metatheoretical perspectives is useful when articulating more specific theories of life-span development. On Level 4, we advance one concrete illustration of an overall life-span developmental theory, a theory which is based on the specification and coordinated orchestration of three processes: Selection, optimization, and compensation. On Level 5, we move to more molecular phenomena and functions. Specifically, we characterize life-span theory and research in such areas of psychological functioning as cognition, intelligence, personality, and the self.

We have chosen this approach—of proceeding from a broad level of analysis to more and more specific and micro levels of psychological analysis—because it illustrates one of the central premises of life-span developmental psychology, that development is embedded in a larger historical and cultural context (P. Baltes et al., 1980; Labouvie-Vief, 1982; R. Lerner, 1986; Magnusson, 1996; Riegel, 1973a). Moreover, this strategy permits us to join the early origins of life-span theory (Tetens, 1777) with present theories. Without having a good understanding of either biological evolution or societal functioning, Tetens had communicated a deep belief in the power of the past, present, and future social-cultural context on the "nature" of human development. Similarly, though at a much higher level of precision, current-day psychologists claim to have achieved new insights from studying the evolutionary precursors and cultural-social conditions of human behavior (e.g., Asendorpf, 1996; Barkow, Cosmides, & Tooby, 1992; Bateson, 1987; Cole, 1996; Cosmides & Tooby, 1989; Durham, 1991; Gigerenzer, 1996; Gottlieb, 1991, 1996; Gould, 1984; Grossmann, 1996; Hammerstein, 1996; Klux, 1993; Trevarthen, 1993). In short, there is a strong argument for the conclusion that the form of current-day ontogenesis has powerful determinants in past biological and cultural evolution. Moreover, psychological theories which are blind to evolutionary and cultural perspectives on the nature of human behavior run the risk of ignoring some of the most important sources of human behavior and its ontogeny.

Recognizing the powerful conditioning of human development by biological and cultural evolution and

Table 18.2 Toward Psychological Theories of Life-Span Development: Five Levels of Analysis

Level 1:	Biological and Cultural Evolutionary Perspectives: On the Incomplete Architecture of Human Ontogenesis and the Life-Span Developmental Dynamics between Biology and Culture
Level 2:	Dynamics of Gains and Losses: Life-Span Changes in the Relative Allocation of Resources in Development to Functions of Growth vs. Maintenance (Resilience) vs. Regulation of Loss
Level 3:	A Family of Metatheoretical Propositions about the Nature of Life-Span Development
Level 4:	An Example of a Systemic and Overall Theory of Successful Life-Span Development: Selective Optimization with Compensation
Level 5:	Life-Span Theories in Specific Functions and Domains: Intelligence, Cognition, Personality, Self

co-evolution (P. Baltes, 1991; Durham, 1990, 1991; see also, chapters by Gottlieb et al., Thelen & Smith, Ch. 10, this Volume) emphasizes that the future is not fixed either, but includes features of an open system. In other words, the future is not something we simply enter but also something that we help create and that is dependent on future genetic, environmental, and cultural conditions. Appreciating this potential of the future is especially important as we contemplate the nature of old age. Human aging, gerontologists like to argue, carries a paradoxical feature. Historically and anthropologically speaking, old age is young and, therefore, still rather underdeveloped. Thus, it is in the second half of life where the relative incompleteness of the biology- and culture-based architecture of human development becomes most conspicuous (P. Baltes, 1994, 1996, 1997; Baltes & Baltes, 1992; P. Baltes & Graf, 1996).

The Overall Architecture of Life-Span Development: A First View from the Perspectives of Biological and Cultural Co-Evolution (Level 1)

Let us now turn in our quest for understanding life-span development to the first level of analysis chosen, the overall biological and cultural architecture of life-span development (P. Baltes, 1993, 1996, 1997). The catch-phrases we use for this purpose comes from the changing dynamics between biology and culture across the life span and the associated incompleteness of the architecture of human ontogenesis.

The questions about the how and why of the role of biology (heredity) and culture (environment) have formed one of the main intellectual frames in developmental psychology (Anastasi, 1970; Asendorpf, 1996; R. Lerner, 1986; Plomin, 1994; Plomin & Thompson, 1988; Scarr, 1993). What is the role of cultural and biological factors in ontogenesis, how do they interact and condition each other? What is the "zone of development," the "norm of reaction" (Hirsch, 1970; R. Lerner, 1986; Schneirla, 1957) that we can expect to operate during ontogenesis? Based on genetic and evolution-based factors and on cultural structures, for instance, only certain pathways can be implemented during ontogenesis, and some of these are more likely to be realized than others (P. Baltes, 1987; Cole, 1996; Edelman, 1987; Edelman & Tononi, 1996; Labouvie-Vief, 1982; R. Lerner, 1986; Maciel, Heckhausen, & Baltes, 1994; Marsiske et al., 1995; Staudinger, Marsiske, & Baltes,

1995; Waddington, 1975; see also, chapter by Gottlieb et al., Ch. 5, this Volume). Despite the sizeable plasticity of homo sapiens, not everything is possible in ontogenetic development and development follows principles which make universal growth impossible.

With a view on the future and future societal changes, we need to recognize first that the overall architecture of human development is incomplete (P. Baltes, 1994, 1997; P. Baltes & Graf, 1996): The overall biological and cultural architecture of human development continues to evolve. A second insight is that what is most "undeveloped" in the gene-environment interplay is both the genetic base and the culture of old age (Baltes & Baltes, 1992; P. Baltes & Graf, 1996). While earlier age periods of the life course have a long tradition of biological and cultural co-evolution (Durham, 1991) and fine-tuning, the "anthropological tradition" of biological and cultural co-evolution for later phases of life, historically speaking, is younger. The evolutionary (biological and cultural) incompleteness of the overall architecture of the life span increases, therefore, as we move from childhood to old age.

Figure 18.1 illustrates the main lines of argument (P. Baltes, 1994, 1997). Note first that the specific form (level, shape) of the functions characterizing the overall life-span dynamics between biology and culture across the life span is not critical. What is critical is the overall direction and reciprocal relationship between these functions. Figure 18.1 identifies three such directional principles that regulate the nature of ontogenetic development.

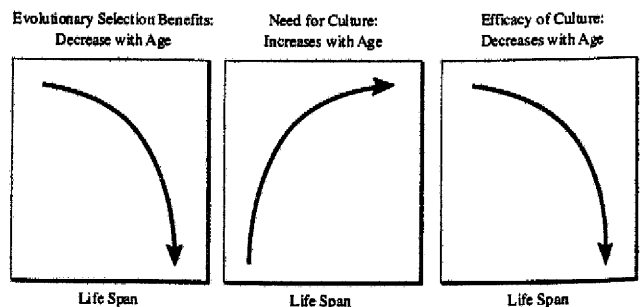


Figure 18.1 Schematic representation of basic facts about the average dynamics between biology and culture across the life span (after Baltes, 1995). There can be much debate about the specific forms of the functions, but less about directionality.

Evolutionary Selection Benefits Decrease with Age

Figure 18.1(a) represents the first part of the argument that derives from an evolutionary perspective on the nature of the genome and its age-correlated changes in expressivity (Finch, 1990, 1996). It shows that the benefits resulting from evolutionary selection display a negative age correlation.

During evolution, the older the organism, the less the genome benefitted from the genetic advantages associated with evolutionary selection. Certainly after maturity, *with age the expressions and mechanisms of the genome lose in functional quality*. This assertion is in line with the idea that evolutionary selection was tied to the process of reproductive fitness and its midlife location in the life course. Reproductive fitness, in other words, related primarily to the context of fertility and parenting behavior, functions that typically extend from conception to adulthood. As a consequence, reproductive fitness-based evolutionary selection—which in the long run resulted in a better and better genome—operated *primarily* during the first half of life. Whatever happened later in the life span benefitted less from the optimizing power of evolutionary selection pressure. This general statement holds true even though there are “indirect” positive evolutionary selection benefits carried into and located in old age, for instance, through processes of grandparenting (Brent, 1978a; Mergler & Goldstein, 1983), coupling, or exaptation (Gould, 1984).

During evolution, this age-associated diminution of evolutionary selection benefits was further enhanced by the fact that in earlier historical times only few people reached old age. Thus, in addition to the negative correlation between age and selection pressure, evolutionary selection could not operate as frequently to begin with when it came to older individuals. Most individuals died before possible negative genetic attributes were activated or possible negative biological effects of earlier developmental events became manifest. Therefore, and quite aside from other factors of the biological processes of aging (Finch, 1990; Martin et al., 1996; Osiewacz, 1995; Yates & Benton, 1995), it has been argued that genes active at later stages of the life course are more often deleterious or dysfunctional genes than those operative at earlier times in the life span. Note in this context that not the entire genome is active in a consequential sense at a given time during ontogenesis, such as at birth, and that

there are genes (such as late-life genes; Finch, 1990) which become operative at later stages during ontogenesis. Such late-life genes can remain relatively silent until advanced age, another reason why they may have been less selected for than genes active at earlier parts of the life span.

One concrete illustration of this aging-based weakening of evolutionary selection benefits is the existence of late-life illnesses such as Alzheimer dementia. This disease typically does not become manifest until age 70. After age 70, however, it increases markedly in frequency such that among 90- to 100-year-olds Alzheimer dementia has a prevalence of about 50% (Helmchen et al., in press). Following the argument outlined in Figure 18.1(a), this disease is at least in part a late-life disease because reproductive fitness-based evolutionary pressure was unable to select against it. Martin et al. (1996) call such an outcome “selection neutrality.”

There are other aspects of a biology of aging which imply an age-associated loss in biological functioning. Many of these are associated with the mechanisms of ontogenesis itself. Among the prevalent models of biological aging are wear-and-tear theories, entropy-based conceptions, as well as interpretations related to the sources of age-accumulated increases in mutations. Currently, for instance, age-associated increases in oxidative damage are proffered as a key possibility to account for aging-associated losses in biological efficacy (Martin et al., 1996).

From a life-span theory point of view, each of these conceptions of biological aging reflect a gain-loss dynamic and the costs involved in creating and maintaining life (Danner & Schröder, 1992; Finch, 1990, 1996; Martin et al., 1996; Osiewacz, 1995; Yates & Benton, 1995). Consider bone growth, a critical part of physical maturation during childhood. A long-term negative side effect of bone growth in early life may be atherosclerosis in old age. This logic of long-term negative “side” effects of growth toward maturity is a cornerstone of the so-called counterpart theory of aging (Birren, 1988, 1995; Yates & Benton, 1995). The counterpart theory of aging proffers that aging processes in part are the negative bi-products of the early life process of growth (P. Baltes & Graf, 1996). Related to this view is the genetic mechanism of *antagonist pleiotropy* (Martin et al., 1996).

These various considerations about the role of genetic factors result in a converging conclusion regarding the role

of biological factors in life-span development. Where evolutionary selection and the biology of aging are concerned, the ontogenetic life span of humans displays a kind of unfinished architecture; because of this incompleteness of biological ontogenesis, biology-based negative consequences increase with age. These insights may be captured with the sentence: "Biology is not a good friend of old age." Certainly after physical maturity, the biological potential of the human organism declines. With age, the genetic material, associated genetic mechanisms, and genetic expressions become less effective and less able to generate or maintain high levels of functioning.

Age-Related Increase in Need for Culture

What about the role of culture and culture-related factors during ontogenesis? With culture, we mean here the entirety of psychological, social, material, and symbolic (knowledge-based) resources which humans developed over millennia; and which, as they are transmitted across generations, make human development as we know it possible (Cole, 1996; Damon, 1996; D'Andrade, 1995; Durham, 1990, 1991; Klix, 1993; Shweder, 1991; Valsiner & Lawrence, 1996). These cultural resources include cognitive skills, motivational dispositions, socialization strategies, physical structures, the world of economics as well that of medical and physical technology.

Figure 18.1(b) and 18.1(c) summarizes our view of the life-span dynamics associated with culture and culture-based processes. Figure 18.1(b) represents in graphic form the proposition that an age-associated increase in the "need" for cultural resources characterizes the interplay between culture and age across the life span. There are two parts to the argument for an *age-related increase in the "need" for culture*.

The first argument is that for human ontogenesis to have reached higher and higher levels of functioning, whether in physical (e.g., sports) or cultural (e.g., reading and writing) domains, there had to be a conjoint evolutionary increase in the richness and dissemination of culture (Cole, 1996; Durham, 1991; Shweder, 1991; Valsiner & Lawrence, 1996). Thus, human development the way we know it in the modern world is essentially and necessarily tied to the evolution of culture. And the further we expect human ontogenesis to extend itself into adult life and old age, the more it will be necessary for particular cultural factors and resources to emerge to make this possible. A case in point

is the historical evolution of medical knowledge, knowledge about health behavior, and the availability of economic resources to create and use medical technology.

To appreciate the power of the evolution of such culture-based resources consider what happened to average life expectancy during the 20th century in industrialized countries. It was not the genetic make-up of the individual or the population that evinced marked changes during this time. On the contrary, it was economic and technological innovations that produced significant additions to average life expectancy, from an average of about 45 years in 1900 to about 75 years in 1995. Similarly, the dramatic increase in literacy rates over the last centuries in industrialized nations were not the result of a change in the genome (that requisite evolution took place at a much earlier time many millennia ago; e.g., Klix, 1993), but above all a change in environmental contexts, cultural resources, and strategies of teaching.

The trajectory depicted in Figure 18.1(b), however, does not mean that children require little cultural input and support. Early in ontogenetic life, because the human organism is still undeveloped biologically, infants and children need a wide variety of psycho-social-material-cultural support. But in terms of overall resource structure, this support in childhood is focused on basic levels of functioning such as environmental sensory stimulation, nutrition, language, and social contact. Subsequent age stages, however, require increasingly more and more differentiated cultural resources, especially if one considers the high levels of knowledge and technology that adults need to function well in modern societies. Thus, it is primarily through the medium of more advanced levels of culture that individuals have the opportunity to continue to develop across life (Cole, 1996; D'Andrade, 1995; Shweder, 1991).

There is a second argument for the theory that, with age, the need for the supportive role of culture increases. Because of the biological weakening associated with age described in Figure 18.1(a), the "need" for culture increases even further as individuals reach old age. While individuals aspire to maintain their previous levels of functioning as they age, the biological resources available for that purpose are increasingly declining. That is, the older individuals are, the more they are in need of culture-based resources (material, social, economic, psychological) to generate and maintain high levels of functioning.

Age-Related Decrease in Efficiency of Culture

Figure 18.1(c) illustrates a further overall characteristic of the life-span developmental dynamic between culture and age. Here, the focus is on a third cornerstone of the overall architecture of the life course, that is, the efficacy or *efficiency* of cultural factors and resources. During the second half of life, and despite the advantages associated with the developmental acquisition of knowledge-based mental representations (Klix, 1992, 1993), we submit that there is an age-associated reduction in the efficiency of cultural factors. With age, and conditioned primarily by the negative biological trajectory of the life course, the relative power (effectiveness) of psychological, social, material, and cultural interventions becomes smaller and smaller, even though there likely are large inter-individual differences in onset and rate of these decreases in effectiveness (Maddox, 1987; Nelson & Dannefer, 1992; Schaie, 1996).

Take cognitive learning in old age as an example (Bäckman, Mäntylä, & Herlitz, 1990; P. Baltes, 1993; Craik & Salthouse, 1992; Kliegl, Mayr, & Krampe, 1994; Lindenberger & Baltes, 1995a; Salthouse, 1991c). The older the adult, the more time, practice, and more cognitive support it takes to attain the same learning gains. And moreover, at least in some domains of information processing, and when it comes to high levels of performance, older adults may never be able to reach the same levels of functioning as younger adults even after extensive training (Kliegl & Baltes, 1987; Kliegl, Smith, & Baltes, 1990).

We submit that the three conditions and trajectories outlined in Figure 18.1 form a robust fabric (architecture) of the life-span dynamics between biology and culture. We argue that this fabric represents a first tier of life-span theory, though psychologists often prefer more proximal and more domain-specific forms of predictive and causal analysis. However, whatever the specific content and form of a given psychological theory of life-span continuity and change, we maintain that it needs to be consistent with the frame outlined in Figure 18.1.

To illustrate further the general implications of this Level 1 analysis, consider the following examples. During the last decade we have witnessed the advancement of "growth" models of adult development and aging (e.g., Alexander & Langer, 1990; P. Baltes, Smith, & Staudinger, 1992; Commons, Richards, & Armon, 1984; Labouvie-Vief, 1995; Perlmutter, 1988; Ryff, 1984, 1989a). With the

perspectives presented, we argue that the opportunity for positive development in the second half of life would need to rest primarily in culture-based incentives and resources. Furthermore, based on the arguments outlined in Figure 18.1, any theory of life-span development which were to posit "general" positive advances across broad domains of functioning in later adulthood is probably false. On the contrary, because of the overall architecture of life-span development as we deduced it from biological and cultural evolutionary perspectives, a major theme of the second half of life must be the management and regulation of losses in biological functioning and the reduced efficiency of optimizing interventions.

Furthermore, any developmental theory that would maintain that ontogenetic development is inherently and entirely a matter of gain, of a positive change in adaptive capacity, is likely to be false as well. Rather, it is more likely that ontogenesis right from the beginning involves multilinear and multidirectional patterns of change, as shown in the life-span dynamics represented in Figure 18.1. Why? As is true for evolution, in some sense ontogenetic adaptivity and ontogenetic attainments are always local, that is, space- and time (age)-bound. As we will describe later, this recognition of development as being time- and space-bound has led life-span researchers to reject any conception of development that is unilinear and based solely on the notion of growth as gain in quantity and quality of functioning (P. Baltes, 1979a, 1987; P. Baltes et al., 1980; Brandtstädter, 1984; Labouvie-Vief, 1980, 1982; Labouvie-Vief & Chandler, 1978; Uttal & Perlmutter, 1989).

The overall landscape of life-span development summarized in Figure 18.1 links life-span theory and research with other important topics in the study of human behavior as well. Take the mind-body problematic as an instance. The scenario characterized in Figure 18.1 is the illustration of what has been identified, by cultural anthropologists and philosophers (Elwert, 1992; Plessner, 1965), as the growing gap (hiatus) between mind and body as ontogenesis extends into old age. In the developmental psychology of intelligence (P. Baltes, 1993; Cattell, 1971; Horn, 1970), the age-related increase in the gap between the fluid mechanics and the crystallized pragmatics is an illustration of this scenario (see below).

The future of old age, therefore, will depend to a large measure on our ability to generate and employ culture and

culture-based technology in compensating for the unfinished architecture of biology, for the age-correlated decrease in biological functioning, for the growing gap between mind and body. This age-associated increase in the gap between biological and cultural resources has many consequences. One is life-span changes in the functions of development to which resources are allocated, as discussed in the next section.

Life-Span Changes in the Relative Allocation of Resources to Distinct Functions of Development (Level 2)

Growth versus Resilience versus Regulation of Loss

Having characterized the overall landscape of human development as it has evolved through biological and cultural evolution, we now take the next step toward the specifics of a psychological theory of life-span human development. In doing so, we move toward a level of organization closer to central concepts of developmental psychology. In Table 18.2, this was designated as Level 2.

We take this next step by reflecting about functions (goals) of development. Thus, we ask to what degree the overall architecture of age-related dynamics between biology and culture outlined in Figure 18.1 prefigures pathways of development and the kind of adaptive challenges that individuals face as they move through life. One possibility is to distinguish between two functions of ontogenetic development: growth and resilience (maintenance and recovery) of functioning (Cicchetti, 1993; Garmezy, 1991; Rutter, 1987; Staudinger, Marsiske, & Baltes, 1993, 1995). Life-span researchers have added to these functions that of management or regulation of losses (P. Baltes, 1987; Brandtstädter & Baltes-Götz, 1990; Brandtstädter & Greve, 1994; Brim, 1988; Dixon & Bäckman, 1995; Staudinger et al., 1995).

Figure 18.2 displays our general life-span developmental script about the allocation of available resources for these three major adaptive tasks of growth, maintenance/recovery (resilience), and regulation of loss (P. Baltes, 1997; Staudinger et al., 1993, 1995). With the adaptive tasks of *growth*, we mean behaviors aimed at reaching higher levels of functioning or adaptive capacity. Under the heading of *maintenance* and *resilience*, we group behaviors which are aimed at maintaining levels of functioning in the face of

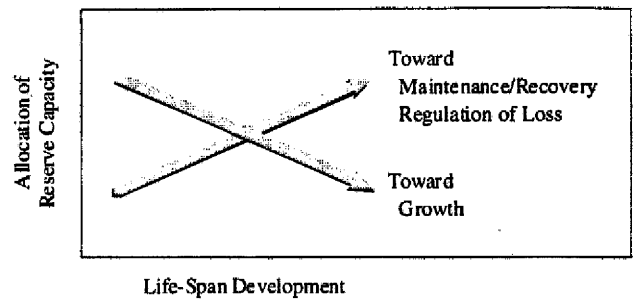


Figure 18.2 Life-span changes in the allocation of resources into distinct functions (objectives) of development: Growth, maintenance and recovery (resilience), and regulation (management) of loss (after Staudinger et al., 1995).

challenge or returning to previous levels after a loss. With the adaptive task of *regulation of loss*, we identify those behaviors which organize adequate functioning at lower levels when maintenance or recovery, for instance because of external-material or biological losses, is no longer possible. Note that for the present purpose, we have grouped together in Figure 18.2 resource allocations for the two functions of maintenance and recovery into one single category (resilience).

We proffer that there is a systematic script to these life-span changes in the relative allocation of resources. In childhood, the primary allocation of resources is directed toward growth; during adulthood, the predominant allocation is toward maintenance and recovery (resilience). In old age, more and more resources are directed toward regulation (management) of loss. In old age, few resources remain available to be allocated to growth. Such a characterization is an oversimplification as individual, domain, and contextual differences need to be taken into account. Thus, the characterization is one about relative probability.

Our general approach in this chapter on life-span theory is to exploit consistencies between levels of analysis. Therefore, note first that the scenario offered is consistent, in principle, with the life-span architecture of the dynamics between biology and culture outlined earlier (Figure 18.1). Growth, maintenance and recovery (resilience), and regulation of loss are important at all stages of the life course. However, their relative saliency and composition changes.

Let us reiterate the chief rationales underlying the life-span dynamic between growth, maintenance, and

regulation of losses outlined in Figure 18.2. Four factors are critical:

1. An age-related general reduction in the amount and quality of biology-based resources as individuals move toward old age.
2. The age-correlated increase in the amount and quality of culture needed to generate higher and higher levels of growth.
3. The age-associated biology-based loss in the efficiency with which cultural resources are used.
4. The relative lack of cultural, "old age-friendly" support structures.

As alluded to before, old age is young in the sense that, historically and demographically, the life period of old age is too recent to have permitted the evolution and refinement of an age-friendly biology and culture (Baltes & Baltes, 1992; Riley & Riley, 1989).

In our view (e.g., P. Baltes, 1987; Staudinger et al., 1995; for related arguments, see also, Brandtstädter & Greve, 1994; Brim, 1992; Edelstein & Noam, 1982; Labouvie-Vief, 1982), the life-span shift in the relative allocation of biology- and culture-based resources to the functions of growth, resilience, and the management of loss is a major issue for any theory of life-span development. This is true even for those theories that, on the surface, deal only with growth or positive aging (e.g., Erikson, 1959; Perlmutter, 1988; Ryff, 1984). In Erikson's theory, for instance, the acquisition of generativity and wisdom are the positive developmental goals of adulthood. Despite the growth orientation of these constructs, note that even in Erikson's theory their attainment is inherently tied to recognizing and managing issues of generational turnover as well as of one's finitude and impending death.

In the history of life-span developmental psychology, the relative importance of resilience and the regulation of losses became more and more evident as researchers studied the everyday life context of adult and aging individuals. This was one reason that life-event theory became an early focus of researchers interested in the study of life-span development (Bandura, 1982; Brim & Ryff, 1980; Dohrenwend & Dohrenwend, 1974; Filipp, 1981; Hultsch & Plemons, 1979; Montada, Filipp, & Lerner, 1992). Furthermore, from the beginning efforts to construct a life-span

theory of developmental tasks (Havighurst, 1948, 1973), the adaptive challenges resulting from health-related issues as well as the loss of significant partners due to death in the period of adulthood and old age were highlighted.

The life-span trajectories outlined in Figure 18.2 regarding the functions of growth, resilience, and regulation of loss also emphasize the significance of the dynamics between these functions. Thus, the mastery of life often involves conflicts and competition among the three functions and objectives of human development. And in old age, the dynamic tilts more and more in the direction of management of vulnerability and loss (Baltes & Baltes, 1990b). Not surprisingly, therefore, life-span researchers have explored the notion that the occurrence and effective mastery of crises and conflicts represent not only risks, but also opportunities for new developments. Thus, dialectical conceptions of development were at the core of early work in life-span developmental theory (Datan & Reese, 1977; Riegel, 1976), as were theoretical efforts to identify trade-offs resulting from development-enhancing and development-challenging conditions (Labouvie-Vief, 1980, 1982).

As to current-day research, one telling example of the dynamics among the functions of growth, resilience, and regulation of loss is the life-span comparative study of the interplay between autonomy and dependency in children and older adults (M. Baltes, 1995, 1996; M. Baltes & Silverberg, 1994; M. Baltes & Wahl, 1992). While the primary focus of the first half of life is the maximization of autonomy, the developmental agenda changes in old age. In old age, to deal effectively with age-based losses and to retain some independence, the productive and creative use of dependency becomes critical. According to Margret Baltes, in order for older adults to maintain autonomy in select domains of functioning, the effective exercise and use of dependent behavior is a compensatory must. By invoking dependency and support, resources are freed up for use in other domains involving personal efficacy and growth.

In sum, we submit that a further step in developing life-span theory is to recognize and specify the nature of the dynamics of resource allocation for growth, maintenance (resilience), and regulation of loss. Of particular importance is the nature of the shift in this systemic interplay and orchestration over the life course. The script changes from a primary concern with growth toward a stronger and stronger concern with maintenance and recovery (resilience) and management of losses.

Deficits as Catalysts for Progress (Growth)

The attention given to the age-related weakening of the biological foundation in Figures 18.1 and 18.2 may have suggested that the consequences of such a loss in biological quality implies also a pervasive age-related loss in behavioral functioning. In other words, that there may be no opportunity for growth at all in the second half of life in those domains where biological factors are important.

To prevent this possible misunderstanding, we describe in the following why this is not necessarily so, why deficits in biological status also can be the foundation for progress, that is, antecedents for positive changes in adaptive capacity (P. Baltes, 1987, 1991; Uttal & Perlmutter, 1989). At least since the publication of *Limits of Growth* by the Club of Rome, there has been increasing public awareness that more is not always better and that progress is possible even in the context of limitations and constraints. Similar perspectives derive from considerations of the adaptive processes in evolution as well as from consideration of the function of compensation during ontogenesis (see also, P. Baltes, 1991; P. Baltes & Graf, 1996; Brandtstädter, this Volume; Brandtstädter & Greve, 1994; Dixon & Bäckman, 1995; Durham, 1990; Elwert, 1992; Gehlen, 1956; Labouvie-Vief, 1982; LeVine, 1968). Because this view that deficits including losses can spell advances is essential to understanding the notion of development advanced by life-span developmental researchers, we present in the following one more general conceptual basis for this argument.

The most radical view of this issue is contained in the notion of *culture as compensation*. The position has been advanced, especially in the cultural sciences, that it is exactly the condition of a limitation or a loss which generates new forms of mastery and innovation. Under the influence of cultural-anthropological traditions (Brandtstädter & Wentura, 1995; Elwert, 1992; Gehlen, 1956; Klix, 1993), some contemporary behavioral scientists maintain that suboptimal biological states or imperfections are catalysts for the evolution of culture and for the advanced states achieved in human ontogeny. In this line of thinking, the human organism is by nature a "being of deficits" (Mängelwesen; Gehlen, 1956) and social culture has developed or emerged in part to deal specifically with biological deficits. Memorization strategies, for instance, were developed in part because human memory is not optimal. To

give another example: The fact that humans are biologically vulnerable regarding outside temperatures (lack of perfect thermo-regulation) is among the reasons for a highly developed body of knowledge, values, and technology about textiles and clothing.

This "deficits-breed-growth view" (P. Baltes, 1991; P. Baltes & Graf, 1996; Brandtstädter & Wentura, 1995; Uttal & Perlmutter, 1989) may account not only for cultural evolution but also play a role in ontogenesis. Thus, it is possible that when individuals reach states of increased vulnerability in old age, they invest more and more heavily in efforts that are explicitly oriented toward regulating and compensating for age-associated biological deficits, thereby generating a broad range of novel behaviors, new bodies of knowledge and values, new environmental features, and as a result, a higher level of adaptive capacity. Research on psychological compensation is a powerful illustration of this idea that deficits can be catalysts for positive changes in adaptive capacity (Bäckman & Dixon, 1992; Baltes & Baltes, 1990b; Dixon & Bäckman, 1995; Klix, 1993; Marsiske et al., 1995).

A Family of Metatheoretical Propositions about Life-Span Developmental Theory (Level 3)

Because of the complexities associated with life-span ontogenetic processes and the challenge involved in the articulation of adequate theoretical concepts, there has been much discussion in life-span work about metatheory of development (e.g., P. Baltes, 1979a, 1983; P. Baltes et al., 1980; Brim & Kagan, 1980; Labouvie-Vief, 1980, 1982; R. Lerner, 1983, 1986, 1991; Nesselroade & Reese, 1973; Overton & Reese, 1973; Reese, 1994; Riegel, 1976). Included in this discussion was a continuing dialogue about the shortcomings of extant conceptions of development as advanced primarily by child developmentalists (e.g., Collins, 1982; D. Harris, 1957). A *family of metatheoretical propositions* intended to characterize the nature of life-span development was one outcome of this extensive discussion (P. Baltes, 1979a, 1987; R. Lerner, 1983).

In the following, we attempt to update this effort at a metatheory of life-span development (Table 18.3). In doing so, we will also point out that similar metatheoretical work exists in other quarters of developmental theory, particularly in conceptual work associated with cultural psychology (Cole, 1996; Valsiner & Lawrence, 1996), evolutionary

Table 18.3 Family of Theoretical Propositions Characteristic of Life-Span Developmental Psychology (updated from P. Baltes, 1987)*Life-Span Development*

Ontogenetic development is a lifelong process. No age period holds supremacy in regulating the nature of development.

Life-Span Changes in the Dynamic between Biology and Culture

With age and certainly after adulthood, there is a growing gap between biological potential and individual-cultural goals. This gap is fundamental to ontogenesis as the biological and cultural architecture of life is incomplete and inevitably results in loss of adaptive functioning and eventually death.

Life-Span Changes in Allocation of Resources to Distinct Functions of Development: Growth vs. Maintenance vs. Regulation of Loss

Ontogenetic development on a systemic level involves the coordinated and competitive allocation of resources into distinct functions: Growth, maintenance including recovery (resilience), and regulation of loss. Life-span developmental changes in the profile of functional allocation involve a shift from the allocation of resources to growth (more typical of childhood) toward an increasingly larger and larger share allocated to maintenance and management of loss.

Development as Selection (Specialization) and Selective Optimization in Adaptive Capacity

Development is inherently a process of selection and selective adaptation. Selection is due to biological, psychological, cultural, and environmental factors. Developmental advances are due to processes of optimization. Because development is selective and because of age-associated changes in potential, compensation is also part of the developmental agenda.

Development as Gain/Loss Dynamic

In ontogenetic development, there is no gain without loss, and no loss without gain. Selection and selective adaptation are space-, context-, and time-bound. Thus, selection and selective adaptation imply not only advances in adaptive capacity but also losses in adaptivity for alternative pathways and adaptive challenges. A multidimensional, multidirectional, and multifunctional conception of development results from such a perspective.

Plasticity

Much intraindividual plasticity (within-person variability) is found in psychological development. The key developmental agenda is the search for the range of plasticity and its age-associated changes and constraints.

Ontogenetic and Historical Contextualism as Paradigm

In principle, the biological and cultural architecture of human development is incomplete and subject to continuous change. Thus, ontogenetic development varies markedly by historical-cultural conditions. The mechanisms involved can be characterized in terms of the principles associated with contextualism. As an illustration: Development can be understood as the outcome of the interactions (dialectics) between three systems of biological and environmental influences: Normative age-graded, normative history-graded, and non-normative (idiosyncratic). Each of these sources evinces individual differences and, in addition, is subject to continuous change.

Toward a General and Functionalist Theory of Development: The Effective Coordination of Selection, Optimization and Compensation

On a general and functionalist level of analysis, successful development, defined as the (subjective and objective) maximization of gains and minimization of losses, can be conceived of as resulting from collaborative interplay among three components: Selection, optimization, and compensation. The ontogenetic pressure for this dynamic increases with age, as the relative incompleteness of the biology- and culture-based architecture of human development becomes more and more pronounced.

psychology (e.g., Bateson, 1996; Gottlieb, 1991, 1996), and systems theory (e.g., D. Ford, 1987; Ford & Ford, 1987; D. Ford & Lerner, 1992; Thelen, 1992; Thelen & Smith, 1994; see also, Fischer & Bidell, Gottlieb et al., Thelen & Smith, Wapner & Demick, this Volume). In the present context, however, we will emphasize the uniqueness of the positions advanced by life-span scholars. This focus will also permit us to explicate the consistency of the metatheoretical framework with the other levels of analysis presented; that is, the consistency with the life-span dynamics between biology and culture derived from evolutionary considerations as well as the age-related shift in allocation of resources from functions of predominant growth to maintenance (resilience) and management of loss.

Reformulating the Concept of Development from a Functionalist Perspective: Development as Change in Adaptive Capacity

From a life-span theory point of view, then, it was important to articulate concepts of development that go beyond unidimensional and unidirectional models, which had flourished in conjunction with the traditional biological conceptions of growth or physical maturation (Labouvie-Vief, 1982; R. Lerner, 1983; Sowarka & Baltes, 1986). In these traditional conceptions (D. Harris, 1957; Wohlwill, 1973), attributes such as qualitative change, ordered sequentiality, irreversibility, and the definition of an end-state played a critical role. Primarily by considering

ontogenetic development from a functionalist perspective (Dixon & Baltes, 1986), the traditional conception of development was challenged.

Development as Selection and Selective Adaptation (Optimization). The traditional concept of development emphasizes a *general* and *universal* development of an entity geared toward a higher level of functioning which, in addition, incorporates most if not all previously developed capacities (D. Harris, 1957; R. Lerner, 1983, 1986; Werner, 1948; S. White, 1983; Youniss, 1995). Historically, this view of ontogenetic development has been pictured as the unfolding and emergence of an entity, primarily formed from sources within that entity and by mechanisms of transformation or stage-like progression. Such a general and organismic script figured prominently among structural cognitivists and, intentionally or not, evinced strong connections to physical growth models of developmental biology (Overton & Reese, 1973).

Such a unidirectional, growth-like view of human development appeared contradictory to many findings in life-span psychology, which included negative transfer from earlier development to later developmental outcomes, differences in rates, age-onsets, and age-offsets of developmental trajectories, multidirectional patterns of age-related change, as well as discontinuities in prediction. Figure 18.3 represents an early representation of this differentiated view of development elicited by life-span thinking and findings, which posed a challenge to traditional conceptions of development as unilinear and holistic growth (see also, Labouvie-Vief, 1980, 1982).

In their ensuing conceptual work, life-span developmentalists attempted to either modulate the traditional definitional approach to development or to offer conceptions highlighting the view that ontogenetic development was not identical with the notion of holistic and unidirectional growth, according to which all aspects of the developing system were geared toward a higher level of integration and functioning. In these efforts, life-span scholars shared the goal of reformulating the concept of development, although they differed in the degree of radicality and in specifics.

Labouvie-Vief (1980, 1982; see also, Edelstein & Noam, 1982; Pascual-Leone, 1983; Riegel, 1976), for instance, introduced new forms (stages) of systemic functioning for the period of adulthood, based on conceptions of development as adaptive transformation and structural reorganization, thereby opening a new vista on Neo-Piagetian

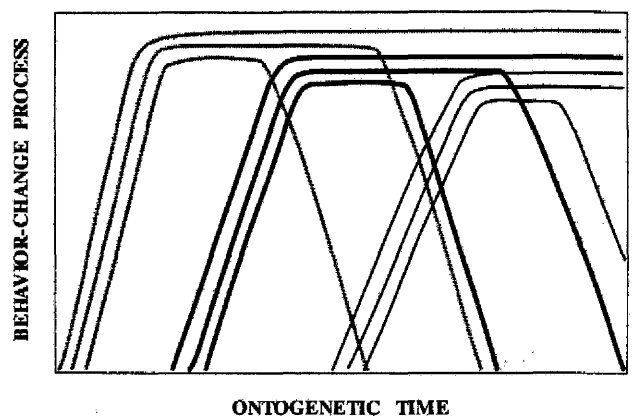


Figure 18.3 Hypothetical examples of life-span developmental processes. Developmental functions (behavior-change processes) differ in terms of onset, duration, termination, and directionality when charted in the framework of the life course. Moreover, developmental change is both quantitative and qualitative, not all developmental change is related to chronological age, and the initial direction is not always incremental (after Baltes et al., 1980).

constructivism. Baltes and his colleagues (e.g., P. Baltes, 1983, 1987; P. Baltes et al., 1980), but also others such as Brandtstädter, Featherman, and Lerner (Brandtstädter, 1984; Featherman & Lerner, 1985; Featherman, Smith, & Peterson, 1990; R. Lerner, 1983), were perhaps more radical in their departure from extant theoretical models of development and attempted to approach the conceptualization of development by a theoretical framework of neofunctionalism (Dixon & Baltes, 1986) and contextualism (R. Lerner, 1991; Magnusson, 1988, 1996). This resulted in an effort to reformulate development as *selective age-related change in adaptive capacity*. Because of the multiple influences on election including the role of individuals as selector agents (R. Lerner & Busch-Rossnagel, 1981), development as selection and selective adaptation displays many attributes. For instance, it can be active or passive, conscious or subconscious, internal or external, and continuous or discontinuous.

In the view of Baltes and his colleagues, such a neofunctionalist approach was the most open to a full consideration of the new facets of ontogenetic change (such as multidirectionality, multifunctionality, adaptive specificities, and predictive discontinuity) that life-span researchers were confronted with. At the same time, however, this conception permitted maintaining traditional growth-like conceptions of development as a special class of developmental phenomena.

This intellectual movement toward a broadly based functionalist conception of ontogenesis entailed a number of features. For instance, to reflect more accurately their understanding of the empirical evidence about life-span changes, and also drawing from alternative conceptions of ontogenesis such as canalization and selective neuronal growth (Edelman, 1987; Waddington, 1975), self-organization (Barton, 1994; Brent, 1978a, 1978b; Lewis, 1995; Maturana & Varela, 1980; Prigogine & Stengers, 1984), as well as expert systems (Chi, Glaser, & Farr, 1991; Chi, Glaser, & Rees, 1982; Ericsson & Smith, 1991; Weinert & Perner, 1996), life-span researchers began to emphasize that any process of development is not foremost the unfolding of an entity. Rather, they focused on development as ontogenetic selection from a pool of more or less constrained potentialities and the subsequent selective optimization of the entered pathways (P. Baltes, 1987, 1997; Labouvie-Vief, 1982; Marsiske et al., 1995; Siegler, 1989, 1994). As a given pathway of ontogenetic development is chosen and optimized, others are ignored or suppressed. In short, some life-span theorists ventured a new start and suggested treating ontogenetic development as a process of selective adaptation reflecting the interaction of biological, cultural, and contextual factors.

Even though life-span researchers increasingly argued for pluralism in conceptions of development, and used concepts such as selection, selective adaptation, and adaptive transformation to characterize ontogenesis, they did not want to communicate that these concepts incorporate all facets and ingredients of development. They did recognize the power of the traditional growthlike concept of development and the attractiveness of enriching this approach by new perspectives (e.g., Labouvie-Vief, 1982). However, in their arguments some life-span researchers were primarily driven by a reaction to the concept of development as indicating universal, cumulative-integrative, and sequentially-ordered movement toward a higher level of functioning and a single endstate. They felt such restricted definitions of development carried major disadvantages, if not fatal flaws, for the articulation of life-span theory; definitions that because of prominent use in child-developmental theory were difficult to overcome. In our view, it is an open question whether these alternative, more functionalist conceptions will offer a viable alternative to enrich and reformulate the traditional concept of development, or whether in the long run, the traditional concept of development will disappear as a theoretical

guidepost and thereby permit a radically new approach to the concept of development itself.

Let us return to the effort to redefine development as age-related change in adaptive capacity. Selection and associated changes in adaptive capacity can be based on a variety of processes and sources which need further elaboration. (One example is presented below under the heading of selective optimization with compensation.) Some of the processes involved in selection and selective adaptation are related to genetically-based dispositions, for instance those related to age-graded physical maturation or genetically-based differences in temperament. In this context, theoretical conceptions of self-organization (Barton, 1994; Lewis, 1995; Thelen & Smith, 1994) are important ingredients. Other sources originate in environmentally-based histories of learning and the sequential structures of culture-based life opportunities, such as those associated with school curricula, professional careers, and status passages (Brim & Wheeler, 1966; Clausen, 1986; Featherman, 1983).

In any case, with the focus on selection and selective adaptation, life-span researchers were able to be more open about the pathways of life-long ontogenesis (P. Baltes, 1987; Labouvie-Vief, 1982). For instance, with this neo-functional approach (Dixon & Baltes, 1986) it becomes possible to treat the developing system as a multivariate and flexible one, in which differing domains and functions develop in a less than fully integrated (holistic) manner, and where trade-offs between functional advances are the rule rather than the exception.

Furthermore, by using and exploring the functionalist concept of selection, the issue of gains and losses in human development becomes prominent. Whereas the traditional concept of development neglects or even hides issues such as negative transfer, undeveloped pathways, or the long-term costs of growth (such as entropy), the concepts of selection and of selective optimization bring such questions to the foreground and require their explicit treatment. As mentioned already, in this regard life-span theory and research have joined other efforts at articulating new conceptions of development such as dynamic systems theory and theories of self-organization (P. Baltes & Graf, 1996; D. Ford, 1987; Thelen & Smith, 1994).

Development as a Gain-Loss Dynamic. A related change in emphasis advanced in life-span theory and research was on viewing development as *always* being constituted by gains and losses (P. Baltes, 1979a, 1987; P. Baltes

et al., 1980; Brandstädter, 1984; Brim, 1992; Labouvie-Vief, 1980, 1982). Aside from functionalist arguments, there were several empirical findings which gave rise to this focus.

One example important to life-span researchers was the differing life-span trajectories proposed and obtained for the fluid mechanics and crystallized pragmatics of intelligence (P. Baltes, 1993; P. Baltes & Schaie, 1976; Cattell, 1971; Horn, 1970; Horn & Hofer, 1992; Schaie, 1996). Very much in line with the life-span dynamic between biology and culture expressed in Figure 18.1, intellectual abilities that are thought to reflect the neurobiologically-based mechanics of intelligence—like working memory and fluid intelligence—typically showed normative (universal) declines in functioning beginning in middle adulthood. Conversely, intellectual abilities that primarily reflect the culture-based pragmatics of intelligence—such as professional knowledge and wisdom—may show stability or even increases into late adulthood. As to the ontogenesis of intelligence, then, gains and losses were postulated to co-exist (see also, the following section).

There were other arguments for the gain-loss dynamic view. The open systems view of the incomplete biological and cultural architecture of life-span development and the multiple ecologies of life also made it obvious that the postulation of a single endstate to development was inappropriate (P. Baltes et al., 1980; Chapman, 1988b; Labouvie-Vief, 1977, 1980, 1982). Furthermore, when considering the complex and changing nature of the criteria involved in everyday life contexts of adaptation (which, for instance, at any age and across age differ widely in the characteristics of tasks demands; e.g., P. Baltes & Willis, 1977; Berg & Calderone, 1994; Berg & Sternberg, 1985a), the capacity to move *between* levels of knowledge and skills rather than to operate at one specific developmental level of functioning appeared crucial for effective individual development. Finally, there were the issues of individual differentiation, for instance by social class and occupational careers (Dannefer, 1984; Featherman, 1983) and negative transfer associated with the evolution of any form of specialization or expertise (Ericsson & Smith, 1991), which required a departure from a monolithic orientation to development as universal growth.

Thus, as some life-span theorists considered substituting the concept of an age-related selection-based change in adaptive capacity for the concept of development

(P. Baltes, 1987; Featherman & Lerner, 1985), one of the topics that motivated their agenda was the importance of viewing as fundamental to any ontogenetic change the notion of simultaneous gains and losses associated with these changes. From a functionalist point of view (Dixon & Baltes, 1986), it is more or less understood that changes in adaptive capacity can be positive or negative, that a given change in developmental capacity may imply different consequences depending on the outcome criteria and the adaptive contexts involved. Thus, the radical view was advanced that, contrary to traditional conceptions of development, there was *no gain in development without loss, and no loss without gain* (P. Baltes, 1987, 1997). Life-span researchers, then, conceive of ontogenetic development not as a monolithic process of progression and growth, but as an ongoing, changing, and interacting system of gains and losses in adaptive capacity. Throughout life, development always consists of the joint occurrence of gains and losses, both within and across domains of functioning. Such an approach does not preclude, of course, that on some level of systemic analysis (that is, considering the entirety of adaptive capacity in a fixed cultural context), ontogenetic development evinces an overall increase in adaptive capacity.

To strengthen the general case for reformulating the concept of development, life-span researchers also suggested applying this multifunctional, multidimensional, and multidirectional view of development to the field of child development (P. Baltes, 1976, 1987; Labouvie-Vief, 1982). Consider as an example the ontogenesis of language recognition and language acquisition in childhood. When one language is acquired as mother tongue, sound recognition and sound production capacity for other languages decreases, especially if such second and third languages are acquired after early childhood (Levelt, 1989).

The study of tasks requiring probability-based imperfect rather than logic-based perfect solutions is another example (P. Baltes, 1987). The more advanced the cognitive status of children (in the sense of capacity for formal-logical reasoning), the less children are able to respond to cognitive problems that are essentially not perfectly solvable and therefore require the use of maximization rather than optimization strategies. Weir (1964) conducted an early critical experiment on this question in the domain of probability-based learning. In probability learning tasks without perfect solutions, there is the seemingly paradoxical finding that very young children outperformed older

children and college students. Considering adaptive trade-offs between levels (stages) of cognitive functioning, this finding becomes meaningful. It is likely that the older children and young adults achieved lower performance outcomes because they understood the experimental task as a logical problem-solving task and, therefore, continued to employ task-inappropriate but developmentally more "advanced" cognitive strategies aimed at a "perfect" optimization.

In retrospect, it is perhaps not surprising that the gain-loss dynamic was identified primarily by life-span researchers as a central topic of ontogenetic analysis. On the one hand, life-span researchers, because of their concern for longterm processes, were pushed toward recognizing the varied forms of developmental change associated with cultural evolution (Nisbett, 1980). On the other hand, on a subjective-phenomenological level, the issue of gains and losses becomes more conspicuous as one considers adult development and aging. In this phase of life, declines and losses, especially those due to biological aging, are difficult to ignore. However, as life-span researchers explored this issue more fully and in terms of functionalist conceptions of development, they were persuaded to argue that the gain-loss dynamic is universal and operates in infancy and childhood as well. Meanwhile, and not the least because of the increasing attention in human-development research given to evolutionary principles of selection and adaptation, similar views on the nature of development have become prominent in other quarters of developmental scholarship as well (e.g., Cairns & Cairns, 1994; Lewis, 1995; Magnusson, 1996; Siegler, 1994; Thelen, 1992; Thelen & Smith, 1994).

Recently, in addition to multidimensionality, multidirectionality, and multifunctionality, one additional concept has been advanced to characterize the nature of life-span changes in adaptive capacity. This concept is *equifinality*. Equifinality highlights the fact that the same developmental outcome can be reached by different means and combination of means (Kruglanski, 1996). The role of equifinality (a related notion is the concept of overdetermination) is perhaps most evident when considering the many ways by which individuals reach identical level of subjective well-being (Baltes & Baltes, 1990b; Brandtstädter & Greve, 1994; Staudinger et al., 1995). Other examples come from research on goal attainment conducted in the framework of action psychology (Brandtstädter, this Volume; Gollwitzer & Bargh, 1996). In this approach,

researchers have distinguished between two general categories of equifinality: equifinality associated with contextual (contingency) match and equifinality based on substitutability (Kruglanski, 1996). In life-span research, notions of equifinality are important, for instance, when attempting to speak of "general-purpose" mechanisms and ways to compensate, both in the domains of intelligence and personality (see later sections). The potential for developmental impact is larger if the resources acquired during ontogenesis in the sense of equifinality carry much potential for generalization and use in rather different contexts.

A Focus on Plasticity and Age-Associated Changes in Plasticity

A further development in life-span research was a strong concern with the notion of plasticity. The focus on plasticity highlights the search for the potentialities of development including its boundary conditions. Implied in this idea of plasticity is that any given developmental outcome is but one of numerous possible outcomes, and that the search for the conditions and range of ontogenetic plasticity, including its age-associated changes, is fundamental to the study of development (P. Baltes, 1987; Coper, Jänicke, & Schulze, 1986; Gollin, 1981; R. Lerner, 1984; Magnusson, 1996).

In fact, the notion of plasticity can be taken so far as to challenge the conceptual foundation of any genetically-based fixity in ontogenesis including whether it is useful to consider the existence of such phenomena as "the" norm of reaction (see also, Gottlieb et al., Ch. 5, this Volume). In a later section, we offer our view on the nature of evidence which is provided by behavior-genetic analysis. Suffice it here to state that we subscribe to an interactive and dynamic view of gene-environment relationships in the sense of conceptions of plasticity. At the same time, we believe that the human genome contains most important information regarding the structure and sequence of cultural evolution and human ontogenesis. We owe the structure and potential of human ontogenesis foremost to these genetically-based condition for life. Cultural evolution, nevertheless, involves the continuing, but never successful search to detach itself from these genetic programs and boundaries.

There were several reasons why life-span researchers increasingly moved in the direction of making the study of plasticity a cornerstone of their metatheoretical posture and empirical work. In retrospect, we emphasize two

such reasons. First, as many life-span researchers did work in the field of aging, plasticity-related ideas such as modifiability were important to them, to counteract the prevailing negative stereotype of viewing aging as a period of universal decline with no opportunity for positive change (P. Baltes & Labouvie, 1973; P. Baltes & Willis, 1977; Labouvie-Vief, 1977; Neugarten, 1969; Perlmutter, 1988). Thus, when aging researchers demonstrated in intervention-oriented research the enhancement possibility of the aging mind, even in domains such as fluid intelligence and memory where decline was the norm, this was counterintuitive evidence.

Second, the use of the concept of plasticity accentuated the view that life-span development did not follow a highly constrained (fixed) course, especially where culture- and knowledge-based characteristics are concerned. On the contrary, the focus on plasticity brought into the foreground that "humans have a capacity for change across the life span from birth to death . . . (and that) the consequences of the events of early childhood are continually transformed by later experiences, making the course of human development more open than many have believed" (Brim & Kagan, 1980, p. 1).

Such an emphasis on life-long plasticity is consistent with the approach described earlier in this chapter of viewing life-span development as incomplete in biological and social-cultural architecture. The insistence on life-long plasticity in human development is also consistent with the argument advanced most prominently by social scientists that much of what happens in the life course is a direct reflection of the goals, resources, and norms of a given society and that societal contexts differ in the structure, emphases, and sequential ordering of such factors (Brim & Wheeler, 1966; Clausen, 1986; Elder, 1979, 1994; Featherman, 1983; Mayer, 1986, 1990; Riley, 1987; Sorenson et al., 1986). Social scientists also emphasize that these sociocultural differences apply both to within—and between—society characteristics (Dannefer, 1984, 1989).

As a result, the concept of plasticity became a mental script which supported the general idea of development as being more open and pluralistic than traditional views of development. For instance, this metatheoretical proposition was opposed to any characterization of the life course as an inverted U-function of growth, followed by stability, and then by decline. Specifically, the concept of plasticity highlighted the metatheoretical posture *that any course of*

development is but one of a pool of potentialities; that the "nature" of human development is not fixed; and that (aside from the fact of finitude) there is no single endstate to human development. In this search for plasticity, life-span researchers found conceptual and empirical support in the work of others, such as neurobiologically inclined investigators (Cotman, 1985; Edelman, 1987; Gollin, 1981; Rowe & Kahn, 1987), who elevated the exploration of the range and the conditions of behavioral and brain plasticity to the central question of developmental studies.

As life-span psychologists initiated systematic work on plasticity, further differentiation of the concept of plasticity was introduced. One involved the question of general versus domain-specific conceptions of plasticity (Marsiske et al., 1995). Furthermore, emphasis on individual differences and ontogenetic age changes in the extent of plasticity became prominent. Thus, the search for the range of plasticity resulted not only in evidence for malleability and plasticity; it also produced new evidence on individual and age-based constraints in the range (norm of reaction) of possible development (P. Baltes & Lindenberger, 1988; Plomin & Thompson, 1988). In work on cognitive aging, for instance, two faces of plasticity emerged. On the one hand, there was increasing evidence that older individuals continued to possess sizeable plasticity. On the other hand, there also was evidence of robust aging-related losses in plasticity (Kliegl & Baltes, 1987; Kliegl et al., 1990).

Differentiation between *baseline reserve capacity* and *developmental reserve capacity* also emerged. Baseline reserve capacity identifies the current level of plasticity available to individuals. Developmental reserve capacity is aimed at specifying what is possible in principle if optimizing interventions are employed to test future ontogenetic potential. Furthermore, major efforts were made to specify the kind of methodologies, such as developmental simulation, testing-the-limits, and cognitive engineering, that lend themselves to a full exploration of ontogenetic plasticity and its limits (P. Baltes, 1987, 1997; Baltes, Cornelius, & Nesselroade, 1979; Kliegl & Baltes, 1987; Lindenberger & Baltes, 1995b).

Ontogenetic and Historical Contextualism as Paradigm

A further key metatheoretical element of life-span developmental psychology is ontogenetic and historical contextualism. Such a contextualist view, rather than a focus on "mechanist" or "organismic" models of development

(Overton & Reese, 1973; Reese & Overton, 1970), evolved with force in the 1970s (Datan & Reese, 1977; R. Lerner, Skinner, & Sorell, 1980; Riegel, 1976) and continues into the present (P. Baltes & Graf, 1996; Elder, 1994; R. Lerner, 1991; Magnusson, 1996). This approach was similar to the evolution of ecological-contextualist perspectives offered by cultural psychology (Bronfenbrenner, 1977; Bronfenbrenner & Ceci, 1994; Cole, 1990). Related to this metatheoretical orientation of ontogenetic and historical contextualism were other theoretical positions, such as action theory (Bandura, 1982, 1986, 1995; Boesch, 1991; Brandtstädter, 1984; Chapman, 1988a; Heckhausen & Schulz, 1995), which makes equally explicit the importance of both individual action and social-contextual factors in the regulation of development.

According to contextualism and also action theory (Boesch, 1991; see also, Brandtstädter, Ch. 14, this Volume), individuals exist in contexts that create opportunities for and limitations to individual developmental pathways. Delineation of these contexts in terms of macrostructural features, like social class, ethnicity, roles, age-based passages and historical periods, is a major goal for the sociological analysis of the life course (e.g., Brim & Wheeler, 1966; Clausen, 1986; Elder, 1994, Ch. 16, this Volume; Featherman, 1983; Kohli & Meyer, 1986; Mayer, 1986; Riley, 1987; Sorenson et al., 1986).

One model that attempted to integrate sociological and psychological approaches to the structuring of developmental influences was one (P. Baltes et al., 1980) which distinguished among three sources of biological and environmental influences in order to understand the entire fabric of development-producing contexts: *Normative age-graded influences*, *normative history-graded influences*, and *non-normative influences*. To understand a given life course, and inter-individual differences in life-course trajectories, this model suggests that it is necessary to consider the interaction among these three classes of influences (Figure 18.4). These sources contribute to similarities in development, but also, because they exist in systematic variations, for instance by social class, genetic dispositions, and ethnicity, they also contribute to systematic inter-individual variations and subgroup-specific patterns of life-span development (P. Baltes & Nesselrode, 1984; Dannefer, 1984, 1989).

Age-graded influences are those biological and environmental aspects that, because of their dominant age

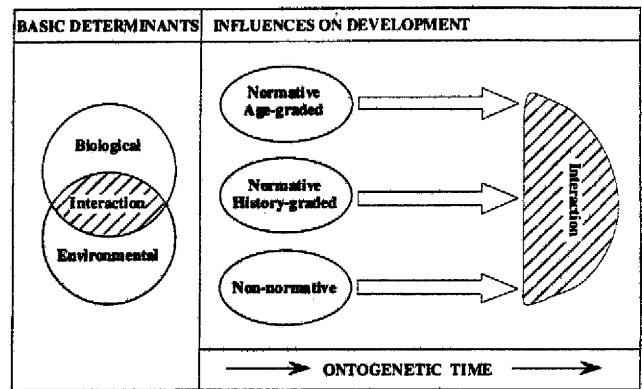


Figure 18.4 Representation of the operation of three major influence systems on life-span development: Normative age-graded, normative history-graded, and non-normative (idiosyncratic) life events. Normative in this content indexes primarily the notion of statistical patterning or generality. These influence systems vary in their interactions for different individuals and for different behaviors and therefore also generate social differentiation. As a whole, the operation of these systems produce commonalities and individual differences in ontogenesis (after Baltes et al., 1980).

correlation, shape individual development in relatively normative ways for all individuals. Consider the temporal and domain structure of life-span developmental tasks (Havighurst, 1948) and the age-based process of physical maturation as examples.

History-graded influences are those biological and environmental aspects that may make ontogenetic development different across historical cohort and periods. Consider the historical evolution of the educational and professional system as an example, or, for a more punctuated period-specific example, the advent of a war. Thus, a given ontogeny proceeds at the same time in the contexts of age-based ontogenetic time as well as historical cohort time. This position has been argued most fervently by Matilda Riley (1987). In developmental psychology, research on birth-cohort effects has made the strongest case for consideration of historical contextualism (P. Baltes, 1968; P. Baltes et al., 1979; Caspi, 1987; Elder, 1974, 1990; Nesselrode & Baltes, 1974; Schaie, 1965, 1996). The topic of historical embeddedness, and the extricating of age-based versus cohort-based differences in ontogenetic development, was also the foundation for the formulation of new developmental methodologies such as cross-sectional and longitudinal sequences (see below).

Non-normative (idiosyncratic) influences on development, finally, reflect the individual-idiosyncratic biological and environmental events that, while not frequent, can have powerful influences on ontogenetic development (Bandura, 1982; Brim & Ryff, 1980; Datan & Ginsburg, 1975; Hultsch & Plemons, 1979). The influence of these non-normative events (such as winning a lottery, losing a leg in an accident) is especially powerful because they generate conditions that are less predictable, less amenable to social control and support, and therefore may represent extreme situations of challenge (approaching testing-of-limits), not unlike the concept of *Grenzsituation* introduced by the philosopher Karl Jaspers (Kruse, 1992; Maercker, 1995).

Individual development, then, proceeds within these closely intertwined contexts of age-graded, history-graded, and non-normative life events. None of these patterns of biologically and environmentally based influences is likely to operate independently from the other. In life-span theory these three sources of influence create the contexts within which individuals act, react, organize their own development, and contribute to the development of others (R. Lerner & Busch-Rossnagel, 1981). Such a focus on contextualism also makes explicit the lack of full predictability of human development as well as the boundedness individuals experience as they engage in the effort to compose and manage their lives (Brandtstädter, 1984; R. Lerner, 1984, 1991). And finally, such a focus on contextualism places individual development in the context of the development of others. It is not surprising, therefore, that life-span researchers have easily embraced concepts such as collaborative development, collaborative cognition, or interactive minds (Baltes & Staudinger, 1996a; Resnick, Levine, & Teasley, 1991; Rogoff, 1990a).

What remains underdeveloped in life-span psychology, however, is the empirical counterpart to this theoretical position. Only recently have we witnessed research efforts to include these contextual- and social-interactive approaches in the study of interactive networks such as communities of learning (Mandl, Gruber, & Renkl, 1996), life-course convoys (Kahn & Antonucci, 1980), mentors (Bloom, 1985), cohort formations (Riley, 1987), kinship relationships (Hammerstein, 1996), cohort-related changes in education and health (Schaie, 1996) as well as the role of neighborhoods. Contextual network conditions formed by history-graded and non-normative life events (for instance,

illness-related social support groups) seem equally understudied in their contribution to the organization and regulation of life-span development (see, however, Elder, 1974, Ch. 16, this Volume).

Methodological Developments

We mentioned already that since the very early origins of life-span developmental psychology (e.g., Quetelet, 1842), the search for methodology adequate for the study of developmental processes was part of the agenda of life-span researchers (P. Baltes, Reese, & Nesselroade, 1988; Cohen & Reese, 1994; Magnusson, Bergman, Rudinger, & Törestad, 1991; Nesselroade & Reese, 1973). In our view, this concern about adequate methodology was so important to life-span researchers because their orientation toward long-term ontogenetic processes and linkages represented an extreme challenge to the goals and methods of developmental analysis. We will briefly illustrate this continuing concern of life-span researchers with issues of methodology with four examples. Each of these examples reflects one or more of the family of metatheoretical principles of life-span developmental psychology outlined in the previous section.

From Cross-Sectional to Longitudinal to Sequential Methodology. A first example is the development of methods appropriate to the study of age-related change, inter-individual differences in age-related change, and the role of historical changes in the contexts of development. Traditionally, the main designs used in developmental psychology were the cross-sectional and the longitudinal method (Nesselroade & Baltes, 1979, for historical review). The focus on the interplay between age-graded, history-graded, and non-normative factors suggested, however, that such methods were insufficient (P. Baltes, 1968; N. Ryder, 1965; Schaie, 1965).

Cross-sectional methods, on the one hand, in which different age groups (say 10-, 20-, 30-, and 40-year-olds) are compared at one historical point in time (such as in 1990), were shown to represent an inherent confound of age and generational membership (cohort). This disadvantage of the cross-sectional method exists in addition to the inability of the cross-sectional method to track trajectories of individual change. The age-cohort confound is present in cross-sectional findings because the comparison age groups "developed" in different historical periods. Longitudinal

methods, on the other hand, while capturing change on the individual level directly, are restricted to the ontogenetic development of a single cohort. Thus, if historical change is relevant in the regulation of human development, longitudinal findings cannot be generalized across birth cohorts. In a certain way, and for historically sensitive phenomena, findings from longitudinal research can be "obsolete" as soon as they have been collected.

This challenge to track both historical and individual-ontogenetic change resulted in the formulation of so-called sequential methods (P. Baltes, 1968; Schaie, 1965, 1996). Figure 18.5 depicts the basic arrangement of what Schaie and Baltes (1975) have come to label as *cross-sectional* and *longitudinal sequences*. Cross-sectional sequences consist of successions of cross-sectional studies; longitudinal sequences of successions of longitudinal studies. When applied in combination, the two types of sequential designs produce, on a descriptive level, exhaustive information about age- and cohort-related change as well as about inter-individual differences in change trajectories. The cross-sectional arrangements can also be used to control for retest effects which make the interpretation of simple longitudinal results difficult (P. Baltes, Reese, & Nesselroade,

1988; Schaie, 1965, 1996). The sequential design also permits the identification of punctuated historical effects, so-called period effects. In contrast to cohort effects, which extend over longer time spans of historical change (such as effects associated with mass education or the introduction of computer technology), the concept of period effects is typically applied to more transient historical events and their consequences, such as a natural catastrophe or a war.

There is much research in human development that has demonstrated the important role of historical cohort effects. Schaie (1996), for instance, has compared both in cross-sectional and longitudinal sequences the adult age-development of several birth cohorts from 1956 into the present and reported impressive evidence that, during middle adulthood, cohort effects can be as large as age effects; moreover, Schaie's work has also shown that the directionality of age and cohort gradients can differ (see too, the next section of this chapter). Similarly, Nesselroade and Baltes (1974), in an early application of longitudinal sequences to the study of adolescence, presented evidence that personality development during adolescence in such measures as achievement and independence evinced major cohort differences over time intervals as short as two years. Their interpretation focused on the role of the Vietnam War as the critical modulator variable and its impact on American youth culture.

Meanwhile, through application of sequential methods, there is a large body of evidence on cohort effects available in developmental psychology, but especially in comparative sociology; evidence that makes explicit one of the important ingredients to life-span theory, namely, the interplay between individual development and a changing society (cf., Elder, Ch. 16, this Volume). Also important in this work is the growing recognition of when cohort effects are likely to be relevant and when not. For instance, researchers now distinguish between at least three types of cohort effects requiring different kinds of interpretative efforts (Nesselroade & Baltes, 1979):

1. Cohort as a *theoretical process* denoting historical change which alters something fundamental about the nature of ontogenesis (e.g., changing gender roles).
2. Cohort as a *dimension of quantitative generalization* (e.g., higher levels of cognitive skills due to an increase in education).

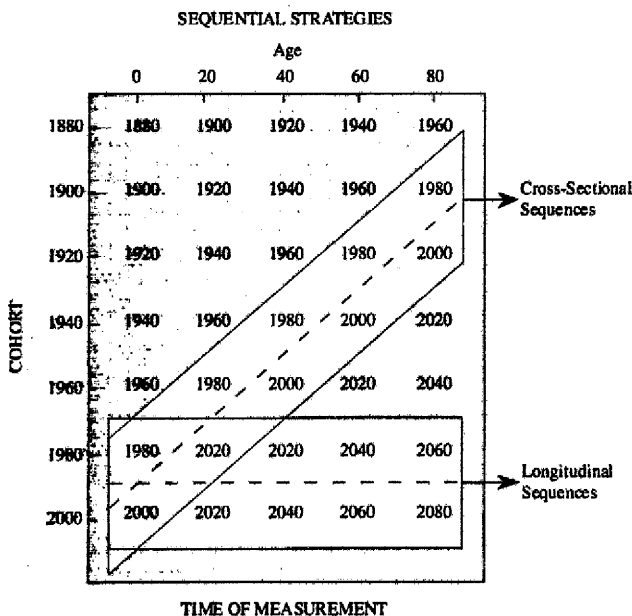


Figure 18.5 Illustration of cross-sectional and longitudinal sequences (bottom). Modified from Baltes (1968) and Schaie (1965).

3. Cohort as *transitory disturbance* (e.g., fluctuant changes in attitudes due to singular events as often reported in opinion survey research).

Life Events and Event-History Analysis. A second methodological development spurred on by life-span researchers concerns methods to organize and study the temporal flow, correlates, and consequences of life events. Life-course sociologists, in particular, have made major contributions to the advancement of this methodology. Among the relevant methods, models of event-history analysis and associated methods such as hazard rate analysis are especially important (Blossfeld, Hamerle, & Mayer, 1991; Blossfeld & Rower, 1995; Featherman & Lerner, 1985; Hertzog, 1996; Magnusson et al., 1991; Schaie, 1988; Willett & Singer, 1991).

As summarized in the family of metatheoretical propositions presented in Table 18.3, life-span theory and research requires a concerted effort toward the multivariate and temporal organization of the conditions and events that shape and regulate human development. The focus on historical embeddedness and contextualism is symbolic for this orientation as is the concern with non-normative and more idiosyncratic factors. Event-history analysis is designed to deal with this requirement.

The Experimental Simulation of Development. A third strategy which was developed primarily by life-span researchers is the explicit use of simulation paradigms in the study of human development. Again, use of such an approach was enhanced by the fact that life-span ontogenetic processes are time-extensive and, therefore, difficult to study without simulation (P. Baltes & Goulet, 1971; Lindenberger & Baltes, 1995).

Table 18.4 summarizes the approach of developmental simulation. In a general sense, the experimental simulation approach is a theory-testing device that arranges for conditions thought to be relevant for the phenomenon of interest. Thus, experimental developmental simulations simulate or mimic variations which are thought to exist in real-time and real-world ontogenesis. As a research strategy, the design of developmental simulation consists of a coordinated sequence of seven steps which, however, do not need to be performed in the sequence specified. A developmental phenomenon is considered to be well understood if knowledge based on all steps is available.

Table 18.4 The Logic of Experimental Simulation in the Study of Development: A Coordinated Sequence of Steps

1. Definition and description of target developmental phenomenon to be studied.
2. Postulation of a causal hypothesis or causal structure about underlying mechanisms and contextual conditions.
3. Experimental manipulation of relevant variables in the laboratory.
4. Test of experimental data against target phenomenon: isomorphism check.
5. Reexamination of causal hypothesis or causal structure (confirmation/rejection/modification) and search for alternative explanations.
6. Evaluation of external validity: descriptive evidence.
7. Evaluation of external validity: interventive evidence.

Modified by Lindenberger and Baltes (1995) after P. Baltes et al. (1988).

In life-span research, such simulations have been used, for instance, to examine the effects of aging-associated changes in sensory input. For this purpose, auditory and visual acuity of adults was reduced to the level of older persons and then tested for cognitive performance (Dickinson & Rabbitt, 1991; Lindenberger & Baltes, 1996). Another example is a research program by Margret Baltes on the many faces of dependency and autonomy in old age (1988, 1996; M. Baltes & Wahl, 1992). In this research program, the key questions were concerned with the conditions and range of autonomy and dependence including their multifunctional characteristics and plasticity.

The opening steps (1–3 in Table 18.4) of this research on autonomy and dependency in old age conducted by Margret Baltes and her colleagues were observations that many older adults display major deficits in autonomy in the domain of self care. In addition to biological aging loss, social-environmental factors, such as negative aging stereotypes and social interactions, were assumed to play a major role in this age-associated emergence of dependent rather than independent behavior. To examine this hypothesis, a series of experimental laboratory studies were conducted to explore the effects of learning conditions (stimulus control, practice, reinforcement schedules) on self-care behavior in older adults. This work demonstrated that many aspects of older adult's dependent behaviors were found to be reversible, supporting the notion that environmental factors (e.g., behavioral contingencies) exert some influence on the aging-associated emergence of dependency or loss of autonomy.

In their research, reflected in steps 4 to 6 in Table 18.4, Margret Baltes and her colleagues observed the social conditions surrounding the occurrence of self-care in the elderly in the natural environment. Indeed, in line with their basic set of hypotheses, they observed the existence of two social-interactive scripts: A *dependency-support* script and an *independence-ignore* script. In other words, social partners of older persons in the context of self-care exhibited a high frequency of behaviors indicative of support of dependence. At the same time, these social partners ignored the occurrence of independent self-care behaviors of older persons and treated those in the same way as they responded to dependent behaviors. Research was also conducted to examine whether the same dependence-support and independence-ignore scripts existed in other settings, for instance, in homes for children or in family settings. The dominant finding was that these scripts were more typical of social interactions with older persons than with other age groups, and that with the elderly, they occurred both in nursing homes and private home contexts.

The ultimate step in this program of research (step 7) was to manipulate the relevant causal variables in the natural environment of older persons. For this purpose, the researchers (see M. Baltes, 1996; M. Baltes, Neumann, & Zank, 1994) intervened in the social environment of older persons in nursing homes. This was done by training nursing home staff to downplay the dependence-support script and move toward an independence-support script. By and large, these changes in the natural environment resulted in the expected outcome. Older persons displayed a higher level of independence in self-care.

Researchers interested in more narrow age spectrums, of course, use similar strategies of experimental simulation of development (Kuhn, 1995). However, we claim that life-span researchers are particularly dependent on the creative use of such arrangements; and, moreover, that life-span researchers are especially aware of the many methodological limitations (such as lack of measurement equivalence, isomorphism, and external validity) associated with such and with other age-comparative research. The explicit use of the term of simulation to denote these limitations underscores this awareness.

Testing-the-Limits. Our fourth example of methodological innovations involves a strategy which life-span researchers have developed to examine the scope and limits

of *plasticity* (P. Baltes, 1987; Kliegl & Baltes, 1987), another key aspect of the family of propositions advanced in life-span theory. This method is similar to efforts in child development to study the zone of proximal development, for instance, through methods of microgenetic analysis or cognitive engineering (Brown, 1982; Kliegl & Baltes, 1987; Kliegl, Smith, & Baltes, 1990; Kuhn, 1995; Siegler & Crowley, 1991).

Again, because of the long time frame of life-span ontogenesis, it is very difficult in life-span research to identify the sources and scope of intra-individual plasticity (malleability) and its age-related changes. At the same time, one key question of life-span researchers is *what is possible in principle* in human development across the life span. One example: Cognitive aging researchers attempted to answer the question of whether what we observe in old age is the reflection of a context that is dysfunctional and not supportive of the optimization of aging. One of the perennial questions of cognitive aging researchers, therefore, was whether aging losses in functions reflect experiential practice deficits rather than effects of biological aging (Baltes & Labouvie, 1973; Denney, 1984; Kausler, 1994; Salt-house, 1991c; Willis & Baltes, 1980). In other words, the central argument was that older persons may display deficits because they have less practice than younger age groups in those tasks and tests which cognitive psychologists typically study.

The resulting method has been labelled the *testing-the-limits paradigm* (Kliegl & Baltes, 1987; Lindenberger & Baltes, 1995; Schmidt, 1971). In testing-the-limits research, the goal is to "compress" time by providing for high density "developmental" experiences; and by doing so to arrange for the best conditions possible and to identify asymptotes of performance potential (plasticity). These asymptotes, obtained under putatively optimal conditions of support, are expected to estimate the upper range of the age-specific developmental potentiality comparable to the traditional notion of the upper limit of the "norm of reaction." The use of testing-the-limits procedures has generated new insights into what is and what is not possible in development. The section in this chapter on intellectual development across the life span summarizes some of the evidence.

Testing-the-limits research, however, is not only relevant for the study of long-term ontogenetic processes. It is equally relevant for other important aspects of developmental research and theory. Two examples follow to illustrate.

A first is the question of sex or gender differences in cognitive functioning. From our point of view, much of the relevant research is not suited to answer the key question: Are there biologically-based differences in various components of cognitive potential? What would be foremost necessary is to depart from simple, non-interventive comparative research and to invest scientific resources into testing-the-limits work. Such research, which admittedly is experiment- and experience-intensive at the individual level of analysis, would be based on the premise that the relevant information is knowledge about differences in asymptotic levels of functioning. Small, carefully selected samples could be used for this purpose (e.g., P. Baltes & Kliegl, 1992; Kliegl & Baltes, 1987; Lindenberger, Kliegl, & Baltes, 1992). The same perspective would hold true for another hotly debated topic; that is, research into genetic differences (R. Lerner, 1995; Plomin, 1994). Rather than investing most of the available resources into largely descriptive behavior-genetics studies, an alternative would be to expose smaller samples of participants to time-compressed experiential interventions and to search for inter-individual differences at the upper or lower levels of functioning (see also, Kruse, Lindenberger, & Baltes, 1993).

An Example of a Systemic and Overall Theory of Life-Span Development: Selective Optimization with Compensation (Level 4)

In the following, we take one further step toward a more psychological level of analysis of the nature of life-span development. For this purpose, we describe a model of development, selective optimization with compensation (SOC), which Margret Baltes, Paul Baltes, and their colleagues have developed over the last decade (M. Baltes, 1987; M. Baltes & Carstensen, in press; P. Baltes, 1987, 1997; Baltes & Baltes, 1980, 1990b; P. Baltes, Dittmann-Kohli, & Dixon, 1984; Marsiske et al., 1995; see also, Featherman et al., 1990). This model offers a systemic view of human development across the life span involving many of the features of life-span development presented in the previous sections. In fact, it is fair to say that the evolution of this model and the articulation of metatheoretical principles of life-span theory proceeded in close contact with each other. A related model was developed by Heckhausen and Schulz (Heckhausen & Schulz, 1995; Schulz & Heckhausen, 1996).

The SOC model has been developed within the context of considerations about the nature of successful development and successful aging (Baltes & Baltes, 1990a). This may not be surprising since historically, the concept of development has always been intimately linked with the search for positive functioning and improvement (S. White, 1983). To this end, presenting any general model of life-span development requires some statement about desirable ends.

In our general approach, successful development is defined as the conjoint maximization of gains (desirable goals or outcomes) and the minimization of losses (avoidance of undesirable goals or outcomes). As alluded to before, the nature of what constitutes gains and losses, and of the dynamic between gains and losses, is conditioned by cultural and personal factors as well as the lifetime of individuals. Thus, a given developmental outcome achieved through SOC can at a later ontogenetic time or in a different context be judged as dysfunctional. Moreover, what constitutes a gain and what a loss is also dependent on whether the methods used to define are subjective or objective (Baltes & Baltes, 1990b).

In our view, the SOC model in its generality is still located at a level of analysis that is distant from specific theory. Thus, as the model is applied to specific domains of psychological functioning (such as autonomy or professional expertise), it requires further specification to be derived from the knowledge base of the domain of functioning selected for application (e.g., Abraham & Hansson, 1995; M. Baltes & Lang, 1996; Featherman et al., 1990; Freund & Baltes, 1996; Marsiske et al., 1995). At the same time, however, because of this generality in formulation, the model of SOC is rather open as to its deployability and domain-specific refinement.

Definition of Selection, Optimization, and Compensation

As mentioned above, we proceed from the assumption that any process of development involves selection and selective changes in adaptive capacity (P. Baltes, 1987; Featherman et al., 1990; Marsiske et al., 1995). Selection from a potential pool of developmental trajectories makes directionality of development possible. We further assume that for selection to result in successful development (maximization of gains while minimizing losses), it needs to work in conjunction with processes of optimization and compensation.

If approached within an action-theoretical framework, the following characterizations of these three components hold:

1. *Selection* involves goals or outcomes.
2. *Optimization* involves goal-related means to achieve success (desired outcomes).
3. *Compensation* involves a response to loss in goal-relevant means in order to maintain success or desired levels of functioning (outcomes).

Figure 18.6 (Baltes & Baltes, 1990b; Marsiske et al., 1995) presents the overall framework of SOC and examples of the kind of events which we classify as selection, optimization, and compensation. An everyday example may help to clarify these distinctions, drawn from the context of aging research that we used in our early efforts at developing the SOC model (P. Baltes, 1984). When the concert pianist Arthur Rubinstein, as an 80-year-old, was asked in a television interview how he managed to maintain such a high level of expert piano playing, he hinted at the coordination of three strategies. First, Rubinstein said that he played fewer pieces (selection); second, he indicated that

he now practiced these pieces more often (optimization); and third, he said that to counteract his loss in mechanical speed he now used a kind of impression management such as introducing slower play before fast segments, so to make the latter appear faster (compensation).

The use of action-theoretical perspectives to illustrate the operationalization of the SOC model might suggest the conclusion that SOC is intended always to be a process with intention and rationality. This is not so. Each of these elements or components can be active or passive, internal or external, conscious or unconscious (Baltes & Baltes, 1996; Marsiske et al., 1995). Moreover, depending on the function of these components in a given behavioral unit, the characterization of a behavioral event can change, for instance, from active to passive. These terms (active vs. passive, internal vs. external, conscious vs. unconscious) are not to be understood in a strict categorical and exclusive sense. They denote a "more or less" quality. In this sense, we side with the Aristotelian principle that all causes (e.g., material, efficient, formal, final) can be simultaneously invoked when trying to understand the totality of a given behavior or action unit. The situation is further complicated by the fact that it is an essential characteristic of the data-theory dynamic in ontogenetic

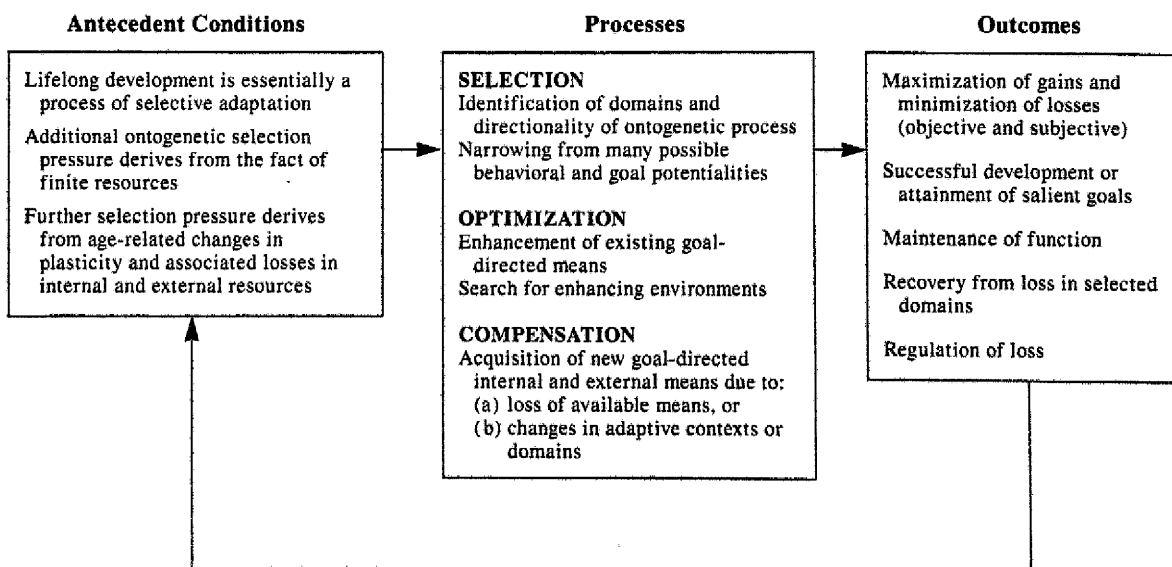


Figure 18.6 The life-span model of selective optimization with compensation. The essentials of the model are proposed to be universal, but specific phenotypic manifestations will vary by domain, individual, sociocultural context, and theoretical perspective (adapted from M. Baltes, 1987; P. Baltes, 1987, 1997; Baltes & Baltes, 1990b; Marsiske et al., 1995).

development (Reese, 1994) that the processes can change, for instance, from conscious to unconscious, as a skill becomes automatic and routinized (Ericsson & Smith, 1991).

Selection. As defined above, *selection involves directionality, goals, and outcomes*. Strictly speaking, selection already begins in embryonic development with features of the sensory system, such as differential sensitivity to light and pattern configurations. Neurophysiological processing of information represents another fundamental example of selection and selection-based specialization (Barkow et al., 1992; Johnson & Karmiloff-Smith, 1992; Karmiloff-Smith, 1992; Klix, 1993; Siegler, 1989).

In our approach to SOC, selection implies a focus of mind and behavior that identifies the domains of behavior and directs behavior and its development. By selection, a given individual (actively or passively) samples from a population of possibilities or opportunities. At the same time, a certain restriction results. Alternative options are not pursued. One concrete illustration of selection in development can be associated with a concept from developmental biology: Selection as the "canalized" (Waddington, 1975) realization of a set of outcomes from the "potentialities of ontogenesis" (plasticity). Another example of selection is the goal system (ranging from skills to attitudes and values), which defines the social and personal frames of desirable development. Selection, of course, can also involve the avoidance of specific outcomes of development such as the undesired self.

In our measurement framework (P. Baltes, Baltes, Freund, & Lang, 1995), we make an effort to distinguish between two kinds of selection: *elective* and *loss-based selection*. Elective selection is assumed to be primarily the result of a prepared module- and motivation-driven selection from a number of possible pathways. Loss-based selection results from the current unavailability of previously existing resources and from the limitations in resources created by an antecedent selection. Table 18.5 (from P. Baltes, Baltes, Freund, & Lang, 1995) contains sample items from a questionnaire to illustrate further this distinction.

Optimization. The focus of *optimization is on goal- or outcome-relevant means or resources*. Thus, while selection is a necessary condition for successful development (defined as the maximization of gains and minimization of losses), selection is not a sufficient condition.

In addition, conditions and procedural mechanisms of goal-attainment, that is, methods of optimization, are required. Optimization, then, involves processes aimed at the generation and refinement of means-ends resources and motivational-goal explication to achieve development-oriented positive outcomes (goals). In general, optimization is not the refinement of a single means. Rather, optimization requires a mutually enhancing coalition of factors, including health, environmental, and psychological conditions (Marsiske et al., 1995; Staudinger et al., 1995).

Table 18.5 Selection, Optimization, and Compensation (SOC) Embedded in an Action-Theoretical Framework (after P. Baltes, M. Baltes, Freund, & Lang, 1995). Note that this specification reflects our specific explication of our general theoretical orientation, that is, from the point of view of action theory.

Selection (Goals/Preferences)	Optimization (Goal-Relevant Means)	Compensation (Means/Resources for Counteracting Loss/Decline in Goal-Relevant Means)
<i>Elective selection</i>		
—specification of goals	—attentional focus	—substitution of means
—evolution of goal system (hierarchy)	—effort/energy	—neglect of optimizing other means
—contextualization of goals	—time allocation	—increased effort/energy
—goal-commitment	—practice of skills	—increased time allocation
	—acquiring new skills/resources	—activation of unused skills/resources
	—modeling successful others	—acquiring new skills/resources
	—motivation for self-development	—modeling successful others who compensate
<i>Loss-based selection</i>		
—focusing on most important goal(s)		—use of technical aids
—search for alternate goals		—use of assistance/help/therapy
—reconstruction of goal hierarchy		
—adaptation of standards		

As was true for selection, optimization can be active and passive, conscious and subconscious, internal or external. Moreover, optimization can be domain- and goal-specific as well as domain- and goal-general. The most domain-general notion of optimization is the generation of developmental reserve capacity (P. Baltes, 1987; Kliegl & Baltes, 1987), or plasticity of general-purpose mechanisms (see below).

Compensation. *Compensation involves a functional response to the loss of a goal-relevant means* (see also, Brandtstädter & Wentura, 1995; Dixon & Bäckman, 1995). This definition of compensation is more specific or restricted than the one proposed by Bäckman and Dixon (1992)—that is, it restricts compensation to responses to losses of means (resources) once available for goal attainment. There are two major functional categories of compensation. A first is to enlist new means as strategies of compensation to reach the same goal. The second compensatory strategy is to change goals of development themselves (Baltes & Baltes, 1990b; Brandtstädter & Baltes-Götz, 1990; Brandtstädter & Wentura, 1995; Heckhausen & Schulz, 1995). This second category, a compensatory change in goals, is related to what we earlier called a loss-based selection effect.

Two main causes give rise to a compensatory situation (Marsiske et al., 1995). A first is conditioned by the very fact of selection and optimization. For reasons of limited capacity of time and effort, selection of and optimization toward a given goal can imply the loss of means relevant for the pursuit of other goals. When an athlete aims for a high-level performance in the shot put, it is unlikely that comparable high levels of performance can be achieved in other types of sports such as gymnastics. As discussed above, there is no selection without loss, and where compensation is concerned, this selection-based loss means a reduction of resources that would be necessary to continue to pursue other developmental goals. Negative transfer is a related result of selection and optimization. The acquisition of a targeted expert skill system "A" can result in negative transfer to another skill system "B" (Ericsson & Smith, 1991). This example highlights the more general phenomenon that any process of development is a process of selective adaptation and, therefore, at the same time produces losses in means (resources) relevant for other goals of development.

A second category of causes of compensation stems from environment-associated changes in resources and age-associated changes in behavioral plasticity. Changing from one environment to another may involve a loss in environment-based resources (means) or may make some acquired personal means dysfunctional. Losses due to the biology of aging are perhaps the best known age-associated negative changes in behavioral plasticity. With aging, there is a reduction in the rate and scope of plasticity (P. Baltes, 1987; Cotman, 1985; Woodruff-Pak & Hanson, 1995). Such normative age-associated decline in plasticity can be accelerated further by non-normative events such as accidents or illnesses. In each of these instances, the central issue is a loss in goal-relevant means. As a result, the evolution of compensatory responses is a continuously changing dynamic of development in the second half of life.

Distinguishing between these categories of causes for compensation is not always easy as multicausality and multifunctionality suggest that multiple antecedent and outcome criteria can be involved. Moreover, the categorical status is likely to change, for instance, as the compensatory responses become automatic and can then be used for other functions such as optimization.

Selective Optimization with Compensation: Coordination and Dynamics in Development

We have noted already that, due to changes in the functional and contextual location, one conceptual and methodological difficulty is uncertainty about whether a given event is selection, optimization, or compensation. Indeed, it is central to ontogenetic development (because of multicausality, multifunctionality, equifinality, and age-related changes in these characteristics) that the logical status of selection, optimization, and compensation varies (Marsiske et al., 1995). However, their collaborative function is always to achieve "successful development" as defined above.

For instance, whether a given behavioral event is classified as selection, optimization, and compensation can vary depending on the point of scientific perspective and entry into the stream of observation of a developmental process. Perspectives vary in terms of the definition of units, of outcomes, as well as of the spatial (contextual) and temporal (developmental) location. In other words, whether a given behavior is interpreted as selection,

optimization, or compensation is conditioned by such issues as multicausality and multifunctionality in behavior and development. In addition, the specification can vary because there are ontogenetic changes in functionality (their use and consequences) of the processes.

Understanding this changing developmental dynamic is particularly important regarding the conceptual distinctiveness of optimization and compensation (Marsiske et al., 1995). At the point of origin, for instance, some behavior may have been compensatory (such as acquiring nonverbal techniques of communication due to a loss of foreign language proficiency), at later points in ontogeny or in different contexts these same compensation-based behavioral means (nonverbal techniques of communication) can be used as a technique of optimization, such as when improving one's performance as an actor. It is important, therefore, to specify the context and the developmental space in which a given behavioral event is considered when deciding about its category allocation to either selection, optimization, or compensation.

As the model of SOC does not designate the specific content and form of desirable developmental outcomes, it is applicable to a large range of variations in goals and means of development. Thus, without offering prescriptive specifications, the nature of SOC is conditioned upon the personal and social definition of the targets of ontogenesis; that is, of the desired and undesired goals or outcomes. In this sense, then, SOC is at the same time *relativistic* and *universal*. Its relativity lies in the variations of motivational, social, and intellectual resources, as well as in the criteria used to define successful development, which can be multivariate and involve both objective and subjective indicators (Baltes & Baltes, 1990b). Its universalism rests in the argument that any process of development is expected to involve components of selection, optimization, and compensation (Baltes & Baltes, 1990b; Marsiske et al., 1995).

Table 18.6 offers a few examples of SOC-related biographies. As can be seen from the examples given, the assumption of the SOC model is that three elements (selection, optimization, and compensation) constitute the basic component processes for age-related change in selective adaptive capacity (development). It is also assumed that in reality the three components are always intertwined, that they form a cooperative (interactive) system of behavioral action or outcome-oriented functioning.

Table 18.6 Selective Optimization with Compensation: Biographical Examples (after Marsiske et al., 1995)

Source	Selection	Optimization	Compensation
Athlete Michael Jordan (Greene, 1993)	Focused only on basketball in youth, excluding swimming and skating	Daily line drills and upper body training	Reliance on special footwear to deal with chronic foot injury
Scientist Marie Curie (Curie, 1937)	Excluded political and cultural activities from her life	Spent a fixed number of hours daily in isolation in her laboratory	Turned to the advice of specific colleagues when encountering scientific problems that were beyond her expertise
Concert pianist Rubinstein (Baltes & Baltes, 1990b)	Played smaller repertoire of pieces in late life	Practiced these pieces more with age	Slowed performance before fast movements (<i>ritardando</i>) to heighten contrast

Without specifying the substantive goals and outcomes of development, the SOC model is intended to characterize the processes that result in desired outcomes of development while minimizing undesirable ones. Depending upon which level of analysis is chosen (societal, individual, microbehavioral, etc.), selective optimization with compensation requires the use of a different lens for different levels of measurement and specification. For instance, at a biographical level of analysis, the lens might focus on the interplay among educational, family, professional, and leisure careers. But when studying cognitive reserve capacity, for instance by means of dual- or parallel-task processing, the lens might focus on the SOC-related interplay between components of working memory and other attentional resources.

In the following two sections dealing with life-span developmental theory and research in two domains of functioning, we will occasionally return to SOC-related interpretations. However, our intent is not to elevate the SOC-model to the one overarching model of life-span development. This would be inappropriate. In our view, the model of selective optimization with compensation is but one of the theoretical efforts that life-span research and theory have spawned. However, we believe SOC to be a

model that displays much consistency across levels of analysis and can be usefully linked to other current theoretical streams in developmental psychology, such as to dynamic systems theory.

INTELLECTUAL FUNCTIONING ACROSS THE LIFE SPAN

As discussed in the previous section, a genuine life-span orientation to developmental change depends critically on articulating the theoretical propositions regarding the macroscopic overall landscape of the entire course of ontogeny with more microscopic research on specific developmental functions, processes, and age periods. Specifically, the knowledge bases generated by researchers interested in different aspects of infancy, childhood, adolescence, adulthood, and late life need to be combined and compared with each other, and organized by the themes and propositions that guide the life-span approach. The resulting life-span integration of perspectives and findings, in turn, is hoped to feed back into the more age- and process-specific developmental specialities, providing for larger interpretative frameworks and provoking the investigation of new or formerly neglected research questions.

Currently, perhaps no other field within developmental psychology is better suited to demonstrate the potential of this dynamic than the field of *intellectual development*, which captured early (Hollingworth, 1927; Sanford, 1902) and thereafter continued attention in life-span developmental psychology. Central themes of intellectual development, such as relative stability (i.e., covariance change over time), directionality (i.e., mean change over time), plasticity (i.e., the malleability of mean and covariance changes), and the role of knowledge-based processes in cognitive development also played a prominent role in life-span theorizing, and are well suited to depict the implications of the life-span approach.

The Biology and Culture of Life-Span Intellectual Development

Our proposed view of the overall landscape of ontogenesis, as it was summarized in Figure 18.1, puts constraints upon the possible form and content of theories about life-span intellectual development. Foremost, any model or theory

on life-span intellectual development needs to recognize that ontogenesis is embedded within two streams of inheritance, the biological and the cultural (Durham, 1990, 1991), and needs to provide a framework for the developmental investigation of these two streams of inheritance in different domains, and at different levels of analysis. Specifically, the model should be consistent with the three-fold characterization of the life-span dynamics between biology and culture: (a) a decrease in the degree of biological orchestration and the quality of genome expression with advancing age; (b) an increase in the need for culture to achieve and maintain adaptive functioning; (c) increased difficulties for culture and individuals to produce adaptive outcomes due to decrements in the quality of the expressed genome.

We posit that this fundamental shift in balance between biology and culture during ontogeny has to occupy a central place in any life-span approach to intellectual development. In addition, models of life-span intellectual development are expected to be consistent with the family of theoretical propositions summarized in Table 18.3. For instance, they need to recognize that development is a life-long process of local (i.e., context-specific and time-bound) selection and adaptation embedded in a changing ontogenetic and sociohistorical context. Moreover, such models (Figure 18.6) need to be prepared to deal with idiosyncratic (non-normative) events which can enter the life course at unexpected times and with possibly powerful consequences.

The Two-Component Model of Life-Span Cognition: Mechanics versus Pragmatics

In the past, one of us (P. Baltes, 1987, 1993, 1994; cf., P. Baltes et al., 1984; P. Baltes & Graf, 1996) has proposed a theoretical framework for the study of intellectual development in which two main categories or components of intellectual functioning are set apart: The *mechanics* and the *pragmatics* of cognition. The model draws on earlier formulations, such as the theory of fluid and crystallized intelligence by Cattell and Horn (Cattell, 1971; Horn, 1982), and the distinction between intellectual power and intellectual products by Hebb (1949). In analogy to computer language, one may refer to these two categories or components as the hardware (cognitive mechanics) and the software (cognitive pragmatics) of the mind. Juxtaposing the two does not imply that they are independent or exclusive. As we will argue in more detail below, the mechanics and

pragmatics interact across ontogenetic and microgenetic time in the production of intelligent behavior. For instance, the pragmatics clearly cannot exist without the mechanics.

The two-component model of life-span intellectual development is consistent with our general notions of the dynamic between biology and culture during ontogenesis. In fact, historically, our views on the overall landscape of human development were developed in close connection with the broadening and systematization of the mechanic-pragmatic distinction (P. Baltes, 1987, 1993, 1997). For this reason, the research agenda entailed by the meta-theoretical propositions of the life-span approach are well articulated within this particular domain of functioning. Specifically, we construe the *mechanics* of cognition as an expression of the neurophysiological architecture of the mind as it evolved during biological evolution (cf., Barkow, Cosmides, & Tooby, 1992; Tooby & Cosmides, 1995) and unfolds during ontogenesis (Rakic, 1995). In contrast, the *pragmatics* of cognition are associated with the bodies of knowledge available from and mediated through culture (see upper portion of Figure 18.7).

The Mechanics. In the mechanics of cognition, biological including neurophysiological brain conditions reign supreme, and the predominant age-graded ontogenetic pattern is one of maturation, stability, and aging-induced decline. Age-based changes in this component early and late in ontogeny are assumed to be strongly influenced by genetic and other brain-status related factors, albeit in fundamentally different ways (P. Baltes, 1994; P. Baltes & Graf, 1996). Early in ontogeny (i.e., during embryogenesis, infancy, and early childhood), age-based changes in the mechanics are assumed to reflect, for the most part, the unfolding and active construction of more or less domain-specific and predisposed processing capabilities (Fischer & Hencke, 1996; Karmiloff-Smith, 1992; Siegler & Crowley, 1994; Wellman & Gelman, 1992). In contrast, negative changes in the mechanics of cognition late in life presumably result from brain-related consequences of less effective phylogenetic selection pressures operating during this period (P. Baltes, 1994, 1997; see the second part of this chapter). In that sense, the life-span trajectory of level changes in the mechanics of cognition can be derived from the life-span changes shown in Figure 18.1(a).

The cognitive mechanics, then, reflect fundamental organizational properties of the central nervous system

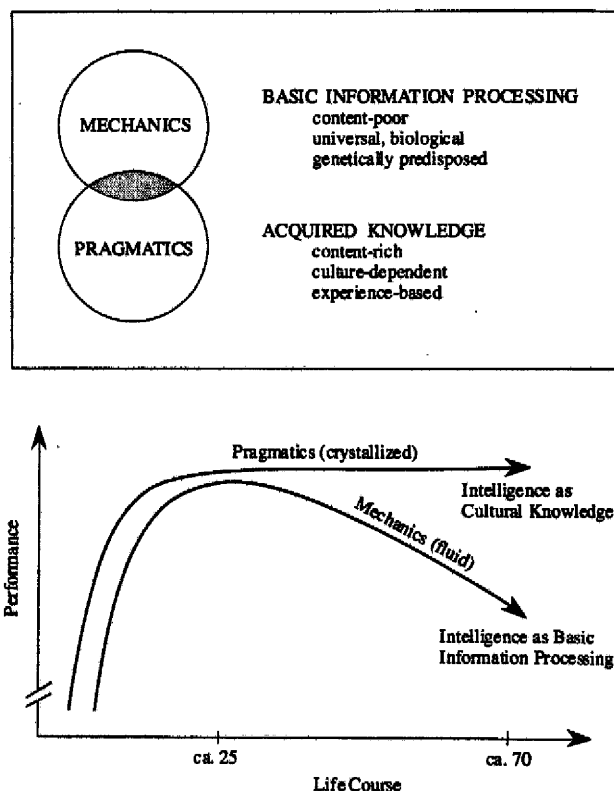


Figure 18.7 Life-span research on two components of cognition, the fluid mechanics, and the crystallized pragmatics. The top section defines the categories, the bottom section illustrates postulated life-span trajectories (after Baltes & Graf, 1996; cf. Cattell, 1971; Hebb, 1949; Horn & Hofer, 1992). The advanced old age, the trajectories evince less and less differentiation (cf. P. B. Baltes & Lindenberger, 1997, see below).

(W. Singer, 1995). In terms of psychological operations, we assume that the cognitive mechanics are indexed by the speed, accuracy, and coordination of elementary processing operations as they can be assessed in tasks measuring the quality of information input, sensory and motor memory, discrimination, categorization, and selective attention, as well as reasoning ability in highly overlearned or novel domains (Craik, 1986; Craik & Jennings, 1992; Craik & Salthouse, 1992; Dawson & Fischer, 1994; Hartley, 1992; Kausler, 1994; Klix, 1992; Moscovitch & Winocur, 1992; Plude, Enns, & Brodeur, 1994; Schieber & Baldwin, 1996).

The Pragmatics. In contrast to the mechanics, the pragmatics of the mind reveal the power of human agency

and culture (Cole, 1996; Lawrence & Valsiner, 1993; Shweder, 1991). Developmental changes in this component reflect the acquisition of culturally transmitted bodies of declarative and procedural knowledge that are made available to individuals in the course of socialization. Some of these socialization events are normative but specific to certain cultures (e.g., formal schooling), others are more universal (e.g., mentoring), and still others are idiosyncratic or person-specific (e.g., specialized ecological and professional knowledge). In any case, the corresponding bodies of knowledge are represented both internally (e.g., semantic networks; cf., Kintsch, 1988) and externally (e.g., books). These knowledge systems are *acquired* during ontogeny but may build on evolutionarily prestructured, domain-specific knowledge (Karmiloff-Smith, 1992). In this way, the pragmatics of cognition direct the attention of life-span developmentalists towards the increasing importance of knowledge-based forms of intelligence during ontogeny (Baltes & Baltes, 1990b; Ericsson & Lehmann, 1996; Ericsson & Smith, 1991; Featherman, 1983; Labouvie-Vief, 1982; Rybash, Hoyer, & Roodin, 1986; Weinert & Perner, 1996). Typical examples include reading and writing skills, educational qualifications, professional skills, and varieties of everyday problem-solving, but also knowledge about the self and the meaning and conduct of life (Berg, 1996; Blanchard-Fields, 1996; Bosman & Charness, 1996; Cornelius & Caspi, 1987; Marsiske et al., 1995; Marsiske & Willis, 1995; Staudinger et al., 1995; Walsh & Hershey, 1993; see the next section of this chapter).

Divergence in Life-Span Trajectories between Mechanics and Pragmatics. The preceding considerations imply specific predictions regarding the shape of ontogenetic trajectories for mechanic and pragmatic aspects of intellectual functioning (see lower portion of Figure 18.7). Specifically, the *level* of performance within these two categories of intellectual functioning is assumed to be governed by two different sources of influence: biological-genetic for the mechanics, and environmental-cultural for the pragmatics. The expected divergence in age trajectories is seen as a consequence of this difference in composition.

Empirical evidence in support of this assumption comes from a great variety of different research traditions (see below). Probably the most longstanding supportive evidence is the difference between maintained and vulnerable intellectual abilities (Denney, 1984; Salthouse, 1991c; cf.,

Jones & Conrad, 1933). Abilities that critically involve the mechanics, such as reasoning, memory, spatial orientation, and perceptual speed, generally show a pattern of monotonic and roughly linear decline during adulthood, with some further acceleration of decline in very old age. In contrast, more pragmatic abilities, such as verbal knowledge and certain facets of numerical ability, remain stable or increase up to the sixth or seventh decade of life, and only start to evince some decline in very old age.

Figure 18.8, which is based on the fifth data collection of the Seattle Longitudinal Study (Schaie, 1996), serves as an illustration (for similar evidence with respect to episodic versus semantic memory, see Nyberg, Bäckman, Erngrund, Olofsson, & Nilsson, 1996). It displays cross-sectional adult age gradients based on multiple indicators

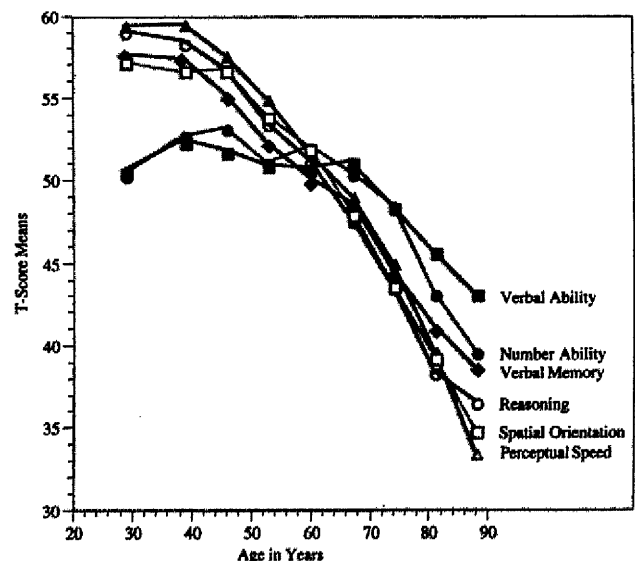


Figure 18.8 Cross-sectional age gradients in six primary mental abilities ($N = 1628$). Abilities were assessed with 3 to 4 different tests, and are scaled in a T-score metric (i.e., $mean = 50$, $SD = 10$). Verbal ability and number ability peak during middle adulthood, and show little or no age decrements before the age of 74. In contrast, perceptual speed, inductive reasoning, spatial orientation, and verbal memory show steady monotonic decline. This differential pattern of prevailing growth, maintenance, and subsequent loss supports two-component theories of life-span intellectual development, such as the distinction between fluid and crystallized intelligence made by Cattell (1971) and Horn (1982), or the juxtaposition of the mechanics and the pragmatics of cognition proposed by P. Baltes (1987, 1993, 1997) (based on Schaie & Willis, 1993).

for six intellectual abilities (Schaie & Willis, 1993). Verbal ability and number ability peak during middle adulthood and show little or no age decrements before the age of 74, whereas perceptual speed, inductive reasoning, spatial orientation, and verbal memory show steady monotonic decline. Data on longitudinal age gradients provide converging evidence (Salthouse, 1991c; Schaie, 1994, 1996).

The Two-Component Model: Relations to Other Theories

As mentioned already, the closest relative, both conceptually and historically, to the two-component model of life-span intellectual development is the theory of fluid (Gf) and crystallized (Gc) abilities by Cattell (1971) and Horn (1982). One rationale common to both conceptualizations is to provide a theoretical explanation for the different age gradients of psychometrically assessed intellectual abilities. However, the two frameworks differ in scope and research emphasis. Whereas the Gf-Gc distinction remains, empirically and theoretically, within the confines of the psychometric research tradition, the mechanic-pragmatic distinction links developmental findings obtained within the psychometric tradition to perspectives from cognitive psychology, evolutionary psychology, cultural psychology, and developmental biology.

Other approaches related to the two-component model include Sternberg's (1985) triarchic theory of intelligence, especially its developmental interpretation by Berg and Sternberg (1985a), Denney's (1984) distinction between unexercised and optimally exercised cognitive abilities, Hebb's (1949) distinction between intelligence A (i.e., intellectual power) and intelligence B (i.e., intellectual products), Ackerman's (1996) recently proposed PPIK (process, personality, interests, and knowledge) theory, and the encapsulation model of adult intelligence proposed by Rybash, Hoyer, and Roodin (1986; Hoyer, 1987). In addition, Hunt (1993) recently offered an information-processing reinterpretation of the Gf-Gc theory which resonates well with the two-component model (see also, Welford, 1993).

In the following, the two-component model will be further elaborated in three separate sections: Mechanics, pragmatics, and their interrelations. In each section, we first present select concepts and research, and provide empirical examples for prototypical life-span trends. The aim of these three sections is not to be comprehensive, but to further specify the two components of cognition as well as their interaction. More comprehensive discussions of

important topics in life-span research on intellectual development are provided in subsequent sections.

The Fluid Mechanics of Cognition

We start this section with a life-span summary of research on constructs that have been proposed to cause or mediate age-based changes in the mechanics of cognition. We then argue that much of the available evidence about age-based changes in the mechanics derives from measures that are contaminated by pragmatic influence, and we underscore the need to arrive at more valid estimates of individual differences in the upper limits of mechanic functioning. In line with the two-component model, we predict that age differences in the mechanics are magnified under purified measurement conditions; and we provide an empirical example from adulthood in support of this prediction.

The Search for Determinants of Mechanic Development

Despite a large overlap in approaches to the study of intellectual development (cf., Lindenberger & Baltes, 1994a), such as the *psychometric* (Cattell, 1971; Horn & Hofer, 1992; Humphreys & Davey, 1988), *information-processing* (Craik, 1983; Kail, 1991; Salthouse, 1991c), and *expertise* (Chi & Koeske, 1983; Ericsson, Krampe, & Tesch-Römer, 1993; Weinert, Schneider, & Knopf, 1988), there are surprisingly few attempts to pursue the themes of infant and child development into adulthood and old age, or to identify thematic and predictive antecedents of adulthood and old age in childhood.

An important exception in this regard concerns work on age changes in general information-processing constraints on intellectual functioning across the life span, or what we would call research on the *determinants of age-based changes in the mechanics of cognition*. Researchers both in the fields of child development (Bjorklund & Harnishfeger, 1990; Case, 1992; Fischer & Rose, 1994; Kail, 1991; McCall, 1994; Pascual-Leone, 1983; Siegler & Shipley, 1995) and cognitive aging (Birren, 1964; Birren & Fisher, 1995; Cerella, 1990; Craik & Byrd, 1982; Hasher & Zacks, 1988; Salthouse, 1996) have been trying to identify developmental determinants or "developables" (Flavell, 1992) that regulate the rate of age-based changes in cognitive and intellectual functioning. More importantly, some scholars have begun to link these two lines of inquiry, and to provide unified accounts of age-based changes in the structure

and/or efficiency of information processing (e.g., Dempster, 1992; Kail & Salthouse, 1994; Mayr, Kliegl, & Krampe, 1996; Pascual-Leone, 1983; Salthouse & Kail, 1983).

In our view, this search for maturational and/or aging-induced general processing constraints may help to identify the processes and mechanisms that underlie positive age gradients in the mechanics of cognition during infancy and childhood, and negative age gradients during late adulthood and old age. So far, three constructs have been studied most extensively: *information processing rate*, *working memory*, and *inhibition*. Research from all periods of the life span suggests that the functional levels of these three mechanisms follow the inverse U-shape pattern predicted by the two-component model. In principle, then, any combination of these mechanisms could act as a pacemaker of life-span development in the mechanics of cognition. Accordingly, these mechanisms often are defined in resource terminology (e.g., energy, time, or space; cf., Craik, 1983; Spearman, 1927). Moreover, first attempts have been made to relate these mechanisms to age-based changes at a more physiological level (Case, 1992; Dempster, 1992; Fischer & Rose, 1994; Moscovitch & Winocur, 1992).

Information Processing Rate. Across a wide variety of cognitive and perceptual tasks, speed of responding increases from childhood to early adulthood, and decreases thereafter. Figure 18.9 provides an illustration of this ubiquitous finding. It displays normative data for two tests of perceptual speed of the Woodcock-Johnson Tests of Cognitive Ability (1990). The data are based on a representative sample of over 6,000 US citizens ranging from six to 80 years of age. The observed age differences are expressed in standard deviation units of a reference group of more than 250 18-year-old individuals. Six-year-old individuals performed about five, and 75-year-old individuals more than two standard deviations below the young-adult mean. Thus, the data clearly follow the inverted U-shape pattern.

The longstanding observation of generalized age changes in response latency has led to the processing rate hypothesis of cognitive development and aging. Probably, this hypothesis holds a more central place in cognitive aging research (Birren, 1964; Birren & Fisher, 1995; Cerella, 1990; Salthouse, 1996; Welford, 1984) than in research on child development (Hale, 1990; Kail, 1991). In the case of cognitive aging, the general slowing-down of

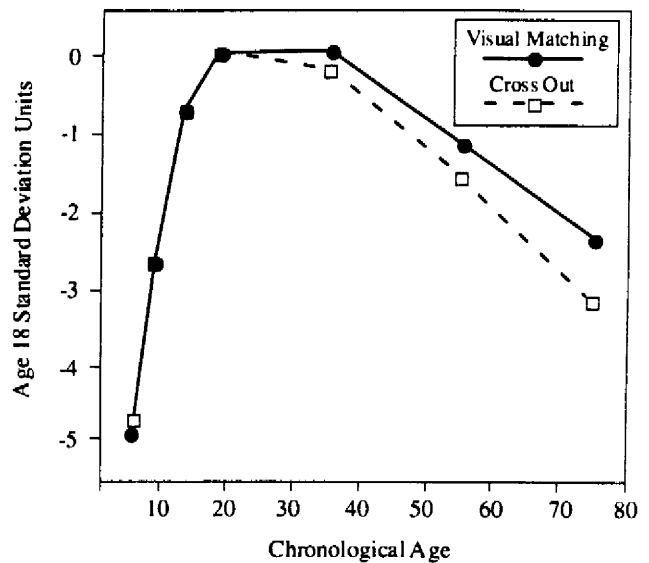


Figure 18.9 Cross-sectional age gradients for two tests of perceptual speed from the Woodcock-Johnson Tests of Cognitive Ability (1990). The figure displays normative data based on over 6,000 individuals between six and 80 years of age. Mean performance levels at different ages are expressed in standard deviations units of 18-year-old individuals (based on Kail & Salthouse, 1994).

cognitive behavior with advancing age is portrayed as the consequence of a general decrement in information processing rate. In agreement with this hypothesis, correlational evidence has supported the prediction that psychometrically assessed perceptual speed accounts for most or all negative adult age differences in other intellectual abilities, even if these other abilities are assessed under time-relaxed or untimed testing conditions (Hertzog, 1989; Lindenberger, Mayr, & Kliegl, 1993; Nettelbeck & Rabbitt, 1992; Salthouse, 1991b).

Additional evidence in support of the processing rate hypothesis has come from meta-analyses of latency data examining the relation between mean latencies for groups of old adults and the mean latencies for groups of young adults (Cerella, 1990; Myerson, Hale, Wagstaff, Poon, & Smith, 1990; but see Perfect, 1994, for methodological problems). Similar analyses of children's versus young adults' reaction time data have led to analogous results (Kail, 1991). Thus, it appears that both children's and old adults' reaction times can be expressed as a function of

young adults' reaction times across a relatively wide range of different tasks, a finding that supports the idea of general age-based changes in speed of processing. At the same time, it needs to be acknowledged that processing rate, as an explanatory construct, is perhaps not unitary (Graf & Uttl, 1995) and, so far, has no direct analogue at the biological level (Bashore, 1993; Wickett & Vernon, 1994). Future research needs to intensify attempts to provide more direct links between psychological changes in speed of processing and ontogenetic neuronal changes, such as increasing myelination during childhood or loss of connectivity in old age (cf., Deary, 1996).

Working Memory. Generally, working memory denotes the ability to preserve information in one or more short-term stores while simultaneously transforming the same or some other information (Baddeley, 1986; Just & Carpenter, 1992). Age differences in working memory have been invoked as a possible cause for intellectual growth during childhood (Case, 1985; Chapman & Lindenberg, 1992; Halford, 1993; Pascual-Leone, 1970), and for age-based decrements during adulthood and old age (Craik, 1983; Craik & Byrd, 1982).

With respect to childhood, Neo-Piagetian theorists have argued that changes in working memory are among the primary pacemakers of intellectual child development (Chapman, 1990). In some conceptions, the capacity of working memory stays constant over age but is used in increasingly efficient ways (Case, 1985). In other models, working memory capacity or M-Space is assumed to increase linearly from one unit at the ages of 3 and four to seven units at the age of 15 (cf., Pascual-Leone, 1970; Ribeaupierre & Bailleux, 1994).

One way to study the effect of age differences in working memory on intellectual functioning is to vary the relative importance of temporary storage and processing (i.e., information transformation) demands within or across tasks. Generally, this research has demonstrated that positive age differences during childhood and negative age differences during adulthood are more pronounced when demands on processing are increased (Craik & Jennings, 1992; Mayr, Kliegl, & Krampe, 1996). In other words, age differences are especially pronounced for tasks that put high demands on the simultaneous coordination of incoming and/or stored information. In addition, more specific longitudinal links during childhood between earlier individual differences in

storing and processing phonological information and later individual differences in vocabulary have been observed (Gathercole & Baddeley, 1993). Finally, correlational studies suggest that working memory measures contribute to positive age differences in the fluid-mechanic component of intelligence during childhood (Chapman & Lindenberg, 1989), and to negative age differences in this component during adulthood and old age (Salthouse, 1991b).

Despite this supportive evidence, the explanatory power of the working-memory construct is difficult to judge. For instance, age-based changes in working memory are often explained by alluding to changes in processing efficiency or processing speed (Case, 1985; Salthouse, 1996). By this account, working memory is not the driving force of developmental change, but the indirect expression of a different developmental mechanism. Another problem concerns our limited knowledge about a central function of working memory—the *conscious control of action and thought*. In the most influential working-memory model (Baddeley, 1986), this task is assigned to the central executive. Evidence from developmental psychology (Dempster, 1992; Houdé, 1995), cognitive-experimental psychology (Conway & Engle, 1994), and the cognitive neurosciences (Goldman-Rakic, 1995; Shallice & Burgess, 1991) suggests that the *abilities to inhibit actions and thoughts and/or to avoid interference* are crucial for the efficient functioning of this component, rather than working-memory capacity per se (cf., Brainerd, 1995; Stoltzfus, Hasher, & Zacks, 1996).

Inhibition and Interference. Recently, developmentalists from different traditions and fields of research have intensified their interest in inhibition and interference (Bjorklund & Harnishfeger, 1990, 1995; Harnishfeger, 1995; Hasher & Zacks, 1988; Houdé, 1995; McCall, 1994; McDowd, Oseas-Kreger, & Filion, 1995; Stoltzfus, Hasher, & Zacks, 1996). This interest in inhibition has led to reinterpretations of available evidence and to the collection of new data trying to support the notion that age differences in the efficiency of inhibitory processes are of general relevance for age differences in cognitive functioning.

For instance, Houdé (1995) and others (Bjorklund & Harnishfeger, 1990, 1995) have argued that children's difficulties in solving certain cognitive tasks (e.g., the A-not-B task) are well explained by their inability to inhibit distracting information. Moreover, recent empirical work with the negative-priming paradigm suggests that some

variants of inhibition function less effectively in children and older adults than in young adults (May, Kane, & Hasher, 1995), and that older adults show more proactive interference in verbal learning than young adults (Kliegl & Lindenberger, 1993). Finally, curvilinear life-span age gradients that resemble those found for measures of perceptual speed have been obtained with typical tests of interference proneness, such as the Stroop color-word test (Comalli, Wapner, & Werner, 1962; cf., Dempster, 1992). At present, however, it is unclear whether these age gradients reflect genuine curvilinear age gradients in interference proneness, or whether they can be portrayed as an epiphenomenon of age differences in speed of responding (Salthouse & Meinz, 1995) and/or selective attention and discrimination (Engle et al., 1995).

Summary and Prospects. Age-comparative research on information-processing determinants has produced a rich and solid empirical data base about life-span changes in fundamental dimensions of the cognitive mechanics. Specifically, processing rate, working memory, and inhibition all evince a pattern of rapid growth during infancy and childhood followed by aging-induced monotonic decline during later parts of adulthood and old age. In addition, this field has witnessed the formulation of specialized developmental theories that are truly life-span in kind (e.g., Kail & Salthouse, 1994; Pascual-Leone, 1983).

Given the propensity of research in this area, and the interdisciplinary potential of the topic, we expect that current conceptions of life-span changes in the mechanics of cognition will undergo important changes during the next decade. Specifically, the search for life-span determinants of the mechanics of cognition is likely to increasingly profit from the general progress in the cognitive neurosciences (Gazzaniga, 1995). In light of the rapid expansion and refinement of theories and methods in that field, and their growing application to cognitive development (C. Nelson, 1995), it seems likely that the domain-general determinants identified so far will undergo revision, and that new determinants will be identified. For instance, closer contact to the neurosciences may help to decide whether the three different determinants identified so far constitute distinct developmental entities, or whether they are differentiated expressions of a common cause. Moreover, such contact will also enhance our knowledge about the systemic properties of developing brains (Fischer & Rose, 1994;

Johnson & Rybash, 1993; Li, Lindenberger, & Frensch, 1996; van der Maas & Molenaar, 1992). One example in this regard is the potential adaptive value for maturing systems to start small and get larger, or the benefits of immaturity (Bjorklund & Green, 1992; Elman, 1993; Kareev, 1995; Newport, 1990; Turkewitz & Kenny, 1982). Finally, developmentalists need to learn more about the dimensionality of age-based changes in the mechanics, that is, about the degree to which such changes are general or function-specific (e.g., modular; cf., Giambra, 1993; Johnson & Rybash, 1993; Light & LaVoie, 1993; Madden & Plude, 1993; Naito & Komatsu, 1993). In cognitive aging research, this issue has led to productive controversies at the interface between different methodological and theoretical approaches, such as the multivariate-psychometric, cognitive-experimental, and neuropsychological (Anderson, 1992; Cerella, 1990; Hertzog, 1996; Kliegl, Mayr, & Krampe, 1994; Maylor & Rabbitt, 1994; Molenaar & van der Molen, 1994; Perfect, 1994; Rabbitt, 1993; Salthouse, 1994).

Age-Based Differences in the Mechanics of Cognition: The Need for Purification of Measurement

Observed age differences or age changes on intellectual tasks and tests, as obtained in standard cross-sectional and real-time longitudinal research, cannot be regarded as direct and pure reflections of age-based changes in the mechanics of cognition. Rather, in addition to the mechanics, such differences or changes are influenced by a wealth of additional factors, ranging from pragmatic components of cognition (e.g., task-relevant pre-experimental knowledge) to other person characteristics (e.g., test anxiety, arousal; cf., Fisk & Warr, 1996). For this reason, much of our knowledge about the life-span trajectory of the mechanics of cognition is based on relatively imprecise indicators.

A likely indication for this admixture of pragmatic variance to supposedly mechanic measures is the secular rise in performance on typical psychometric marker tests of fluid intelligence (cf., Flynn, 1987). Apparently, performance on these tests is more sensitive to short-term historical trends in schooling and acculturation than originally assumed. Another example concerns the measures of perceptual speed that form the basis of Figure 18.9. One of them, the Visual Matching Test, requires individuals to locate and circle the two identical numbers in a row of six numbers. Proficiency in this task is not a pure function of perceptual speed but also reflects, to some degree, specific

experience in dealing with numbers, which most likely introduces a bias against children.

The need for better estimates of individuals' performance potential in the mechanics of cognition is further nurtured by the life-span proposition that epigenesis is probabilistic but not random (P. Baltes, 1987; Gottlieb, 1983, 1996; Gottlieb et al., Ch. 5, this Volume; R. Lerner, 1984; see Table 18.3). In biological terms, an implication of this view is that individuals' cognitive performance as it can be observed under standard testing conditions represents just one possible phenotypic manifestation of their range of performance potential, or "norm of reaction." Therefore, if the goal is to separate the possible from the impossible over age, and to solidify the evidence on age differences in the mechanics of cognition, the context of measurement needs to be moved towards the *upper limits* of the performance potential. This line of reasoning resembles claims made by other research traditions, such as clinical and developmental diagnostics (Carlson, 1994; Guthke & Wiedl, 1996), the differentiation between performance and competence, gestalt and cultural-historical theoretical orientations (Rogoff, 1995; Vygotsky, 1962; H. Werner, 1948; cf., Brown, 1982), and work on age differences in learning (Reese & Lipsitt, 1970). Large differences in epistemology and purpose notwithstanding, all these traditions are inspired by an interest in exploring individuals' upper limits of intellectual performance.

Testing-the-Limits of Age Differences in the Mechanics of Cognition. Within life-span developmental psychology and as alluded to above, the testing-the-limits paradigm has been introduced as a research strategy to uncover age differences in the upper limits of mechanic functioning (P. Baltes, 1987; Kliegl & Baltes, 1987; Kliegl et al., 1990; Lindenberger & Baltes, 1995b). The main focus of this paradigm is to arrange for experimental conditions that produce maximum (i.e., asymptotic) levels of performance. Thus, similar to stress tests in biology and medicine (M. Baltes, Kuhl, Gutzmann, & Sowarka, 1995; Fries & Crapo, 1981), testing-the-limits aims at the assessment of age differences in maximum levels of cognitive performance by providing large amounts of practice and/or training combined with systematic variations in task difficulty. Furthermore, and in line with the microgenetic approach to the study of change (Kuhn, 1995; Siegler & Crowley, 1991; Siegler & Jenkins, 1989), testing-the-limits

is based on the assumption that changes occurring on different time scales share essential features (cf., H. Werner, 1948). Therefore, in addition to the more general goal of measurement purification, the detailed analysis of time-compressed developmental change functions is assumed to enhance our understanding of the mechanisms and the range of medium- and long-term developmental changes.

A Prototypical Example: Adult Age Differences in Upper Limits of Short-Term Memory (Serial Word Recall)

Most age-comparative testing-the-limits research has been conducted with adults of different ages, rather than with children of different ages, or with children and adults. Figure 18.10 shows the result of a study involving a total of 38 sessions of training and practice in the Method of Loci, a mnemonic technique for the serial recall of word lists. Two findings from this study are noteworthy. First, adults in both age groups greatly improved their memory performance. This findings confirms earlier work on the continued existence of cognitive plasticity in cognitively healthy (i.e., nondemented) older adults (P. Baltes & Lindenberger, 1988; P. Baltes & Willis, 1982; Denney, 1984; Verhaeghen, Marcoen, & Goossens, 1992).

Second, however, practice and training resulted in a close-to-perfect separation of the two age groups, thereby

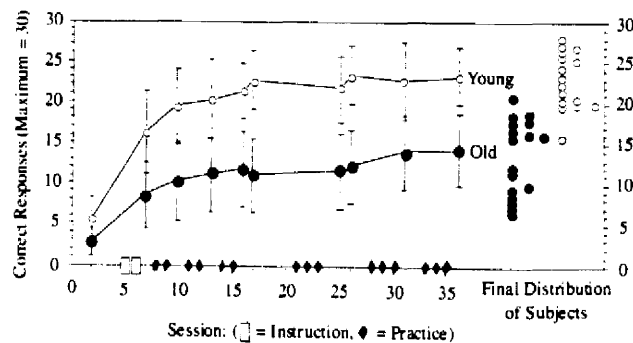


Figure 18.10 Testing-the-limits research, which is aimed at the identification of asymptotes of performance potential, suggests the existence of robust age-related losses in the mechanics of cognition. The example given involves a memory technique, the Method of Loci. After 38 sessions of training, most older adults did not reach the level of performance reached by young adults after only a few sessions. In the final distribution, not a single older person was performing above the mean of the young adults (adapted from P. Baltes & Kliegl, 1992).

demonstrating the existence of sizeable negative age differences at limits of functioning. Even after 38 sessions of training, most older adults did not reach the level of performance that young adults had reached after only a few sessions. Moreover, at the end of the study, not a single older person functioned above the mean of the young-adult group.

The findings obtained with the testing-the-limits paradigm are consistent with our general notion that the mechanics of cognition decrease during adulthood and old age. It appears worthwhile to intensify the use of this paradigm with lower age groups to obtain genuine life-span gradients regarding maximum limits of performance potential in different domains (see Levinson & Reese, 1967, for an early example in this regard). In addition, the focus on age differences in maximum level needs to be complemented by an emphasis on age-differential changes in variances and covariances with practice (P. Baltes, Labouvie, & Frohning, 1973; Rogers, Fisk, & Hertzog, 1994). Given our assumptions regarding life-span changes in adaptive capacity of the mechanics of the mind and the knowledge-contaminated nature of standard assessments, our prediction is that life-span peaks in performance levels are shifted towards younger ages when individuals are given the opportunity to come close to the upper limits of their mechanic potential.

The Crystallized Pragmatics of Cognition

We now direct our attention toward the ontogeny of the cognitive pragmatics, or the cultural and knowledge-rich dimension of intellectual life-span development. First, we discuss the relation between mechanics and pragmatics from an evolutionary perspective. Then, we introduce the distinction between normative and person-specific forms of pragmatic knowledge, and discuss stage- and knowledge-oriented approaches to the issue of intellectual growth after adolescence. To illustrate the knowledge-oriented approach, we end this section with a prototypical example from our own research on expert knowledge about the fundamental pragmatics of life (wisdom).

Mechanics and Pragmatics in Evolutionary Perspective

In recent years, nativist approaches to infant cognitive development have revealed the evolutionary prestructured nature of the human processing system (Mandler, 1992; Spelke & Newport, Ch. 6, this Volume; Spelke, Vishton, &

von Hofsten, 1995). Through innovative advances in experimental methodology, it has become increasingly clear that infants and young children cannot be considered a cognitive *tabula rasa*, as extreme versions of constructivist (e.g., Piaget, 1967/1971, but see Piaget, 1980, pp. 11–12) or behaviorist (e.g., Skinner, 1966) theorizing may suggest. Rather, not unlike members of other species, humans begin their extra-uterine lives with a well-orchestrated set of domain-specific constraints and expectations that guide behavior and form the basis for later acquisitions (cf., Karmiloff-Smith, 1995; Smotherman & Robinson, 1996).

We assume that the pragmatics of cognition, or the bodies of knowledge provided by culture (P. Baltes, 1993), build on, extend, and reorganize these prestructured core domains (Perner, 1995; Wellman & Gelman, 1992). Taken together, these processes of extension and transformation eventually give rise to forms of knowledge and behavior that are, in part by virtue of necessity, *compatible* with the biological architecture of the mind, but cannot be characterized as the *direct consequence* of evolutionary selection pressures.

The resulting potential of ontogenesis to create and adapt to the new, or the difference between current functions and evolutionary history, is sometimes referred to as exaptative generalization or *exaptation* (Gould & Vrba, 1982). Exaptation helps to explain why members of the human species are good at doing things that were certainly not directly at the focus of natural selection, such as reading a book or driving a car (cf., Sherry & Schacter, 1987). Put more generally, exaptation may help to characterize the early ontogeny of the link between the pragmatics and the mechanics of cognition. It also reminds us that the evolution of culture must reflect some degree of match with, and reciprocal influence on, evolution-based genetic disposition (cf., Durham, 1991). For instance, pragmatic knowledge may evolve from and/or mimic predisposed knowledge in evolutionarily privileged domains, but come with the advantage of being tuned to the idiosyncratic demands of specific cultures, biographies, and contexts (cf., Siegler & Crowley, 1994).

Normative versus Person-Specific Pragmatic Knowledge

An important, albeit necessarily imperfect, distinction within the pragmatics of cognition concerns normative versus person-specific knowledge. *Normative* bodies of

knowledge are of general value to a given culture. Typical examples include verbal ability (e.g., verbal fluency, vocabulary, reading, writing), number proficiency (e.g., subtraction, addition), and basic general knowledge about the world (e.g., Maylor, 1994). Individual differences in these domains are closely linked to years of education and other aspects of social stratification, and are amenable to psychometric testing (Cattell, 1971). In contrast, *person-specific* bodies of knowledge that branch off from the normative knowledge-acquisition path are less closely tied to mandatory socialization events, and result from specific combinations of experiential settings, personality characteristics, motivational constellations, and cognitive abilities or talent (Marsiske et al., 1995). As a consequence, these bodies of knowledge often escape psychometric operationalization, and are more amenable to study within the expertise paradigm (Ericsson & Smith, 1991).

Normative Pragmatic Knowledge. Due to their general value for a given society, age-based differences in normative pragmatic knowledge are well captured by standard psychometric testing procedures, and are well explained by psychometric theory (Cattell, 1971; Horn, 1982). According to Cattell's (1971) line of reasoning, individuals invest their cognitive potential (e.g., *Gf*) into culturally valued bodies of knowledge during schooling and later periods of ontogeny. As a consequence of this investment relationship, resulting competencies, referred to as crystallized abilities, are acquired later during ontogeny than the abilities that are invested.

To motivate the idea that crystallized abilities (e.g., the normative pragmatics) are less prone to aging-induced decline than fluid abilities (e.g., the mechanics), Horn and Hofer (1992) invoked the analogy of neuronal overdetermination. Specifically, they argued that the kind of knowledge typical for crystallized abilities is implemented in highly interconnected networks that contain many possible ways to access a given piece of information (e.g., overdetermined information access). It follows that an age-associated loss in brain efficiency (e.g., connectivity) is relatively inconsequential as long as the number of remaining connections remains sufficiently large to activate the relevant information (cf., MacKay & Burke, 1990).

Person-Specific Pragmatic Knowledge. Psychometric research on crystallized abilities needs to be supplemented

by approaches with a more explicit focus on knowledge acquisition and utilization to more fully capture the diversity and specificity of pragmatic knowledge. Whereas normative pragmatic knowledge applies in similar ways to most individuals of a given society, person-specific pragmatic knowledge is seen as a response to idiosyncratic adaptive demands and opportunities (e.g., the work place). Metaphorically speaking, person-specific knowledge systems branch off or diversify from the normative path into individualized pathways.

For the most part (but see Bjorklund, Schneider, & Harnishfeger, 1992; Brown, 1982; Chi & Koeske, 1983; Schneider, Gruber, Gold, & Opwis, 1993; Weinert & Perner, 1996; Wilkening & Anderson, 1990), developmental research on person-specific bodies of knowledge has been undertaken with adults. A typical approach has been to identify the effects of domain-specific knowledge by comparing the performance of experts and novices both inside and outside their domain of expertise. Examples include the classical domains of expertise research such as chess (Charness, 1981) and card games (Bosman & Charness, 1996; Charness, 1983; Knopf, Kolodziej, & Preussler, 1990).

Two main conclusions can be drawn from this research. First, expertise effects, or the consequences of specific bodies of declarative and procedural knowledge, rarely transcend the boundaries of the target domain. Specifically, there is little evidence to suggest that the mechanics of cognition are altered in themselves by domain-specific knowledge (Salthouse, 1991a). Whenever there is evidence for effects of a more general kind, *transfer of pragmatic knowledge* (positive or negative) appears to be a more plausible explanation than the postulation of a basic change in the mechanics.

One example in this regard comes from life-span sociology, and concerns transfer from professional attitudes and behavior to coping with retirement and old age (Featherman et al., 1990). Specifically, Featherman and his colleagues hypothesized that expert engineers with reflective planning orientation are more likely to adapt to life challenges after retirement than expert engineers with a rational problem-solving orientation, because the former are more experienced in dealing with ill-structured tasks than the latter. Another example comes from longitudinal work by Kohn and Schooler (1983) on the relationship between the substantive complexity of work and ideational flexibility. Kohn and Schooler found that work complexity predicts

increments in ideational flexibility over a period of 10 years, even after controlling for initial differences in ideational flexibility. It should be noted, however, that the interpretation of findings of this type in terms of experiential factors is rendered difficult through nonrandom placement of individuals into experiential settings (Davies & Sparrow, 1985; Waldman & Avolio, 1986; cf., Scarr & McCartney, 1983).

The second major conclusion concerns the power of pragmatic knowledge to make up for losses in the mechanics *within* the domain of expertise (Bosman & Charness, 1996; Hess & Pullen, 1996; Maylor, 1994; Morrow, Leirer, Fitzsimmons, & Altieri, 1994). Here, the results from several studies suggest that acquired knowledge endows aging individuals with a form of natural and local (e.g., domain-bound) ability to withstand the consequences of aging-induced losses in the mechanics. This finding is of central importance for the issue of successful intellectual aging, and supports the general life-span theory of selective optimization with compensation (P. Baltes, 1993; Staudinger et al., 1995; see the next section). In addition, the idea that knowledge compensates mechanic decline is consistent with the observation that negative adult age differences, compared to standard psychometric or cognitive-experimental assessments, tend to be attenuated in knowledge-rich domains of everyday relevance, such as practical problem solving (Berg, 1996; Heidrich & Denney, 1994; Park, 1992; Sternberg & Wagner, 1986; Sternberg, Wagner, Williams, & Horvath, 1995), social intelligence (Blanchard-Fields, 1996; Cornelius & Caspi, 1987), memory in context (Hess & Pullen, 1996; Perlmutter, Kaplan, & Nyquist, 1990), and interactive-minds cognition (P. Baltes & Staudinger, 1996a, 1996b; Dixon & Gould, 1996; Graf, 1996; Mandl, Gruber, & Renkl, 1996; Staudinger, 1996b; Staudinger & Baltes, 1996).

Intellectual Growth during Adulthood: Stage Conceptions versus Functionalist Approaches

An important debate within life-span intellectual development refers to the question of (a) whether adult intellectual development follows a stage-like logic, and can be described as a movement toward higher forms of reasoning and thought (Basseches, 1984; Labouvie-Vief, 1982); or (b) whether functionalist approaches (P. Baltes & Graf, 1996; Dixon & Baltes, 1986) emphasizing the local nature of developmental adaptations, as they prevail in the study

of knowledge acquisition, selective specialization, and transfer provide a better, or at least more parsimonious and operationalizable, description of adult intellectual growth (Alexander & Langer, 1990; Blanchard-Fields, 1989, 1996; Dixon, Kramer, & Baltes, 1985; Kramer, 1983; Labouvie-Vief, 1982, 1992; Riegel, 1976; Rybash, Hoyer, & Roodin, 1986).

Much of the search for more advanced forms of reasoning and thought in adulthood originates in Piaget's theory of cognitive development (Chapman, 1988a; Labouvie-Vief, 1982; Pascual-Leone, 1983; Piaget, 1970; Riegel, 1976), and posits the possible emergence of one or more post-formal or dialectical stages of cognitive development after the advent of formal operations. The conceptual description of these stages often connects personality development (e.g., generativity in the Eriksonian sense) with logical considerations (e.g., awareness and acceptance of contradiction). As a consequence of this particular linkage, the emergence of such stages is assumed to be accompanied by increments in reflexivity and general awareness for the human condition (cf., Fischer & Bidell, Ch. 9, this Volume; Keil, Ch. 7, this Volume; Spelke & Newport, Ch. 6, this Volume; Thelen & Smith, Ch. 10, this Volume; also see the next section of this chapter). Evidence in support of such stages is scarce, which is not surprising given the difficulties in obtaining reliable indicators of stage-like cognitive change (cf., Molenaar, 1986; van der Maas & Molenaar, 1996).

Despite his constructivist and dialectical epistemology (Chapman, 1988a; Garcia, 1980; Lourenço & Machado, 1996; Piaget, 1980; Piaget & Garcia, 1983), Piaget himself was reluctant to posit any stages beyond formal operations. Instead, he argued on one occasion (Piaget, 1972), that the notion of *horizontal décalage* gives sufficient room to adult intellectual growth within his theory. Specifically, he expected that late adolescents and adults would exhibit formal-operational reasoning within their areas of expertise, but not necessarily across all possible domains of knowledge. This view seems consistent with the two-component model of fluid-crystallized or mechanic-pragmatic intelligence in that the potential for adult intellectual growth is linked to factors operating within rather than across domains (e.g., acquisition of pragmatic knowledge; cf., Flavell, 1970).

Although the debate over the existence of stages in adult intellectual development is far from being settled, it appears

to us that a knowledge-based functionalist approach is more amenable to operational definition and empirical investigation. From this perspective, *the structuralist search for higher forms of reasoning can be reframed as the search for bodies of knowledge with a high degree of generality and meaning* (Dörner, 1986). In full agreement with the intent of structuralist theorizing on adult intellectual development, the acquisition of such bodies of knowledge is assumed to counteract the life-span tendency toward fragmentation and specialization induced by less general bodies of knowledge. In this context, *wisdom*, or expertise about the fundamental pragmatics of life, has been proposed as a prototypical example (P. Baltes & Smith, 1990; P. Baltes & Staudinger, 1993; Clayton & Birren, 1980; Sternberg, 1990).

A First Prototypical Example: Expertise in the Fundamental Pragmatics of Life (Wisdom)

Most people, lay persons and researchers alike, regard wisdom as the hallmark of positive intellectual aging (Clayton & Birren, 1980; Sternberg, 1990). Based on the two-component model of intellectual development, P. Baltes and Staudinger (1993; see also, P. Baltes & Smith, 1990) defined wisdom as "an expertise in the fundamental pragmatics of life permitting exceptional insight and judgment involving complex and uncertain matters of the human condition." Accordingly, the fundamental pragmatics of life are defined to embody valuable information about the conduct, interpretation, and meaning of life, including its developmental variability, plasticity, and limitations. Furthermore, wisdom involves the fine-tuned coordination of cognition, motivation, and emotion as it is illustrated in wisdom as the combination of exceptional insight and mature character (P. Baltes & Smith, 1990; P. Baltes & Staudinger, 1993; Staudinger & Baltes, 1994). More specifically, wisdom-related knowledge and judgment have been characterized by a family of five criteria (factual knowledge, procedural knowledge, contextualism, value relativism, and uncertainty).

Thus far, our main methodological strategy in investigating wisdom as an expertise in the fundamental pragmatics of life has been to ask persons to think aloud about difficult life problems. These responses are then evaluated on the five wisdom-related criteria by a trained rater panel. Figure 18.11 displays the results of one of these studies (P. Baltes, Staudinger, Maercker, & Smith, 1995). In

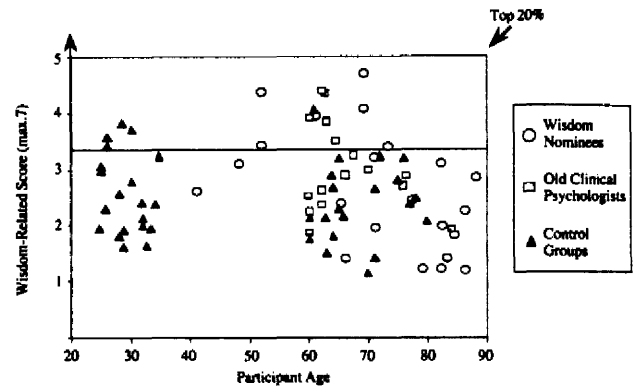


Figure 18.11 Wisdom-related performance of four different groups of individuals averaged across two wisdom-related tasks and five evaluative criteria (factual knowledge, procedural knowledge, contextualism, relativism, and uncertainty). There were no age differences in the age range from 25 to 75 years. In addition, wisdom nominees and clinical psychologists provided significantly more high-level (top 20%) performances than the old control group. Max. = maximum (after P. Baltes, Staudinger, Maercker, & Smith, 1995).

Figure 18.11, an overall wisdom score based on all five criteria is plotted against age for four different groups: Wisdom nominees (i.e., distinguished individuals nominated as being wise in a two-step Delphi technique), clinical psychologists, and two control groups involving adults with comparable advanced levels of education (young and old).

Two findings are noteworthy. First, when comparing adults of about 25 to 75 years of age, there was no indication of a negative age trend in wisdom-related performance. This finding has been replicated in five other studies (cf., Staudinger & Baltes, 1996). Second, older persons with wisdom-facilitative experiences (e.g., older clinical psychologists and wisdom nominees) contributed a disproportionately large share to the top responses (see also, Smith, Staudinger, & Baltes, 1994; Staudinger, Smith, & Baltes, 1992). Both findings stand in clear contrast to the negative age gradients observed for the cognitive mechanics (see Figure 18.10), thereby providing further support for the two-component model.

The findings also demonstrate that living long (age) in itself is not a sufficient condition for the development of wisdom. Rather, as suggested by our working model of the ontogenesis of wisdom (Figure 18.12), it appears that favorable macro-structural contexts (e.g., historical period),

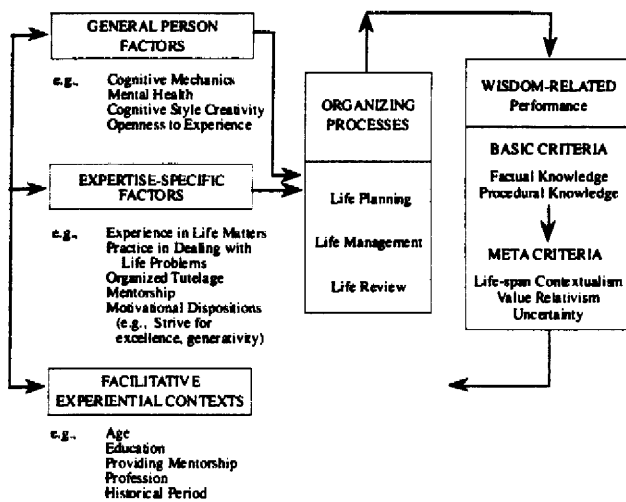


Figure 18.12 A research framework describing antecedent factors and mediating processes for the acquisition and maintenance of wisdom-related knowledge and skills across the life span. The likelihood of attaining expert levels of performance in this prototypical domain of the cognitive pragmatics is assumed to depend upon an effective coalition of life-context, expertise-specific, and general person-related factors (after P. Baltes & Staudinger, 1993; Staudinger & Baltes, 1994).

expertise-specific factors (e.g., experience and training in the fundamental pragmatics of life, strive for excellence, mentorship), and general person factors (e.g., fluid mechanics, cognitive style, openness to experience) need to work in coalition to move people toward wisdom (cf., P. Baltes & Staudinger, 1993). Some of these wisdom-facilitative factors (such as generativity) are age-related; however, there are also wisdom-debilitating influences (such as rigidity, decrease in fluid mechanics) that might come with age. On average, the net result of age-related facilitators and debilitators seems to equal out. Only under favorable conditions, facilitators outweigh debilitators and thus result in an increase of wisdom-related performance with age.

At a more general level of analysis, our research on wisdom serves to highlight the *relative independence of the pragmatics of cognition vis-à-vis the biology-based mechanics*. In fact, within the normal range of adult mechanic functioning, the mechanics' contribution to individual differences on wisdom-related tasks is small, both in absolute terms and relative to other factors such as personality and task-relevant life experience. For instance, in one

adult-developmental study (Staudinger, Maciel, Smith, & Baltes, 1996), the most important contributors to wisdom-related performance were personality characteristics as measured by the NEO as well as wisdom-relevant professional training and experience, rather than psychometrically assessed intelligence or chronological age. However, when it comes to very old age, additional evidence (P. Baltes et al., 1995) suggests that the mechanics of cognition delimit wisdom-related performance if they fall below a critical threshold of functional integrity. Based on our own data, we tentatively suggest that the ninth decade of life may represent such a threshold.

Varieties of Mechanic/Pragmatic Interdependence

The mechanics and pragmatics of life-span intellectual development are intertwined in many ways and at various levels of analysis (cf., Bosman & Charness, 1996). At the phylogenetic level, they are connected in the sense that members of the human species are biologically predisposed to acquire cultural knowledge (cf., Klix, 1993; Plessner, 1965). At the ontogenetic level, the interdependence also runs both ways. For instance, the potential to acquire and use pragmatic knowledge is conditioned by the development of the mechanics. At the same time, the mechanics alone are of little use for problem solving in highly specialized domains of knowledge; in many cases, domain-specific knowledge (Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson & Lehmann, 1996) or common sense (Sternberg et al., 1995) is more critical.

In the following sections, we further elucidate different facets of this interdependence. We then argue, with respect to the overall landscape of life-span development, or the ontogenetic dynamics of gains and losses, that the mechanic-pragmatic interdependence converges upon the notion of a *compensatory relation between mechanic efficiency and pragmatic knowledge*. This compensatory relation increases in importance with advancing age and culminates in old age.

The Mechanic-Pragmatic Interdependence: Evidence at the Cortical Level

One intriguing demonstration for the interdependence between mechanic and pragmatic development concerns the increased cortical representation of the left hand in players of string instruments (Elbert, Pantev, Wienbruch, Rockstroh,

& Taub, 1995). Compared to normal individuals, areas of the somatosensory cortex representing the fingers of the left hand seem to occupy more space in string players. Most likely, this increase in cortical representation has been induced by large amounts of goal-directed and deliberate practice (cf., Ericsson et al., 1993). In this sense, the increase is a representation of pragmatic knowledge (of a procedural kind, in this case).

At the same time, Elbert et al. (1995) provided clear evidence in support of age-graded differences in cortical plasticity (Figure 18.13). Specifically, the brain's physiological aptness to provide more cortical space for the fingers of the left hand was found to depend upon the chronological age at inception of musical practice. As this example illustrates, the ability to acquire pragmatic knowledge (e.g., the potential for developmental change in the pragmatic component) is conditioned by the age-graded status of the mechanics.

The Age of Peak Performance in Complex Skills

The mechanics of cognition not only condition the acquisition, but also the expression of pragmatic knowledge (Bosman & Charness, 1996; Molander & Bäckman, 1993).

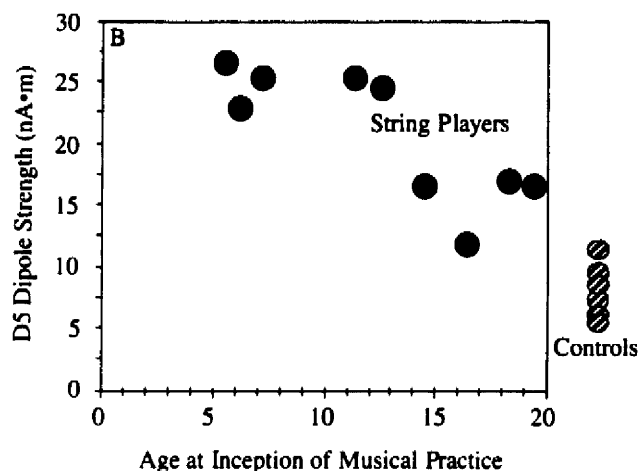


Figure 18.13 The cortical representation of the fingers of the left hand is increased in string players, but the magnitude of the increase depends on the age at inception of musical practice. The findings illustrates how life-span changes in the potential for the acquisition of new pragmatic knowledge are conditioned by age-based changes in the mechanic component (adapted from Elbert et al., 1995).

A good example in this regard is the difference in peak age for tournament versus correspondence chess (Charness & Bosman, 1990). The mean age at which a world championship is first won is about 46 years of age for correspondence chess, but about 30 years of age for tournament chess. In correspondence chess, players are permitted three days to deliberate a move; in tournament chess, deliberation averages three minutes per move. Thus, the difference in peak age between the two activities seems to reflect differences in the relative importance of cognitive/perceptual speed and knowledge.

This example points to a general dilemma governing the relation between the mechanics, the pragmatics, and age/time (cf., Ericsson, 1990). On the one hand, the acquisition of expertise takes time. For instance, Simon and Chase (1973) argued that ten years of deliberate practice are needed to reach excellence in a particular domain of functioning. For this reason alone, experts tend to be older than novices (cf., Lehman, 1953). On the other hand, decrements in certain aspects of the mechanics, such as perceptual speed, can be reliably identified by age 30 (Salthouse, 1991c). Therefore, differences in peak age across domains can be seen as ontogenetic compromises between biology and culture, and are probably good indicators of the relative importance of pragmatic knowledge and mechanic processing efficiency.

To avoid misunderstandings, we hasten to add that an exclusive focus on ages of peak productivity or peak achievement would hide essential and unique features of late-life intellectual growth. For instance, some exceptional individuals seem to escape mechanic decline well into the ninth decade of their lives. If these individuals also happen to be experts in a particular domain, they can produce outstanding works throughout their life. One example might be Sophocles (497–406 B.C.), who won his first prize for the best drama of the year at age 28, wrote over 120 dramas, and developed a new dramatic style in his 80s. Commenting on his own late-life artistic development, Sophocles said that he finally had liberated himself from the artificiality of his earlier style, and had found a language that was the best and the most ethical (Schadewaldt, 1975, p. 75).

Another example pointing to the uniqueness of late-life experts comes from a study on classical composers by Simonton (1988, 1989). Guided by the general notion that artists facing death may feel the need to make optimal use

of their limited future, Simonton examined the relationship between closeness to death and a set of criterion variables for a sample of 1,910 works written by 172 classical composers. Last works scored lower in melodic variability and performance duration, but higher in repertoire popularity and aesthetic significance. Based on this evidence, Simonton argued that this tendency towards condensed expression of the essential is a general feature of late-life intellectual productivity.

A Third Prototypical Example: Speed and Knowledge in Aging Typists

The preceding considerations indicate that the degrees of freedom within the pragmatic component of cognition are constrained by age-based changes in the potential and status of the mechanic component. However, in agreement with the notion of culture-biology co-evolution (Durham, 1991), we argue that the interdependence between the mechanics and the pragmatics also runs in the other direction.

First, the pragmatics of cognition provide the *medium* or content for the phenotypic unfolding of the mechanics during ontogeny. A good example is the mapping of Universal Grammar onto the structures of a specific language during first-language acquisition (cf., Pinker, 1994). Second, the pragmatics of cognition serve to *optimize* levels of performance in content-rich and evolutionarily nonprivileged domains of intellectual functioning, as research on expertise has convincingly demonstrated (Ericsson & Lehmann, 1996). Third, pragmatic knowledge helps to *compensate* for age-based losses in the mechanic component. For this reason, the pragmatic component, when compared to the mechanics rather than to itself across ontogeny, actually appears in a more aging-friendly light. In fact, we expect that more and more of an individual's potential for continued growth and maintenance of functioning is shifted away from the mechanic component, and into the continued refinement (e.g., optimization) and use of the pragmatic component.

A good empirical demonstration of the ensuing gain/loss dynamic between the cognitive mechanics and the cognitive pragmatics comes from a study on aging typists using the so-called molar equivalence/molecular decomposition approach (Salthouse, 1984). In this paradigm, adults of different ages are equated in general (e.g., molar) task proficiency to investigate whether equal levels of criterion performance are attained through age-differential profiles

of "molecular" component processes (Charness, 1989). Thus, age differences at the molecular level of analysis are seen as a reflection of age-based changes in the relative contribution of knowledge and basic processing efficiency to criterion performance.

Using this paradigm, Salthouse (1984) studied a total of 74 transcription typists ranging from 19 to 72 years of age. Figure 18.14 displays an interpretation of the main findings of this study in terms of the two-component model. In this sample, age and level of typing skill (i.e., net words per minute) were uncorrelated (e.g., molar equivalence). Age was negatively related to measures of perceptual/motor speed (e.g., tapping speed), but positively related to eye-hand span. In other words, older typists were slower in tapping speed but looked further ahead in the text to be typed. These findings are consistent with the interpretation that aging typists extend their eye-hand span to counteract the consequences of aging losses in perceptual/motor speed, and illustrate the compensatory relationship between knowledge and speed.

In fact, to the extent that selective attrition does not play a prominent role, the performance pattern of older typists is, in part, the result of *loss-induced development*, or compensation in the strict sense of the term (Baltes & Baltes, 1990b; Dixon & Bäckman, 1995; Salthouse, 1995). With respect to methods, this example demonstrates how the combination of

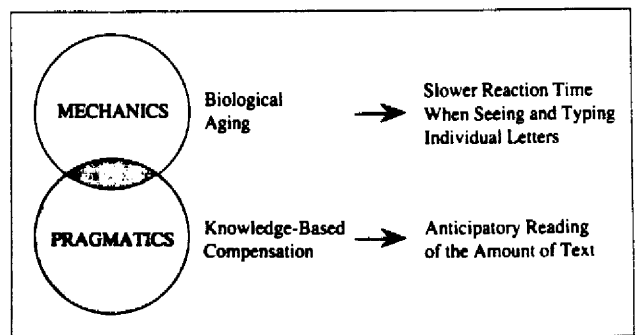


Figure 18.14 Older typists can maintain a high level of functioning by reading farther ahead in the text to be typed, despite a loss in reaction time when typing individual letters. The example illustrates the compensatory relationship between the pragmatics and the mechanics of cognition, and suggests that selective optimization with compensation may play a key role in successfully adapting to aging-induced losses in the mechanics of cognition (based on Salthouse, 1984).

expertise and information-processing approaches may lead to a better understanding of the compensatory relation between acquired bodies of cultural knowledge and basic aspects of information processing efficiency.

Malleability (Plasticity) in Intellectual Functioning across Historical and Ontogenetic Time

As is true for development in general, life-span changes in intellectual functioning represent the overdetermined antecedents, correlates, and outcomes of a large variety of different sources of influence (e.g., mechanics, pragmatics, motivation, personality, societal opportunity structures). Therefore, differences in level of intellectual performance reflect, within the age-graded boundaries provided by the mechanics, variations in physical and sociocultural aspects of environmental conditions (Klix, 1993). In the following section, we report two interrelated lines of research in support of this contention. The first line of research addresses environmental change at a large (i.e., historical) time scale. The second example refers to the malleability of adult-intellectual functioning in the context of cognitive intervention studies.

Cohort Effects, Period Effects, and Environmental Change

As expected on the basis of life-span contextualism, ontogenetic processes unfold in a constantly changing social and cultural environment. As a consequence, age gradients in intellectual abilities are not fixed but reflect history-graded systems of influence, such as enduring differences between individuals born at different points in historical time (cohort effects), specific influences of historical events across chronological age (period effects), or generalized and enduring shifts in the environment affecting individuals of all ages and subsequent cohorts (general environmental change). For methodological reasons, discriminating among these varieties of environmental change is not easy (P. Baltes, 1968; P. Baltes, Cornelius, & Nesselroade, 1979; Lindenberger & Baltes, 1994a; Magnusson et al., 1991; Schaie, 1965, 1994).

A first step to discern effects of large-scale environmental change is to compare the performance of same-aged individuals across historical time (i.e., time-lagged comparisons). With some exceptions (e.g., number ability; cf., Schaie, 1989), the general picture resulting from such

comparisons is that higher test scores are obtained at more recent times (Flynn, 1984; Schaie, 1983). Probably, this historical increase in test scores across historical time is not due to changes in the genetic composition of the population or differential sampling bias, but reflects some general change (i.e., improvement) in health- and education-related conditions. The magnitude of these effects can be quite large. For the U.S. population during the 20th century, for instance, they sometimes exceeded a standard deviation within a 30-year range of historical change (Schaie, 1996). It should be cautioned, however, that we do not know whether environmental-change effects of the same order of magnitude would be observed with pure indicators of the mechanics of intelligence. For instance, much of the measures used in the battery of the Seattle Longitudinal Study (Schaie, 1996) have a strong cultural-knowledge component, and are more likely to be affected by historical change and dissipation than other, less knowledge-loaded measures of brain efficiency.

Studies with cohort-sequential (e.g., mixed) designs such as the Seattle Longitudinal Study (Schaie, 1983, 1996) are well suited for three different kinds of comparisons across age: Cross-sectional, longitudinal, and independent-sample same-cohort comparisons (e.g., age comparisons based on independent samples from the same birth cohort). In the case of the Seattle Longitudinal Study, for example, independent-sample same-cohort and cross-sectional comparisons were found to yield practically identical estimates of seven-year change after controlling for the general increase in performance over historical time revealed by time-lagged comparisons (Salthouse, 1991b). In contrast, longitudinal age changes, also corrected for historical change, showed somewhat less of a decrement with age. Given the convergence between cross-sectional and independent-sample same-cohort comparisons, the more positive age gradients found with longitudinal samples may be partly due to practice effects and selective attrition.

Theoretically, the direction and precise magnitude of historical-change effects is generally of little importance. From a history-of-science point of view, however, such effects, and especially their interpretation as culturally-based cohort effects, were instrumental in pointing to the substantial malleability (plasticity) of intellectual performance during all periods of the adult life span (P. Baltes, 1973). The resulting growth in awareness for the existence of life-span plasticity eventually led to advances in life-span

theorizing, and to more controlled investigations into the range of intellectual plasticity and its age-based limits (P. Baltes & Kliegl, 1992; P. Baltes & Lindenberger, 1988; P. Baltes & Willis, 1982; Willis, 1987, 1990).

Cognitive Intervention Work: Activation of Learning Potential among Older Adults

Intervention work (P. Baltes & Willis, 1982; Denney, 1984; Willis, 1987, 1990) is a more direct (i.e., experimentally controlled) way to explore the degree of plasticity in intellectual functioning than cohort-comparative research. In the field of adult development and aging, intervention studies were done to examine whether age-based decrements in standard psychometric tests of intellectual functioning are reversible, in full or in part, through training and practice (Schaie & Willis, 1986; Willis & C. Nesselroade, 1990). For the most part, interventions involved older adults only, and focused on tests from the fluid (mechanical) ability domain.

The major results of this cognitive intervention work can be summarized in five points (cf., P. Baltes & Lindenberger, 1988):

1. Training gains in the practiced tests among healthy older adults are substantial (i.e., they roughly correspond to the amount of naturally occurring longitudinal decline between 60 and 80 years of age).
2. Transfer, however, is limited to similar tests of the same ability.
3. Training gains are maintained over lengthy periods of time up to several years (Neely & Bäckman, 1993; Willis & C. Nesselroade, 1990).
4. The factor structure of the ability space is not altered substantially through training (Schaie, Willis, Hertzog, & Schulenberg, 1987).
5. In persons at risk for Alzheimer's disease or afflicted by other forms of brain pathology (Nebes, 1992), training gains have been found to be restricted to experimental conditions of high external support (Bäckman, Josephsson, Herlitz, Stigsdotter, & Viitanen, 1991) or to be nonexistent (M. Baltes, Kühl, & Sowarka, 1992; M. Baltes et al., 1995).

These results indicate that the majority of healthy older adults, including those who display the typical pattern of

age-related losses in the mechanics of cognition (e.g., fluid abilities) under untrained conditions, are able to greatly improve their performance after a few sessions of task-related training or practice. Thus, cognitive plasticity in the mechanics of cognition is preserved into old age, and is easily activated through experiential manipulations (cf., Woodruff-Pak, 1993, for relevant neurophysiological evidence). However, there is little evidence to suggest that training gains generalize to related abilities or to everyday functioning. Moreover, the results of testing-the-limits research presented above clearly indicate that the *amount* (scope) of plasticity decreases with advancing age, at least during adulthood. At limits of functioning, older adults definitely display less potential. Finally, it is difficult to counter the rival interpretation, namely that training gains are primarily due to pragmatic rather than mechanic components of performance potential.

Relative Stability in Intellectual Functioning across the Life Span

The issue of continuity and discontinuity, or stability and change, has a long tradition within developmental psychology at large (Kagan, 1980), and life-span intellectual development, in particular (Collins & Horn, 1991; Hertzog & Nesselroade, 1987; McArdle & Epstein, 1987; Nesselroade, 1989, 1991c; Schaie, 1989, 1994). Different forms of stability, such as stability in level, rank order, and profiles, have been set apart (Caspi & Bem, 1990). The main emphasis of the following life-span synopsis of intellectual development is on inter-individual rank order, or on what Kagan (1980) has called relative stability, which denotes the extent to which individual differences during later periods of ontogeny can be predicted on the basis of individual differences observed during earlier periods. In addition to our primary focus on relative stability, we will also address changes in level (e.g., ontogenetic increases and decreases in functional competence), especially with respect to the period of adulthood and old age.

Statistically, stability in rank order and stability in level can vary independently. Empirically, they often seem to covary across ontogeny. For instance, periods in which level stability is high, such as middle adulthood and early old age, also show a high degree of relative stability (rank order of inter-individual differences) per unit of ontogenetic time. Conversely, periods of pronounced change in

level, such as early and middle childhood, also tend to show less inter-individual stability. An explanation for this congruence between changes in rank and level is offered below.

In most cases, evidence on the relative stability after infancy is based on undifferentiated measures of general intelligence, or IQ tests. We agree with others that an exclusive focus on these omnibus measures hides essential features of life-span intellectual development and the structure of intelligence (cf., Cattell, 1971; Gardner, Ch. 8, this Volume; Horn, 1989). Specifically, such measures can be seen as mixtures of mechanic and normative-pragmatic components of intellectual functioning which approximate, to varying degrees, the centroid of the intellectual ability factor space (i.e., Spearman's g). With this qualification in mind, we restrict the following discussion, with one exception (i.e., infant development), to undifferentiated or IQ-like measures of intellectual functioning.

Predicting Childhood Intelligence on the Basis of Infant Behavior

Until the end of the first half of this century, it was generally believed that intelligence was an immutable characteristic of the individual, which led to the unchallenged assumption that individuals maintain their rank order on measures of intellectual functioning throughout life. Starting in the 1960s, however, it was found that stability in early mental test performance was low (McCall, 1979). On the basis of this evidence, it was concluded that standardized tests of infant development do not predict later intelligence at useful levels of prediction until after 18 to 24 months of age. The apparent lack of inter-individual temporal stability was attributed to fundamental changes in the nature of intelligence from infancy through childhood to adulthood (Kopp & McCall, 1982). For instance, it was believed that mental development during infancy consists of specific stages of an invariant developmental program, and that individual differences reflect transient and inconsequential fluctuations in the rate at which this program is expressed, rather than enduring inter-individual differences in intellectual functioning.

This majority view of ontogenetic instability of inter-individual differences during infancy was successfully challenged by research using habituation and recognition-memory paradigms (Bornstein & Sigman, 1986). In contrast to standardized infant tests of sensorimotor capacities, these two paradigms were originally based on

operant-conditioning and/or information-processing perspectives, and refer to infants' tendency to change their behaviors as a function of prior exposure to a stimulus (e.g., decrements in attention in the case of habituation, or novelty preference in the case of recognition memory). On average, individual differences in habituation and recognition memory performance between 2 and 8 months were found to be moderately correlated with standard tests of intelligence such as the Wechsler, Bayley, or Binet administered between 1 and 8 years (median correlation, $r = .45$; after attenuation for unreliability, $r = .70$; cf., Bornstein, 1989; McCall & Carriger, 1993). Behavior-genetic research suggests that individual differences in at least some of the measures used for prediction have a genetic component (Benson, Cherny, Haith, & Fulker, 1993; Cardon & Fulker, 1991; DiLalla et al., 1990).

These results show that both change and stability are important aspects of life-span intellectual development from its very beginning. According to one interpretation (Bornstein, 1989; Fagan & McGrath, 1981), infants who habituate more efficiently, and who tend to look at the novel object, rather than the old, are better able to inhibit action tendencies associated with already existing representations (cf., McCall, 1994). The hypothesis that inhibition may mediate the predictive link is consistent with neuropsychological investigations of infants' recognition memory (e.g., Diamond, 1988; Johnson, Posner, & Rothbart, 1991). It also supports the more general claim that inhibition ability and novelty preference are central features of intelligence (cf., Berg & Sternberg, 1985b).

Relative Inter-Individual Stability after Infancy

For reasons that are not yet well understood (Cardon & Fulker, 1991; McCall & Carriger, 1993), the magnitude of the correlation between infant measures of habituation (i.e., 2 to 8 months) and childhood measures of intelligence (i.e., 1 to 12 years) is temporally stable or even increasing (Cardon & Fulker, 1991; DiLalla et al., 1990), rather than decreasing over time. In contrast, relative stability after infancy is rather well described on the basis of quasi-simplex assumptions (Humphreys & Davey, 1988; Molenaar, Boomsma, & Dolan, 1991). Thus, adjacent time points in ontogeny tend to be more highly correlated than more distant time points.

In addition, stability coefficients computed over identical lapses of time show a considerable increase in magnitude from childhood to adolescence into middle adulthood

and early old age (Gold et al., 1995; Hertzog & Schaie, 1986, 1988; Humphreys & Davey, 1988). For instance, Humphreys and Davey reported a continuous increase in *one-year* stability coefficients of general intelligence, with a value of .76 between the ages of 4 and 5, and a value of .90 for the ages of 8 and 9. With respect to later ages, Hertzog and Schaie (1986) found that *seven-year* stability coefficients for a general ability composite ranged from .89 to .96 in samples with mean ages between 25 and 67 years at first test. These are extraordinarily high levels of inter-individual long-term stability.

In agreement with others (e.g., Humphreys & Davey, 1988; Molenaar, Boomsma, & Dolan, 1993), we propose that these *age-based changes in relative inter-individual stability should be interpreted in connection with age-based changes in level*. According to this line of reasoning, inter-individual differences change more rapidly early in development because the intellectual repertoire is smaller but growing faster than at later points during ontogeny, thereby giving room for larger amounts of new variance per unit time (both environmental and genetic). By the same token, we expect that aging-induced losses not only lead to decrements in level, but also to a reshuffling of individual differences in very old age (Lindenberger & Baltes, 1994a, 1994b). In accord with this prediction, recent longitudinal studies on the oldest old report a decrease in relative stability after age 70 (e.g., Mitrushina & Satz, 1991).

Changes in Heritability across the Life Span

We now turn to the study of age-based changes in the contribution of genetic and environmental sources of inter-individual variability to individual differences in intelligence. We start with a consideration of general and ability-specific effects, and then turn our attention to life-span changes in heritability estimates for general (i.e., undifferentiated) measures of intelligence across the life span.

Before we turn to the evidence on life-span changes in heritability estimates, we will briefly summarize our view of the meaning, strength, and limitations of the behavior-genetics approach (Baltes, Reese, & Nesselroade, 1988). Given the critical debates surrounding the interpretation of behavior-genetic data (cf., Bronfenbrenner & Ceci, 1994; Burgess & Molenaar, 1995; Gottlieb et al., Ch. 5, this Volume; R. Lerner, 1995; Scarr, 1993), such a note may help to avoid possible misunderstandings.

A Note on the Nature of Behavior-Genetic Evidence

A detailed coverage of the full range of behavior-genetic research designs, including their recent links to molecular genetics (Boomsma, 1996; McClearn, Plomin, Gora-Malask, & Crabbe, 1991) and their important role in the study of developmental pathologies (Rutter, 1993, 1997), is beyond the scope of this note. Rather, we restrict our commentary to the interpretation of heritability estimates in normal samples. We will explicate three points that are relevant both for the following section on intellectual functioning as well as on personality and the self.

The first point is intended to show that heritability coefficients in human research (where selective inbreeding and exposure to extreme environments is limited) are statements about the scope of inter-individual differences more so than statements about the processes and mechanisms of genetic expression at the individual and intra-individual level of analysis. The second point highlights the fact that the overall role of environmental forces is not best tested by behavior-genetics models. The power of environmental forces is best tested by environmental variation studies which are designed to generalize *across* inter-individual differences in genetic dispositions. The third point emphasizes that heritability estimates are fixed-level statistics. In other words, heritability estimates are always restricted to what consequences (phenotypic expressions) are produced under a given and specific set of inter-individual differences in genetic and environmental conditions.

As to the first point: Heritability estimates are statements about inter-individual differences more so than statements about the processes and mechanisms of genetic expression at the individual level of analysis. In other words, heritability-based estimates cannot be generalized to the individual level of analysis and within-person (intra-individual) functioning. This critical view of heritability information and its limited value for understanding genetic processes is the predominant position of molecular biologists who work on the level of gene expression (e.g., Gottlieb et al., Ch. 5, this Volume). They claim that the search for gene expression through behavior-genetic work is at best indirect. Population-based behavior genetics can give clues about the existence of heritability of inter-individual differences, but knowledge about heritability in the general population is not an immediate guidepost for identifying the specific locations and the biological-genetic ways of gene expression (see, however, Boomsma,

1996; McClearn, Plomin, Gora-Malask, & Crabbe, 1991; Nilsson et al., 1996, for ways to bridge the gap).

The second point highlights the fact that the overall role of environmental factors or *levels* of performance is best tested, not by heritability estimates, but by studies which examine the role of the impact of environmental factors across the population and across inter-individual differences in genetic make-up. Often, high heritability estimates are interpreted as if they would preclude the operation of environmental factors. This is simply wrong. Consider as a first example the study of expertise (Ericsson & Smith, 1991) where the typical finding is major increases in performance for *all* persons who participate in expertise-inducing interventions. Another example is the historical evolution of cultural skills such as reading or writing in industrialized countries, from a low of a few percent in the middle ages to close to 100% in modern times (Olson, 1995), or the evolution of life expectancy during the 20th century in industrialized countries, from an average of about 45 years to an average of about 75 years (P. Baltes & Graf, 1996). During these times, it was not the genetic make-up of the population or of individuals which changed to permit the acquisition of reading and writing or to live longer. What changed was primarily the set of environmental conditions (such as schooling, medical technology, etc.) which regulated the probability of optimizing the genetic potential available to practically all members of society.

The third point emphasizes that heritability estimates are always fixed-level statistics (P. Baltes, Reese, & Nesselroade, 1988; Plomin & Thompson, 1988). This applies both to the expressed genome as well as to the environment. In the experimental design literature, for instance, a fixed-level statistic means that the "treatment" conditions are not a random sample of the full spectrum of treatment possibilities. On the contrary, fixed-level statistics are specifically instantiated levels of the treatment. Therefore, the results obtained from human behavior-genetic research cannot speak to what genetic and environmental effects exist in principle, but only to the conditions defined by the levels chosen or available. Therefore, in behavior-genetic work, heritability estimates of inter-individual differences reflect only those genetic and environmental conditions that exist at a given point in history and in a given demographic and sociocultural context. If a behavior-genetics study, for instance, is conducted in Sweden, it is the genetic and environmental context of Sweden, and its possible

inter-individual variations, which is under study, and the resulting heritability coefficients reflect that fixed or specific level of "Swedish" environmental modulation of "Swedish" inter-individual differences in genetic make-up. To counterbalance this restriction to generalizability, behavior-genetics research aims at comparative studies in which other and possibly wider or more restricted environmental conditions and genetic samples are observed (e.g., Finkel, Pedersen, McGue, & McClearn, 1995; Pedersen, 1993).

Despite these limitations in interpretation, we suggest that information deriving from behavior-genetics research is important. Findings based on behavior-genetics research, especially if based on longitudinal and cross-cultural comparative data, provide *estimates* of the degree to which, on a population level of analysis, *inter-individual differences in developmental outcomes* are co-determined by inter-individual differences in genetic predispositions and extant environmental variations. Thus, everything else being equal, high heritability estimates of a given behavioral outcome suggest that *inter-individual differences* in this behavioral outcome and in this "life space" (Lewin) are strongly genetically determined, stronger than those *inter-individual differences* in behavioral outcomes with low heritability estimates. Note again, however, that high heritability does not speak to the level (plasticity, malleability) of developmental outcomes (expression) that is available to all members of the population; nor does it imply that inter-individual differences are genetically fixed.

Genetic and Environmental Influence over Ontogenetic Time: Specific and General Effects

Numerous studies have shown that genetic and environmental influences can be operative in the regulation of individual differences at both ability-specific and more general levels (Cardon & Fulker, 1993, 1994; Pedersen, Plomin, & McClearn, 1994). In longitudinal analyses of hierarchically organized intellectual abilities obtained from genetically informative data sets, it is possible to determine the genetic and environmental contributions to stability and change in rank order and mean level both at the level of specific abilities and at the level of a general factor.

An interesting example for the class of findings that can be obtained with this method comes from child cognitive development. In an analysis of data from the Colorado

Adoption Project, Cardon and Fulker (1993, 1994; Fulker, Cherny, & Cardon, 1993) found that strong novel contributions of genetic variance at the general level emerge at the ages of 3 and 7, but are absent at the ages of 4 and 9. This pattern is consistent with the notion of generalized, discontinuous changes in intellectual functioning (e.g., Piaget, 1970). In addition, it suggests that a major portion of inter-individual differences in this transition are genetic in origin.

Estimates of Heritability of Inter-Individual Differences across the Life Span

Similar to life-span changes in stability, heritability (e.g., the amount of inter-individual variance in intellectual functioning attributable to genetic differences) increases from about 40% to 50% during childhood and adolescence to about 80% in early and middle adulthood (cf., McGue, Bouchard, Iacono, & Lykken, 1993b). In contrast, shared environmental influences on inter-individual differences generally do not persist beyond the period of common rearing (McGue et al., 1993b).

It should be kept in mind that these findings are based on samples representing the normal range of environments and genes, and cannot be generalized beyond this normal range (e.g., to extremes of environmental deprivation or reshuffled environments). Within this normal range, however, the life-span increase in heritability of inter-individual differences is consistent with the notion that adolescents and adults have more of a chance to actively select environments that match their genes than infants and children (Scarr & McCartney, 1983). With respect to late-life heritability, recent data from the Swedish Adoption Twin Study of Aging (SATSA) suggest that heritability of inter-individual differences in intellectual functioning may drop to values around 55% after age 70 (Finkel, Pedersen, McGue, & McClearn, 1995).

Based on the preceding summaries, it appears that relative stability and heritability exhibit similar life-span age gradients (cf., Plomin & Thompson, 1988). More behavior-genetic longitudinal evidence is needed to fully understand the covariance dynamics of this life-span parallelism. One possibility would be that individual differences in intellectual functioning around middle adulthood are highly stable because the genetic variance component has stabilized at a high level (e.g., not much new genetic variance is added over time), and because environments (which, in part, have

been selected on the basis of genetic endowment) also tend to be stable during this period of the life span. Similarly, the breakdown of well-orchestrated genome expression in very old age (see above) may cause late-life decrements in level, relative stability, and heritability.

The Mechanics and Pragmatics in Very Old Age

So far, our discussion of life-span intellectual development was organized around topics, rather than age periods. In this last section, we deviate from this practice by giving special attention to the life period of very old age. In our view, this last phase of life merits such attention because it represents a natural boundary condition for the validity of the two-component model of intelligence and cognition. Specifically, we expect that an increasing portion of the very old population eventually attains levels of mechanic functioning that are sufficiently low to impair intellectual functioning in a relatively global manner.

A number of recent empirical observations from the Berlin Aging Study (BASE; cf., Baltes, Mayer, Helmchen, & Steinhagen-Thiessen, 1993) support and qualify this prediction. The first-wave sample of this study consists of 516 individuals between the ages of 70 and 103 stratified by age and gender. Cognitive functioning was assessed with a psychometric test battery comprising multiple indicators of reasoning, perceptual speed, and memory (i.e., short-term acquisition and retrieval) from the fluid-mechanic domain, as well as verbal knowledge and word fluency from the normative-pragmatic domain (cf., Lindenberger, Mayr, & Kliegl, 1993). Three results from this very old sample are most pertinent to the two-component model (cf., P. Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1997).

Covariance Dedifferentiation

First, ability intercorrelations both between and within fluid-mechanic and normative-pragmatic domains were of much higher magnitude in old age than corresponding ability intercorrelations during middle and early adulthood. Based on these data, the amount of covariation among intellectual abilities, or the prominence of *g*, seems to increase considerably in very old age. The idea that *g* may vary as a function of age and/or ability level dates back to Spearman (cf., Deary & Pagliari, 1991), and has led to the differentiation/dedifferentiation hypothesis of life-span intelligence (cf., Garrett, 1946; Lienert & Crott, 1964;

Reinert, 1970). Due to methodological difficulties in testing this hypothesis (Nesselroade & Thompson, 1995), the evidence obtained so far is still inconclusive, but generally seems supportive (P. Baltes et al., 1980; Deary et al., 1996; Schaie, Willis, Jay, & Chipuer, 1989).

From the perspective of the two-component model of cognitive development, the decrease of ability intercorrelations during childhood and the increase of intercorrelations in very old age point to age-based changes (i.e., decrements and increments) in the importance of domain-general processing constraints. In fact, there are clear indications from the Berlin Aging Study that dedifferentiation in very old age transcends the cognitive domain, and also affects sensory functioning (e.g., vision and hearing) and sensorimotor functioning (e.g., balance/gait), which gives further credibility to this line of reasoning (P. Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1994b; cf., Schieber & Baldwin, 1996).

Directionality Dedifferentiation

The second finding from the Berlin Aging Study concerns the directionality of the age gradients. In very old age, differences in directionality between mechanic and normative-pragmatic abilities tend to disappear. Instead, we observe gradations of age differences in the negative direction. For instance, fluid-mechanic abilities show somewhat more decline (e.g., $r = .49$ to $.59$) than normative-pragmatic abilities (e.g., $r = .41$ to $.46$). Albeit statistically significant, this difference is relatively small. The tendency towards the unification of age gradients in very old age supports our claim (see Figure 18.1) that biology puts increasingly severe constraints upon intellectual life with advancing age.

Maintenance of Divergence in Explanatory Correlational Patterns

Given the two preceding findings, one may begin to wonder whether the distinction between the mechanics and the pragmatics of cognition loses all of its empirical foundation in very old age. Figure 18.15 suggests that this is not the case, comparing the correlational patterns of perceptual speed, a fluid-mechanic ability, and verbal knowledge, a normative-pragmatic marker, with variables related to individual differences in sociostructural-biographical or biological status.

Without exception, correlations to indicators of biological functioning were more pronounced for perceptual

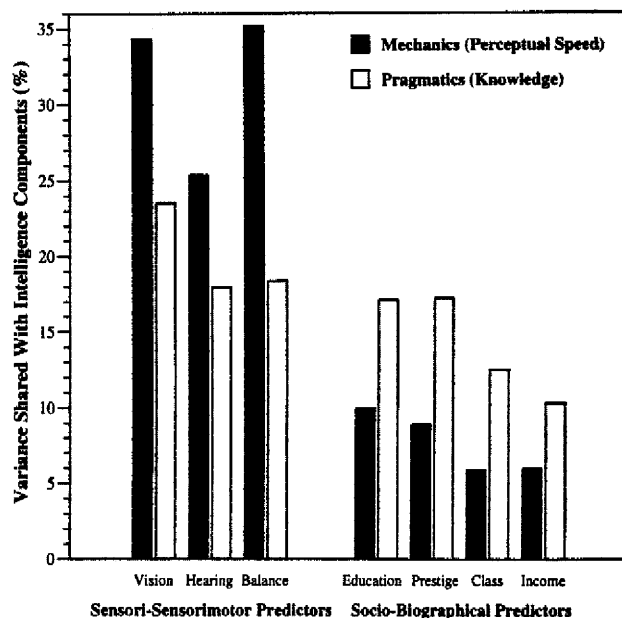


Figure 18.15 The divergent validity regarding explanatory sources of the two-component model of life-span intellectual development continues into very old age. The figure displays differential correlational links of perceptual speed, a marker of the fluid mechanics, and verbal knowledge, a marker of the crystallized pragmatics, to indicators of sociostructural-biographical and biological (e.g., sensory) status. The marker of cognitive mechanics was more highly correlated with biological indicators than verbal knowledge, the marker of cognitive pragmatics, and verbal knowledge was more highly correlated with sociostructural-biographical indicators than perceptual speed. Thus, despite a general tendency towards dedifferentiation due to age-based losses in the mechanics on the descriptive level, the two components of life-span cognition in old age evince the expected divergence regarding its explanatory sources (biological vs. cultural). Data are taken from the Berlin Aging Study ($N = 516$, age range = 70–103 years) (after Lindenberger & Baltes, 1997).

speed (e.g., the mechanics) than for verbal knowledge (e.g., the pragmatics). The reverse was also true: Correlations to sociostructural-biographical markers were more pronounced for verbal knowledge than for perceptual speed. Apparently, then, the mechanic-pragmatic distinction does not dissolve completely in very old age, but is maintained in the guise of divergent relations to biological and cultural systems of influence.

Life-Span Intellectual Development: Conclusions

Based on the foregoing (admittedly selective) review of research and theory, we would like to propose the following synopsis of the overall ontogenetic landscape of life-span intellectual development:

1. To capture the life-span dynamics between biology and culture in the domains of intelligence and cognition (P. Baltes, 1987, 1993), we contrasted the mechanics with the pragmatics, and propose a two-component model of intellectual development. This model is inspired by the psychometric theory of fluid and crystallized intelligence (Cattell, 1971; Horn, 1970, 1982). At the same time, it calls for a wider range of conceptualization, including evolutionary-psychological, cognitive-experimental and expertise approaches, to arrive at more valid and comprehensive representations of life-span intellectual development. The two-component model accurately predicts a relatively late life-span peak followed by maintenance and only a late-life decline for the knowledge-saturated cognitive pragmatics, and a much earlier life-span peak followed by monotonic decline for the cognitive mechanics. It also accurately predicts differential ontogenetic sources of explanation. In adulthood and old age, for instance, the mechanics are primarily regulated by biological factors, whereas the cognitive pragmatics evince, in addition, a substantial link to culture-based experiential factors.
2. In terms of mechanisms, age-related changes in information processing rate, working memory capacity, and the inhibition of irrelevant information are the three most prominent candidates for the explanation of life-span changes in the mechanics of cognition. At present, these constructs tend to suffer from a lack of formalization, a lack of direct evidence at the physiological level, and from difficulties in making differential predictions. It is expected that a closer link to the cognitive neurosciences will foster further progress in this area of research.
3. Extant measures of mechanic functioning tend to be contaminated by pragmatic influences. To arrive at more accurate descriptions of life-span gradients in the mechanics of cognition, and to move towards explanation in terms of critical components and mechanisms, measurement needs to be purified through the utilization of methods that are better able to assess individuals' upper limits of functioning. As predicted by theory, the use of such methods (e.g., testing-the-limits) results in cleaner separations of individuals from different ages than the use of standard measures.
4. In contrast to the mechanics, the knowledge- and culture-based pragmatics of cognition offer the potential for positive change during adulthood and old age. Within the pragmatic domain, we proposed the distinction between normative and person-specific bodies of knowledge. Normative bodies of knowledge are acquired in the context of general socialization events, such as basic cultural skills and educational curricula, and in general are well amenable to psychometric testing (e.g., vocabulary tests, aptitude tests). Person-specific knowledge refers to specialized knowledge systems that branch off from the normative (average) path, with professional expertise being the most prominent example studied so far. The content of person-specific bodies of knowledge differs widely across individuals, and is better captured within the expertise paradigm (Ericsson & Smith, 1991).
5. The acquisition of expert levels of knowledge during adulthood may lead to an increasing fragmentation of the intellectual system, but it also may offer the opportunity for acquiring bodies of knowledge with a wide range of applicability, generality, and integration. Wisdom-related knowledge, or knowledge about the meaning and conduct of life, is a prototypical example in this regard. The likelihood of acquiring such domain-general bodies of person-specific knowledge depends upon a special coalition of life-history, expertise-specific, and person-related factors.
6. Throughout ontogeny, the pragmatics and mechanics of cognition are intertwined. In everyday life, intellectual functioning and intellectual products represent joint effects of both. For instance, the emergence of domains of pragmatic knowledge builds on, and presumably extends and modifies, evolutionarily predisposed core domains (Karmiloff-Smith, 1992). The mechanisms of this pruning of cultural knowledge onto species-specific architecture await further study. Another example of pragmatic/mechanic interdependence concerns the acquisition and use of pragmatic knowledge to compensate for mechanic decline. In close agreement with our general conception of the overall landscape of life-span

development, this compensatory function of the pragmatics increases in importance with advancing age but also loses in efficiency. Therefore, in advanced old age, pragmatic performances decline as well.

7. The study of plasticity (malleability) of intellectual functioning has been a cornerstone of life-span research (P. Baltes, 1987). Intellectual performance is malleable throughout life. With some exceptions (e.g., dementia of the Alzheimer type), and within the limits provided by the mechanics, there is room for sizeable plasticity at all ages and for all individuals. Evidence in support of this contention comes both from the study of long-term environmental change and from cognitive intervention studies. At the same time, age-based losses in the mechanics lead to a reduction in the amount of plasticity with advancing age. The resulting bounded openness of life-span intellectual development is consistent with the contextualist framework of life-span developmental psychology.
8. The joint consideration of different strands of research reveals a striking congruence between three different life-span trajectories: Heritability of inter-individual differences, relative stability, and level changes in the normative pragmatics (e.g., crystallized intelligence). In all three cases, there is an increase from childhood to middle and late adulthood, coupled with indications of decline in very old age. This life-span parallelism between the genetic component of inter-individual differences, continuity of inter-individual differences, and general knowledge is consistent with the notion of gene-environment correlations in behavioral genetics (Scarr & McCartney, 1983), and the notion of niche picking in ethology (Dawkins, 1982). Whether one likes it or not, this parallelism testifies to the existence of a powerful life-span synergism between sociostructural and genetic inter-individual differentiation, at least within the range of developmental conditions offered by Western industrialized societies.

FOCI AND FACETS OF LIFE-SPAN DEVELOPMENT IN SELF AND PERSONALITY

We now illustrate what life-span theory has to offer in organizing and instigating research on the development of self and personality. To do so, we will first introduce three

areas and perspectives that in our view currently have a prominent place in theory and research on personality development. The first area can be subsumed under the heading of personality, the second under the heading of self concept and identity, and the third under the notion of self-regulatory processes. These three areas and perspectives are related to different construct clusters, and cross-links are still somewhat rare, especially in the context of life-span development.

In presenting the research and attempting an integrative view on the three areas selected, we will explore how the levels of analysis approach introduced above applies to the field of self and personality. Thus, theory and evidence available in the area of self and personality development will be used to illustrate the biology-culture interface and the differential allocation of resources idea. Furthermore, three of the life-span propositions introduced above that bear special relevance for the life-span development of self and personality are discussed in more detail and at the level involving psychological characteristics and mechanisms. These three issues are stability and change in self and personality development across the life span, opportunities and constraints of personality development, and the adaptive potential or reserve capacity of the self.

Current Research Traditions in the Field of Self and Personality Development

Research and theory building in the field of self and personality have been quite diverse (e.g. Hogan, 1995; Pervin, 1990). For the present purpose, we divide this large and heterogeneous field into three distinct and—at least functionally—interrelated areas:

1. Personality.
2. Self-concept, self-definition, or identity.
3. Self-regulatory processes.

To the expert, each of these areas belongs to a different theoretical frame, employs different methods, and possesses its own and somewhat unique agenda. Nevertheless, we will attempt to emphasize integrative perspectives among these three areas.

Under the heading of *personality*, we subsume efforts to characterize individuals in terms of attributes and behavioral dispositions, a line of research that originated primarily in the psychometric tradition. Research in this area

focuses on the identification of the structure of personality, on inter-individual differences, and the extent of longitudinal stability. This agenda is in line with a life-span perspective which is interested in the emergence, maintenance, and transformation of personality structure, and the conditions of constancy and change in inter-individual differences (Brim & Kagan, 1980). Furthermore, a life-span perspective is aimed at discerning the degree to which these personality attributes and behavioral dispositions evince intra-individual change trajectories and intra-individual plasticity (malleability). Such questions are pursued in the exemplary research programs involving scholars such as Block (e.g., 1981, 1995), Costa and MacCrae (1994, 1995), Goldberg (1993), and Nesselroade (e.g., 1989, 1991b).

Under the heading of *self-concept*, *self-definition*, and *identity*, we subsume lines of work that characterize individuals as multifaceted dynamic structures of a relatively stable array of self-conceptions (e.g., Baumeister, 1992; Greenwald & Pratkanis, 1984; Markus & Wurf, 1987). Self-conceptions are not meant to encompass any self-referent attitude but rather are confined to those beliefs or cognitions that constitute important (fundamental) self components. Work under the heading of identity focuses on the social meaning of such attitudes (e.g., Gergen, 1971; Marcia, 1976; Waterman & Archer, 1990). Different situations or contexts activate different subsets of this composite structure of self-conceptions or self schemata. Markus and Wurf (1987) have called this the working self-concept. This view of the self as both stable and dynamic fits life-span conceptions that emphasize the potential for continuity as well as change as a characteristic feature of transactional adaptation during development. In contrast to personality research that aims at inferring behavioral dispositions "from the outside," research on self-conceptions is often (but not necessarily) related to what Singer (Singer, 1984; Singer & Kolligian, 1987) has called the study of private experience or private personality, and Ryff (1984) has labelled as the study of personality from the inside. Operationally, however, at least as most of the adult research is concerned, both traditions, that is research on personality and on self-conceptions, rely on self-report. Besides the classics such as Erikson (e.g., 1959) or Bühler (e.g., 1933), research programs around scholars such as Loevinger (e.g., 1976), Levinson (e.g., 1986), Ryff (e.g., 1984, 1989b, 1995), Whitbourne (e.g., 1987), Dittmann-Kohli (e.g., 1991), and Markus and Herzog (1991) focus on

the life-span development of the self-concept and of its adaptive qualities.

Finally, under the heading of *self-regulatory processes*, we subsume all efforts that are aimed at characterizing the organized abilities and skills a person brings to bear on monitoring behavior and experience. With regard to life-span development it is the regulatory behaviors of reaching, maintaining, and regaining psychological equilibrium—in particular one's sense of coherence, continuity, and purpose under conditions of microgenetic and ontogenetic change—that are of particular interest. A host of constructs discussed in the literature can be subsumed under this heading, such as self-evaluative processes, goal-related processes, coping, control beliefs and self-efficacy, or emotional regulation. The focus of such research is on investigating the self-related adaptive potential and the reserve capacities as well as their limits in the course of life-span development. As this field encompasses many different constructs, the group of scholars engaging in this type of endeavour is quite large and still growing. Thus, we can only mention a few names in order to illustrate the type of work we include under the heading of self-regulatory processes in a life-span perspective, such as Brandtstädter (e.g., Brandtstädter & Greve, 1994; see also, Brandtstädter, Ch. 14, this Volume), Cantor (e.g., Cantor & Fleeson, 1994), Carstensen (e.g., Carstensen, 1993), Filipp (e.g., Filipp & Klauer, 1991), Labouvie-Vief (e.g., 1992), Lachman (e.g., Lachman, 1986), and Blanchard-Fields (e.g., Blanchard-Fields & Norris, 1994). Another example is the effort by Heckhausen and Schulz (1995) to construct a life-span theory of self-based control.

In the following section, we will not only present relevant information, but also attempt to integrate these three areas of research and their related perspectives in a life-span definition of self and personality. As we attempt this integration, a necessary by-product is that we are tempted occasionally to transform the foci that were at the core of the work of the original proponents.

Key Features of a Life-Span Approach to the Development of Self and Personality

Definition and Meta-Theoretical Notes

We define self and personality as denoting *the ways in which human beings behave, experience, believe, and feel with regard to themselves, others, and the material world.*

With regard to the sources and outcomes of human development, self and personality have *multiple functions* (cf., principles of multicausality and multifunctionality). First, self and personality develop, that is, they are the outcome of developmental processes. Second, self and personality also as antecedents influence developmental processes, and co-regulate outcomes. And finally, self and personality are correlates of other developmental processes.

Taking a life-span view implies (a) that we are concerned with the *commonalities* in how self and personality develops. This is reflected in developmental models like the one presented by Erikson (e.g., 1959) but also in theories about the driving forces and the mechanisms of personality development (e.g., Bandura, 1984; R. White, 1959). At the same time, as life-span developmentalists we are also interested in (b) the *inter-individual differences* in the development of self and personality characteristics. For instance, do developmental trajectories become less and less similar as transactions between a given personality make-up and particular environmental conditions accumulate across the life span? R. Lerner (1988) has used the notion of "social genotype" to describe this life-span change. (c) Finally, we want to learn about the *intra-individual variability or plasticity* in the ways an individual behaves, experiences, believes, and feels about him- or herself, others, and the material world. Is it possible, for example, that an extraverted person under certain circumstances behaves more like an introvert? And does this plasticity increase or decrease with age, or does it stay the same?

These three questions of commonalities, inter-individual differences, and of intra-individual plasticity can be pursued within a *structural* and a *process-oriented* approach to the study of self and personality and its development. Under the heading of form or structure, it is primarily the classic personality dispositions and the self-conceptions, schemata, or images that are considered. Under the heading of process research, self-regulatory mechanisms are most prominent. At least five categories can be distinguished within that category: emotional regulation, coping, self-evaluation, goal seeking, and goal restructuring.

Finally, all three facets of structure, process, and function can be approached from a *componential* (multivariate) and a *holistic* (ipsative) view (see also, R. Lerner, 1986). The componential approach is illustrated by evidence on the Big Five personality factors (e.g., Costa & McCrae,

1995; Goldberg, 1993). And Block's ipsative approach to personality assessment (e.g., Block, 1995) is an inspiring example of the holistic approach. We suggest that life-span work on self and personality development profits from integrating both.

The Search for General Purpose Mechanisms in the Area of Self and Personality Development

Throughout this chapter, we have emphasized the significance in life-span work of the search for the conditions of successful development. From the field of cognitive psychology, we have taken the idea of general purpose mechanisms. Thus, we ask whether in the field of self and personality it is possible also to articulate *general purpose mechanisms*. With general purpose mechanisms, we mean (internal and external) resources and capacities that individuals employ to master rather varied developmental challenges. General purpose mechanisms in the field of self and personality might help the individual to organize and coordinate the ways in which he/she behaves, experiences, believes, and feels with regard to him/herself, others, and the material world such that the goal of maximizing gains and of minimizing losses is approached.

There seems to be a foundation of research on which to build when exploring the notion of general purpose mechanisms. Empirical evidence, especially when focusing on longitudinal studies that search for predictors of adaptive developmental outcomes, has identified a number of candidate concepts. Impulse control or ego control, perceived control, delay of gratification and ego resilience/flexibility, for instance, suggest to us that they might possess the characteristics of such general purpose mechanism qualities in the self and personality domain (e.g., Bandura, 1993; Block, 1993; Caspi & Bem, 1990; Kagan & Zentner, 1996; Lachman, Ziff, & Spiro, 1994; Mischel, Shoda, & Rodriguez, 1989; Rutter & Rutter, 1993; Skinner, 1995; E. Werner, 1995). As is true in cognitive psychology, such general purpose mechanisms will not function by themselves. Rather, they are part of a system of personality characteristics and self-regulatory mechanisms that are functional or adaptive only under specific circumstances.

One reason why we chose to explore the power of the notion of general purpose mechanisms is the relative openness and broad contextuality of human development (Macciari et al., 1994). From a life-span point of view, there is no single endpoint and singular context of development of any

facet of self and personality. The challenge is to coordinate resources under varying conditions. Thus, there seems to be theoretical and empirical grounds for the assumption that self and personality functioning is efficacious if (a) many different ways of being are available (e.g., being internally as well as externally controlled, being optimistic as well as pessimistic, being introverted as well as extraverted) and if (b) adaptive algorithms that monitor the dialectic between such supposedly antagonistic states are accessible (e.g., Blanchard-Fields & Norris, 1994; Colvin & Block, 1994; Labouvie-Vief, 1982). By means of such algorithms the most functional personality characteristic for a given time, place, and circumstance is exhibited. This restates in different terms what has been characterized as a wise person (e.g., Staudinger & Baltes, 1994; Sternberg, 1990). The approach is also similar to the notion of fluid intelligence in the domain of intellectual functioning (see above). It is a special characteristic of that category of the intellect that in the sense of a general purpose mechanism it can be applied to, invested into, a large variety of cognition problems (Cattell, 1971).

The Executive Function of Self and Personality

Life-span theory further suggests a *systemic view* on psychological phenomena. This systemic view has at least two consequences for the way we think about the self and personality. First, we believe that the different components of self and personality, introduced above, *together* form the self and personality system. Dynamic systems theory postulates that, by means of recursive interactions, such components form the basis of self-organization as well as the emergence and stabilization of new forms (e.g., Ford & Lerner, 1992; Lewis, 1995; Thelen, 1992; see also, Thelen & Smith, Ch. 10, this Volume). Second, the systemic view directs our attention also to the cross-linkages between self and personality and other subsystems of the developing individual, such as physiological and cognitive functioning. As mentioned already, it seems that the self and personality have something like an *orchestrating or executive function* with regard to these other systems and the developmental changes occurring in these systems (e.g., Caprara, 1996; Erikson, 1959; Mischel & Shoda, 1995; Waterman & Archer, 1990). The psychology of action (Brandtstädter, Ch. 14, this Volume; Gollwitzer & Bargh, 1996) has recently been suggested as a unifying framework for the microgenetic study of the interplay of cognition, emotion,

and motivation. Efforts are also made to extend action psychology to issues of life-span development (e.g., Baltes & Baltes, 1990a; Brandtstädter & Greve, 1994; Heckhausen & Schulz, 1995). The question whether and how principles of microgenetic action regulation change when applied to an ontogenetic life-span framework has opened a whole new vista of research.

For example, self and personality develop to serve a self-reflective function. Self and personality reflect and evaluate developmental changes in the other subsystems and try to integrate them. This integrative function of self and personality is also mirrored in the fact that subjective measures of adaptation such as subjective well-being or happiness are often used as measures of self. Empirically, this is not without costs. The problem of circularity of argument and measurement dependency has to be critically examined when relating characteristics of self and personality to self-report measures of adaptivity (e.g., Staudinger & Fleeson, 1996).

Providing Links from Infancy to Old Age

A further issue with regard to a life-span view on the definition and study of self and personality development concerns encompassing the ontogenetic course from *infancy* to *old age*. Empirically and theoretically, this distance may often still appear as a gap. Infancy and childhood research on the one hand and adulthood and old age research on the other typically proceed independently from each other with little overlap in concepts, methodology, and consequently empirical data base.

Search for Continuity in the Face of Transformations. Bridging this gap and achieving interconnectivity indeed is not easy (e.g., Brim & Kagan, 1980). It seems necessary to identify constructs that have been used to describe personality development across the life span or have at least shown predictive relationships. This concerns the question of homotypic and heterotypic continuity, a terminology introduced by Kagan and Moss (1962), or of Block's notion of temporal coherence (e.g., Block, 1981). The notion of heterotypic continuity implies that the phenotypic behavior might change between childhood and adulthood, but that specific behaviors in childhood might still be conceptually consistent with adult behaviors. Phenotypically different but conceptually related responses might be derivatives of earlier behavior (e.g., Livson & Peskin, 1980;

Moss & Susman, 1980). Ryder (1967), for example, found that childhood task persistence was related to adult achievement orientation. Caspi, Bem, and Elder (1989) reported that males who showed dependency in childhood transformed this interactional style into a mature, nurturant style characterized by being calm, warm, giving, and sympathetic, qualities that fit well in intimate relationships and the family world.

There are a number of interesting candidates that could serve as examples of constructs that span a lifetime, such as attachment style, control beliefs, or the self-concept. For its recent surge and relatedness to what we call a general purpose mechanism and to a systemic view, we opted for another sample case, *temperament*. Not only has temperament been shown to provide quite strong predictive links between early infancy and even old age in multiple studies (e.g., Caspi & Bem, 1990; Friedman et al., 1995; Kagan & Snidman, 1991; Lerner & Lerner, 1983; Thomas & Chess, 1977), but temperament also provides the possibility to link a biological level of analysis with a psychological one without implying a reductionistic approach (cf., Zuckerman, 1994, 1995).

The Sample Case of Temperament. From an ontogenetic perspective, temperament might be called the first inter-individual differences indicator of personality, making individuals distinct even in the womb. Temperament can be called an umbrella term. Although various temperamental facets have been identified by different authors, there seems to be consensus that activity, reactivity, emotionality, and sociability are four of the major components of temperament (e.g., Bates, 1994; G. McCall, 1987; Strelau & Augleitner, 1997). Kagan and colleagues (Kagan & Zentner, 1996), for example, have focused on one temperamental facet, that is, behavioral inhibition. Behavioral inhibition is defined as the tendency to be extremely shy and restrained in response to unfamiliar people and situations. From Kagan's approach, it is also clear that temperament carries a general-purpose and a systemic quality. For instance, inhibition as one temperamental facet may at a very microanalytic level of analysis provide a link between personality and cognitive development (e.g., Hasher & Zacks, 1988; Pascual-Leone, 1983).

Quite robust evidence also suggests that inter-individual differences in temperament stay fairly stable throughout the life course (e.g., Bates & Wachs, 1994). In a longitudinal

adoption and twin study, Buss and Plomin (1984) found that temperament had a considerable heritability component. Between 50% and 60% of the inter-individual variability in temperamental measures during infancy and childhood seems to be due to genetic influences. And at least up to early adulthood this heritability component did not seem to be subject to age-related changes.

With regard to spanning the life time, it seems that temperamental differences in aggression or shyness or dependency among children are preserved from infancy through middle and later childhood, adolescence and into adulthood (e.g., heterotypic continuity; Kagan & Moss, 1962). Caspi and colleagues (Caspi, Elder, & Bem, 1987) have shown, using data from the Berkeley Growth and Oakland Guidance Studies, for example, that ill-tempered boys become ill-tempered men. In another study, it was found that temperament as assessed through behavioral ratings at age 3 predicted personality as assessed by the MMPI at age 18 (Caspi & Silva, 1995). In specific, the undercontrolled temperament type related positively to later impulsivity, danger seeking, aggression, and interpersonal alienation. The inhibited temperament type, contrariwise, related negatively to later impulsivity, danger-seeking, aggression, and social potency. In addition, the so-called well-adjusted temperament at age 3 related to a normal personality profile at age 18 (Caspi & Silva, 1995).

These kinds of predictive relationships should not be interpreted as a deterministic argument. The work by Chess and Thomas (1984) as well as Lerner and Lerner (1983) on temperament illustrates this point. They have used the notion of "goodness of fit" between child and context to point to the importance of the interaction between child and context. On the one hand, they found that many children with difficult temperaments became maladjusted adults. In such cases, they were able to show that the parents did not manage to adapt to the temperament of the child. On the other hand, these researchers also demonstrated that difficult children with parents who were better able to deal with the temperament of their child developed into well-adapted adults. Lerner and coworkers have extended the work on the "goodness-of-fit" idea, but focused not only on the match between child and parent but also considered the match between child and peers or child and teacher. In a similar vein, they found that children's fit with their peers' temperamental preferences resulted in higher sociometric ratings and also, through the better quality of their peer

relations, indirectly influenced adjustment at a later point in time (East, Lerner, Lerner, & Soni, 1992; J. Lerner, Nitz, Talwar, & Lerner, 1989).

There has been notable progress in identifying some of the mechanisms that might link infant temperament and adult personality and that might enable a joint organization of concepts of temperament and personality (e.g., Eysenck & Eysenck, 1985; Strelau & Angleitner, 1991; Zuckerman, 1995). Zuckerman (1994), for example, has proposed what he calls the turtle model of personality. In this model, personality traits at the top are linked to genetics at the bottom through (from top down) social behavior, conditioning, physiology, biochemistry, and finally neurology. This model is not meant to be reductionistic; it is necessary to study each level of analysis with its own intellectual agenda to gain a complete understanding. As Zuckerman (1995, p. 331) puts it, "We do not inherit temperamental patterns as such. What is inherited are chemical templates that produce and regulate proteins involved in building the structure of nervous systems and the neurotransmitters, enzymes, and hormones that regulate them. . . . We are born with differences in reactivities of brain structure and differences in regulators." Very much in line with our systemic emphasis, it is included in this multiple levels of analysis model of Zuckerman that the type of temperamental pattern, which initially may have a strong genetic component, attains features of contextually-based self-organization. Thus, the temperamental pattern is transformed by context and experience in ways that it becomes an outcome of a multicausal and self-organizing process. In this sense, the developed temperament—if adaptive—might be called a general purpose mechanism and becomes an organizing force as the individual deals with his or her environment and the developmental themes and tasks of later ontogeny.

Of the small number of higher-order factors that have been consistently identified to describe personality (e.g., Goldberg, 1993), two have been of special interest to research on temperament. Those are negative emotionality, which includes variables such as fearfulness, anxiety/tension, inhibition, and dysphoria, and positive emotionality, which includes enthusiasm, excitement, and happiness. Zuckerman (1994) makes a good case for a third dimension, termed impulsive, unsocialized sensation seeking, which appears to be separate from positive and negative emotionality. This impulsivity dimension, the counterpart to

Kagan's behavioral inhibition, seems to be closely related to what Eysenck has called Psychotism, Block's Ego Control, and Costa and McCrae's Conscientiousness. Relationships between this impulsivity dimension and deviant behavior have been found in multiple studies (e.g., Horvath & Zuckerman, 1993; Newcomb & McGee, 1991). Similarly, Caspi and colleagues have demonstrated that childhood temper tantrums predicted delinquency in adolescence (e.g., Caspi, Ch. 6, Volume 3; Caspi, Elder, & Bem, 1987).

We have presented an integrative view on research on the development of personality, self-concepts, and self-regulatory processes. In order to gain an understanding of the life-span development of self and personality, it seems useful to consider structure and processes, as well as functions. A dynamic systems approach to development provides a useful theoretical framework for the integration of the different components of self and personality discussed in the literature. In addition, interest centers on features—such as temperament—that operate across multiple settings and across the life span and, if adaptive, possess attributes of general purpose mechanisms. Based on this conceptualization, we will now apply the level of analysis approach, introduced in the beginning of this chapter, to the field of self and personality.

Illustrations of the Role of Biology and Culture in Self and Personality Development

How does Figure 18.1 apply to the field of self and personality? Working from the assumption that the genome and its expressions, by means of evolution, are not yet optimized with regard to old age, what are the implications for self and personality functioning across the life span? So far the evolutionary base of personality—both in terms of biological and cultural-social forces in the sense of co-evolution—has received less attention than the evolution of cognition (e.g., Asendorpf, 1996; Barkow, Cosmides, & Tooby, 1992; Klix, 1993).

As selection primarily worked through fertility and parenting behavior, most of the evolutionary work in the field of personality (in the widest sense) has focused on gender differences in altruism, cooperative behaviors, sexual competition, or jealousy (e.g., DeKay & Buss, 1992; Hammerstein, 1996). In addition, however, arguments have been raised that the ability for self-deception might have been favoured by evolution because it seems to

increase the ability to deceive others (e.g., Gigerenzer, 1996; Lockard & Paulhus, 1988; Trivers, 1985). The evolutionary importance of the ability to deceive others in turn is related to the crucial role of reciprocal relationships for reproductive fitness (e.g., Axelrod, 1984). We would like to suggest that this ability "to deceive oneself," or one could also say "redefine reality," indeed serves an important adaptive function across the life span and probably increasingly so in old age. Thus, the fact that the evolutionary base has been less optimized for the postreproductive phases of life than for younger ages may not be as detrimental for the ontogenesis of self and personality as for biological and cognitive functioning. Perhaps what is relevant here is that the "mechanics of the mind" which evince definite aging losses (see above), either carry little implication for self and personality functioning, or that evolutionary selection in humans provided a different genetic basis for personality and self than for intellectual functioning.

This interpretation of findings from evolutionary psychology, that self and personality are less at a genetic disadvantage than cognition and biological functioning, is supported by findings on the genetic component of inter-individual differences in personality functioning as advanced by behavior-genetic research. Evidence from the cross-sectional as well longitudinal analyses of the genotype and the phenotype of self and personality characteristics seem to point to a different pattern than the one just reported for the domain of intellectual functioning. During the life course, stability or slight *decreases* in heritability coefficients (in the sense they have been introduced in an earlier section) have been found (e.g., Pedersen, 1993). Moreover, at least until the eighth decade of life (Smith & Baltes, 1993, in press-a) there is very little evidence for age-related losses in self and personality functions.

This very general summary statement, however, needs qualification and differentiation. So far, only few behavior-genetic studies of personality based on longitudinal data with extensive age intervals are available. Highly complex statistical methods that allow modelling of the genetic architecture of development (Pedersen, 1991) by simultaneously taking into account mean levels and growth curves (e.g., Hewitt, Eaves, Neale, & Meyer, 1988; McArdle, 1986; Molenaar, Boosma, & Dolan, 1991) have become available. However, due to the lack of appropriate data sets and to the recency of their availability, they have not been widely applied yet. Therefore, authors in the field of behavioral

genetics consider the available evidence as preliminary (e.g., Loehlin, 1993; Pedersen, 1993; Rowe, 1993).

Taking such limitations into account, the following preliminary insights into the developmental behavioral genetics of personality seem to find consensus among behavioral geneticists (e.g., Brody, 1993; Pedersen, 1993). First, results of behavior-genetic analyses of personality assessments are difficult to compare with the equivalent analyses of intelligence assessments because the latter are based on behavioral performance measures, whereas personality measures typically refer to self-reports. Thus, strictly speaking, personality-related analyses refer to the heritability and its life-span changes in how people report about themselves. Second, the extent to which genetic influences account for phenotypic variability in personality measures is smaller than for measures of intelligence, with heritability coefficients between .4 and .6 depending on the personality trait and the age of assessment. Third, the importance of genetic influences on inter-individual differences in personality seems to decrease slightly with increasing age (e.g., McCartney, Harris, & Bernieri, 1990; McGue, Bacon, & Lykken, 1993a; Pedersen, 1993). And fourth, there is initial evidence for a quite high overlap in the genetic effects operating on personality expression at different ages, although at each point in time they account for not more than half of the variance (e.g., McGue et al., 1993a; Pedersen, 1993).

How can we try to understand the two findings that genetic influence at any given age is about half of the inter-individual variance in personality measures, but that at the same time the genetic influence on the stability and change of personality attributes seems to decline? Genes may exert their influence on complex psychological traits through various types of gene-environment interactions (e.g., Scarr & McCartney, 1983). For example, environments react in a certain way to certain persons (evocative type), or certain persons with certain genomes seek out certain environments (proactive type). And indeed there is indication that incidental differences in personality development are primarily, and increasingly with age, influenced by environmental events not shared by individuals reared together (e.g., Plomin, Chipuer, & Loehlin, 1990); whereas shared rearing environments seldom account for more than 10% of the variation in personality late in life (Pedersen et al., 1991). In addition, we suggest that—very much in line with dynamic systems theory (Fischer &

Bidell, Ch. 9, this Volume; Ford & Lerner, 1992; Thelen & Smith, 1994; Thelen & Smith, Ch. 10, this Volume)—individuals strive toward maintaining identity; and that the application of self-regulatory principles are successful in enhancing stability in self organization.

The finding of age-related stability or even a decrease of the longitudinal genetic influence on individual differences in personality across the life span is in contrast with genetic influences in other domains of behavioral functioning, such as cognitive development. The dominant finding there had been one of *increasing* heritability of individual differences (Plomin, Pedersen, Lichtenstein, & McClearn, 1994). Combining this evidence with the finding that no major declines (at least up until the age 75–80) in self-related functioning are observed (see below), can be taken to imply that functioning in the domain of self and personality is to a lesser degree subject to the detrimental effects of the incomplete evolutionary architecture of human ontogenesis (see Figure 18.1(a)). Unless pathological conditions, such as Alzheimer's disease, infect the whole system, no age-related increases of pathological conditions in the personality domain are recorded. Conversely, however, more recent evidence from the Berlin Aging Study (Smith & Baltes, 1993, in press-a, in press-b) points to more discontinuity in functional status of self and personality in *advanced* old age. Indeed, it appears as if the study of the very old (above age 85) may reveal losses in personality and self-functioning as well. At this point, it is unclear whether this increasing instability is primarily due to overriding conditions of morbidity or whether self and personality functioning itself undergoes such changes in very old age.

The Allocation of Resources in the Area of Self and Personality

In an earlier section, we emphasized the life-span developmental script of a reallocation of resources, from a predominant allocation into growth to an increase in relative allocation into maintenance and management of losses (see also, Staudinger et al., 1995). Thus, in contrast to the domain of cognitive functioning where resources in old age are depleted to maintain a certain level of functioning, the resource situation for life-span growth in self and personality might present itself more favorably. Taking a system's view on psychological functioning, we can assume

therefore that the self by virtue of being the self-reflective head of the living system "human being" (a quality emerging during childhood) might be able to continue to deliver its orchestrating or executive function with regard to managing the gains and losses across various domains of functioning (cf., Staudinger et al., 1995).

It is an open question, however, whether self-related resources are available in old age to promote the further development of the self-system itself. In other words, as life reaches old age available self-related resources are invested in managing cognitive, physical, and social declines and losses. Possibly only under very favorable developmental conditions would self-related resources be sufficient to invest in further development of the self itself. Although, in principle, life-span changes in self and personality could include advances, we do not expect them to occur in everyone. Under very favorable conditions, personality growth might even involve such high goals as wisdom (cf., Erikson, 1959; see Table 18.7; see also, P. Baltes, Smith, & Staudinger, 1992).

Further, we assume that the "self" also manages and organizes the extension of internal resources (e.g., cognitive capacity, physical strength, personality characteristics) by referring to others and the physical and institutional context as resources (for overview see Staudinger et al., 1995). Others can help to do things that one's own health or time or ability does not allow. External memory aids can help to compensate for the loss in memory performance. Given this line of thought, one can also conceive of a situation that allows the self to optimize the use of external resources such that enough internal resources are left for further personality development, for example, toward wisdom. An extreme case for such self-based orchestrating of resources aimed at selective optimization is the loss of independent functioning. There the task is to accept dependency in such domains as household management in order to free up resources for other purposes (M. Baltes, 1996).

The notion that self and personality perform an orchestrating or executive function with regard to the management and identification of resources raises the following question: Is it possible to distinguish the mechanisms and characteristics that support the overarching orchestrating or executive functions from those that constitute one of the three domains of psychological functioning, that is intelligence and cognition, self and personality, and social relations, or are both inextricably intertwined? This is a

question which is discussed in research on *resilience* (Staudinger et al., 1995). By taking such a research perspective on the origins, maintenance, and consequences of self and personality—ideally in a longitudinal manner—it becomes possible to identify, for instance, whether, or how, the self and personality manage themselves while at the same time manage extraordinary challenges such as losses in cognitive functioning or losses of significant others due to death, or to challenges of one's own finitude. Each process and each characteristic constituting the self and personality can thus be identified as phenomenon in itself but also in its executive and orchestrating function.

The Development of Self and Personality as Life-Long Transactional Adaptation

In the following, we will discuss in more detail three issues of life-span development of self and personality. The first is the question of stability and change across the life span. Aside from questions of stability in individual rank order, this issue can also be phrased as investigating the gains, maintenance, and losses in the area of self and personality. The second issue relates to the opportunities and constraints of self development. And finally, the third issue will illustrate the adaptive self-related potential across the life span, which arguably might present the most comprehensive general purpose mechanism involved in the conduct of life-span development.

It is a core assumption that follows from a life-span perspective that self and personality development occurs from birth until death. "Transactional adaptation" (e.g., R. Lerner, 1984, 1986) or person-environment interaction (e.g., Kindermann & Valsiner, 1995; Magnusson, 1990; Magnusson & Stattin, Ch. 12, this Volume) are considered the central developmental processes. Self and personality do not simply passively unfold as a consequence of pre-wired maturational programs or the mechanistic reaction to environmental stimuli. Self and personality develop out of a constant and active process of the individual's transactions with changing internal and external influences, including changes in historical conditions of society. In this process of transactional adaptation of self and personality, systemic principles of self-organization (e.g., Lewis, 1995) are key ingredients.

We need to take into consideration, however, that not only self and personality develop, but also that internal and

external contexts (and their associated risks and resources) as well as the functional consequences (evaluative criteria) change with age. As described earlier, multicausality and multifunctionality are an essential characteristic of life-span development. To give an example, it is not only the self-concept that changes with age but also the social and material contexts of its acquisition and application in everyday life. The research program of Damon and Colby (e.g., Colby & Damon, 1992; Damon, 1996) illustrates this notion for the sample case of moral goals and moral behavior. Furthermore, the criteria according to which the level and form of self-concept development is evaluated undergo age-related changes. We will later argue that in addition to the behavioral level of functioning, the amount of available self-related reserve capacity also changes. Self and personality development is brought about by continuous *and* discontinuous internal and external factors and associated processes. Therefore, in life-span thinking any argument in favor of *either* continuity *or* discontinuity is inherently misplaced. By the very nature of the developmental process, the system of self and personality in a life-span perspective is one of both continuity and change.

We will begin by presenting evidence for continuity and stability in personality development on both the mean-level and with regard to inter-individual differences. This information is captured most precisely by the so-called trait-models of personality development (e.g., Kogan, 1990). At the same time, however, and as persuasively argued by Nesselroade (e.g., 1991a) on both theoretical and empirical grounds, there is also sizable evidence for intra-individual (within-person) variability. Thus, there are two sides to consider: Changing amounts of inter-individual continuity on a group level of analysis as well as changing amounts of intra-individual plasticity (see also, Brim & Kagan, 1980).

Trait Models of Personality: Focus on Stability and Continuity of Personality Development

Trait models of personality approach the question of continuity and discontinuity and stability and instability from the continuity side. Trait-oriented researchers are interested in exploring and possibly arriving at a structure of personality characteristics that captures an individual's experiences and behaviors in a way that is as comprehensive and continuous as possible. Roughly, two major approaches can be distinguished. One is the lexical tradition (e.g., Allport & Odbert, 1936; Cattell, 1943), which

selected from the Webster's dictionary such single-word descriptors that allow the comprehensive description of the consistent and stable modes of an individual's adjustment to his or her environment. As Cattell put it, this approach was based on the lexical hypothesis that all aspects of human personality that are or have been of importance, interest, and utility have already become recorded in the substance of language (Cattell, 1943, p. 483). Using adjective-based ratings as the method of personality assessment, this approach has been carried into the present (e.g., Goldberg, 1993; Nesselroade & Bartsch, 1977; Norman, 1963).

The other approach is based on questionnaire items. Through Cattell's work (Sixteen Personality Factor 16PF; Cattell, Eber, & Tatsuoaka, 1970) this approach can also be traced back to the lexical tradition, but it is influenced as well by personality theories that were developed independent of the lexical approach, for instance, by Murray's theory of human needs, which is reflected in the Personality Research Form (Jackson, 1984). In this tradition and with much interest in life-span development, Costa and McCrae (e.g., 1995) have worked since the 1970s on identifying the personality dimensions which form the common denominator of available personality questionnaires and to trace their ontogeny across the adult life span.

Both approaches, the lexical and the questionnaire approach, have been statistically related to each other and among a large number of personality researchers there is presently consensus that personality can be reasonably well described by the so-called "Big Five." The Big Five have been identified by means of factor analysis across different instruments and different samples, though labels vary somewhat among authors (cf., John, 1990). We have chosen Costa and McCrae's factor names to convey the information: Extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience.

Recently, there has been heated debate about whether these five superfactors indeed capture all there is to personality (see Block, 1995; Costa & McCrae, 1995; Goldberg & Saucier, 1995). We do not want to elaborate on this discussion; we would only like to alert the reader to the fact that on the one hand, the Big Five structure has been shown to be useful in describing personality and predicting developmental outcomes, but on the other hand, it should not be mistaken to imply that there are no other facets of personality. As most of this work has been informed by a personality-psychology rather than a developmental

perspective, there has been, to our knowledge, no systematic study of the factor structure of the *original* pool of adjectives by age group. The selection work on the original pool of adjectives was done with young adults (for an overview see Block, 1995).

A longitudinal study of adolescent personality by John and others (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994) is informative in this respect. In this study, using a childhood version of a standard personality assessment instrument (California Adult Q-set; McCrae, Costa, & Busch, 1986) that had been shown to reflect the Big Five (McCrae et al., 1986), two additional factors of activity and irritability were identified. The two additional factors were primarily based on items characterizing specific aspects of adolescent personality that are not included in the adult version. In their careful interpretation of the finding, the authors suggest that indeed activity and irritability cannot be reduced to the adult factors of extraversion and neuroticism but that they might be linked to each other in the sense of heterotypic continuity (Kagan & Moss, 1962). Similar arguments may apply to other stages of the life span.

Growth Models of Personality Development

As mentioned before, stability and continuity are only one side of the coin. However, some stability and continuity most likely is a must for the evolution of personal coherence and adaptive fitness. However, precisely because of life-long ontogenetic challenges and motivation for improvement (White, 1959), self and personality development also involves discontinuities and changes in directionality (gains and losses). The growth models of self and personality development as exemplified in the notions of identity development, ego development, or the concept of developmental tasks capture one aspect of this phenomenon, namely that of a systemic advance in level of self- and personality-based functioning (e.g., Bühler, Erikson, Havighurst, Jung, Loevinger).

We would like to offer a selection of such models without trying to be comprehensive. Rather, we aim at combining developmental models from quite different traditions and with quite different goals in order to show the overarching themes and structures that cut across different theoretical models and different facets of self and personality development. Table 18.7 lists the theoretical models of seven developmentalists. They range from the development

Table 18.7 Overview of Source Life-Span Models with Relevance to Self and Personality Growth

Piaget & Pascual-Leone	Kohlberg	Labouvie-Vief	Loevinger	Erikson	Havighurst
Sensorimotor		Sensorimotor	Presocial	Trust vs. mistrust Hope	Maturation of sensory and motor functions Social attachment Emotional development Sensorimotor intelligence and primitive causality Object permanence
Preoperational	<i>Preconventional</i> Punishment -Obedience	Presymbolic	Symbiotic	Autonomy vs. shame Will power	Elaboration of locomotion Self-control Fantasy and play Language development
Concrete Operational		Symbolic	Impulsive	Initiative vs. guilt Purpose	Sex role identification Early moral development Group play Development of self-esteem
Formal Operations	Instrumental- Hedonistic	Intrasystemic	Self-protective	Industry vs. inferiority Competence	Friendship Self-evaluation Concrete operations Skill learning Team play
Late formal	<i>Conventional</i> Good boy morality		Conformist	Identity vs. confusion Fidelity	Physical maturation Emotional development Formal operations Internalized morality Membership in peer groups Heterosexual relationships Autonomy from parents Sex role identity Career choice
Predialectical	Authority Orientation <i>Postconventional</i> Morality of contract	Intersystemic	Conscientious	Intimacy vs. isolation Love	Marriage Childbearing Work Life style
Dialectical	<i>Postconventional</i> Morality of contract	Autonomous- Integrated	Autonomous	Generativity vs. stagnation Care	Nurturing the marital relationship Management of household Child rearing Management of career
Transcendental	Individual principles of conscience		Integrated	Integrity vs. despair Wisdom	Promoting intellectual vigor Redirecting energy towards new roles Accepting one's life Developing a point of view about death Coping with physical changes of aging Developing a psychohistorical perspective Traveling uncharted terrain

of basic cognitive functioning to ego and identity development in the sense of Loevinger and Erikson. These models differ in the degree to which they focus on the development of structure of self-concept, personality, and self-regulatory processes that self and personality serve throughout the life span.

We have chosen to include Labouvie-Vief's (1982) general model of the development of mature thought rather than any of her more specific ones because we believe it is this fundamental developmental structure that then can be applied to such seemingly diverse areas as development of emotional regulation and representation or

self representation (Labouvie-Vief, Chiodo, Goguen, Diehl, & Orwoll, 1995; Labouvie-Vief, DeVoe, & Bulka, 1989; Labouvie-Vief, Hakim-Larson, DeVoe, & Schoeberlein, 1989). In a similar way as, for instance, Pascual-Leone, Labouvie-Vief attempts in her theoretical considerations to integrate the development of cognition, motivation, and emotion.

It may seem surprising that cognitive models such as that of Labouvie-Vief are included in this overview table. However, if one assumes that self-reflexivity and aspects of intersubjectivity and social cognition are important components of self and personality, cognitive development has its natural place in any developmental model of self and personality. Developmental research previously has rarely dealt with the interplay between cognitive and personality development. One important exception was theorizing and empirical research in the Vygotskian tradition (e.g., Overton, Ch. 3, this Volume; Rogoff, 1990a; Valsiner, Ch. 4, this Volume; Wertsch, 1991). Recently, there seems to be a change in this attitude and a renaissance of Vygotskian ideas (e.g., Bornstein & Bruner, 1989; Cohen & Siegel, 1991; Wozniak & Fisher, 1993). Similarly, work stemming from other traditions, such as social intelligence, collaborative cognition, and interactive minds, has moved in this direction (e.g., P. Baltes & Staudinger, 1996a; Resnick, Levine, & Teasley, 1991; Wellman & Gelman, 1992). Dunn's work on the interaction between development of attachment and theory of mind is another interesting example from childhood research (Dunn, 1995). Another recent exception is the application of a dynamic systems perspective to personality development. Lewis (e.g., 1995; see also Caprara, 1996; Mischel & Shoda, 1995), for example, argued that it is through the interactions between cognition and emotion that personality and social development are propelled.

At the heart of most of the selected developmental models lies—according to our reading—aside from the focus on age-graded tasks, the basic idea of the dialectics of development, and in this regard especially the coordinated dialectics between the self and the other (Kramer, 1983; Riegel, 1973b). This implies that in a first developmental step the basic “constitution” (of e.g., emotion, self, morality, world) has to be acquired. In early ontogeny, this happens in an absolutist fashion, which implies that there is one truth about such diverse matters as the world, myself, or my emotions. In the next developmental step, primarily

due to cognitive advances permitting the occurrence of social decentering and intersubjectivity, and the emergence of the sense of a socially differentiated identity, it becomes possible to acknowledge that there are multiple views of the same phenomenon. Cognitively guided models further argue that under favorable conditions, multiple views are subsequently integrated without, however, loosing the flexibility to switch among different ones. In Piagetian terms, a coordinated system of horizontal and vertical *décalage* of selfhood and selves evolves. A similar developmental progression can also be identified in psychoanalytically informed models such as the one by Erikson (1959) or more recently Vaillant's model of ego development (Vaillant, 1993). Within the framework of a reciprocal developmental relationship between self and other, we would still argue that the developmental organization is described to move from the self as focus to the other and eventually to the integration of both. First, self-related attributes (including receiving relationships with others) such as trust, hope, competence, and identity are acquired, before we become able to turn to others and give, or, in Eriksonian terms, develop love and generativity. Eventually, under ideal conditions, we should become able to integrate our selves and our lives including the contributions by and views of others.

Havighurst's model of developmental tasks (Havighurst, 1948; see Table 18.7) differs from the others in that it focuses on the development of the orchestrating or executive function of the self-society match rather than on the development of self and personality *per se*. For each life period, the model lists the challenges that are presented by different areas of life such as physical, cognitive, personality, and social functioning. It is interesting to note that with increasing age, Havighurst's tasks become more and more social and biological in nature. On the one hand, this is to a certain degree a reflection of the nature of life-span development and the increasing gap between mind and body (see also, Baltes, Reese, & Lipsitt, 1980, Figure 18.3). But on the other hand, it may also reflect the interdisciplinarity of life-span scholars (Havighurst, 1973) and especially their strong connection to sociology with its focus on age-graded norms, roles, and passages. Therefore, we believe that it might be especially fruitful to combine, for example, Labouvie-Vief's model, which starts out from Piaget's theory of cognitive development and extends and modifies it by a more explicit account of the effects of emotions and social relations on cognitive development, with Havighurst's quite

comprehensive listing of age-related social and biological requirements. What is also lacking in the models listed is an explicit concern with historical change (see however, Elder, Ch. 16, this Volume).

A second meta-analytical perspective offered by Table 18.7 refers to the fact that the development of self and personality per se encompass two aspects that are captured by the different models in differing degrees. Recent empirical evidence suggests that there is one aspect of self and personality growth which refers to the internal and more cognitive side of the self, and another which refers to the external or psychosocial side of ego development (e.g., Helson & Wink, 1987; Labouvie-Vief, Hakim-Larson, DeVoe, & Schoeberlein, 1989; Vaillant & McCullough, 1987).

Development of the cognitive internal side of the self is exemplified by the notion of ego development (e.g., Loevinger, 1976), or the notion of post-formal operations as it has been proposed in the Piagetian tradition (e.g., Basseches, 1984; Labouvie-Vief, 1992; Pascual-Leone, 1983; Riegel, 1973b). This cognitive side of ego development focuses on growth in cognitive complexity, tolerance of ambiguity, and objectivity, and is closely linked to cognitive development. The other aspect of self and personality growth refers to the "external" psychosocial maturity and the continued exchange with social norms and expectations. The Erikson model of psychosocial crises (e.g., Erikson, 1959) or Vaillant's model of the development of adjustment (e.g., Vaillant, 1977, 1990) are examples for this aspect of self and personality growth.

Of the models listed, Erikson's is perhaps the best known, although empirically still underdeveloped. In his epigenetic theory of personality development, Erikson (1963) distinguished eight "ages of life" (life tasks) representing critical, age-specific challenges that have to be successfully mastered for the individual to develop optimally. The eight life tasks and associated ego skills characterizing human life-span development are listed in Table 18.7. Erikson links these themes to certain ages. One should keep in mind, however, that although Erikson implied a certain predominance of a given task at a given age, he also suggested that these tasks are present in principle at all ages and represent a life-long continuing template. Achieving each succeeding stage requires, on the one hand, successful mastery of the previous life tasks and, on the other hand, accelerative and supportive conditions associated with the material and social environment.

Psychosocial development for Erikson (1959, 1963) denotes growth and change in the individual as both person and society evolve. At the end of an optimal developmental trajectory, according to Erikson, stands a self characterized by the following ego skills: Hopeful, willful, finding purpose in life, competent, loyal, capable to love, caring, and wise. Such a pattern of attributes represents the cluster of Western Christian values or virtues. It is occasionally argued that this pattern has an elitist and absolutist flavor which is more monopolistic than cultural and personal variations of life-span development suggest. In this sense, Erikson's model may lack the pluralism and flexibility that some life-span researchers have claimed to be essential to a comprehensive model of life-span development (e.g., P. Baltes, 1987, 1997; Chapman, 1988b; Maddox, 1987; Valsiner & Lawrence, 1996).

Self and Personality: Between Stability, Growth, and Decline or between Continuity and Discontinuity

After elaborating on some of the theoretical models that underlie either personality stability or personality growth, we will now turn to an overview of the available evidence with regard to the questions of stability, growth, and decline in self and personality characteristics.

Defining Gains (Growth) and Losses (Decline) with Regard to Personality Development

Using the notions of growth and decline or gain and loss with regard to personality characteristics makes the criterion problem of what is a gain and what a loss even more obvious and pressing than it is with regard to intellectual functioning. In cognitive research, it seems obvious that the more words one can remember, the better; the faster we can complete a problem solving task, the higher the level of performance. But even with regard to intellectual functioning such criteria of adaptive fitness, of what is a gain and what a loss, may need to undergo revision in everyday life. When it comes to self and personality, we are presented with the problem of determining a "best" direction of personality development. What is the desirable end state of personality development? Is there one, or are there many potentially incompatible ends depending on the outcome criteria we examine? To what degree do subjective and objective criteria converge?

For example, let us take extraversion and assume that being extraverted is set as an aspired goal of personality development. We can think of occasions, however, when, on the contrary, introversion turns out to be the more adaptive personality feature. Similarly, it is very important to strike a balance between affiliation and solitude or between autonomy and dependence. Such considerations remind us of the argument presented above about general purpose mechanisms. We argued there that it is the flexibility and the availability of a monitoring algorithm that defines context-dependent optimality with regard to self and personality functioning, rather than one or the other personality characteristic. Similar views can be applied to coping research. There, high domain-specificity with regard to the functionality of coping behaviors has been identified. Furthermore, coping behaviors which are adaptive as immediate responses need not be adaptive in the long run. Thus, even with regard to coping, implications for everyday functioning are not fully known (Filipp & Klauer, 1991).

One possible solution of this dilemma is to invoke subjective assessments, for instance, about the perceived desirability or undesirability of a given self-related attribute to obtain estimates of what is considered a gain. In a series of studies on beliefs and expectations about development, Heckhausen and Baltes found that people have quite clear conceptions about what they consider to be a desirable and what an undesirable developmental outcome and also when it is supposed to occur. For example, only two desirable personality characteristics were thought to continue to grow in old age, that is wisdom and dignity, whereas many other positive characteristics were mentioned for the periods of young and middle adulthood (cf., Heckhausen, Dixon, & Baltes, 1989). It was also found in these studies that people of different ages and socioeconomic backgrounds agree about how personality develops and about what is a desirable and what undesirable personality development, that is, what is a gain or a loss.

In the following section, as we characterize gains and losses in life-span development of self and personality, we use two approaches. A first is based on research on subjective conceptions of the desirability of developmental outcomes. The second is our assessment of which self and personality characteristics are based on growth models of development (e.g., ego maturity, integrity, generativity) or on general conceptions of functionality and dysfunctionality (e.g., neuroticism). We alert the reader to the problem

that these categorizations are preliminary and by no means absolute. They are most likely oversimplifications because of the multidimensionality and multifunctionality of characteristics contributing to adaptive fitness.

Evidence Based on Trait Models of Personality

With regard to the stability and change of personality dispositions, there is wide-ranging consensus that the Big Five, that is neuroticism, extraversion, openness to experience, agreeableness and conscientiousness, show a high degree of stability after age 30 and far into old age (e.g., Conley, 1985; Costa & McCrae, 1994; Kogan, 1990). With regard to the statistical determination of stability, at least four interpretations can be distinguished (e.g., Nesselrode, 1989, 1991b). One refers to the stability of mean levels, the second to the stability of inter-individual differences, the third to the stability of covariances or structural stability, and the fourth one to the stability of one person's personality profile. With regard to the Big Five, the first three facets of stability have been much investigated and the evidence demonstrates a high degree of stability.

Structural Invariance of Personality. Among others, life-span methodologists have convincingly argued (e.g., Nesselrode, 1989) that meaningful comparisons of personality dimensions across the life span require the investigation of the degree of structural invariance of the underlying set of dimensions. The question of structural invariance involves two subtopics. A first is substantive and asks whether the structural properties change with age, for instance, in the number of traits or their interrelationships. The second is methodological and concerns measurement equivalence across age. Thus, when comparing extraversion scores of adolescents to those of old adults, it is important to know whether the same psychometric construct can be assumed to exist in the two age groups.

For the Big Five factorial model of personality, much information on structural stability is available (e.g., Conley, 1985; Costa, McCrae, & Dye, 1991; McCrae & Costa, 1997). It shows that a high degree of structural similarity can be assumed above age 10. Below that age, either observer ratings or information on temperament can be used as precursors of later personality dispositions (see above). Both strategies, however, could not be used to extend information about structural invariance below age 10, which is usually accepted as the lower limit for meaningful

administration of personality questionnaires (e.g., Eysenck & Eysenck, 1975).

The evidence on structural invariance across most of the adult life span is restricted, however, by two limiting conditions. A first is the content generality of the traits measured. Would structural invariance be demonstrated if traits were measured context-specific and especially if age-specific contexts (e.g., work vs. retirement contexts) were compared? Furthermore, we know very little about the degree of structural similarity in old age.

Stability and/or Change of Inter-Individual Differences. Costa and McCrae have made it a focus of their work and have invested impressive energy and diligence in collecting and organizing the available longitudinal evidence on personality development across the life span (e.g., Costa & McCrae, 1992, 1994, 1995). Table 18.8 lists their compilation of longitudinal studies using the Big Five framework and varying in measurement intervals from 6 to 30 years.

It seems to be the case that stability coefficients decline with increasing time intervals between measurements, from .83, .82, .83, .63, .79 (6 or 3 years) to .56, .56, .62, .65, .64 (30 years), respectively. In general, it seems that about half of the inter-individual variance is accounted for by stability and half by change. Costa and McCrae do not follow this interpretation because they argue that these stability coefficients need to be corrected for measurement error. When they do so and in addition project the development of coefficients over a 50-year interval from age 30 to 80, they arrive at the conclusion "that three-fifths of the variance in true scores for personality traits is stable over the full life span." (Costa & McCrae, 1994, p. 33). In contrast, other authors using a meta-analytic or multitrait-multimethod approach arrive at the conclusion that a 50% change and 50% stability division is the best description of the available evidence (e.g., Conley, 1984, 1985; McGue et al., 1993a; Pedersen, 1993; Schuerger, Zarella, & Hotz, 1989; Siegler, Zonderman, Barefoot, & Williams, 1990).

We would like to note that when interpreting such longitudinal evidence, it should be taken into account that most of the studies cited worked with highly positively selected samples to start with, and certainly they have sample attrition over a time span of 30 or 50 years. It remains unclear whether positively selected samples might result in more or less stability than more heterogeneous samples. In none

Table 18.8 Stability Coefficients for Selected Personality Scales in Adult Samples

Factor/Scale	Source	Interval	r
Neuroticism			
NEO-PI N	Costa & McCrae, 1988	6	.83
16PF Q4: Tense	Costa & McCrae, 1978	10	.67
ACL Adapted Child	Helson & Moane, 1987	16	.66
Neuroticism	Conley, 1985	18	.46
GZTS Emotional			
Stability (low)	Costa & McCrae, 1992	24	.62
MMPI Factor	Finn, 1986	30	.56
		Median:	.64
Extraversion			
NEO-PI E	Costa & McCrae, 1988	6	.82
16PF H: Adventurous	Costa & McCrae, 1978	10	.74
ACL Self-Confidence	Helson & Moane, 1987	16	.60
Social Extraversion	Conley, 1985	18	.57
GZTS Sociability	Costa & McCrae, 1992	24	.68
MMPI Factor	Finn, 1986	30	.56
		Median:	.64
Openness			
NEO-PI O	Costa & McCrae, 1988	6	.83
16PF 1: Tender-Minded	Costa & McCrae, 1978	10	.54
GZTS Thoughtfulness	Costa & McCrae, 1992	24	.66
MMPI Intellectual		30	.62
Interests	Finn, 1986		Median: .64
Agreeableness			
NEO-PI A	Costa & McCrae, 1988	3	.63
Agreeableness	Conley, 1985	18	.46
GZTS Friendliness	Costa & McCrae, 1992	24	.65
MMPI Cynicism (low)	Finn, 1986	30	.65
		Median:	.64
Conscientiousness			
NEO-PI C	Costa & McCrae, 1988	3	.79
16PF G: Conscientious	Costa & McCrae, 1978	10	.48
ACL Endurance	Helson & Moane, 1987	16	.67
Impulse Control	Conley, 1985	18	.46
GZTS Restraint	Costa & McCrae, 1992	24	.64
		Median:	.67

Note: Interval is given in years; all retest correlations are significant at $p < .01$. NEO-PI = NEO Personality Inventory, ACL = Adjective Check List, GZTS = Guilford-Zimmerman Temperament Survey, MMPI = Minnesota Multiphasic Personality Inventory. Taken from Costa, P. T., & McCrae, R. R. (1994).

of the studies have systematic selectivity analyses been conducted either. Consequently, one can only speculate whether the subjects that dropped out would have increased or decreased the stability of inter-individual differences. Moreover, as argued most persuasively by Nesselroade (1989, 1991b), it is important to acknowledge that the pool of items and scales selected for use in this longitudinal work is selected toward stability. Traditionally, psychometric construction favored items which evinced temporal stability.

Stability and/or Change of Mean Levels. Studying the age-related development of mean-levels of personality dimensions is the next natural step. For example, do we become more or less open to experience as we age or do we stay the same? Again, most of the available evidence on this question is based on cross-sectional studies. The main and replicated finding of those studies (e.g., Costa & McCrae, 1992, 1994) show that across an age range from, for instance, 29 to 93 or 21 to 64 years on average there are relatively small changes. The dominant result is age-related continuity in mean levels. For instance, age correlations are of modest size. Negative age correlations are found for neuroticism ($r = -.15$ or $r = -.12$), openness ($r = -.16$ or $r = -.12$), and extraversion ($r = -.16$ or $r = -.12$). Modest positive age correlations were obtained for agreeableness ($r = .18$ or $r = .17$) and conscientiousness ($r = .05$ or $r = .09$). All correlations were significant but accounted for only about 3% of the variance in any of the scales. So, put in everyday terms, it seems that over the adult life span, the aging population on average becomes less open to new experiences and less outgoing, less neurotic, more easy to deal with, and more reliable. In terms of gains and losses—as indexed by subjective assessments of desirability—this pattern leans somewhat more towards gains. However, cohort effects may overlap with age effects in these cross-sectional studies.

When it comes to longitudinal studies, Costa and McCrae only report one seven-year study in which participant age, however, is averaged across an age span of 20 years (29–49 yrs.; Costa & McCrae, 1992). This design or manner of analyzing the data makes it very hard to follow developmental trajectories and discover potential age-graded changes. It actually works against discovering potential mean-level changes. Using this procedure, Costa and McCrae reported an increase in level of conscientiousness for women of the size of one third of a standard deviation. In addition, individual facets of openness and extraversion decreased by a similar magnitude for men and women alike. In the instance of longitudinal evidence, it seems that the pattern of results leans a little bit more toward neutral than toward gains.

In sum, methodological problems notwithstanding, it seems fair to conclude that a major feature of life-span development in personality is sizeable stability of structure, sizeable continuity in inter-individual differences (close to 50%), as well as only moderate changes in mean levels. The

latter can be interpreted to constitute a neutral to gain rather than a loss pattern. Recently, it has been suggested, however, that when it comes to *very* old age, the pattern of results seems to change towards a loss pattern (P. Baltes & Mayer, in press; Smith & Baltes, 1993, in press-b). A key task now seems to be the search for the conditions of continuity and especially of shifts in inter-individual differences. We need to learn more about the changing half of the distribution. Equally important is to complete the lifetime connection between childhood and adulthood as well as that between adulthood and old age.

Empirical Evidence Based on Growth Models of Personality Development

A major shortcoming of trait models of personality may be the relatively high level of aggregation of the structural conceptions as well as their psychometric foundation in stability. More open towards the possibility of development-related gains and actually providing theoretical grounds for such gains are what have been called the “growth” models of personality. One of the central historical figures of this school of thought is Erikson (1959, 1963; see also, Levinson, 1980; or Vaillant, 1990), with his theory of eight ego-developmental stages. Erikson’s theory, for instance, predicts that in the second half of life, individuals in the post-reproductive phase of life either develop generativity and wisdom or fall into stagnation and despair (see also, Table 18.7; Erikson, Erikson, & Kivnick, 1986).

Traits as Facilitative Constraints for Adaptive Change. Given the fact that one of the functions of self and personality is to provide a continuous basis to an individual’s planning, action, and evaluation, it would be surprising not to find facets of self and personality that serve exactly that purpose and demonstrate continuity (Filipp & Klauer, 1986). Rather than precluding transactional change in self and personality, it is possibly exactly the continuous and coherent personality structure as measured within the psychometric or trait approach to personality that provides the frame for effective transactional adaptations to changing developmental contexts.

In a similar vein, in behavior-genetic research the notion “norm of reaction” has been coined to identify the constraints that the genome places on developmental trajectories. Taking a dynamic view of the notion of norm of

reaction, we would argue that depending on their personality trait profile, individuals will show different adaptational changes in self and personality functions. We suggest that it is in this sense that research based in growth models of personality development (see Table 18.7) has identified changes on personality features like generativity or integrity. Thus, personality growth becomes a developmental outcome and personality traits are subsumed as "facilitative constraints" on the antecedent side. By and large the empirical evidence, especially of the longitudinal type, to support these theoretical contentions is still scarce. In addition, measurement instruments used in the tradition of personality growth are less developed with regard to criteria of psychometric quality.

Stability of Inter-Individual Differences. The Berkeley and Oakland Longitudinal Studies (e.g., Block, 1971; Haan, 1981; Haan, Millsap, & Hartka, 1986) by now cover more than 50 years, from ages of 5 to 60. Personality assessment in these studies was done predominantly by means of the California Q-sort (Block, 1961) and the CPI (Gough, 1957) but only at some measurement points. In the research reported here, the Q-sort data subsequently were clustered using a component analysis (Meredith & Millsap, 1985). Six components were derived: self-confident, assertive, cognitively committed, outgoing, dependable, and warm. Componential analysis according to the authors solves the problem of negative correlations due to ipsative measurement, which characterizes the California Q-sort. The authors report reliabilities of .67, which are somewhat lower than those of trait measures. Although some overlap with CPI scales has been demonstrated, it does not seem to be the case that these six components are just another reflection of the Big Five.

Bridging a time span of 50 years (5 to 60), Haan and others reported stability coefficients (of inter-individual differences) on the six components ranging from .14 to .37. It seems that this data set is telling a somewhat different story than the Costa and McCrae (e.g., 1994) work, when it comes to the stability of inter-individual differences. In order to interpret and compare these findings, however, one needs to take into consideration at least three factors. First of all, there is the difference in measurement instruments including their psychometric qualities. Second, the Oakland and Berkeley Studies started personality assessment in early childhood and extended into late adulthood,

whereas the previously reported studies all started in young adulthood, around age 30, and then extended into old age. Third, there is a methodological problem that deserves consideration. It deals with the fact that the six personality components that were extracted on average explained 61% of the variance in the data. Thus, a considerable reduction in variance was involved. All of these issues might have contributed to the relatively low long-term stability coefficients.

As a consequence, it is difficult to treat these data as strong evidence for the adaptational potential of self and personality. In our theoretical framework, however, we would like to treat such results at least as first indicators of that potential which, as mentioned before, is *not* juxtaposed to the psychometrically very strong evidence for continuity presented above. Rather, it is our goal to convey the notion of a multifaceted self and personality that encompasses components supporting continuity as well as those producing change. Not unlike the fluid-crystallized distinction in work on intellectual functioning, it may be crucial to take such findings as evidence for different interacting components of a larger personality-self system that includes stable dispositions as well as more fluctuant and dynamic features.

Mean-Level Stability. Also with regard to mean-level stability, the Berkeley and Oakland Studies report more lifetime changes. Costa and McCrae (1992, 1994) do acknowledge these findings and attribute the difference to the longer time span. They agree that up to age 30 more pronounced mean-level changes are to be observed, as this is still the formative stage of personality. Adolescents seem to report higher levels of neuroticism and extraversion and lower levels of agreeableness and conscientiousness when compared to young adults. Men and women in their twenties seem to report intermediate levels located between adolescents and middle-aged adults (e.g., Costa & McCrae, 1994).

Although using a different personality assessment instrument (the California Q-sort involving 6 personality components: Self-confident, assertive, cognitively committed, outgoing, dependable, warm), data from the Haan et al. study (1986) also support this view. Haan and colleagues found the lowest correlation between late adolescence and early adulthood ($r = .33$ vs. $r = .58$, $r = .47$, $r = .61$, $r = .44$, $r = .49$). Dependability increased between age 17 and

somewhere in the 30s, which theoretically could be related to the positive age differences in conscientiousness found by Costa and McCrae (1994). Alternatively, the increase identified as "warmth" for females can be seen to parallel, over the same time span, the positive age difference in agreeableness and the negative age differences in neuroticism in the Costa and McCrae research.

In the study of Haan et al. (1986; see also, Jones & Meredith, 1996), however, sizable mean-level changes were also identified *after* age 30. Between the 30s and the 40s, the components self-confident and outgoing showed increases for both genders, and assertive and cognitively committed increased only in females. Between the 40s and 50s the component warmth increased for both males and females. Even Costa and McCrae (1994, p. 145) suggest that, using the language of the Eriksonian tradition, one might call this an increase in maturity (cf., Vaillant, 1977, 1993; Whitbourne & Waterman, 1979). These findings seem also to support the assumption that developmental tasks and themes, as presented in Table 18.7, do provide a useful logic for the description of lifetime personality development, and may be invoked to intertwine findings on various indicators of personality- and self-related functioning.

Studies in the tradition of motives and needs, à la Murray (1938), have also provided evidence for increases, decreases, as well as stability in personality development across the whole life span. In a life-span study assessing two nationally representative samples (21 yrs. and older) at two points in time about 20 years apart, Veroff and others (Veroff, Reumann, & Feld, 1984) found that the affiliation and the achievement motives declined for women starting in their 40s, whereas fear of weakness and hope of power stayed the same. For males, the hope for power was especially high in midlife. Using a very elaborate cross-sequential design and the Edwards Personal Preference Scale, Stevens and Truss (1985) could also demonstrate that when grouping individuals according to their trajectories on the 16 EPPS Scales (age range: 20–48 yrs.), most participants in their adult years demonstrated increases in relative need strength on achievement, autonomy, and dominance, and decreases in affiliation and abasement. No change was found for the majority of individuals on deference, order, exhibition, succorance, and endurance.

Evidence about personality growth as described in Erikson's or Loevinger's model (see Table 18.7) is still scarce and hardly any longitudinal studies are available. With

respect to the concept of generativity, for example, there is cross-sectional research suggesting that older adults more than younger adults redirect their ambition toward offspring rather than toward their own achievements (McAdams & St.Aubin, 1992; Ochse & Plug, 1986). Whitbourne and others (Whitbourne, Zuschlag, Elliot, & Waterman, 1992), to our knowledge, conducted the only longitudinal and even cohort-sequential study using measures representing the Eriksonian stages. This study covered the time span between 21 and 43 years of age. Strong increases in industry and strong decreases in integrity across this age range were observed. Only slight age-related changes were discovered on the other Eriksonian measures (trust, initiative/guilt, autonomy, identity, generativity, and intimacy). This study is also of interest because it permits consideration of the historical cohort dimension which life-span theory considers an important ingredient of human ontogeny. Thus, Whitbourne and her colleagues based on their cohort-comparative evidence concluded that the decrease in integrity scores cutting across the three cohorts may reflect a more general, societywide crisis of morality and purpose affecting adults of all ages rather than an age-based developmental trend.

One aspect of what Erikson has called ego integrity, and what other developmental theorists have referred to as maturity (e.g., Loevinger, 1976; Vaillant, 1977), can also be conceptualized as a process of gaining perspective and competence in mastering one's own emotional life. Several studies suggest that older adults seem to be better able to manage their emotions and deal with emotional issues (e.g., Blanchard-Fields, 1986; Cornelius & Caspi, 1987; Staudinger, 1989). Labouvie-Vief and her colleagues (Labouvie-Vief et al., 1989), for example, have developed a four-level assessment scheme for the understanding and control of emotional states, such as anger, sadness, fear, and happiness during adulthood. They reported that middle-aged and older participants demonstrated developmentally higher levels of emotional understanding and control than did young adults.

Another major effort at not only articulating a theoretical conception about change (and growth) in self and personality functioning but also at generating a solid body of empirical evidence is that of Ryff and her associates. Their findings (Ryff, 1989a, 1995; Ryff & Keyes, 1995) provide joint evidence for stability, growth, and decline. The dimensions of autonomy and environmental mastery showed

positive age difference when comparing young, middle-aged, and old adults. The dimensions "purpose in life" and "personal growth" evinced negative age differences between middle and old age. This last finding is in line with a study on age differences in the level of self-representation. In this study, Labouvie-Vief et al. (1995) found that self-representations demonstrated the highest level of complexity during midlife. In both studies it has been taken into account, however, that effect sizes were moderate to small ($\frac{1}{2}$ to $\frac{2}{3}$ of a standard deviation) and that there is a real need for longitudinal evidence.

Age changes or age differences in themselves, of course, are not the final answer to developmental analysis. Age is not the only developmental organizer. It is also crucial to decompose the sources of influence associated with age. More and more evidence illustrates that variables other than age seem to be relevant when searching for personality growth. Age-comparative studies of wisdom-related knowledge and judgment, for example, have found that experiential contexts such as professional careers and historical events play a central role (P. Baltes et al., 1995; Smith, Staudinger, & Baltes, 1994; Staudinger, Maciel, Smith, & Baltes, in press; Staudinger, Smith, & Baltes, 1992). As far as biological processes are reflected in chronological age, age puts constraints on personality growth in the early years as well as in old age (see Figure 18.1). Only under very favorable conditions can these constraints be overcome and result in personality growth well into old age.

Summary on Stability and Change in Self and Personality across the Life Span

We have witnessed a strong trend toward the study of adult life-span development in self and personality. Although the evidence is far from complete—especially due to a lack of long-term longitudinal and cohort-sequential studies covering the whole life span that concern themselves with the intersection between self and personality—there appears much promise. Most importantly, we argue that it is critical to move beyond antagonism between stability- and change-oriented approaches.

The answer to the question asked at the beginning of this section, does personality change or does it stay the same, is "both." The stable components as assessed in trait models of personality provide the frame within which the transactional adaptation of self and personality can take place. Personality structure seems to exert a function not unlike

the one discussed under the heading of "norm of reaction" in behavior genetics (although in a dynamic sense as introduced earlier in this chapter), which asserts that genetic inheritance contributes to the constraints exerted on self and personality development and thus codetermine the potential for developmental change in transactional-adaptive capacity. In this sense, one might argue that this stable frame, which seems to reflect a person's sense of continuity and coherence, contributes to the *potential* of self and personality processes to master developmental changes and also to flexibly adapt to changing circumstances. Once accepting such a position, the more exciting question becomes how stable and changing components of self and personality can be predicted and how they work in collaboration. This question will be addressed in the next section dealing with the various internal and external opportunities and constraints of self and personality development, and how they interact.

What Are the Intra- and Extrapersonal Conditions That Transact to Produce Continuity or Discontinuity? Opportunities and Constraints of Self and Personality Development

As described above, the life-span perspective defines development—and this includes personality development—as an ongoing process of transactional adaptation. Thus, development is always the simultaneous and complex outcome of forces of nature and nurture, of genes and environment, of intra- and extrapersonal influences. In the beginning of this self and personality section, we discussed the evidence with regard to genetic and environmental contributions to personality and personality development and reported that in young adulthood, about half the variability in personality trait measures is accounted for by genetic influences. Recent evidence suggests this proportion is reduced to about 30% in later adulthood (Pedersen, 1993).

As noted earlier, P. Baltes, Reese, and Lipsitt (1980) have proposed a tripartite model of development of internal and external contextual influences: Normative age-graded influences, normative history-graded influences, and non-normative (idiosyncratic) influences. These three sets of influences may serve important analytic and explanatory functions in understanding both interpersonal and intercultural regularities and differences in developmental trajectories of self and personality characteristics. Table 18.9

Table 18.9 Illustrating the System of Opportunities and Constraints Influencing Self and Personality Development across the Life Span. These Sources also Interact.

The Grading of Opportunities and Constraints by	Opportunities and Constraints of Self-Development	
	Biology	Sociocultural Context
Age	Neuronal Maturation Physical Growth Puberty Pregnancy Menopause Increasing Morbidity Changes in Level of Energy Changes in Sensory-Motor Function	Family of Origin Peers Teacher and Mentors Professional Context Financial Context Partnership and Family Social Network Retirement
History	Altered Ecologies Nutrition Medical System Cultural and Biological Co-Evolution	Value Changes Role Changes War Economic Depression Technological Changes
Non-Normative	Specific Physical Strength and Weaknesses Genetic Risk Premature Birth Accidents Person-Specific Health Stresses Nuclear Catastrophies	Orphanhood Unemployment Divorce Widowhood Win in Lottery Crime

illustrates the interplay between the two major developmental influences on the one hand and the three gradings of such influences on the other. The variables mentioned in each cell only serve illustrative purposes and by no means are meant to be exhaustive. The scheme is further complicated by the fact that the three gradings also interact with each other such that, for example, it might depend on the age of an individual as to which effect a certain historical event has (e.g., Elder, 1994). Moreover, these life events differ in management-relevant features such as desirability and controllability (Brim & Ryff, 1980).

What has been called sociocultural context is a system of interlocking frames ordered along a dimension of proximity. A number of scholars have been very diligent in spelling out the different kinds of social contexts influencing development, which range from the day-to-day interactions with our closest social and physical environment to

the world of institutions and constitutions (e.g., Bronfenbrenner, 1979; Lawton, 1988; R. Lerner & von Eye, 1992; Magnusson, 1995; Moen, Elder, & Lüscher, 1995). For a long time, the facilitative and debilitative effect of social interaction in the most proximal sense has been an important topic of social psychology (see for review, Staudinger, 1996b). In developmental psychology, it has been prominent in childhood research following the legacy of Vygotsky (e.g., Azmitia, 1996; Cole, 1996; Rogoff & Chavajay, 1995). But recently, research on life-span development has rediscovered the opportunities and constraints for development related to social interaction and interacting minds (e.g., P. Baltes & Staudinger, 1996b). Understanding (a) the conditions that optimize the facilitative effect of social interactions and interacting minds and (b) the ways by which such social transactions give directionality and enhance goal attainment are the major objectives of such efforts.

The interaction between biology and sociocultural contexts with regard to age-graded influences is well recognized by the models of self and personality development such as those of Erikson's or Havighurst's listed in Table 18.7. Historical and idiosyncratic influences of both kinds have been less systematically considered in existing models of self and personality development. But there is extensive research in both areas. With regard to the grading of biological and sociocultural influences through history, for example, certainly the seminal work of Elder and colleagues on the consequences of historical events on development deserve mention and are described elsewhere in this Volume (e.g., Elder, 1980, 1994; see also, Ch. 16, this Volume). One of the very important points to remember from this research is that the historical event by itself does not determine the developmental outcome. Rather, it needs to be taken into account at which age and under which idiosyncratic circumstances the historical event "meets" the individual. In addition, Elder shows that historical effects (such as the Great Depression) on development can be mediated through generational lineages and need not become obvious immediately (e.g., Elder, 1994). More recently, a similar research program on the interplay between individual development and historical change has evolved around the unification of Germany (e.g., Little, Oettingen, Stetsenko, & Baltes, 1995; Mayer et al., 1995; Oettingen, Little, Lindenberger, & Baltes, 1994; Trommsdorff, 1995).

The matrix of opportunities and constraints that shape personality development, of course, needs to be projected into time as well, in order to become a truly developmental approach. The question not only refers to how opportunities and constraints at a given point in time shape self and personality, but also whether, and if so how, opportunities and constraints present at one point in time have relevance for self and personality at a later point in time. One can ask, for instance, whether childhood opportunities and constraints persist in their influence into adolescence and even adulthood. Moreover, one can examine whether such connections follow a "simplex" model, that is, adjacent periods influence each other strongly but with an increasing time interval correlations decrease. An alternative model would be a "sleeping effect" model suggesting that constraints and opportunities exhibit time-delayed consequences. Finally, it can be investigated whether what has been an opportunity at one point in time becomes a constraint later on in personality development and vice versa. This exemplary list of questions demonstrates the complexity of possible nature/nurture by age and ontogenetic time interactions.

The presentation of empirical evidence with regard to the question of whether early personality profiles continue to exert positive or negative effects may serve as an example. A number of recent reviews on this question come to the conclusion that long-term relationships are much weaker than stereotypes of continuity may lead us to expect. It seems that long-term maladaptive outcomes require a combination of at least three, largely independent factors:

1. A particular personality profile or temperament.
2. An environment which amplifies this psychological vulnerability (and this environment needs to be maintained in order to be effective over longer periods of time).
3. Stressors that precipitate the symptoms (Jessor, 1993; Kagan & Zentner, 1996; Rutter & Rutter, 1993; Werner, 1995).

The reviews listed cite a number of biological and environmental constraints such as maternal deprivation, loss of parent, extreme malnutrition, low economic status—all of these constraints seem to be "counterbalanced" at the latest by young adulthood, however, if the just introduced combination of factors is not present. The most robust finding is the

one between impulsivity and lack of control during the first four years of age and asocial or delinquent behavior in adolescent males. But again, once those adolescents reach adulthood only a small percentage is still delinquent (e.g., MacFarlane, 1963; Werner, 1995). This finding speaks to the complexity of human behavior and development, but also speaks to the adaptive power of the self and personality during childhood and adolescence.

Does such a nonlinear model of the development of personality disorder find its counterpart in a model for the development of personality growth? Mapping the findings from the realm of developmental psychopathology onto the realm of developmental growth seems not as easy. Easy temperament and a supportive environment over extended periods of time and the absence of stressful events do not ensure growth (e.g., Rutter & Rutter, 1993; Skolnick, 1975). Rather, it seems that too smooth and successful a childhood might even have maladaptive effects because it lacks the challenges and crises that might spur personality development and growth (see also, discussion of the steeling effects of critical life events; Elder, 1994; Filipp & Olbrich, 1986; Magnusson, 1996; Riegel, 1976).

Reserve Capacities of Self and Personality Development

As a further life-span problematic, we have selected the notion of reserve capacity (P. Baltes, 1987) and resilience for further elaboration. This notion gains special importance for a functional perspective on personality development, that is, for perspectives that aim at an analysis of the orchestration of self and personality as a system of adaptive functioning. The topic of reserve capacity and resilience in the domain of self and personality relates to the allocation of resources introduced above but discusses this theme at a more microanalytic level of analysis. What are the self-related mechanisms and characteristics that either show or contribute to reserve capacity?

Traditionally, the central role of reserve capacity, or related concepts such as resilience, is articulated within the province of child development (e.g., Cicchetti & Cohen, 1995). More recently, this view has been extended to include adulthood and old age (e.g., P. Baltes, 1991; Rutter & Rutter, 1993; Staudinger et al., 1995; Staudinger, Freund, Linden, & Maas, in press; Vaillant, 1990, 1993). For the present purpose, we have chosen aging as a forum of

illustration. We have opted for this selection for several reasons. One is the relative novelty of this age period for researchers in child development. Another is because presenting research on aging permits us to elaborate more clearly the theme of gains and losses and the dynamic of differential allocation of resources into growth, maintenance, and management of losses.

We have discussed that little or no correlation between age and trait-based personality structure is found. In a similar vein, there is little correlation between age and various self-related indicators of adaptation (e.g., P. Baltes, 1991, 1993; Brandtstädter, Wentura, & Greve, 1993), including self-esteem (e.g., Bengtson, Reedy, & Gordon, 1985), sense of personal control (e.g., Lachman, 1986), or happiness and subjective well-being (e.g., Costa et al., 1987; Ryff, 1989b; Smith, Fleeson, Geiselman, Settersten & Kunzmann, in press). This also includes 70- to 80-year-olds (Smith & Baltes, 1993). Only in advanced old age, do we seem to observe more salient changes towards a lower level of desirable functioning in traitlike dispositions (Smith & Baltes, in press-b). Thus, on the group level, for the larger part of the adult age spectrum, age does not seem to be a "risk" factor for these aspects of self and personality.

The absence of strong relationships between age and self-related indicators of well-being, despite what we have characterized above as an increase in risks and potential losses with advancing age, but also for certain disadvantaged groups, is theoretically and methodologically important. Indeed, the discrepancy between an increasing number of risks on one hand, and maintenance of adaptive functioning in the self on the other, is perhaps one of the most persuasive indicators of the power of self and personality in dealing with reality (Baltes & Baltes, 1990b; Brandtstädter & Greve, 1994). It is suggested that the self exhibits resilience, or reserve capacity, in the face of age-related risks and primarily health-related losses. In a similar way, it has been argued in childhood research conducted in the field of developmental psychopathology that certain self and environment constellations allow maintenance of adaptive development even in the face of adversity (e.g., Garmezy, Rutter, Werner).

Multiple arguments can be presented to understand this discrepancy between an age-related increase in risks and stability in self-related indicators of well-being (see also, Staudinger & Fleeson, 1996). First, age is only a rough proxy of increasing risks; not everyone of a given age

cohort needs to be concerned by them. Therefore, the negative effects need not necessarily show on a group level. Second, as argued above (e.g., Brandtstädter & Greve, 1994; Filipp & Klauer, 1986), the self has a strong interest in continuity and growth. Over a given period of time, the self adapts to even adverse circumstances as if nothing or not much has happened. Thus, for researchers interested in the "self at work," it seems crucial at which point in this adaptational process the assessment takes place. Third, the changes due to increasing risks may be chronic rather than acute and therefore might not affect the self suddenly, but gradually. It may be difficult, therefore, for the self to recognize them and reflect them in self-report measures.

In the following section, we illustrate the reserve capacity of self and personality by citing select findings ordered according to the distinction introduced above between (a) form and structure of self and personality and (b) self-regulatory and self-transformational processes. Except for few studies with objective indicators of adaptivity, such as longevity or professional success, in most of the studies adaptivity is measured by self-report indicators of well-being. First, with regard to form or structure we will highlight information on differences in the adaptive fitness of personality and self profiles. Second, we will select evidence on the adaptive value of self-regulatory processes in three domains for further illustration of life-span developmental changes: (a) Goal seeking and reorganization; (b) self-evaluative comparison processes; and (c) coping.

Evidence for Reserve Capacity in Indicators of Self and Personality Structure

Which Personality Profile Develops More "Successfully"? The current body of research suggests that personality traits might indeed serve a mediating function between age and indicators of self-related resilience such as subjective well-being (e.g., Costa et al., 1987; Diener, Saudvik, Pavot, & Fujita, 1992). Individuals with certain patterns of personality characteristics are likely to master challenging events better than others. Neuroticism and extraversion have been shown, for example, to evince significant predictive relations to subjective well-being as measured by the Bradburn Affect Balance Scale. Over a period of 10 years during middle adulthood, neuroticism was found to predict the degree of negative affect, and extraversion the level of positive affect (Costa, McCrae, & Norris, 1981). In a study with young adults, Magnus and

colleagues (Magnus, Diener, Fujita, & Pavot, 1993) found, for example, that over a period of four years, extraversion predisposed people to experience positive events and neuroticism to experience negative events. Although both sources of variation were not assessed independently of each other, the investigators had tried to differentiate more "objective" from "subjective" events. This finding is consistent with an interpretation that events not only happen to people but that people also seek out events according to their personality (e.g., R. Lerner & Busch-Rossnagel, 1981; Scarr, 1993).

An often used index of successful life-span development is length of life (longevity, mortality). Evidence on the personality predictors of longevity has recently been reported from the longitudinal data set of the Terman study of gifted children, which was started in 1921 when participants were 11 years. The data set by now contains information about seven decades and has an attrition rate of only 10%. Although the gifted people of the Terman study are a positively selected group with regard to intellectual functioning (reduced variability in measures of intelligence) because this was the original purpose of the study, we assume that, as cognitive indicators typically are not highly related to personality functioning, this selective sampling effect is of less relevance for variability in personality variables.

Using survival analysis, it was found that conscientiousness reduced and cheerfulness increased the mortality risk (Friedman et al., 1993). A person in the 75th percentile or above on conscientiousness had only 77% the risk of a person in the 25th percentile of dying in any given year. The same was found for cheerfulness, but quite unexpectedly in the other direction. That is, the more cheerful as a child the greater the later risk for mortality. With regard to effect size, these risk factors for mortality are comparable to biological risk factors such as systolic blood pressure or serum cholesterol.

The risk related to cheerfulness in childhood seems contradictory to findings from short-term longitudinal studies in adulthood (e.g., 10 years), where optimism has been found to be highly protective (e.g., Cohen & Williamson, 1991; Scheier & Carver, 1987; Somervell et al., 1989). The authors acknowledge this contradiction and propose various explanations. Taking a life-span perspective, one of the more persuasive explanations seems to be that it is important to distinguish between short-term and long-term

predictions. The authors suggest that humor and optimism might be very effective coping mechanisms in particular situations rather than lifelong protective temperamental dispositions. Also interesting is that neuroticism, which had often been identified as a risk factor for adaptive outcomes, did not show significant effects. However, this lack of significant effects of neuroticism may also be due to unreliability of measurement and therefore not be very informative.

The protective power of *conscientiousness* obtained in the Friedman et al. (1993) work is in line with findings on other personality constructs such as *ego strength*, *ego resilience*, *tough mindedness*, *cognitive investment*, and *competence*. Such measures have been found to be positively related to various measures of well-being and adaptation, both cross-sectionally and longitudinally (e.g., Ardel, 1997; Block, 1981; George, 1978; Haan, 1981; Helson & Wink, 1987; Robins et al., 1996). In further studies, Friedman and colleagues investigated possible mediating mechanisms of this protective power (Friedman et al., 1995). They found that neither cause of death nor health behavior seemed to be related to the protective effect of conscientiousness. Rather, the authors concluded that the effect of conscientiousness on longevity might be mediated through psychosocial processes. Conscientious people may be better able to cope with stressful events because they are better prepared psychologically (e.g., anticipation) and pragmatically (e.g., with insurance). Conscientious people are also more dependable and reliable and therefore may have more stable social relationships and better systems of social support, which have been shown to predict health and longevity (e.g., House, Landis, & Umberson, 1988).

When we turn from extraversion, neuroticism, and conscientiousness to *openness to experience*, there is indication that individuals with a greater degree of openness to experience (Costa & McCrae, 1985) are better able to adapt to changes and that this characteristic increases until the middle years and declines afterwards (Haan, 1981). An aging individual who is experientially open, as captured by characteristics such as being emotionally responsive, seeking variety, being intellectually curious and broad-minded, may be more aware of bodily changes, and may also be able to devise innovative strategies to adapt to them. Empirical evidence with regard to the adaptivity of openness to experience is still scarce (Whitbourne, 1987). From research on the personality correlates of wisdom, however, there is a

suggestion that individuals who are more open to new experiences and who hold a middle position on the introversion-extraversion dimension also evince higher levels of wisdom-related performance (Staudinger, Lopez, & Baltes, in press; Staudinger, Maciel, Smith, & Baltes, in press). In the same vein, research from the Seattle Longitudinal Study (Schaie, Dutta, & Willis, 1991) has suggested that maintaining "behavioral flexibility" may be an important covariate of late-life adaptation: The progression of intellectual ability from middle to old age was substantially related to a flexible personality style over time. Taken together, these findings imply that in addition to a lack of neuroticism, an intermediate degree of extraversion and a high degree of openness to experience seem to be protective factors when it comes to managing the self-related challenges of old age.

Evidence from the field of *control beliefs* (e.g., Lachman, 1986; Lachman, Weaver, Bandura, Elliott, & Lewkowitz, 1992; Lachman, Ziff, & Spiro, 1994; Skinner, 1995) has demonstrated that, on the one hand, internal control beliefs stay relatively stable across the life span and continue to be adaptive. On the other hand, beliefs about the power of others over one's life increase with age-related changes in contingencies (e.g., Nurmi, Pulliainen & Salmela-Aro, 1992). For older adults it is adaptive to place greater weight on external resources and thereby compensate for decreases in internal resources (see also, M. Baltes, 1996). Thus, if older persons believe in the power of others over one's life this is not synonymous with giving up responsibility over one's life. Rather, it may imply that others are incorporated to become part of one's resources. In sum, internal control beliefs, that is, the belief that one has power over one's life has high adaptive value across the whole life span (M. Baltes & P. Baltes, 1986; Bandura, 1995; Skinner, 1995). With increasing age, the adaptive value of external control beliefs increases due to changes in the availability of internal resources. This increase in external control beliefs, while on the surface characterizable as a loss, may signify, however, an adaptive response (see also, Heckhausen & Schulz, 1995, regarding the dynamics between primary and secondary control or Brandtstädter & Greve, 1994).

The idea of *ego maturity* and its putative benefits for functioning and subsequent development have been discussed in other approaches to the study of personality development such as Loevinger's model of ego development (Loevinger, 1976), Vaillant's model of adult adjustment

(e.g., Vaillant, 1977, 1990), Haan's development of ego structures (Haan, 1977), or concepts of maturity as derived from scales of the California Personality Inventory (CPI; e.g., Helson & Wink, 1987). Ego level as measured according to Loevinger's Sentence Completion Test is reported to display a positive relation with reality-oriented and flexible coping (e.g., Picano, 1989) as well as with tolerance, sensitivity, and responsibility (e.g., M. White, 1985). With regard to its relation to higher levels of adjustment, the empirical evidence is equivocal (e.g., McCrae & Costa, 1983). In a longitudinal study, comparing two conceptions of maturity, Helson and Wink (1987) found that different measures of maturity predicted different aspects of adjustment (e.g., self-related, other-related).

In sum, there is longitudinal and cross-sectional evidence that individual differences in largely stable personality characteristics contribute to the level of adaptation. From a life-span perspective, it is important to note that the adaptive patterns differ somewhat depending on whether short- or long-term predictions are considered. This applies especially to two traits widely assumed to constitute a risk or a protective factor, that is, neuroticism and optimism or cheerfulness. Both have been reported to be a risk or a protective factor respectively when it comes to shorter time spans (up to 10 years). However, when considering predictions across a lifetime, neuroticism becomes neutral and cheerfulness actually turns into a risk factor. Thus, it seems necessary to distinguish between lifelong protective dispositions or general purpose mechanisms and adaptive mechanisms with regard to certain situations or life periods. Very little is known yet about the mediating processes that lead to such differentiation. As very few life-time studies are available, our knowledge about the long-term protective personality profile to date is still limited. Nevertheless, it seems safe to say that across a number of studies, positive expressions of the following personality characteristics have been demonstrated to increase adaptive fitness: Conscientiousness, extraversion, openness to experience, behavioral flexibility, ego resilience, ego level, internal control or agency (efficacy) beliefs, and cognitive investment.

Multiple and Possible Selves. Another strand of research focuses less on trait-based personality characteristics than on the structure and content of self-conceptions. Evidence is accruing that a multifocal and diversified

structure of priorities and self-conceptions, or identity projects, makes transactive adaptation to developmental changes easier (e.g., Cross & Markus, 1991; Linville, 1987; Thoits, 1983). Adults who define their "selves" through multiple though interconnected identities that are richly construed, positively evaluated, and anchored in the present, are more successful (as measured by subjective well-being) in their mastery of negative developmental changes associated with their health condition (Freund, 1995). Similarly, a variety of sociologically-oriented studies suggest that a greater number of identities (e.g., family and work) is related to better mental health (Coleman & Antonucci, 1982; Kessler & McRae, 1982). The adaptivity of interconnected multiple selves forming a dynamic self system should not be confused, however, with the pathological category of a multiple personality constituted by structurally unrelated identities.

Along these lines, research by Markus and others (e.g., Cross & Markus, 1991; Markus & Nurius, 1986) is particularly informative. In this work, Markus and her colleagues have demonstrated that, for example in negotiating the changes and transitions of adulthood, "possible selves" (i.e., those identities which are either feared or hoped for in the present, in the past, or in the future) are used as resources to motivate and defend the individual. For instance, an individual currently dissatisfied in the workplace might use the hoped-for possibility of a future promotion as a facilitator for subjective well being for self-esteem, and as a motivator for continued engagement. Such findings point to the possibility that having access to a larger set of well-developed and systemically interrelated possible selves may be a protective factor as we confront and manage growing old. In a study on possible selves and perceived health (Hooker, 1992), the majority of older adults had possible selves in the domain of health, and also they rated the most important possible self as being in the realm of health. In addition, self-regulatory processes (e.g., perceived efficacy, positive outcome expectancy) explained over half of the variance in self-perceived health when it was also listed as the most important hoped-for self component. In other words, older adults felt subjectively healthier if at the same time they reported hopes for their health and believed that they had some control over their health. In the same vein, a study on the effects of community relocation on mental health in old age found that the psychological centrality of certain life domains (e.g.,

family, economics) moderated the resilience-increasing effect of social comparisons and of self-perceptions of activity level (Ryff & Essex, 1992).

Evidence for Reserve Capacity in Self-Regulatory Processes: The Goal System and Self-Evaluation

Selection of Goals and Life Priorities. Life-span theory emphasizes the critical importance of selection of domains and life priorities for effective regulation of developmental processes. In this sense, personality traits as well as possible selves act as motivational sources and are linked to goals that are either strived for or avoided. Content and priorities of life goals and personal life investments are not arbitrary but embedded in subjective conceptions of the life course, as well as reflecting the changing developmental tasks and themes of life (Cantor & Blanton, 1996; Cantor & Fleeson, 1994).

In a cross-sectional survey study of 25- to 103-year-olds, for instance, it was found that the four domains with highest personal investment in terms of time and effort followed the developmental tasks and themes of the respective life period (Staudinger, 1996a; Staudinger & Fleeson, 1996). From 25 to 35 years of age, it was work, friends, family, and independence that were ranked highest with regard to the degree of personal life investment. From 35 to 45 years of age it was family, work, friends, and cognitive fitness. From 55 to 65 the top four ranks of personal life investment were held by family, health, friends, and cognitive fitness. Not much changed in the rank order for the 70- to 85-year-olds: Family, health, cognitive fitness, and friends. Finally, in the age range from 85 to 103 years, health had become the most important investment theme and was followed by family, thinking about life, and cognitive fitness. Such findings are depicted in Table 18.10 and illustrate the kind of life-span developmental scripts and ecologies that regulate the motivational forces of life-span development. Similar findings have been reported for importance ratings of life domains across the life span (Heckhausen, in press).

Similar to findings on cognitive pragmatics of the mind (e.g., expertise research), these results also point to selection into individual life contexts and the importance of internal and external contexts in defining salient features of the self across the life span (see also, Brandtstädter & Rothermund, 1994; Cantor & Fleeson, 1994; Carstensen, 1993, 1995). In socioemotional selectivity

Table 18.10 Patterns of Degree of Personal Life Investment across the Adult Life Span (Listing of top four; after Staudinger, 1996a)

Young Adulthood 25–24 Years	Middle Adulthood 35–54 Years	Late Adulthood 55–65 Years	Later Adulthood 70–84 Years	Very Late Adulthood 85–105 Years
Work	Family	Family	Family	Health
Friends	Work	Health	Health	Family
Family	Friends	Friends	Cognitive fitness	Thinking about life
Independence	Cognitive fitness	Cognitive fitness	Friends	Cognitive fitness

theory, Carstensen, for instance, argues that there are systematic life-span changes in the goals we pursue and the priorities we set in the domain of social relationships. Of the two main social motives, Carstensen (1995) claims that in later adulthood emotional regulation and not information seeking are the driving forces for contacts. Fredrickson and Carstensen (1990) found, for instance, that older people, in contrast to younger adults, reported preferring familiar over novel social partners. Older people—in contrast to younger adults—also reported that they preferred social relationships that are related to anticipated affect rather than information seeking or future contact. When asked why, older people would quite explicitly state that they had no time to waste and had to be careful about their choices. So, it seems that lifetime constraints in the social domain may involve a shift in the criteria used in the selection of social relationships (Carstensen, 1993).

Age-related changes in goal structures that reflected developmental tasks were also found on a meta-level of aggregation. Using a sentence completion technique, Dittmann-Kohli (1991) demonstrated that older adults find meaning in life predominantly by searching for “contentment,” whereas younger adults more often reported that they searched for “happiness.” In this view, Emmons (1996) has recently provided an overview of research on the adaptivity of goal selection and comes to the conclusion that it is the attainment of *meaningful* goals that seems adaptive rather than the sheer act of attainment. Furthermore, Ryff (1989b) determined that younger people are more likely to assess their subjective well-being in terms of accomplishments and careers, whereas older people are more likely to associate well-being with good health and the ability to accept change. It seems to be highly protective to renounce or

relegate to the periphery of importance those roles and commitments that are no longer serviceable, and to invest in others more “in tune” with current conditions of living (e.g., Brim, 1992; Dittmann-Kohli, 1991; Lazarus & DeLongis, 1983; see Table 18.11). Again, the general line of argument is that selection and resetting of priorities are facilitated if there is a rich variety of self-defining concepts to select from and to rearrange. In this sense, a rich variety of interrelated but well-articulated life priorities is part of a person’s developmental reserve capacity (cf., P. Baltes, 1991; Staudinger et al., 1995).

Adjustment of Aspirational Levels through Social Comparisons. In addition to the change in content and ranking of self-concepts and goals, there is evidence for other self-regulatory processes protecting or putting at risk the self throughout adulthood. For instance, research on the self also suggests that aging individuals modify their aspirational levels within given domains of functioning in order to adapt to decreases in their behavioral competence or negative changes in their health condition. We would like to emphasize again that we expect similar processes to operate at younger ages as well. We focus primarily on old age because we believe that these processes are more easily identified at higher ages than at younger age levels. In some respects, old age is a more powerful “research model” for the investigation of the dynamics involved in the availability and activation of reserve capacity than is childhood.

Adjustment of aspirational levels can occur through a variety of mechanisms. Quite often, it is related to processes of social comparison and other forms of interactive minds (e.g., Baltes & Baltes, 1990b; P. Baltes & Staudinger, 1996a; Festinger, 1954; Schulz & Heckhausen, 1996; Wills, 1981). New reference groups are selected in order to permit a reorganization of personal standards of evaluation. This might be done, for example, by comparing

Table 18.11 Life-Span Differences in Meaning of Life and Determinants of Well-Being

	Meaning of Life and Determinants of Well-Being	
	Young Adulthood	Later Adulthood
Dittmann-Kohli (1991)	Happiness	Contentment
Ryff (1989)	Accomplishment Career success	Good health Ability to accept change

oneself to specific subgroups, such as age, gender, and ethnic-cultural groups, rather than the population at large. Three types of social comparisons, that is downward, lateral, and upward comparisons can be distinguished and serve distinct and age-related, self-regulatory functions. Downward comparisons, in which individuals compare themselves to people who are worse off in a relevant domain of functioning, may become more and more important with age or with increasing levels of maladaptation (Heckhausen & Krueger, 1993; Heidrich & Ryff, 1993; Markus & Cross, 1990; Taylor & Lobel, 1989; Wood, 1989). For example, women with breast cancer rated their postsurgery level of well-being as positive, even as more positive than before they were diagnosed with cancer. The same women reported overwhelmingly that they were doing as well or better than other women in a similar situation (Wood, Taylor, & Lichtman, 1985). Similarly, in a study of the effect of community relocation on subjective well-being, it was demonstrated that endorsement of social comparisons predicted various aspects of well-being (e.g., personal growth, self-acceptance; Ryff & Essex, 1992).

In general, then, the contention is that internal or external selection of appropriate comparison groups is an important protective mechanism that empowers the adult and aging individual to manage the gains and losses of aging. Better functioning groups are selected for comparison, that is upward comparison, if the goal is to maintain and to improve, while more poorly functioning group referents, that is downward comparisons, tend to be selected if the goal is to deal with losses. Note that despite the discussion of these comparison strategies as though they were operating at a conscious level, little is known about the level of consciousness at which such mechanisms operate. And, again, note also that similar comparison processes operate in childhood, adolescence, and young adulthood.

The research evidence is not as clear cut as regards the very intuitively appealing theoretical contention that downward comparisons are protective. Many reasons can account for this. For example, much of the evidence is derived from either laboratory studies or studies with clinical populations and other results stem from correlational survey work. Furthermore, the operationalization of what is called a downward comparison varies markedly between studies and makes the comparative evaluation of different studies very difficult. Some studies, for instance, evaluate spontaneously provided reasons for certain self-evaluations,

which are later coded for which kind of comparison standard was mentioned. Other studies ask for the frequency with which social upward, downward, and lateral comparisons are made and relate this to measures of well-being (e.g., Filipp & Buch-Bartos, 1994; Taylor & Lobel, 1989). Still other studies have participants rate themselves and a generalized other on certain personality dimensions, and then indirectly infer upward or downward comparisons and how this is related to self-related adaptation (e.g., Heckhausen & Krueger, 1993). As suggested above, it seems that the most critical question regarding the adaptiveness of such mechanisms might be the use of the functional comparison at the appropriate time during the transactional adaptation to the situation. Goals shift in any activity during the life span, and those shifts lead to shifts in the selection and weighting of comparative information (Bandura & Cervone, 1983; Frey & Ruble, 1990).

The adaptive value of such attributional patterns has caused lively discussion, centered around the issue of the adaptivity of the discrepancy between reality and attribution. Is it true that *positive illusions* always are more adaptive than veridical views (e.g., Baumeister, Smart, & Boden, 1996; Taylor & Brown, 1988)? Or does this relationship follow an inverted U-shaped function? Baumeister (1989) has introduced the notion of the optimal margin of illusion. With this notion he implies that, if the discrepancy between reality and attribution becomes too large, touch with reality is lost and this attributional style may become maladaptive (e.g., Colvin & Block, 1994; Lopez, Little, Oettingen, & Baltes, 1996).

It seems that general statements such as "positive illusions are adaptive" need qualification in order to adequately reflect the complexity of mechanisms of self-regulation. They need qualification with regard to the circumstances under which they are adaptive (e.g., at which point in the action sequence). It may, for instance, be adaptive to have positive illusions before the action is completed in order to keep up motivation. But it may be dysfunctional to keep up positive illusions when interpreting outcomes, because this may hinder adequate actions to be taken. Along this line of reasoning, Taylor and Gollwitzer (1995) have shown, for example, that people think more realistically when *setting* goals than when *implementing* them. In this context, the notion of mental simulation and its adaptive value has recently attracted much research activity (e.g., Taylor & Pham, 1996). Positive illusions might also need specification with

regard to which self-regulatory components are concerned. The work by Oettingen (1996; Oettingen & Wadden, 1991) has shown, for example, that positive behavior outcome *expectations* but negative *fantasies* about the same outcome resulted in the best behavioral outcome.

Evaluative Adjustment through Lifetime (Temporal) Comparisons. Besides social comparisons, comparisons across one's own lifetime constitute an important resource for the self. Suls and Mullen (1982) have suggested that temporal comparisons, especially retrospective temporal comparisons, provide an additional strategy for effective self-management and self-evaluation in adulthood. Indeed, they have argued that with increasing age, social comparisons become less frequent and lifetime (temporal) comparisons increase in frequency. The evidence to support this hypothesis, however, is still scarce (e.g., Filipp & Buch-Bartos, 1994). Filipp and Buch-Bartos (1994), for instance, found that when older adults were asked to explain certain self evaluations provided earlier in time, they tended to do more prospective than retrospective temporal comparisons. And indeed those prospective comparisons were negatively related to well-being. With regard to retrospective temporal comparisons, Woodruff and Birren (1972) actually retested a sample after 25 years using the CPI and found that participants had a tendency for what one might call "time enhancement." That is, they perceived improvement as compared to their own past, whereas the actual CPI ratings collected at the two occasions did not reveal significant change. Again, it seems that it is not the temporal comparison per se that is protective; rather, depending on the characteristic or the domain selected and on the point in the self-regulatory process, lifetime comparisons can result in either the realization of, or loss in, self-enhancement.

In earlier age-comparative research on beliefs about development across the life span, it has already been demonstrated that such beliefs differ when people are asked to generate expectations about themselves, versus a generalized other, versus a personal ideal, and retrospectively versus prospectively (Ahammer & Baltes, 1972; Harris, 1975; Ryff & Baltes, 1976). This approach of systematic instructional variation (e.g., age referent, social referent) has been explored with regard to the question of age-related change versus stability of subjective well-being. In this vein, it seems that for many older adults shifting the temporal

point of reference may be an effective strategy in maintaining high subjective well-being across the life span. Ryff (1984, 1991) has found that when different age groups are asked to report on their current functioning in different facets of personality (such as autonomy, social relations, personal growth), they do not differ. Age differences become apparent, however, when instructional variations in temporal referent are introduced. Younger adults have a more positive evaluation of their future and a less positive evaluation of their past than older adults. Conversely, it seems that older adults, perhaps due to fewer opportunities to achieve in the present and a richer set of positive experiences in the past, increasingly refer to successes of the past. Indeed, reference to earlier achievements may fortify current levels of optimism and energy for dealing with present challenges. Selectively attending to positive aspects of the self at different points in the lifetime can serve to support a positive sense of self at the present. The endorsement of selective lifetime comparisons may contribute to the finding that in concurrent (present-day) self evaluations, only few age differences emerge.

Beyond the possibility to uncover more change than present self ratings suggest, temporal instructions for the assessment of personality, that is asking individuals not only about their self descriptions at present but also in the past and in the future, gives additional meaning to present ratings of personality. Fleeson and Baltes (1996), for example, collected data which showed that past and future ratings of personality predicted well-being above and beyond present ratings. One result suggested, for instance, that a medium-level of extraversion as assessed under the present instruction, that is combined with a high-level rating by the same person under past instructions, has a different meaning than the same present rating when it is combined with a low-level past rating. These differences in the predictive value for adaptive outcomes cannot be discovered when only present ratings are assessed.

In future work on life-span personality development, therefore, it seems important to introduce a stronger focus on *subjective lifetime comparisons*. Such work would be less aimed at reconstructing or preconstructing ontogenetic reality as it was or will be. Rather, the goal would be to introduce in personality assessment a perceived lifetime dimension of change and continuity: Who was I, who am I, who will I be?

Coping: Further Evidence for Reserve Capacity Related to Self-Regulatory Processes

Stress and coping are concepts that match very well the developmental task perspective on self and personality development that is illustrated by Havighurst's model (see Table 18.7). Each developmental task can be viewed as a stressor with which the individual has to cope one way or the other. With increasing age the stressors, or the developmental tasks, become more and more complex, both in scope and temporal extension. More and more different domains of life are concerned and need to be monitored and managed at the same time. Life complexity is also increased by the history and experiences that characterize certain life domains and certain social relations. The number of people we have to deal with and the number of life domains that are relevant to a given developmental task systematically increases until middle adulthood and decreases thereafter. This is not meant to imply that middle age is the most stressful and difficult life period, because this characterization of complexity does not touch upon the resources that, on average, are also very rich during midlife. Therefore, when taking into consideration both available resources and degree of challenges or stress, it seems fair to speculate that the net demand exerted by different life periods may be comparable. Smith and Baltes (in press-b) suggest, however, that this may not be true for advanced old age, a suggestion that is in line with many other findings about the nature of advanced old age (P. Baltes, 1997; P. Baltes & Mayer, in press). In fact, an alternative speculation would be that the life-span challenge or stress curve follows the life-span mortality curve.

In the 1970s, Pfeiffer (1977) suggested that with increasing age, *regressive* coping tendencies increase. In the same year, however, Vaillant (1977) reported an age-related increase in *mature* coping mechanisms. In his model of adult adjustment, Vaillant (e.g., 1977, 1990) extended psychoanalytic conceptions of defense mechanisms into a developmental framework of more or less mature or adaptive defense mechanisms. Vaillant (e.g., 1983) argued that mature defenses may provide an explanation for some of the "invulnerability" among the disadvantaged. More recently, he provided evidence from long-term longitudinal data for this protective and development-enhancing power of mature defenses in middle and later adulthood (Vaillant, 1990).

In a similar vein, Folkman, Lazarus, Pimley, and Novacek (1987), for example, found that older respondents were less likely to seek social support or use confrontive coping and were more likely to use distancing and positive reappraisal. In fact, more and more of the recent evidence supports this "growth" view of coping in adulthood and old age (e.g., Aldwin, 1991; Diehl, Coyle, & Labouvie-Vief, 1996; Irion & Blanchard-Fields, 1987; Labouvie-Vief, Hakim-Larson, & Hobart, 1987; McCrae, 1989) or at least speaks for stability in coping behavior.

With respect to the developmental stability of coping behavior during adult life, it has been observed, for instance, that individual differences in the endorsement of coping mechanisms are more a function of the type of stressful event than of age (McCrae, 1989). This finding is extended by evidence from the Berlin Aging Study. In that study, based on data from a representative sample of 70- to 105-year-olds, it is suggested that those old individuals who reported selective flexibility in their use of coping strategies also demonstrated the highest level of well-being (Staudinger & Fleeson, 1996). Figure 18.16 illustrates this finding.

Similar findings are reported in research on depression in old age. Rather than any particular form of coping, it seems that self-related resilience as indicated by measures of mental health is related to the availability of a large number of different forms of coping (Forster & Gallagher, 1986). We have argued above that the multiplicity of self definitions has protective value, and it has been demonstrated that, similarly, social relations with multiple functions are a richer resource than other types of relationships (for an overview, see Staudinger et al., 1995). This evidence suggests that access to a wide repertoire in functioning (e.g., coping, self definitions, functions of a relationship) may be a key "general-purpose" resource, as it facilitates the person-situation fit.

Furthermore, older adults seem to be more flexible in adapting their coping response to the characteristics of the situation (e.g., controllability) than younger adults (e.g., Aldwin, 1991). Such evidence is congruent with findings that, in comparison to younger adults, older adults have been found to demonstrate an accommodative coping style in the face of adversity or failure; that is, older adults were more flexible and better able to adjust their strivings to changed circumstances than were young

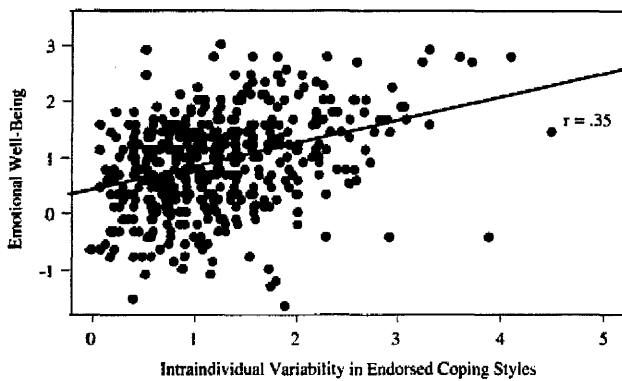


Figure 18.16 The greater the intraindividual variability (plasticity) in endorsed coping styles (i.e., some styles are endorsed strongly and others very little), the higher the level of well-being (adapted after Staudinger & Fleeson, 1996). Each dot represents one person. This is evidence taken from aging research to illustrate the notion of self-related general purpose mechanisms. It seems that the availability of a rich variety of self-regulatory processes including algorithms guiding adaptive application constitute such a general purpose mechanism.

adults (Brandtstädter & Renner, 1990). Conversely, younger adults were more likely to adhere to their once established goals (i.e., assimilative coping), even if they were no longer realizable. With age, Brandtstädter and Renner (1990) have demonstrated that adults favor *accommodative* (goal flexible) over *assimilative* (goal persistent) coping. In a similar vein, Heckhausen and Schulz (1993) have more recently proposed and presented empirical evidence (Heckhausen, in press) that an age-related shift from *primary* to *secondary control* strategies takes place in order to master the tasks of aging.

In our view, such evidence on age-related stability and positive transformations in coping efficiency is significant for two reasons. First, if later adulthood and old age are characterized by an increasing number of varied stressful events, then the findings on coping efficiency seem to suggest the presence of another component of self-related reserve capacity. Second, in contrast to stereotypical conceptions of the elderly as rigid, the evidence suggests that, based on processes of self-representation, self-regulation, and self-enhancement, older adults possess a substantial capacity for adjustment and flexible mastery of demands. We need to acknowledge, however, that this efficacy of

self-related mechanisms may find its limits in extreme situations including the challenges of advanced old age (P. Baltes, 1997).

Summarizing Foci and Facets of Life-Span Development in Self and Personality

In this section, we brought together theory and research from three different areas of research, that is, personality, self-conceptions and identity, and self-regulatory processes. Each of these areas is characterized by its own foci and methodological approaches. We have argued that a life-span perspective on self and personality development, rather than viewing these three approaches as relatively independent from each other or even mutually exclusive, tries to incorporate theoretical and empirical evidence from these fields. Dynamic systems theory and similar theoretical perspectives provide useful theoretical guidance for this endeavor:

1. A central feature of personality development is the emergence of personality and self structures and of an associated system of self-regulatory mechanisms that mediate successful transactional adaptation. Beginning in childhood, we obtain solid evidence for structure, a sense of coherence, and some stable modes of adaptive behavior (e.g., Caspi & Bem, 1990). Such a view is represented in dynamic-system models of development (Lewis, 1995; Magnusson, 1996), where principles of structural emergence and self-organization are critical for successful ontogenesis. Structural organization and coherence of personality, self, and self-regulatory mechanisms are a necessary precondition (constraint) for adaptive fitness and further growth.
2. We have learned from personality research that about 50% (and up to 75%) of the inter-individual variance in major traits such as the Big Five is stable. And it has been reported from evidence based on growth models of personality that personality characteristics are indeed changing as we move through different developmental periods. This seemingly contradictory empirical evidence is congruent with an interpretation that adaptive self and personality functioning is constituted by a dialectic between continuity and change.

From the perspective of dynamic-systems models of development but also dialectical life-span theory (Datan & Reese, 1977), conflict and synergism between continuity and change are important ingredients to adaptive functioning and developmental advances. If researchers such as Costa and McCrae (e.g., 1995), for instance, report a high level of inter-individual stability in personality structure, this should not be taken as counter-evidence for ontogenetic development. Rather, such evidence should be taken to indicate that people's self and personality are organized. By no means does such evidence preclude, within this frame of a stable structure or this sense of coherence, individuals from transactively adapting to their developmental contexts and thereby also developing additional characteristics of self and personality. To appreciate the facilitative effects of a stable system, it may be useful in personality development research to apply modes of thinking similar to the concept of constraint in cognitive psychology.

3. We have argued and provided some evidence that within limits, the negative life-span trajectory of biological functioning is less of a debilitating factor to self and personality functioning than it is to cognitive functioning. In dealing with the opportunities and constraints of life-span development, self and personality, therefore, manage to serve a lifelong orchestrating function with regard to the activation and allocation of internal and external resources. Limits to this overall efficacy exist, however, in extreme conditions such as advanced old age and conditions of psychopathology.
4. Self and personality as a dynamic system composed of various components with different properties holds a domain-general potential for the transactional adaptation of the developing organism. We argued and presented evidence that self and personality serve an executive or orchestrating function with regard to the management of gains and losses during ontogeny. Self and personality possess a great ability to negotiate the opportunities and constraints of development that come with age, historical, and idiosyncratic conditions. What we have called general purpose mechanisms play a central role in this adaptational process. Besides a protective self and a coherent personality structure, it is primarily the availability of a rich variety of self-regulatory mechanisms, and of an adaptive algorithm which monitors their application,

that contribute to the adaptational power of self and personality. Table 18.12 summarizes these protective features in more detail. This adaptive potential reaches its limits in very old age when, due to biological processes, the functional losses may for more and more persons reach an overwhelming degree or at earlier ages when other extreme life circumstances result in an imbalance of gains and losses (P. Baltes, 1997; Staudinger et al., 1995).

5. The systemic and overall developmental theory of selective optimization with compensation introduced in the first part of this chapter serves as a useful theoretical tool when analyzing the adaptive potential of the self and personality (Baltes & Baltes, 1990b). When orchestrating the optimization of development by processes such as selection and compensation, the appraisal of resources is of central importance. Questions such as how to evolve a goal structure and the associated goal-relevant means and motivational investment strategies, how to deal with selection-related disengagements from other possible goals, when to accept a loss and reorient one's life, and when to still strive

Table 18.12 Summary of Protective and Optimizing Characteristics of Self and Personality

Self and Personality Components	Protective and Optimizing Characteristics (Examples)
Personality	Conscientious, extraversion, openness to experience, behavioral flexibility, ego resilience, advanced ego level, and cognitive investment
Self-Concept	Interrelated, well-articulated variety of self-conceptions and life priorities Positive agency (efficacy) beliefs
Self-Regulation and Life-Management	
• Self-evaluation	Application of the functional type of comparison (up, down, lateral, temporal) at the appropriate time and context in the adaptational process
• Goal setting and restructuring	Selection and reorganization of life priorities
• Coping styles	Intraindividual plasticity and flexibility in coping styles and compensatory strategies Flexibility in adapting goals to circumstances
• Systemic processes	Selective optimization with compensation

harder because current behavior is not yet employed to its fullest capability becomes crucial in composing life development. Brim has argued, for example, that one criterion for making this decision could be to consider something like a "performance/capacity ratio" (Brim, 1992). According to this rationale, acceptance of a certain loss becomes necessary when the display of the behavior requires a "dysfunctionally" high amount of reserve capacity.

6. For future research, we suggest a stronger focus on constructs that are suitable for the investigation of self and personality development throughout the life span. Second, we would like to suggest that the links between cognitive and personality development need more intensive research efforts. Moreover, future work needs to address the question of the joint operation and interface of structural and dynamic components of self and personality, perhaps not unlike the distinction between fluid and crystallized components in the area of intelligence, where fluid intelligence is considered a general purpose resource. We need to learn more about the modulating effects of personality dispositions as general risk and protective factors for the optimization of one's self-enhancement. And finally, we suggest the use of testing-the-limits paradigms, as proposed in cognitive-developmental work, to gain additional insights into the range and age-associated limits of self and personality functioning.

CONCLUDING COMMENTARY

This chapter presented life-span developmental psychology as a theoretical orientation to the study of human development. Because the dominant theoretical approaches in developmental psychology have been formed primarily by research on infants, children, and adolescents, we made special efforts to highlight the uniqueness in developmental theory that emanates from a life-span developmental framework. An unfortunate by-product of this strategy of presentation may have been the relative inattention paid to important commonalities between age-specialized developmental theories and theoretical efforts in life-span work.

In fact, we believe that there is a larger (and growing) commonality in theoretical approach between more age-

specialized developmental theories and life-span developmental theory than might appear to be the case based on the arguments presented in this chapter (e.g., Scarr, 1986). In part, this is true because there are several new sources (only alluded to in this chapter) from which innovative theoretical efforts in various quarters of developmental psychology have emerged and which contain a structure of arguments similar to those put forward in life-span developmental theory. In our view, work in cultural psychology, dynamic systems theory, and on other forms of self-organization in ontogenesis, are examples of this new theoretical treatment of ontogenesis that is beginning to pervade the developmental field as a whole.

As was true for life-span psychology and the benefits it derived from its contact with the biology of aging, these new kinds of theoretical treatments have benefitted much from transdisciplinary dialogue, especially with modern developmental biologists but also anthropologists. Biologists, for instance, have perhaps led the way in moving research away from unilinear, organismic, and deterministic models of ontogenesis to a theoretical framework that highlights the contextual, adaptive, probabilistic, and self-organizational dynamic aspects of ontogenesis (P. Baltes & Graf, 1996; Magnusson, 1996). In a similar vein, cultural psychologists and anthropologists (e.g., Cole, 1996; Durham, 1991; Valsiner & Lawrence, 1996) have succeeded equally in convincingly demonstrating that human ontogenesis is not only strongly conditioned by culture, but that the architecture of human development is essentially incomplete as to the culturally-engineered pathways and possible endpoints (P. Baltes, 1997).

Not the least because of this transdisciplinary dialogue, a new conception has emerged regarding the "nature" (Kagan, 1984) of human development. In the modern context, its nature no longer refers to the fixed-biological (P. Baltes, 1991, 1997; R. Lerner, 1984; Magnusson, 1996). Rather, in modern versions of ontogenesis, its nature is both biological and cultural, and both of these categories are subject to dynamic and interactive changes as well as systemic transformations. Of all developmental specialties, life-span development, because of its intimate connection with long-term processes of individual development, cultural evolution, and generational transmission is perhaps the field most dependent on, and committed to, such views.

The future of life-span developmental theory will depend significantly on the extent to which the metatheoretical

perspectives advanced turn out to be useful in the conduct of empirical inquiry. On this score, the 1980s have witnessed impressive growth. In the area of intellectual development, for instance, we now have available a cohort- and age-sequential study that extends over close to 40 years (Schaie, 1996) and demonstrates the varied conditions and outcomes which we can observe when placing adult development into the context of historical change and, in addition, consider processes of individual differentiation. There also have been advances in demonstrating the usefulness of the life-span approach for other specialties such as clinical (Staudinger et al., 1995; Vailant, 1990) and applied psychology (Abraham & Hansson, 1995; Sterns & Dorsett, 1994). In fact, these intersects of the life-span approach to the study of human development with other psychological specialties need to be identified and nurtured.

Close to 20 years ago, one of us (P. Baltes) wrote (1979b, p. 1): "There can be no strong field of life-span developmental psychology without a solid foundation in and connection to childhood. By the same token, the study of child development does not exist in a vacuum, but is vitally enriched by considering the aftermath of childhood." Since then, there has been much progress in elaborating this reciprocal connection between age-focused developmental specialties and their integration into a life-span view of human development, but at the same time, this challenge continues to be with us.

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