Understanding Human Development

Dialogues with Lifespan Psychology

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1 Why Read Another Book on Human Development? Understanding Human Development Takes a Metatheory and Multiple Disciplines

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The Idea

The description, explanation, and enhancement of development in individuals and groups of individuals are seen as important goals of scientific inquiry in most of the social, behavioral, and life sciences. At the same time, scholars working in these three research traditions increasingly agree that cultural and biological processes interact in the co-construction of human ontogeny. This broad and growing consensus provides a fertile common ground for scientific exchange. In the process, communication across research traditions and disciplines, while acknowledging necessary differences in terminology and methodology, needs to establish a common conceptual framework. Psychology, with its links to sociology, cultural anthropology, and history, on the one hand, and to cognitive neuroscience, evolutionary biology, and developmental biology, on the other, appears to be in a good position to mediate such a framework. The general goal of the present volume is to explore the tenability of this assertion.

Specifically, the book features lifespan psychology, a metatheoretical framework that was first proposed by Paul B. Baltes (1987, 1997; see also Baltes, Lindenberger, & Staudinger, 1998; Baltes, Staudinger, & Lindenberger, 1999). Lifespan psychology articulates the two major sources of human development, biology and culture, and posits three central developmental mechanisms—selection, optimization, and compensation (Baltes, 1997). Development, in the lifespan sense, is not reduced to growth but encompasses growth, stability, and decline from conception to the end of life.

review of interactionism in developmental science, see, e.g., Lerner, 1984). The human genome cannot unfold without a given context, and this context influences the way it unfolds (see Kirkwood, this volume; Singer, this volume). And certainly, culture needs an organism on which to unfold its influences (see Köller, Baumert, & Schnabel, this volume; Mayer, this volume).

The nature-nurture debate has a long history that has been stimulated by recent developments in quantitative genetics (McClearn, this volume). The complexities of gene-gene and gene-environment developmental interactions are progressively uncovered. In basic agreement with Molenaar, Huizenga, and Nesselroade (this volume), McClearn concludes that a comprehensive view of human ontogeny needs to embrace the language, concepts, and methods of developmental systems theory, such as network causality, hierarchical organization, catastrophes, bifurcations in chaotic systems, and feedback loops. In this context, the actions and intentions of the developing individual constitute—besides biology and culture—a third, emergent source of influence on development (e.g., Brandtstädter & Rothermund, this volume). Intentional human behavior (such as actions) and its corollaries (such as choice, self, life goals, and so on) are closely linked to the openness of human ontogeny.

The dynamics between biology and culture described by Baltes (1997) provide the basic script for lifespan changes in many functional domains. For example, in the domain of cognitive performance, measures assessing individual differences in processing efficiency (such as measures more closely related to biology) are generally negatively related to age during adulthood and old age. In contrast, measures assessing individual differences in the cumulative products of past processing (such as measures more closely related to culture) tend to show little or no decrements during adulthood. This developmental dissociation between “process” and “product” measures (Hebb, 1949) is at the heart of several two-component theories of cognition, such as the theory of fluid and crystallized intelligence by Cattell (1971) and Horn (1989) or the theory of the mechanics and pragmatics of cognition by Baltes (1987, this volume; for a comparison, see Lindenberger, 2001).

At a more specific level of analysis, Salthouse (this volume) discusses and empirically examines various explanations for the widespread absence of negative age-cognition relations in the pragmatics of cognition. The data presented in his chapter are well explained by the migration hypothesis, a term proposed by Salthouse (this volume), according to which individuals tend to “migrate” from lower to higher levels of knowledge with advancing age. From the other end of the lifespan, however, Wellman (this volume) questions the expertise analog (such as proceeding through the accumulation of the specific to the general) as a description of cognitive development during early childhood. He provides convincing evidence that early development, at least in certain cases, proceeds from the general and abstract to the specific and concrete, and not the other way around, as the transition from novices to experts generally would suggest.

Through the innovative use of existing methodological tools (such as experimental age simulations) and the development of new ones (such as time-accuracy functions),

Kliegl, Krampe, and Mayr (this volume) further differentiate the distinction between “process” and “product” mentioned above. They suggest that processing serving the production of novel ideas is more negatively affected by advancing age than processing that dwells on the retrieval of existing knowledge (see also Sternberg, 1985).

Another example for the interaction between biology, culture, and person is the self and personality domain. Again, we find a biological basis, the mechanics of life, that is reflected in basic emotional (positive, negative) and motivational (approach, avoidance) tendencies, as well as basic activity patterns (Staudinger & Pasupathi, 2000). In countless interactions with cultural contexts, these basic biological components of self and personality become regulated, differentiated, and enriched (Cloninger, this volume). As a result individuals develop their pragmatics of life. They possess highly complex emotional patterns ranging from guilt to pride, goal systems encompassing, for instance, the pursuit of a professional career and the construction of meaning in life, as well as multifaceted personality characteristics and self definitions (Staudinger & Pasupathi, 2000). This developmental course, however, should not be mistaken as a devaluation of biological forces. The synergistic operation of biology and culture is maintained throughout life, notwithstanding the fact that in very old age biological powers decrease. Decreases in biological functioning may lead to reduced vitality and psychological energy and influence goal pursuit, the emotional budget and the personality structure accordingly (see also Roberts & Caspi, this volume; Smith, this volume). At the same time, the resources propelling self-regulatory processes are reduced, and, thus, in very old age the biological basis of self and personality shines through more strongly than during adulthood (Staudinger & Pasupathi, 2000).

Processes of Development

The developmental sources of biology, culture, and person are linked to different developmental processes. In biology, the developing organism is described at first as *maturing* and later as *senescing* (see Kirkwood, this volume; Singer, this volume). From a cultural point of view, development is *learning* (see Köller, Baumert, & Schnabet, this volume; Mayer, this volume). And finally, *actions* taken by the developing human being contribute to development. The dynamic relations between intentionality and ontogenetic time are considered both as a resource for action and a source of meaning (see Brandstädter & Rothermund, this volume). It is by means of these three processes that biology, culture, and person interact and produce development and aging (see Li, in press, for an attempt to specify those interactions).

The development of the human brain and of human cognition may serve as illustration for the interaction among these three processes. During pregnancy, infancy, and childhood, brain structures mature. These processes, however, are *not* following a fixed biological maturation program but rather interact with and depend on contextual characteristics such as plasma composition or nutrition (see Kirkwood, this volume; Singer, this volume). Further, there is intrinsic chance of genome expression that adds

to the variability of maturational processes. Turning to work on cultural learning, we realize how closely human cognition and intelligence are intertwined with the social and material context in which we develop (e.g., Tomasello, 1999). With the emergence of the ability to select, the developing individual further complicates or better enriches the etiology of brain and cognitive development. Which are the learning contexts the individual selects, and which contexts are avoided? What is the individual's motivational structure? To demonstrate how deeply such personal choices interact with biological processes, consider evidence from research on brain plasticity. Research on brain plasticity suggests, for instance, that a person who opted for and over years pursued a career as a professional string player at the same time affects the structural and functional aspects of her cortical organization. As a result of years of practicing to play a string instrument, the cortical representations of fingers of the left hand were found to be increased (e.g., Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995).

The pervasiveness of epigenetic (e.g., person-specific) processes in human ontogeny has important consequences for developmental methodology. As argued by Molenaar, Huizinga, and Nesselroade (this volume), the conceptually privileged unit of analysis in human ontogeny is the developing individual. However, most of developmental psychology routinely utilizes statistical methods that focus on differences among individuals such as standard longitudinal or cross-sectional factor analysis. Methods with an explicit focus on intraindividual change, such as time-series analysis or dynamic factor analysis, are notoriously underused in psychology. (Note that the situation is somewhat different in lifecourse sociology; cf. Blossfeld, Hamerle, & Mayer, 1991). Specifically, when lifespan researchers use interindividual-difference methods to study within-person change, they tacitly assume that individuals are homogeneous with respect to the number, structure, and relative importance of developmental causes. Available empirical evidence (such as the molecular genetics of epigenesis; cf. McClearn, this volume) and theoretical considerations (such as developmental systems theory; Lerner, Dowling, & Roth, this volume) strongly suggest that the homogeneity assumption is generally incorrect. Under conditions of heterogeneity, however, the structure of interindividual variation as revealed by standard interindividual-difference methods does not yield an approximation of within-person changes. This mismatch between theoretical intentions and research design is likely to go unnoticed in standard applications of interindividual difference methods because they will tend to work properly in a technical sense. Put simply, the best way to find out about the degree of heterogeneity among different developmental systems (that is, different developing individuals) is to study it. As John Nesselroade and others have argued for quite some time (Baltes, Reese, & Nesselroade, 1977; Nesselroade & Bartsch, 1977), formal comparisons of multivariate individual developmental trajectories (cf. Molenaar & Nesselroade, 1998) are ideally suited for this purpose. Molenaar, Huizinga, and Nesselroade (this volume) strengthen this argument through formal simulations, and we hope that their line of reasoning will entice researchers in developmental psychology and in other developmental disciplines to make increased

use of research designs that focus on the observation of change processes within individuals.

Plasticity of Development

Human development is the result of variable and interacting systems of influence and any observable developmental trajectory is but one possible manifestation of a large but not infinite range of alternative trajectories (cf. Tetens, 1777; for a recent review of plasticity, see Li, in press). Thus, for any given individual, at any given age, and for any given psychological dimension, alterations in developmental context carry the potential to funnel developmental trajectories in more or less desired directions. In this context, the notions of plasticity, reserve capacity, and latent potential are used in lifespan psychology to denote the difference between realized and maximum potential. In principle, however, the notion of plasticity also includes deviations in the negative direction. These phenomena and processes related to the maintenance or regaining of levels of functioning under conditions of stress are subsumed under the concept of resilience (e.g., Staudinger, Marsiske & Baltes, 1995).

In this vein, Lerner, Dowling, and Roth (this volume) argue that human development is best understood as a system comprising the person within context. This system consists of subsystems (such as biological organism, cognition, personality, motor performance, family, neighborhood, and nation) that show intra- and intersystemic co-actions. Given this systemic nature, human development demonstrates great plasticity. The plasticity of human development is also pivotal for philosophical anthropology. It is captured there by the notion of world-openness (see Mittelstrass, this volume). But beyond its malleability and variability, philosophical anthropology is also interested in the constants of human development.

A central goal of lifespan psychology is to chart the magnitude of plasticity and the extent to which it covaries with age. Probably the most direct strategy to examine age changes in the range and limits of plasticity is through active experimental intervention (Baltes & Kliegl, 1992). Another strategy is to explore the range and malleability of developmental pathways is the study of "turning points" in naturalistic settings (Caspi, 1998; Magnusson & Stattin, 1998; Rutter, 1996; Staudinger et al., 1995). Finally, a third strategy is to document differences in behavior across cultures or historical time (Flynn, 1987). Despite large differences in method, the common theme of these research strategies is to better understand the nature of human plasticity.

The conceptual emphasis on age changes in plasticity needs to be accompanied by the search for methods that allow for valid and reliable assessment of intraindividual change. Nesselroade and Ghisletta (this volume) present a historical and systematic summary of the measurement and structural representation of change. In line with Molenaar, Huizenga, and Nesselroade (this volume), they invite developmental researchers to move toward more dynamical models for representing developmental change. One of the models they propose in this context, dampenend linear oscillators

(e.g., Boker & Nesselroade, 2001), has its origins in the natural sciences (e.g., physics). The general lesson to be learned is that lifespan psychology may profit from methodological exchange with fields remote in substance but equipped with a rich set of methodological tools for representing change.

The Role of Constraints (Enabling, Disabling) and Opportunity Structures in Lifespan Development

The plasticity of human development is regulated by the properties and interactions of its constituent resources: biology (maturation), culture (learning), and person (action). A first set of constraints, both enabling and disabling, refers to the biological script that governs the life course. During infancy and early childhood, maturation and learning produce a system of enabling constraints that facilitate the acquisition of complex performances. Language development may serve as an example. It has been suggested, on the basis of formal simulations, that young children's short working-memory span may facilitate the acquisition of grammar because it facilitates an initial focus on simple sentences (Elman, 1993). Such a constraint may be called enabling because it fosters ontogenetic development (see also Wellman, this volume).

Enabling constraints are especially prominent early in life but continue to exist throughout the entire life span. With increasing adult age, however, and especially after the end of the reproductive phase, disabling constraints due to senescence become more prominent. As Baltes (1997) poignantly argued, biological sources of development deplete with increasing age. Evolution did not yet have enough time or means to optimize later phases of the lifespan. Consequently, cultural sources have to compensate for this depletion. In this sense, cultural sources of development gain special importance in old age. Plasticity in old age, however, is diminished due to the depletion of resources (not only the biological ones), and consequently the efficiency of cultural compensation is reduced (Baltes, 1997). Age-graded decrements in evolutionary selection benefits in humans and other mammalian species are predicted by disposable soma theory (Kirkwood, 1977, 1997) and antagonistic pleiotropy theory (Williams, 1957). Kirkwood (this volume) summarizes both theories and convincingly argues that they provide a more compelling account of human senescence than rival explanations such as the notion of a programmed death.

Maier and Vaupel (this volume) critically investigate the last tenet of the lifespan architecture—that the efficiency of cultural compensation is reduced—by using the sample case of the extension of longevity and show that during the last 30 to 40 years mortality reductions have been highest at highest ages (that is, 90 or 100 years). Very much in line with lifespan theory, they use the case of gender-specific change in mortality rates to argue for the interaction between biological, evolutionary, and historical forces in supporting survival. Finally, the authors raise the stimulating question of whether the age-related efficiency of culture may vary depending on cultural-historical context rather than show general age-related decline.

Certainly, the biological script is complemented by a sociocultural script. Social opportunity structures and cultural tasks such as the school setting, professional settings, or retirement constrain and enable the range of possible experiences and actions and thus contribute to developmental outcomes. In this sense, the scientific agendas of lifespan psychology and lifecourse sociology are intertwined. Mayer (this volume) suggests that the two research traditions could remedy some of their weaknesses by more exchange. Using the conceptual tools of lifecourse sociology, lifespan psychology could profit from considering the effects of institutional and other forms of socioeconomic regulation on the development, stability, and change of normative orientations at the psychological level of analysis. Conversely, lifespan psychology could help lifecourse sociology in filling "the black box of the actor" by providing concepts that focus on interindividual differences in processes such as control and goal striving, control beliefs, and selective optimization with compensation.

From the perspective of the educational sciences, Köller, Baumert, and Schnabel (this volume) argue that schools represent powerful contexts for cognitive development. Schools are highlighted as environments that place a considerable number of constraints on students' actions. To enhance educational outcomes, the patterns of constraints provided by school contexts should be synchronized with age-graded changes in the students' capabilities and needs.

A third set of constraints on the plasticity of development is "orthogonal" to the biological and cultural constraints and describes three logics according to which biology and culture unfold their enabling and disabling constraints. The first logic is age. Depending on an individual's age, biology and culture have different developmental effects. The second logic is history. And this refers to the fact that depending on historical time, biological and cultural constraints differ. And finally the third logic is person-specific and acknowledges the fact that biological and cultural constraints unfold their interactions in a highly idiosyncratic manner.

For instance, personality traits increase in consistency *with age* and are mostly consistent across adulthood, and yet they retain the capacity for change throughout the adult life course (see Roberts & Caspi, this volume). This proposition is in line with lifespan theory that argues for the dialectic between continuity and change. Evidence is provided for why personality is consistent as well as for why it changes. Identity structure—that is, the *person-specific* logic—is offered as an important link to understand age-related increases in consistency. Considering the historical logic, it has been demonstrated that given certain *historical contexts*, such as the student and peace movement of the 1960s and 1970s, personality development during these times showed changed trajectories (for instance, that autonomy showed earlier peaks; Baltes, Reese, & Nesselroade, 1977).

In her commentary, Labouvie-Vief (this volume) offers still another logic, and that is the logic of gender and how it constrains and enables development. She argues that leaving out gender from a theory of development is usually symptomatic for a number of other deletions. This omission may lead to hosting many dualities of development,

such as gains and losses or cognition and emotion or symbolism and logic, without offering mechanisms of integration.

Regulatory Processes in Human Development: Selection, Optimization, and Compensation (SOC)

Due to the plasticity of human development, models of developmental regulation are of utmost importance to developmental science. Among existing regulatory models, the model of selection, optimization, and compensation (SOC) (Baltes & Baltes, 1990) has been introduced and is described in a number of chapters of this volume as a potent means to describe, explain, and predict developmental regulation in various developmental subsystems ranging from the biological through the psychological to the societal levels of development. Selection is an inextricable part of development. Each developmental step implies that other steps are not taken and thus that selection has taken place. Selection by itself, however, is not enough. After selection, optimization has to take place, and sometimes optimization is possible only through compensation for lost means. In some of the chapters, the interplay between intentional and subintentional processes in developmental regulation is introduced as a fascinating research topic (Cloninger, this volume; Heckhausen, this volume).

Baltes and Baltes (1990) have argued that the three processes of selection, optimization, and compensation are universal almost in the sense of anthropological constants (see Mittelstrass, this volume) but that the combination and content are highly idiosyncratic. M. Baltes and Carstensen (this volume) specify in great detail the three central mechanisms of developmental regulation and their interaction as well as empirical evidence for their contribution to successful aging. Among others, selection, compensation, and optimization are, for instance, discussed as mechanisms promoting continuity as well as change in personality structure across the life span (see Robert & Caspi, this volume). Or aging individuals may be able to protect cognitive performance levels in a given domain of life (such as their professional life) against decreases in innovative solutions by allotting more time to this domain (optimization), at the cost of reducing or eliminating the time allocated to other domains (selection). For instance, Kliegl, Krampe, and Mayr (this volume) discuss possible consequences of differential rates of slowing for various types of cognitive operations from a selection, optimization, and compensation perspective (see also M. Baltes & Carstensen, this volume; Freund, Li, & Baltes, 1999). Specifically, they suggest that aging individuals may be able to protect a given domain of life (such as their professional life) against the decreasing likelihood of coming up with novel solutions by allotting more time to this domain, at the cost of reducing or eliminating the time allocated to other domains.

Gigerenzer (this volume) compares the concept of the adaptive toolbox (Gigerenzer, Todd, & ABC Group, 1999) with the SOC metatheory. Conceived within the general framework of evolutionary psychology, the adaptive toolbox contains a collection of domain-specific heuristics that can function quickly and effectively for solving specific

problems when used in the proper environment. SOC metatheory may help to shed light on the regulation and coordination of this behavioral repertoire.

Alternative models of developmental regulation argue that selection, compensation, and optimization can be subsumed under primary and secondary control (Heckhausen, this volume) or embedded in a model of self-regulation that contrasts two basic processes—goal pursuit and goal adjustment (see Brandtstädter & Rothermund, this volume). From an economist's perspective, Behrman (this volume) argues that the lifespan architecture postulated by P. Baltes (1997) does not distinguish between total and marginal costs and benefits and does not provide a formal algorithm for optimization. In this context, both Behrman (this volume) and Mittelstrass (this volume) insist that selection, compensation, and optimization are interdependent.

Looking Back and Looking Ahead

The search for common conceptual ground in the study of human ontogeny was a main motive for editing this volume. By initiating conceptual exchange between lifespan psychology and other disciplines in the social, behavioral, and life sciences, we hope to enrich lifespan psychology through exchange with other disciplines and to establish a common, transdisciplinary framework for articulating the dynamics between culture and biology in human ontogeny.

In retrospect, it seems to us that the first goal was more realistic than the second. We feel that lifespan psychology has profited considerably from the multifaceted and diverse interrogations by scholars working in the related fields documented in this volume. As for the establishment of a common conceptual framework that transcends disciplinary boundaries, we feel reminded of what Piaget (and others before him) once called "le recul de l'objet": the goal seems to recede as one approaches it. For good reasons, the quest for a transdisciplinary framework about human ontogeny will never come to an end. Rather, discipline-specific innovation and transdisciplinary coordination are equally important, and what matters is to have an open eye for both.

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