SELECTIVITY IN LIFE-SPAN DEVELOPMENT

Biological and Societal Canalizations and Individuals’ Developmental Goals

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In recent years we have proposed a life-span theory of control that starts from the assumption of two fundamental challenges to the regulation of behavior and ontogenetic change in particular (Heckhausen, 1999; Heckhausen & Schulz, 1993, 1995; Schulz & Heckhausen, 1996). These two

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fundamental challenges are the regulation of selectivity and the compensation of failure and loss. Our life-span theory specifies two types of control behavior, primary and secondary control, that the individual can employ, jointly and in a refined distribution of regulatory tasks, to master the challenges of developmental selectivity and failure compensation (regarding our model of optimization by primary and secondary control, or OPS model, see Heckhausen, 1999; Heckhausen, Schulz, & Wrosch, 1998).

In this chapter we focus on the issue of selectivity in developmental regulation across the human life span. The basic position we put forward here is that life-span developmental selectivity is jointly produced by biological and societal canalization of developmental pathways and the individual's efforts to influence and come to terms with his or her unfolding development and life course. Moreover, we propose that the specifically realized interactions of the three influencing systems—biology, society, and individual—tend to form optimally efficient regulatory higher-order systems. In such optimized higher-order systems, regulatory mechanisms of the three systems together make positive trade-offs, so that (relatively) stable systems contain minimized conflicts among biology, society, and individual and also entail minimized overdetermination by the three systems. Optimized systems of developmental regulation can vary with regard to the respective profiles of relative influence of biology, society, and individual. However, we propose that this variability of higher-order regulatory systems is constrained to a limited repertoire of optimizable systems as a function of human phylogeny and history, in a manner analogous to the way individual life courses are constrained by “constrained developmental pathways” (Heckhausen & Schulz, 1993).

Finally, we discuss in this chapter a model of the individual's contribution to developmental regulation in modern industrial societies, with their elaborate systems of labor division, corresponding social strata, and structures of social mobility. According to this model, individual developmental regulation is organized around age-graded and sequential action cycles in pursuing developmental goals, their activation and deactivation, according to age-graded opportunities and constraints.

FUNDAMENTAL REQUIREMENTS OF HUMAN BEHAVIOR AND DEVELOPMENT

Within the phylogeny of mammals, a biological stratum characterized by open behavioral programs (Mayr, 1974), Homo sapiens has evolved as a
species with unprecedented variability and flexibility in the regulation of behavior and ontogeny. With few exceptions, human behavior is not regulated by preprogrammed stimulus-response patterns but entails the potential for adaptation to a variety of ecologies and stimulus constellations, in terms of both concurrently available behavioral options and—even more important for ontogenetic change—the acquisition of new behavioral patterns. This holds and is even accentuated when one views the evolution of the human mind from a perspective of evolved domain-specific behavioral and cognitive modules (Cosmides & Tooby, 1987, 1994; Fodor, 1983; Gigerenzer, 1991) that are open to ecological and cultural variations (e.g., Tooby & Cosmides, 1992). In the course of human phylogeny such evolved mental modules may have escaped domain-specific encapsulation (see Fodor’s original conception of encapsulated modules, 1983) and thus provided the building blocks of human intellectual capacities and behavioral adaptiveness (on “cognitive fluidity,” see Mithen, 1996; on “accessibility” of “adaptive specializations,” see Rozin, 1976).

Humans have evolved with the ability to adapt flexibly to a great range of environmental conditions, and in particular with the ability to generate new patterns of behavior. Piaget (1967) conceptualizes this process as a breakage of instinctual control that gives way to more flexible regulations of behavior and mental processes. Thus, when one takes into account human ontogenetic potential and its evolved openness to experience and enculturation, the scope of variability and adaptive flexibility in human behavior is further enhanced. Indeed, this great potential for variability, plasticity, and adaptivity in human ontogeny is a cornerstone of life-span developmental theories (Baltes, 1987; Baltes, Lindenberger, & Staudinger, 1998; Brandstädter, 1997, 1998; Ford & Lerner, 1992; Lerner, 1984). The combination of genetic and environmental factors can thus generate an immense, albeit not infinite, spectrum of potential developmental pathways (on “relative plasticity,” see Ford & Lerner, 1992). This variability in behavior and development is as much a product of evolution as the more narrowly constrained behavioral systems of other species (e.g., Wilson, 1980).

However, the relative dearth of biologically based predetermination of behavior gives rise to a high regulatory requirement on the part of the human individual and the social community. The sociocultural community and the individual along with the biological predispositions jointly fulfill two major regulatory requirements: the management of selectivity and the compensation for failure and loss (Heckhausen, 1999). An overall adaptive
and thus reasonably stable higher-order system of regulation needs to control behavior such that resources are invested in an organized and focused way and that failure experiences lead to improvement rather than to deterioration of behavioral means. It is these requirements for regulation that set the stage for the phenomena we address in this chapter. In particular, we address the requirements of developmental selectivity and the ways in which biological and societal opportunities and constraints provide adaptive challenges in terms of “constrained developmental pathways” (Heckhausen & Schulz, 1993) for the individual’s attempts to coproduce his or her own development.

Selectivity

The great variability and flexibility of human behavior and development are advantages in terms of enhanced adaptive potential. However, the organism needs to organize his or her resource investment by making choices and focusing resources accordingly. Thus life-span development theory inherently raises questions of how individuals decide which domains or goals to select and how they remain focused on the domains or goals they have chosen. Therefore, the notion of selection or selectivity has been emphasized in various life-span developmental conceptions, such as in Baltes and Baltes’s prototheoretical model of selective optimization with compensation (see Baltes & Baltes, 1990; Freund & Baltes, in press; Marsiske, Lang, Baltes, & Baltes, 1995) and Carstensen’s (1993, 1998) socioemotional selectivity model.

The requirements of behavioral and developmental selectivity are twofold: First, the organism must make a choice among behavioral options or goals; second, once it has made a choice, the organism has to invest its resources in a selectively focused way on the chosen action path or developmental pathway (Heckhausen, 1999).

The choice aspect of selectivity is the classic domain of motivational psychology, with its emphasis on evaluative and expectancy aspects of goal choices. A case in point is the student selecting a subject for a graduate project. Such a choice will be informed by the student’s subjective interest and anticipated enjoyment of the work, the longer-term gratifications the student expects the project to have for his or her professional career, the amount of difficulty and controllability posed by study of the subject, and the student’s perceived personal agency (for a detailed review of expectancy-value models of motivation, see Heckhausen, 1989/1991).
This example also illustrates how the regulation of choices becomes even more salient and consequential when considered from an ontogenetic perspective. Across the life span, different choices of developmental paths result in a great diversity of life-course developmental tracks. People become butchers, generals, steelworkers, professors, or doctors; they marry or stay single, have children or not, divorce and remarry; develop conservative, liberal, or radical political views; and so on. The long-term effects of choosing a particular life-course option are amplified with the passage of time. Alternative paths move further and further out of reach as the individual invests resources exclusively in promoting the chosen life path. Moreover, time is a scarce and irretrievable resource, which renders investment in inappropriate life goals a highly prohibitive enterprise. Such nonadaptive investments prevent the individual from pursuing and realizing more suitable goals, and, what makes matters worse, the costs accumulate ever more with time spent on the wrong choice of path. This holds particularly for long-term goals such as professional careers and family building, which consume an entire lifetime and therefore are, at least in the given domain of functioning, exclusive enterprises. Therefore, the choice of goals has to be monitored in view of life-span-encompassing and domain-overarching criteria of adaptiveness on the higher-order regulatory level of optimization (see the discussion of principles of developmental optimization below).

The focus aspect of selectivity refers to the focused investment of resources in a chosen goal. An individual can successfully implement his or her goal choice only by focusing resources on the chosen activity. Resources include behavioral investments (e.g., activity extended over time, effort), motivational and volitional commitment (e.g., resisting conflicting temptations and distractions), emotional resources (e.g., affective balance, self-esteem), and external support (e.g., others’ help). We will see below how the management of these four types of resource investments is reflected in different strategies of control. At this point, it seems important to emphasize the inclusion of motivational/volitional focus in our model. This aspect of focused investment in a chosen goal corresponds to modern motivational theories and their renewed interest in phenomena of volitional commitment (Heckhausen, 1989/1991; Heckhausen & Kuhl, 1985; Kuhl, 1983, 1984). Once the individual has chosen a particular goal or course of action, he or she must protect that choice against competing action tendencies, especially when, during the course of action (or development, for that matter), unexpected obstacles arise.
Compensation of Failure and Loss

The second fundamental requirement of behavioral and developmental regulation is the compensation of failure and loss. Again, this characteristic of human life-span development has led to important theoretical models, such as Baltes and Baltes's (1990; Marsiske et al., 1995) model of selective optimization with compensation and Salthouse's (1985, 1991) cognitive aging model that incorporates a compensatory process. The model of optimization in primary and secondary control (Heckhausen, 1999; Heckhausen & Schulz, 1993; Heckhausen, Schulz, & Wrosch, 1998; Schulz & Heckhausen, 1996) identifies two control strategies to cope with the compensatory requirements: compensatory primary control, which involves the recruitment of help, technical aids, and unusual means; and compensatory secondary control, which is directed at protecting motivational and emotional resources (hopefulness and self-esteem) from being depleted by failure experiences (see the discussion of the OPS model below).

This requirement to compensate failure and loss is also a result of the great variability and flexibility of human behavior. The human potential to learn and acquire new skills has great adaptive value. However, it also exposes the individual to experiences of failure in the process of acquisition, especially at intermediary levels of difficulty, when learning potential is maximized but so is the likelihood of failure experiences that are diagnostic of the individual's ability (see the review in Heckhausen, 1989/1991). These failure experiences bear a twofold danger to the individual's potential for action: frustration and negative effects on self-esteem, a key element of motivational resources. Frustration is a negative affective experience that withdraws the individual's attention from goal striving. Moreover, repeated frustrations might well deplete the individual's future motivation to try the goal activity again. Moreover, repeated failure experiences tend to undermine the individual's perceived competence and even feelings of general self-worth, and these in turn are essential ingredients of successful goal striving.

Across the life span, negative effects of wrong choices accumulate, and therefore a greater need to compensate for mistakes arises. In addition, due to aging-related declines in various domains of functioning, the elderly are especially failure-prone, and therefore need mechanisms to balance the risk of frustration and loss of self-worth even more than do people at other ages. Empirical support for this assumption is increasing. For example, older adults are more prepared to adapt their goals flexibly to objective
conditions (Brandtstädtter & Renner, 1992; Brandtstädtter & Wentura, 1995; Heckhausen, 1997). Moreover, older adults tend to view their own developmental changes in psychological attributes more favorably than those of most other old adults ( Heckhausen & Krueger, 1993), and if they are problem stricken in a given domain ( e.g., health, finances, loneliness), their psychological well-being is improved by their viewing age peers as suffering even more in that domain ( Heckhausen & Brim, 1997).

**Summary and Implications**

The necessity of managing selectivity and compensation of failure results from the vast behavioral and ontogenetic potential in human behavior. In the context of life-span development, both requirements are enhanced in their salience and consequences. The management of selectivity comprises two aspects: the choice of behavioral options and the focusing of behavioral resources. The consequences of both choice and focus of behavior are amplified in the context of ontogenetic change across the life course. Experiences of failure and loss are inevitable and frequent in human behavior, and thus need to be compensated for. Compensation addresses two consequences of failure experiences: the frustration of goal intentions and negative effects on self-perception in terms of competence. Experiences of failure and loss have enhanced consequences in the context of development throughout the life span and become more prevalent toward the end of life. Accordingly, the need to compensate for failure and loss is present throughout the life span, but it is enhanced at older ages.

It is important to note that the individual faces fundamental choices for certain life-course developmental pathways infrequently and only at certain critical junctures (Geelen, 1981), such as when choosing an occupation or making a commitment to a long-term relationship. It is characteristic for human developmental regulation that biological and sociostructural constraints reduce the number of such choice situations. We discuss the principles and mechanisms that constitute these biological and sociostructural canalizations in the next two sections.

**MODELS OF CANALIZATION IN DEVELOPMENTAL BIOLOGY**

In this section we consider processes of developmental canalization that arise from the universal changes associated with biological maturation and
aging. In addition, we discuss biological conceptions of canalization in ontogenesis as models for explaining universal characteristics in developmental change. The phenomena addressed are those of selective focus in developmental change. How does development run along certain pathways rather than produce arbitrary change? The regulatory load for channeling behavioral and motivational resources into certain paths does not have to be carried by the individual alone. Biological processes of maturation and aging and the social structure of the life course provide an adaptive scaffold of age-graded opportunities and constraints.

Biological influences on development are typically expressed in age-related and relatively universal patterns of change, which include maturational processes as well as aging-related decline. Modern evolutionary biology and behavioral biology assert that genetic influences on development—far from being simply determinants of change—are mediated by relevant exogenous conditions for the expression of genetic programs of development (Gottlieb, 1991; Plomin, 1986). Genetically controlled patterns of biological development are most pronounced during childhood, adolescence, and early adulthood, but they also extend far beyond childhood into adulthood and old age. These genetically controlled biological change patterns mold and channel development into certain paths. However, the biologically based “canalization” of development weakens at ages beyond childhood (McCall, 1979). Increasingly at older ages, evolutionary genetic influences become less functionally adapted, because at ages beyond reproduction genetically determined characteristics are less subject to the processes of evolutionary selection for inclusive fitness (Charlesworth, 1990; Finch, 1990; Rose, 1991; Williams, 1957).

It is important to note that evolution not only favors adaptive behavior, but may, as a secondary effect of adaptive selection, promote the spread of dysfunctional characteristics in a population. For reasons of anatomical structure (e.g., inherently related features in anatomy) or genetic transmission (e.g., physical linkage of genetic information), maladaptive characteristics may accompany selection processes (Gould, 1977; see also the metaphor of the “spandrels of San Marco” in Gould & Lewontin, 1979). Typically this happens when the benefits of adaptive characteristics outweigh the costs of maladaptive characteristics for inclusive fitness.

In the context of laying out his theory of coevolution of genes and culture, Durham (1991) reports a case in point regarding the differential prevalence of sickle-cell anemia in different but neighboring West African populations. Durham shows that a gene that is adaptive in conferring
resistance to malaria in the heterozygote state is nonadaptive, even lethal, when it causes sickle-cell anemia (in the homozygote state). This state of affairs favors a higher prevalence of sickle-cell anemia in populations inhabiting areas with a high risk for malaria infection (due to forest clearing and seasonal accumulation of open ponds that allow for mosquito breeding). The punch line of this example in the context of Durham’s theory of gene-culture coevolution is that the agricultural custom of clearing the forest—thus creating opportunities for open water puddles and thereby mosquito breeding grounds—is the ultimate reason for the generation of a selective advantage of the sickle-cell-anemia-prone but malaria-resistant gene cluster. In this way, a cultural activity (agriculturally motivated clearings in the forest) has directly influenced the gene pool of local populations.

Negative side effects of selective adaptations are especially relevant for the biology of aging (see overviews in Baltes et al., 1998; Crews, 1993; Finch, 1990) because selective fitness is mostly determined by prereproductive and reproductive characteristics rather than by postreproductive late-onset characteristics. Given that selective adaptations are focused on the life span before and around reproduction, late-onset malfunctions and disease will not be eliminated from the genetic pool. In a species with costly and extended prereproductive phases and high mortality rates in young adults—true for the early hominids—late-onset nonadaptive characteristics might well accumulate (Charlesworth, 1990; Finch, 1990; Rose, 1991; Williams, 1957). Thus evolutionary selection in humans most likely has favored various nonadaptive late-life-onset side products of early-onset adaptive characteristics. Such old-age genetic calamities can be brought about by a variety of mechanisms. One such mechanism is captured by the concept of “antagonistic pleiotropy” (Williams, 1957) or the “counterpart theory of aging” (Baltes & Graf, 1996; Birren, 1988; Yates & Benton, 1995), which proposes that the long-term effects of developmental growth in early life are detrimental in old age. A case in point is the gene selected for the physiological process of bone growth in childhood, which produces arteriosclerosis in old age (a hypothetical example offered by Williams, 1957). Another particularly destructive mechanism disfavoring old age may be the coupling of late-onset disease with adaptive characteristics in early life. Thus, in a way similar to that in which sickle-cell anemia is genetically coded along with malaria resistance, some important resilience factor relevant for early life (e.g., resilience against life-threatening infectious diseases) may, for instance, have the side effect of rendering an individual vulnerable for Alzheimer’s disease in old age. Such a systematic
mechanism could be expected to produce high prevalence rates of Alzheimer's in old age, as have actually been found in very old populations (about 50% of adults over 90 years of age; see Helmchen et al., 1996).

Life-span trajectories of age-related decreases in evolutionary selection pressure have also been discussed for the realm of psychological functioning (Baltes & Graf, 1996; Baltes et al., 1998). Thus biological aging brings about major restrictions in capacities, declines in physiological and psychological functioning, and vulnerability to disease. All of these present major challenges for the regulation of human behavior and development by the cultural system, societal institutions, and the individual. The sociocultural construction of old age by the society and the individual is, therefore, presented with increasing requirements at higher age levels in adulthood so as to bridge the widening gap between biological resources and sociocultural expectations associated with old age (see Baltes et al., 1998, regarding "age-related increase in need for culture").

In general, the biological resources for physical and mental capacities follow an inverted U-shaped trajectory across the life span. During childhood and adolescence, the individual's motor and mental capacities develop and mature from complete helplessness and dependence on adult caregivers to advanced functioning in a rich assortment of domains. During childhood, maturation of motor skills and the nervous system produces an ordered sequence of developmental attainments in the sense that new abilities (walking, counting, writing) typically are expected and expressed as soon as they move into the range of the individual's developmental capacity ("zone of proximal development"); Vygotsky, 1978; see also Brown, 1982).

However, depending on the cultural system and its construction of the life span, developmental attainments may be delayed relative to their maturational availability. An example is the case of reproduction, which in most societies is delayed to some point after sexual maturity has been reached. Biological change and aging in particular also mark the inverse phenomenon, that certain capacities of the organism become unavailable at higher ages. Again the prototypical case is reproduction, which is severely constrained for women after age 40, due to rapidly declining productivity of the ovaries. We will return to this issue below in our discussion of the model of developmental deadlines.

Sometime during adulthood, functioning in each of these domains peaks, plateaus, and thereafter declines (Lehman, 1953; Simonton, 1995). A case in point is neuronal functioning in terms of receptivity to neurotransmitters, which starts to show significant decreases by midlife and progressive
losses up to 40% by the ninth decade of life (see the review in Finch, 1986, 1990). Another prototypical case is fertility in women, and to a lesser degree in men, which shows a biologically determined age trajectory from maximum functioning in young adulthood to minimal functioning in midlife. Age-related trajectories of maturation and aging in vital biological systems, such as the immune response (Miller, 1990) and cardiovascular and pulmonary functioning (Lakatta, 1990), lead to increasing risks for functional decline and disease at higher ages in adulthood and particularly in old age. Other salient trajectories of increase, peak, and decline can be identified in those domains of functioning that the individual has selected as top priority, because they are most sensitive to reductions of reserve capacity, which is known to decrease from midlife to old age (Schaie & Hertzog, 1983). This is shown in activity-specific age trajectories of peak performance—for instance, in superathletic performance (Ericsson, 1990; Schulz & Curnow, 1988), expert mnemonics (Kliegl & Baltes, 1987), and with regard to late-life dementia being predicted by performance speed in highly trained intelligence tasks (Baltes, Kähler, & Sowarka, 1992).

Health as the basic biological resource of the individual starts to become more vulnerable during late midlife. In advanced age, individuals become increasingly susceptible to various diseases, chronic conditions, disabilities, and life-threatening illnesses (Brock, Guralnick, & Brody, 1990). At the upper limits of the life span, the majority of individuals will develop frailty and multiple chronic illnesses, eventually leading to death (Schneider & Rowe, 1990).

Given the inverted U-shaped trajectory of biological resources, the individual first increases and then decreases physical capacities to obtain important goals in life. This implies that during childhood and adolescence certain goals that were hard or impossible to obtain earlier (e.g., climbing stairs, learning to write) become accessible and even prescribed as developmental tasks (Havighurst, 1973). Conversely, during midlife and increasingly in old age, certain goals become harder to obtain (e.g., running at competitive speeds with younger adults) and thus have to be either given up or pursued with increased effort so as to compensate for the physical constraints. These age-graded changes in opportunities and abilities to pursue certain developmental goals constitute “constrained pathways” (Heckhausen & Schulz, 1993) that guide individuals in their efforts to shape and regulate their own development and life course.

A particularly fruitful model of constrained pathways from developmental biology refers to the process of developmental canalization (Alberch,
1980; Gottlieb, 1991; Oster & Alberch, 1982; Waddington, 1957). Developmental processes are canalized into restricted paths and thus produce a limited and discrete set of outcomes rather than a continuous and random variation of outcomes. Developmental canalization organizes the combination of different characteristics, so that certain types as opposed to arbitrary and form-exhaustive structures can result. Processes of canalization apply to numerous phenomena both in the evolution of species and in the development of individual organisms. In fact, the concept of epigenetic regulation is at the interface of evolution and development in that “morphological phyletic evolution is seen as the product of ontogenetic changes in timing and rates” (Alberch, 1980, p. 660).

An example is the morphogenesis of skin organs, which can lead to feathers, scales, hair, or skin glands (Oster & Alberch, 1982). After some initial stages of epithelia development that are uniform across the diverse outcomes, morphogenesis branches into two different pathways for feathers and scales on the one hand and hair and skin glands on the other; these are later differentiated further. Similarly, the morphogenesis of limbs, with their highly specialized cells and structures, involves a dedication of initially undifferentiated cells (muscle, bone, and so on) to ever more specific functions and forms. The dedication of a given cell and thus the entry into an epigenetic pathway depends on the cell’s neighboring tissue. Transplanting cells to new sites leads to a redirection of morphological development unless the specialization has already happened and the cell “is well on its way,” in which case deviant structures such as limbs with multiple forearms will result.

Developmental canalization involves a set of key characteristics. First, developmental constraints and predispositions make possible a small set of outcomes out of an essentially infinite range of possible outcomes. Second, at the start of the developmental process, comparatively small and often minute (e.g., regionalization of cell tissue in early embryonic development) differences may get amplified into qualitatively different and thus discrete outcomes. Third, development along the epigenetic path is buffered against disturbances. There is a very strong tendency for normal development to occur. Fourth, the preceding three characteristics of epigenesis taken together imply that genes and permissive environments do not directly determine development. Development starts out as a stochastic process, and increasingly along the pathway generates a life of its own. And fifth, the developmental pathways are shaped by genes, permissive environments, and also behavior. Behavior itself can be part of this constraining
context to development (Gottlieb, 1991). Gottlieb (1991) has proposed a systems perspective on canalization according to which canalization processes occur not only at the genetic level, but at all levels of the developing organism, including genetic expression, neural activity, behavior, and experience in the environment. The typical or usual experience of an organism promotes species-typical behavior and also favors species-typical over species-atypical experiences (environment, stimulation). Thus canalization is a function of the constellation of many factors (genetic, physiological, behavioral, and environmental). It is plausible that a limited set of combinations of individual behavior, sociocultural system, and biological maturation and aging could represent functional systems of influences to promote adaptive developmental trajectories across the life span.

MODELS OF STRUCTURAL CONSTRAINTS IN LIFE-COURSE SOCIOLOGY

An analogous line of argument regarding the relative flexibility of human behavior and its consequences for regulation holds for the role of socio-structural and age-normative constraints. Social structure and its age-graded and age-sequential organization as well as social norms about the timing and sequencing of life-course transitions provide an adaptive scaffold for the individual's attempts to regulate his or her own development. This reasoning has strong roots in social anthropology as well as in life-course sociological research.

Theories of sociological anthropology argue that the relatively weak biologically based predetermination in human behavior constitutes a fundamental anthropological universal (Berger & Luckmann, 1967; Claessens, 1968; Gehlen, 1958; see reviews in Esser, 1993; Huinink, 1995). However, it is this insufficiency that also furnishes an openness to the world (Weltoffenheit), an ability to act, and a readiness to develop. But this advantage comes at a cost, the cost of regulatory challenge. The individual needs a social scaffold and social reassurance to regulate his or her behavior. Humans are thus dependent on social institutions for behavioral regulation.

While emphasizing the adaptive implications of the great variability and flexibility in human behavior, Claessens (1968) asserts that these advantages need to be supported by the regulatory impact of social groups. Being part of a social group releases some of the regulatory load and provides
reassurance to the individual about his or her own behavior by way of group approval. Modern cultural anthropologists argue more specifically that social conventions become transformed into institutionalized ways of thinking (Douglas, 1986). When it comes to implicitly regulating individuals' behavior, institutional ways of thinking are superior to explicit social conventions because conventions as pragmatic rules for social interactions are too transparent and therefore vulnerable to conflicts of interest between social agents. In contrast, institutionalized ways of thinking are powerful shapers of individuals' beliefs because they appear to be grounded in nature itself. From the individual's perspective, institutionalized ways of thinking "turn individual thought over to an automatic pilot," and for society "there is a saving of energy from institutional coding and inertia" (Douglas, 1986, p. 63). Berger and Luckmann’s (1967) notion of social constructions of reality follows a similar logic in that social constructions provide both societal stability and predictability as well as subjective certainty about a mutually habituated, and thereby institutionalized, foundation of individual action.

In the consideration of life-course developmental patterns, one characteristic of societies is particularly relevant for both the opportunity structure and the social constructions of reality: the degree of social mobility available in a given social structure. Societies at different times in history as well as concurrently differ greatly with regard to the opportunities and risks they provide for individuals to move upward or downward in social rank. In feudalistic times, most individuals were fixed at the social rank of their parents. This changed gradually with the rise of industrialization in the increasingly influential cities of medieval Europe. A radical increase in social mobility both between generations and within generations came with the rise of manufacturing and industrial production. Today, however, and in spite of the much-cited phenomenon of globalization, social mobility patterns are far from uniform across the industrial nations. There are impressive differences both in terms of overall life-span encompassing social mobility and in terms of postadolescent, or post-early-adulthood, mobility. Permeability of occupational careers, as one key aspect of social mobility, is, for instance, much greater in the United States, with its potential for midlife career changes, than in Germany, where occupational career tracks are usually set by late adolescence (Hamilton, 1994). Accordingly, the individual faces greater or lesser challenges in terms of both avoiding the risk of being downgraded and realizing chances for moving up the social ladder. Social constructions of what it means to lead a
successful life would have to reflect these constrained or expanded opportunities for producing successful life courses. Examples are found in values and belief systems that emphasize either individual achievement and merit or social adjustment and duty.

In most human societies, the life course is composed of age segments or age categories that stratify the society into age groups (Riley, 1986) and also involve age norms for important life events and role transitions. Regarding the regulation of individuals' behavior directed at the life course and development, two types of sociocultural influences need to be considered. One is the social structure of the life course, with its age-chronological and age-sequential constraints, such as laws for child and adolescent welfare (Jugendschutz), prescribed entry and exit ages for the educational system, and retirement laws. The other pertains to age-normative conceptions about age timing that are internalized and shared by the members of a given community and thereby contribute to the notion of good and bad timing of life events and transitions—the "social clock" (Hagestad & Neugarten, 1985; Kohli & Meyer, 1986). We propose that these two sources of constraining influences form a historically dynamic system of regulation (see also Heckhausen, 1990, 1999). We will first consider the sociostructural constraints of life-course patterns, and then discuss the historical dynamic and role of age-normative conceptions about development and the life course held by individual members of a given society.

**Sociostructural Constraints of Life-Course Patterns**

Externally institutionalized age-chronological constraints are constituted by entry, exit, and transition times institutionalized in legislation and state as well as private organizations' promotion rules (e.g., Mayer, 1986; Mayer & Müller, 1986). Such social institutional constraints provide time-ordered opportunity structures for certain life-course events and thus form part of the "sociostructural scaffolding" of life-course development. Specifically, this implies that for any given life event there is an age range with optimal opportunities. In contrast, individuals at "off-time" ages face nonfacilitative opportunity structures and even obstacles. Consider, for instance, the availability of student grants for individuals at different ages or in different life-course periods. In most European countries it is much easier to obtain a study grant at the age of 20, before one has started an occupational career, than at the age of 45, after one has worked in an occupation for 25 years. The same holds for the availability of summer
jobs, cheap accommodations, and so forth. Society provides an opportunity structure to study for the 20-year-old, but not for the 45- or 60-year-old. This means that the “off-time” student has to invest many more personal resources to compensate for the lack of sociostructural support.

Another kind of externally institutionalized life-course constraint is the age-sequential structure of life-course events and developmental change, which restrains the repertoire of potential sequences. Age-sequential constraints provide order and predictability to individuals’ life courses, both for individuals’ and societal planning. Instead of fanning out in arbitrarily meandering life paths, life courses are typically channeled into sequential patterns or biographical tracks (e.g., Geulen, 1981). As individuals try to attain certain life-course outcomes, they are channeled through sequentially organized patterns of opportunities and constraints (Sørensen, 1986), guided by prescriptions for sequencing and spacing of life events and transitions (Hogan, 1981; Marini, 1984; Mayer & Huinink, 1990). For example, after completing occupational training one can obtain an entry-level job, followed by the first promotion, and so on. Similar to chronological constraints, these sequential constraints are generated by multiple sources, such as the state and its laws (such as laws dealing with equality in job opportunities based on qualification only).

Age-sequential constraints can come into play through segregated biographical paths, segregated labor markets, and social networks (Blossfeld & Mayer, 1988; Featherman & Lerner, 1985; Geulen, 1981; Kohli & Meyer, 1986; Mayer, 1986). Such constraints foster selectivity and can thus be conceived of as “canalization” of life courses.

From a critical perspective, these constraints are conceived as differential and socially unjust allocations of resources to individuals of different social classes (Mayer & Carroll, 1987), gender (Mayer, Allmendinger, & Huinink, 1991), and race or ethnicity (Jencks, 1992) that result in unequal opportunities for social mobility (Dannefer, 1987). The greater the investments along the constrained developmental pathways, the greater the accumulated effect of canalization. Further along a life-course track, an individual has optimized his or her investment of material, behavioral, and motivational resources, and thus has less flexibility to switch to another pathway.

In sociology this phenomenon has been studied as the sequentially enhanced effect of differential allocations of social resources over the life course (Dannefer, 1988; Merton, 1968). In a study on advantages and disadvantages in scientists’ career patterns, Merton (1968, 1973) identified
fetime-sequential cumulations of resources, a phenomenon he labeled the Matthew effect,” from the gospel of Matthew: “To he who hath, shall more be given, and to he who hath not, shall be taken away, even that which he hath” (as cited in Dannefer & Sell, 1988, p. 4). Dannefer (1987; Dannefer & Sell, 1988) has proposed applying the notion of the Matthew effect to a wider range of life-course phenomena reflecting “aged heterogeneity.” In this more general application of the concept, the Matthew effect denotes the fanning out of life-course careers across the life span that is based on initial social inequality. Recent research on lifetime accumulation of personal resources has provided empirical support for the idea that interindividual divergence increases across the life span (e.g., Henretta & Campbell, 1976; Maddox & Douglas, 1974; Rosenbaum, 1984; Schaie, 1989; Walberg & Tsai, 1983).

We take a nonevaluative perspective on this issue and focus on identifying the function of the combined system of societal institutions and individuals’ conceptions about the life course that helps regulate individual life courses. Across history, we propose, this system is calibrated such that the individual members of society can psychologically manage their life courses (avoidance of volition or planning overload) while the life-course patterns remain reasonably predictable on the societal level so as to safeguard social stability. We now turn to a discussion of the role of age-normative conceptions about the life course shared by members of a given society.

Age-Normative Conceptions About the Life Course

The idea of a historically dynamic system of developmental regulation is inspired by Norbert Elias’s (1969) analysis of the process of civilization in Western societies. Along with many of his contemporary sociologists, cultural anthropologists, and historians, Elias was fascinated by the question of what makes people comply with certain rules of social conduct in a given society if these rules are not enforced by direct sanctions of social institutions. How do individual members of society become “civilized” into conforming to commonly shared rules, and how does this process relate to the evolution and change of social institutions? Elias answers these questions by showing, with reference to various domains of behavior (e.g., table manners, control of aggression, patterns of cosleeping), that external enforcement by way of the suppressive institutions of the feudalistic social system was gradually, over centuries, transformed into rules and norms of
conduct and behavior that were internalized by individuals. To the extent that the individual members of society accepted such norms as guidelines for their own behavior, the external suppressive institutions became obsolete. The regulation of behavior and affect came to appear natural and inevitable (see also Parsons, 1951; and Douglas, 1986, on "institutionalized ways of thinking").

In a similar way, modern regulation of life-course patterns may have come under increasing control of internalized age norms and conceptions about proper sequencing of developmental transitions (Heckhausen, 1990, 1999). Such a conception would help resolve the apparent paradox found in the weakening institutionalization of the life course (Dannefer, 1989; Held, 1986; Neugarten, 1979; Rindfuss, Swicegood, & Rosenfeld, 1987) while normative life-course patterns with constrained age timing of life events and transitions still prevail in the general population (Hogan, 1981; Marini, 1984; Modell, Furstenberg, & Hershberg, 1976; Modell, Furstenberg, & Strong, 1978; Uhlenberg, 1974). It is important to note that even when social institutions were partially dissolved in the course of World War II and the Great Depression, the age timing of life transitions (e.g., graduation from school, marriage) did not change (Blossfeld, 1987, 1988), and neither did age-normative conceptions about the age timing of these life events (Modell, 1980). Blossfeld (1987, 1988) investigated the age timing of transitions in education during the post-World War II period in Germany and found stable age timing of transitions even during a period when the societal system had collapsed. Modell (1980) has reported similar findings regarding the age timing of marriage in the United States during the 1930s and 1940s. Modell shows that normative conceptions about the ideal age timing of marriage remained constant even when people were forced to delay marriage because of the Great Depression or to marry earlier because of World War II. Thus it seems that age-normative conceptions are inert and powerful regulators of developmental and life-course timing, even (or especially) when externally institutionalized constraints are weakened.

How do normative conceptions about development and the life course gain influence over individuals’ attempts to influence their own development? Some life-course sociologists have proposed that people’s age-normative conceptions about the life course are merely epiphenomenal to sociostructural systems of age grading, in that they only reflect statistically dominant behavioral patterns that may have been socialized and modeled to the individual (Marini, 1984; Mayer, 1987, 1996; Riley, 1986). Propo-
ponents of this approach have argued against the view that age-normative conceptions are constitutive for homogeneity and variability in populations’ life-course patterns (e.g., Marini, 1984) and have also opposed the conceptualizing of age-normative beliefs of individuals as social norms, because such beliefs lack two fundamental characteristics of social norms: They are not behavioral prescriptions in the sense of “ought” rules, and they do not elicit social sanctions in the case of transgressions.

However, from the point of view of social psychology and the sociology of knowledge, age-normative conceptions about development and the life course may serve as guiding images that regulate behavior. Their committing force may result precisely from the fact that they are *not* enforced by external institutional control but rather are internalized and thereby naturalized as social frames of reference (see also the distinction between social control and socialization drawn by Parsons, 1951).

In accordance with Kelley’s (1967) model, an explanatory need arises once an individual departs from what is perceived as the norm (“consensus”). Typically, the reasons for norm discrepancies are attributed to the individual’s disposition. In a study on social perceptions of on-time and off-time characteristics of middle-aged adults, Krueger, Heckhausen, and Hundertmark (1995) showed that off-time developmental attainments elicited surprise and more extreme judgments of the personal characteristics of the target persons.

Thus the internalization of age norms by individual members of a society has much more far-reaching implications than if these norms were merely a passive reflection of statistical age norms. Age-normative conceptions provide social frames of reference and, as such, produce age-graded aspirations in the pursuit of developmental goals for individual agents. An individual’s failure to attain these aspirations and goals has negative consequences for self-evaluation. In this way, age-normative conceptions acquire a psychological control over life courses that their counterparts in the realm of social institutions may have lost to some degree: They do have the status of ought rules, and failing to abide by them results in sanctions.

**THE INDIVIDUAL AS A COPRODUCER OF DEVELOPMENT: DEVELOPMENTAL GOALS AS ORGANIZERS OF DEVELOPMENTAL REGULATION**

What is the role of the individual in optimizing selectivity in life-span development? Based on what we have said in the previous two sections on
the developmental and life-course pathways carved out by biological and sociostructural constraints, one might argue that few degrees of freedom are left for the individual to coproduce developmental change and life-course patterns. And in a sense this is true. Indeed, individuals' influences are constrained, but they are constrained adaptively, in that the age-graded structure of opportunities provided by biology and social system scaffolds the individual's attempts to shape his or her own development (Heckhausen, 1999). The age-graded constraints lend predictability to what would otherwise appear to the individual as a world of ubiquitous affordances, without order in time and space. The joint influences of developmental biology (maturation and aging) and social structure provide age-timed windows for individual choice and action, and shepherd along the individual's volition to stay on a chosen developmental pathway.

To be sure, the degree to which biological and social ecologies of development are constraining is not universal; it varies across historical time and cultures, even within fairly similar societies such as the United States and Germany. In addition, radical sociohistorical transitions or crises such as the Great Depression (e.g., Elder, 1974; Elder & Caspi, 1990) and German reunification (Heckhausen, 1994, 1998) can weaken the effects of previously stable sociostructural constraints. Accordingly, more or less leeway—with accompanying chances and risks—is given to individual agents to coproduce their own lives. Thus the influence of individual initiative on life-course outcomes is extended, and with it the effects of interindividual differences in action-related beliefs (Diewald, Huinink, & Heckhausen, 1996; Huinink, Diewald, & Heckhausen, 1996) and other relevant personality characteristics on developmental outcomes are amplified.

One potentially highly relevant personality factor in this context involves individual profiles of relative importance for key motive systems, such as the motive systems for achievement, affiliation, and power. At the level of the individual organism, this requirement of selectivity is probably best served by domain-specific emotions and motivational systems (Schneider, 1996; Schneider & Dittrich, 1990; see also Schulz & Heckhausen, 1997). They provide incentives to strive for and set priorities between potentially conflicting domains (e.g., work as favored by a strong achievement orientation, family as favored by a strong affiliation orientation). Over and beyond the opportunity structure in a given developmental ecology, such individual preference profiles across major motive systems help to channel individuals' activities along chosen developmental paths. Such individual preference profiles may also allow the individual the deviate from age-
normative developmental patterns, but at the cost of unusually high investments in a given goal, so that “swimming against the stream” of age-graded opportunity structures is rendered successful (Heckhausen, 1989). However, such cases of deviant life courses are the exception and bear high risks of failure, because they do not make optimal use of biologically and societally provided opportunity structures and have to come up against constraints. In the typical case, the key to a successful development across the life span is the fit that the individual achieves in his or her life course with the biologically and sociostructurally determined opportunities at any given age.

Three Principles of Developmental Optimization

Individuals can achieve optimal fit between their efforts to regulate their own development and age-graded opportunities by choosing the goals they strive for carefully, in accordance with certain principles. The careful choosing of developmental goals is what we call, in the context of the OPS model, optimization (Heckhausen, 1999; Heckhausen & Schulz, 1993; Schulz & Heckhausen, 1996). Developmental optimization is guided by three principles: age appropriateness, management of positive and negative trade-offs, and maintenance of diversity.

The first principle of optimization, age appropriateness, implies that the individual selects his or her developmental goals to strive for when the opportunities provided by the biological resources and the societal support systems (e.g., education, parental, or state support) are at their maximum. In this way, age-appropriate goal selection is in agreement with Ford and Lerner’s (1992) conception of “individual’s behavior as the means of fusing the influences of biology and context on development” (pp. 80 ff.). The notion that opportunities for certain developmental attainments are age structured and reach maxima at certain ages during the life span converges with the concept of developmental tasks (Havighurst, 1952, 1953). Age-appropriate goal selections not only maximize access to relevant resources for goal attainment, they minimize the regulatory burden for volition. Pursuing age-typical developmental goals means that age peers strive for similar goals and thus, by way of social facilitation (modeling, common concern), help to keep the goal in focus. By selecting age-appropriate goals, the individual can orchestrate goal investment in a sequential manner, rather than strive for multiple goals simultaneously—although sometimes overlap may be difficult to avoid. A particularly helpful feature of the
opportunity structure in this regard is the shifting point from advantageous to disadvantageous opportunities, the developmental deadline (we return to this topic below). Developmental deadlines provide salient age-time markers for shifting developmental investment from one goal to another, depending on favorable versus unfavorable opportunities.

The second principle of developmental optimization addresses the issue of positive and negative trade-offs between domains of functioning and between short- and long-term implications of goal investment. Investing behavioral and motivational resources for a given developmental goal often has consequences far beyond the domain immediately involved. For one thing, investments in one domain always imply that the resources invested cannot be used for other domains at the same time. Thus excessively focused goal investments, such as the pursuit of a career as a world-class athlete, may be devastating for fundamentally important domains that compete for resources, such as education and occupational training (Schulz & Heckhausen, 1996). A moderate negative trade-off for other domains is unavoidable for any pursuit of developmental goals. However, the costs have to be taken into account and excess damage to other domains and long-term development must be prevented. Positive trade-offs of striving for developmental goals typically ensue when the goals involve general-purpose abilities. An example is education in terms of basic abilities and skills, such as reading, writing, algebra, and languages. It is hardly surprising that this principle of developmental optimization is not left to the individual but institutionalized in modern educational systems. It has become part of the societal canalization of developmental growth.

The third principle of developmental optimization pertains to the issue of diversity of developmental potential. Analogously to phylogensis and the process of evolution, ontogenesis and developmental growth require variability. Change in general cannot occur without its raw material, the availability of multiple options and pathways. Too narrow developmental pathways with excess specializations leave the individual highly vulnerable. Any change in the opportunity structure pertaining to the chosen narrow path can curtail further development and leave the individual without options to switch developmental investments to or to compensate.

Whereas developmental optimization in terms of adaptive goal selection fulfills the fundamental regulatory requirement of selectivity, the principle of maintaining diversity embedded in optimization protects the individual from excessive narrowing down of developmental pathways. Although
selectivity in resource investment is necessary, it has the potential of becoming dysfunctional if pushed to the extreme.

An example of a domain where continuous selectivity throughout the life course may become dysfunctional is social relations. According to the widely respected theory of socioemotional selectivity (Carstensen, 1993), the shift from informational to socioemotional needs that occurs with increasing age throughout adulthood motivates individuals to narrow down their social networks cumulatively to exclude less close social partners to the benefit of very close social partners (see also Lang & Carstensen, 1994). It seems, however, that if such a process of lifelong winnowing out is not balanced by periods of diversification, the individual might end up with too few social partners to satisfy even the most select need for close emotional relations in old age. Most individuals at late adolescence or early adulthood start out with a pool of social contacts who to a large extent become irrelevant and nonadaptive for later phases of the life span. Precisely because individuals often select social partners to suit the needs of the developmental phases they are in, there is no reason to assume that contacts established earlier in life have a longer-term likelihood to be adaptive than contacts formed later in life, unless we talk about family relations—between individuals and members of their own families of origin, or between individuals and their partners and/or children—which are likely to emerge relatively early in life and stay with us for most of our lives.

We propose that cycles of diversification and contraction of social networks occur during developmental segments of the life course, such as during college time, work life, and retirement. Thus at the beginning of a new period in life (e.g., school-to-college transition) an individual will expand his or her social network. Then, in the course of the developmental period, the individual will structure his or her social network in terms of closeness (i.e., differentiating into closer and less close social partners) and start the winnowing-out process. Finally, toward the end of the developmental period, when the “social ending” (Carstensen, 1993) draws near, the individual will narrow down the social network to the close and dear.

Optimization in Primary and Secondary Control

Given the selection of appropriate developmental goals as described in the section on optimization above, the individual can employ a set of
TABLE 3.1  OPS Model: Optimization in Primary and Secondary Control

<table>
<thead>
<tr>
<th>Optimization</th>
<th>Selective primary control</th>
<th>Compensatory primary control</th>
<th>Selective secondary control</th>
<th>Compensatory secondary control</th>
</tr>
</thead>
<tbody>
<tr>
<td>adaptive goal selection: long-term and age-appropriate goals</td>
<td>investment of effort, ability</td>
<td>recruitment of others’ help</td>
<td>enhancement of goal value</td>
<td>goal disengagement (four grapes)</td>
</tr>
<tr>
<td>management of positive and negative trade-offs for other life domains and future life course</td>
<td>investment of time</td>
<td>seeking of others’ advice</td>
<td>devaluation of competing goals</td>
<td>self-protective attributions</td>
</tr>
<tr>
<td>maintenance of diversity, avoidance of dead ends</td>
<td>acquisition of new skills</td>
<td>use of technical aids</td>
<td>enhancement of control perception</td>
<td>self-protective social comparison</td>
</tr>
<tr>
<td></td>
<td>fighting of difficulties</td>
<td>employment of unusual means</td>
<td>anticipation of positive consequences of goal attainment</td>
<td>self-protective intraindividual comparison</td>
</tr>
</tbody>
</table>

SOURCE: Adapted from Heckhausen (1999).

control strategies to strive for and disengage from goals. Table 3.1 informs about the four types of control strategies, along with the three principles of optimization, as proposed in the OPS model (Heckhausen, 1999; Heckhausen & Schulz, 1993; Schulz & Heckhausen, 1996).

First, we distinguish between primary and secondary control strategies. Primary control strategies are directed at the external world and serve to bring about effects in the environment. Secondary control strategies, by contrast, are directed to the internal world of the individual and serve to focus and protect the motivational resources for primary control.

Specifically, we differentiate four control strategies (see Table 3.1): Selective primary control involves the investment of behavioral resources such as time, effort, and skills to achieve effects directly in the environment. Compensatory primary control comes into play when internal resources are insufficient and external means are recruited, such as other people’s help and advice, technical aids, or unusual action. Selective secondary control refers to the focusing of motivational resources to goal pursuit by means of volitional self-commitment, such as enhanced perceptions of goal value, devaluation of alternative and competing goals, and boosted perceptions of control for goal achievement. Finally, compensatory secondary control protects the individual’s motivational and emotional resources after
experiences of failure and loss, and involves such strategies as goal disengagement, goal substitution, self-protective attribution, and strategic downward social comparisons.

Strategies adaptive for goal striving are selective primary, compensatory primary, and selective secondary control. Goal disengagement and long-term protection of motivational resources are promoted by compensatory secondary control strategies.

**Action Cycles of Developmental Goal Pursuit:**
**An Action-Phase Model of Developmental Regulation**

Throughout the life course, the individual encounters changes in opportunities for attaining various developmental goals. During phases of increasing opportunities, developmental goals become activated. As opportunities decline, an individual who has not yet realized a given goal will have to invest increased effort to attain the goal before opportunities vanish. The point at which opportunities have declined so much that goal attainment becomes unlikely can be called a *developmental deadline.*

Figure 3.1 displays an action-phase model of developmental regulation. The model builds on Heinz Heckhausen's (1989/1991; Heckhausen & Gollwitzer, 1986) "Rubicon model" of action phases, which distinguishes predecisional phases of action, which are characterized by deliberations of goal selection before the decisional Rubicon is crossed, from postdecisional phases of action, when the individual has committed to a goal and is volitionally focused and biased toward it. We have extended the Rubicon model of action phases to include a postaction transition from predeadline goal engagement to postdeadline goal disengagement. According to the respective functions of goal engagement to disengagement, appropriate control strategies are expected to be dominant. Thus, during the urgent predeadline phase of goal striving, selective primary, selective secondary, and compensatory primary control strategies will be intensified. In contrast, these three types of control strategies are expected to be deactivated once the deadline is passed. Postdeadline processing after failure to reach the goal is characterized by compensatory secondary control processes such as goal disengagement, goal substitution, self-protective social comparisons, and causal attribution.

We investigated this action-phase model of developmental regulation around deadlines for two paradigmatic developmental goals. The first is the developmental goal of parenting, which for women is subject to the
Figure 3.1. Action-phase model of developmental regulation
SOURCE: Adapted from Heckhausen (1999).
so-called biological clock. We found clear patterns of predeadline goal selection, endorsements of control strategies, and biased cognitive processing (Heckhausen, Schulz, & Wrosch, 1998; Heckhausen, Wrosch, & Fleeson, 1998). Predeadline women without children report more child- and family-related goals, value selective primary and selective secondary control more highly, and show greater incidental recall of positive aspects of having a child. Postdeadline childless women, by contrast, report more goals directed at self-development or at improving the social network; they value compensatory secondary control strategies more and evidence lower incidental recall of positive aspects of having a child.

The second paradigm for deadline-dependent goal striving pertains to the partnership domain (Wrosch, 1999; Wrosch & Heckhausen, in press a, in press b). Men and women in early (20 to 35 years) and late (50 to 60 years) adulthood who were recently separated from their partners versus those who had recently committed to a new partner were asked about developmental goals and control strategies, and performed an incidental memory task on partnership-related positive and negative attributes. In accordance with the model of developmental regulation around deadlines, younger separated adults more frequently reported the goal of forming a new partnership. Interestingly, newly committed older adults were highly invested in their new partnerships, even more so than younger freshly committed adults. Young adults in general favored selective primary control and selective secondary control more than older separated adults. Older separated adults more frequently preferred compensatory secondary control strategies. Finally, older separated adults recalled a greater proportion of negative attributes about partnerships than did younger separated or older committed adults.

Thus we have consistent evidence from different life domains that individuals’ attempts to regulate their own development are organized in action cycles of goal engagement and disengagement around developmental deadlines.

CONCLUSION

One of the fundamental regulatory requirements for life-span development is selectivity. Individuals need to select certain pathways and goals out of an array of possible options. Once they make their choices, they must invest their behavioral and motivational resources in a focused manner. Mecha-
nisms and systems of selectivity are a key component of developmental and evolutionary biology, and may be best described in Waddington's (1957) model of epigenetic landscape. Small, continuous, and chance-based differences in the beginning of a change process lead to substantial differences and discrete outcomes in the end. Societal structuring of the life course, chronological timing, and sequential organization of normative life events and transitions function in an analogous manner to the constrained pathways provided by the biology of development. Thus, in the course of maturation and aging, and by way of societally organized life-course transitions, individuals' developmental pathways are canalized. Within these canalized pathways, individuals hold manageable degrees of freedom to regulate their own life courses and developmental change. Individuals' contribution to developmental regulation across the life span is organized by cycles of engagement for and disengagement from developmental goals. The onset of goal engagement is given by the emergence of opportunities for goal attainment during a given lifetime window. Striving for goal achievement becomes urgent when opportunities become more scarce. Finally, goal disengagement processes and self-protection strategies need to be activated when developmental deadlines have been passed without goal attainment. Thus biological and societal canalizations help to organized cycles of engagement for developmental goals along the lifetime axis, and thus function as adaptive scaffolds for life-span development.

NOTE

1. Of course, such volitional commitment can become maladaptive when costs of the chosen action course become prohibitive. In such cases, the phenomenon of adaptive regret comes into play (see also Heckhausen, 1999, in press).

REFERENCES


Selectivity in Life-Span Development


