PART ONE

SETTING THE STAGE ACROSS THE AGES OF THE LIFESPAN

1

Prologue: Biocultural Co-Constructivism as a Theoretical Metascript

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The main objective of this book is to advance research and theory in the study of brain–culture relationships. Contentwise, our primary arena is the study of human behavior, in general, and human development, in particular. When speaking of human development, we refer to the view that human development is a lifelong process, extending from conception into old age. When we speak of culture in this context, we use it in its most general sense and mean to include all aspects of the environment – physical, material, social, and symbolic.

On the one hand, we note the already existing and recently strengthened connections between researchers and scholars in the neuro, behavioral, social, and cultural sciences that give testimony to a new level of "interdisiplinarity." It is increasingly recognized that such collaborative work, aimed at a more explicit treatment of the brain–culture interface, is necessary to better understand the interactive systems that shape the human mind and its development.

On the other hand, we also suggest that there are lacunae or misunderstandings in recognizing the full reciprocal nature of the brain–culture interaction. One example is the occasionally high emphasis that brain researchers place on brain determinism. A similar one-sidedness exists among some social scientists when they engage themselves in demonstrating the exclusive role of social-cultural environmental conditions. To counteract such lacunae or one-sided perspectives, we introduce a new "metatheoretical" paradigm as a guiding principle. This is the principle of *developmental biocultural co-constructivism*. In principle, it states that brain and culture are in a continuous, interdependent, co-productive transaction and reciprocal determination. This was true for the interplay between genetic and cultural evolution, continues to be true for modern-day human behavior, and applies to all stages of human life from conception to death. In our view, this concept, if accepted and practiced as a guiding theoretical paradigm, will facilitate a deeper recognition of the

brain–culture interface, counteract discipline-bound biases, reduce misunderstandings, and, above all, suggest new lines of inquiry.

In the following, we begin by describing in more detail the background that resulted in this book, as well as why we think that introducing a new concept is helpful in directing the field to the kind of full-fledged collaboration that in our view is necessary to capture the brain–culture dynamic. Then we make an attempt to formalize the co-construction hypothesis at the level of individual learning. By this, we want to explicate how endogenous and exogenous factors co-construct in a highly dynamic manner both the functional-structural architecture of the brain and the environment of an acting organism. We conclude with a characterization of the individual chapters. In describing the chapters, we make an effort to highlight their special contributions to understanding the brain–culture relationship.

BACKGROUND OF THE VOLUME

The origins of this volume lie not only in recent developments signaling a rapprochement among the neurosciences, the behavioral sciences, and the social sciences in the study of behavior in general and human development in specific (Lerner, 2002; Li, 2003; Magnusson, 1996; Tomasello, 1999), but perhaps more significantly in the nature of the public and scientific discussions that arose since the 1990s in connection with new imaging methods to study the brain. The surge of the neurosciences as the foundation of human development appeared to us as so rapid and seductive, especially when presented to the public and in the media, that despite the parallel evolution of collaborative interdisciplinarity, we were faced with a revival of reductionist biological determinism of mind and behavior – this time focused on the brain rather than on genetics. Such an all-too-biology-based determinism was strengthened by the emergence of molecular genetics and associated findings linking specific genes to specific pathologies. For some molecular biologists and brain scientists, genes and brains seemed to hold the potential for unidirectional and all-encompassing causality and determination of mind and behavior.

What seemingly was often overlooked in this debate is that the brain itself is a dependent variable, something that is co-shaped by experience and culture, something that does not operate within an environmental vacuum, but that at any moment is subject to environmental constraints and affordances. The same, of course, applies in principle to modes of thought that place the environment into the driver's seat of development, as some proponents of environmental behaviorism attempted to teach us during the twentieth century.

Certainly, this characterization of the impact of the recent advent of neuroscience is an oversimplification of the intellectual dialectics within the scholarly community. Most certainly, and this is especially true for

researchers with a developmental orientation, whether evolutionary or ontogenetic, there were and are researchers who understand the vexations of the problem, who did not and do not forget the historical lessons learned from the nature–nurture debate, including the extremes of both sides, such as full-blown environmentalism or geneticism, and who do promote in their work the important role that reciprocity and interactional processes – between genes, brain, nonbrain bodily states, experience, behavior, physical environment, and culture – play in the evolution, ontogeny, and production of behavior.

We already mentioned the special role of developmental scholars in the recognition of the reciprocal effects in the nature–nurture and brain–behavior–culture dynamic. This is not surprising. Developmental researchers focus not only on the proximal, but also on the distal antecedents of change (Baltes, Reese, & Nesselroade, 1977); therefore, they are immediately confronted with the question of the interplay between nature and nurture and between brain and culture. On the one hand, in this spirit, the arguments for explicit recognition of reciprocity and interactional processes evolved from groundbreaking work over the last decades in evolutionary theory and the role of cultural evolution (e.g., Durham, 1991; Ehrlich & Feldman, 2003; Jablonka & Lamb, 2001). On the other hand, a similar scientific evolution occurred in the ontogenetic developmental sciences. Here, it was argued that the process of ontogenetic development requires the joint (distal as well as proximal) action of genes, brain, material environment, culture, and behavior (e.g., Baltes, Reese, & Lipsitt, 1980; Baltes & Singer, 2001; Bronfenbrenner & Ceci, 1994; Cole, 1996; Gottlieb, Wahlsten, & Lickliter 1998; Greenfield, 2000; Greenough & Black, 1992; Li, 2003; Magnusson, 1996; Nelson, 2000; Quartz & Sejnowski, 1997; Singer, 2003; Staudinger & Lindenberger, 2003; Tomasello, 1999). The kind of categories used to describe the internal and external forces and dynamics varied, but the thrust of the argument was always similar, namely, to treat the determining system as interactive and reciprocal, over time and across space (context).

Yet, we as editors and organizers of a preparatory conference – although with different degrees of conviction and rationales – believed that, to move the field forward and to not lose the insights of the past, more needed to be done to counteract the seemingly overemphasized position of biological factors, if not of unidirectional biology- or brain-based determinism. Even if our evaluative and chagrined view of the new Zeitgeist was out of proportion, we believed that having another chance to articulate the issues and promote constructive dialogue across theoretical orientations seemed enough reason to bring together brain- and culture-oriented scholars. We were convinced that the new paradigm of human development demanded a full-fledged view of the principles of collaboration between biological and cultural systems.

We hoped for a more firmly based dialogue, not only between the respective scholars and specialized fields, but also in support of the notion that human behavior itself is inherently the outcome of a "dialogue" among and "co-production" of genes, brain, and culture. To achieve such a goal, we also believed that exploring a new concept, if not a new metaphor, would be beneficial. We were looking for a metaphor that would consolidate and solidify the intellectual position that brain, behavior, and culture are a reciprocal and interactive system of influences, mechanisms, and outcomes, with each being affected by the other – in the past, the present, and the future; at all levels of analysis from the molecular to the molar to the social-cultural; and for each of the two major dimensions of human development – the evolutionary and the ontogenetic (Baltes, Lindenberger, & Staudinger, 1998, in press; Baltes & Singer, 2001; Jablonka & Lamb, 2005; Li, 2003). As described in this chapter, our suggestion for such a new metascript, if not metaphor, is the term *biocultural co-constructivism*.

ON THE ROLE OF METAPHORS

Here is the place where a brief detour to the notion of metaphor may be helpful, although we immediately concede that our own choice of metaphor by the criteria of metaphors that follow is not optimal. There is much debate about the specific meaning of metaphors and their varying role in communicating knowledge, generating knowledge, and crystallizing a particular theoretical orientation (Lambourn, 2001); the sum evidence seems to have tilted in the direction of the perspective that metaphors and other language-based, short-hand concepts play a powerful role in the shaping of a field, including (1) the ways in which research questions are asked; (2) how they are conceptualized on a general level of analysis; (3) what and how data are generated; and (4) how results are interpreted, mentally represented, and communicated.

In recent history, the book by Lakoff and Johnson (1980), *Metaphors We Live By*, has become a kind of classic, illustrating the endemic nature of metaphor in everyday understanding, as well as its usefulness in generating and maintaining a given body of knowledge. In psychology, Leary's (1990) work, *Metaphors in the History of Psychology*, is a persuasive example, as is the book by Sternberg (1990) entitled *Metaphors of Mind*: *Conceptions of the Nature of Intelligence*.

What are metaphors? The concept carries a variety of meanings (Lambourn, 2001). One of the seemingly agreed-on commonalities is that metaphors often involve other modes of representation than language, such as visualization. Another is that metaphors involve a process of comparison or a crystallized characterization at a higher level of conception. The "other" used for comparison or characterization can take many forms.

It can be a word or operation from everyday life, a model, or a concept from another field of study. Importantly, metaphors are short-hand for communicating something larger about the ways and means of the object or phenomenon under consideration. "Intelligence functions like a computer" would be an example (see Sternberg, 1990, for other examples). If such a metaphor of intelligence is deemed to be persuasive, research into intelligence is likely to follow the concepts and methods of computer systems and technology. One ensuing example would be to consider intelligence as composed by two components – hardware and software.

In this spirit, we proceeded to ask whether the field under consideration, the study of lifespan human development, or even behavior in general, is remiss in not having the kind of metaphor that would protect us from all-too-simple principles of biology or brain-based determinism. Although the risk of one-sidedness concerns, of course, both sides – the biological-neuronal and the cultural-social – we believed that at the present time, protection against the bias of brain-based unidirectional determinism is the more important goal. To repeat our starting point – the excitement and enthusiasm about the new evidence generated by modern genetics and functional and structural measures of the brain, in which we share, seemed to have pushed many researchers into a position that did not sufficiently reflect the conceptual achievements of the past, namely, the recognition that there are complex and truly reciprocal interactions and influences between genes, brain, behavior, and culture.

FROM INTERACTIONISM OVER CONSTRUCTIVISM TO BIOCULTURAL CO-CONSTRUCTIVISM

For quite a few years now, interactionism has been in style. But how far does this concept take us? The situation in the field linking environmental-cultural to genetic-neurobiological factors is not unlike the conceptual history of the nature–nurture debate (Ehrlich & Feldman, 2003; Lerner, 2002; Singer, 2003). In this instance, researchers introduced the concept of interactionism to highlight that nature and nurture interact in reciprocal ways. Some may think, therefore, that the term interactionism should be sufficient to clarify that nature and nurture, genes and environment, brain and behavior, and brain and culture influence each other. However, for others, although this is definitely a step in the right direction, it may not be sufficient to communicate a state where such interactions alter the factors of nature and nurture themselves.

Thus, in our view the concept of interaction, although pointing in the right direction, is underspecified and not sufficiently robust. Depending on one's conceptual predilection, the meaning of interactionism can be tilted in one way or another. For instance, one often raised question is whether the interactions are conceived of as "weak" or "strong." The more reciprocity,

nonlinearity, and *emergent properties* are involved, the more the conceptual core of interaction is considered as being strong rather than weak. In other words, does the concept of interaction communicate with sufficient clarity that the sources, nature and nurture, are not mere passive and additive recipients of input from each other, but that the developmental outcome is one of shared and *collaborative production*, including *reciprocal modification*, and which under some conditions involves qualitatively new states whose emergence cannot be fully predicted from either of the two sources alone? The emergence of species in biological evolution is one example of a *developmental qualitative innovation*; the emergence of intentionality in human evolution and formal logical thought in cognitive ontogeny of children is another. A further example is the role of "collective memory" systems and their impact in defining human identity and constructions of past history (Assmann, 2006).

As a consequence, we join in the argument that the use of the term "interaction" alone is not sufficient and that additional qualification is necessary. In this spirit, we have witnessed the emergence of additional concepts that credit both genes and cultures, and brain and behavior, with being agents and producers of novel phenomena that are not in the core of the influences themselves. Making this point resulted in espousing notions such as *co-evolution* for the case of evolutionary development and *constructivism* for the case of ontogenesis.

Yet, in discussions with esteemed colleagues, we continued to be impressed that neither concept, co-evolution and constructivism, was sufficiently known across the isles of the forum, nor did they seem to carry with firmness the whole message that we were after, namely, that brain and culture are independent sources and full-fledged partners and reciprocal modifiers. In other words, they not only work together in the production of the brain, behavior, and culture, but they also change, "develop," and influence each other in an ongoing fashion – in the past, the present, and the future. Perhaps we were overly sensitive and not sufficiently cognizant of the state of affairs. However, we believe that it continues to be worthwhile to look for a concept that would not permit priority to be allocated to one or the other, but that by its very nature would give equal standing to both the brain and the environment. Our primary focus is on creating a metaphorical language that would make such perspectives a key and unalterable mode of thinking.

Thus, as we were pondering a title for this book and the possibility of promoting a robust concept for our favored orientation, we deemed three interrelated aspects essential. First, the concept should permit the separate identification of biological and environmental factors as sources of influence. Second, the concept should be unequivocal about the premise that each factor is an independent partner that, in collaboration with the other, produces the brain, the behavior, and the human environment. Third, the

concept should be unequivocal and not permit deviations from the underlying framework, at whatever level of analysis. No term would suffice that would not satisfy these three postulates.

This is a tall order, and we are not necessarily happy with the semantic elegance of the term that emerged. The result was the concept of *"biocultural co-constructivism."* We claim no theoretical originality with this concept. There were and are important forerunners (Durham, 1991; Ehrlich & Feldman, 2003; Gottlieb, Wahlsten, & Lickliter, 1998; Quartz & Sejnowski, 1997; Tomasello, 1999). Moreover, we do not believe that the concept is easily digested or that it represents a new theory. At best, it is a theoretical or metatheoretical orientation. We are also not overly excited about the visualization and memory strength of the metaphor. If, for instance, there is a visualization component in the concept of biocultural co-constructivism, it is language of architecture and construction (see also Baltes, 1997, for a discussion of the concept of the biocultural architecture of the life course). Understanding that nature and nurture have been co-constructing partners of brain, behavior, and culture is an essential component of what we want to communicate as firm knowledge about human development in evolution and ontogeny.

In the spirit of the heuristic role of metaphors, we only argue that having the metaphor of "biocultural co-constructivism" protects us from an unintended bias or even seeming ignorance. The brain itself is the result of such co-construction, as is behavior, as is culture. Of course, similar arguments can be advanced with other concepts. More recently, for instance, we found that Jablonka and Lamb (2005; see also Baltes et al., 1998; Li, 2003) advanced similar lines of thought by focusing on the concept of "levels of analysis" and different forms of "inheritance" (genetic, epigenetic, behavioral, and symbolic) to more fully understand questions of co-evolution and ontogeny. We are fully prepared to accept such alternative forms of making the argument that we assume under the metaphorical concept of biocultural co-constructivism.

CONCEPT OF PLASTICITY AS ILLUSTRATION

In the developmental sciences, there is one concept that has repeatedly spurred the notion of interactionism and reciprocal modifiability. It is the concept of plasticity (e.g., Baltes et al., 1980; Cotman, 1985; Lerner, 1984, Magnusson, 1996). Arguably, plasticity is the concept most emphasized, at least by developmental and cultural scholars, to highlight the momentary and long-term modifiability of brain, behavior, and culture in association with internal and external conditions of life. Among neuroscientists, for instance, one speaks of experience- or learning-dependent brain development, among behavioral and social scientists of the many and rather varied phenotypes that can result from different compositions of factors of nature

and nurture. The concept of epigenetic inheritance, defined, for instance, by Jablonka and Lamb (2001) as "the transmission from one generation to the next of structural and functional variations that do not depend on genetic differences," is another illustration, this one advanced primarily in neurobiological and genetic-anthropological circles. In a similar spirit, comparative cultural and lifespan developmental research conducted by social scientists is assumed to demonstrate the wide range of manifestations that genetically similar, if not identical, individuals can express if living in different cultural contexts, at different stages of life, or in different generations within a given culture (Assmann, 2006; Baltes et al., 1998, 2006; Dannefer, 2003; Schaie, 2005; Settersten, 2005; Valsiner & Lawrence, 1997).

The focus on plasticity, then, highlights the search for the developmental potentialities of brain, behavior, and culture, including their boundary conditions. To prevent a possible misunderstanding, note that plasticity does not refer to complete or arbitrary malleability and constructability of brain, behavior, and culture. Rather, it denotes that behavior is always simultaneously open and constrained (Hagen & Hammerstein, 2005). For developmentalists, the search for the conditions and ranges of plasticity is fundamental to their raison d'être. The concept implies that developmental outcomes are not fixed, but modifiable, and although such modifiability does not necessarily involve each component (genome, brain, behavior, environment), it at least suggests that if modifiability exists, there must be antecedent, correlated, or consequent changes in some of them.

Following are some historical observations. Although in modern times the concept of plasticity seems rooted primarily in neurobiology (e.g., Cotman, 1985; Gottlieb, 1982; Gottlieb et al., 1998; Lerner, 1984; Li, 2003), it has a counterpart place in psychology (e.g., Baltes & Schaie, 1976; Baltes & Singer, 2001; Lindenberger & Baltes, 1999; Tetens, 1777). The meanings attached to the concepts of plasticity are varying. However, the primary emphasis on modifiability and constructability seems to be shared by whatever scientific discipline is using the terms. This meaning of modifiability and constructability can be found in rather early forerunners, predating the fields of evolutionary biology and neuroscience. For Germans, the two-volume work of the philosopher-psychologist Tetens written more than 200 years ago (Tetens, 1777) is the historical masterpiece.

In the following, we explore how the concept of plasticity can be used to present the case of biocultural co-constructivism at a general level of analysis. To this end, we speak of at least three kinds of plasticity: neurobiological, behavioral, and societal or cultural. We suggest that understanding on a general and perhaps metalevel of analysis the existence of these three kinds of plasticity and their dynamic interactions is critical to avoid unnecessary restrictive biases in one direction or the other, and to advancing and explicating the metaphorical notion of biocultural co-constructivism. The

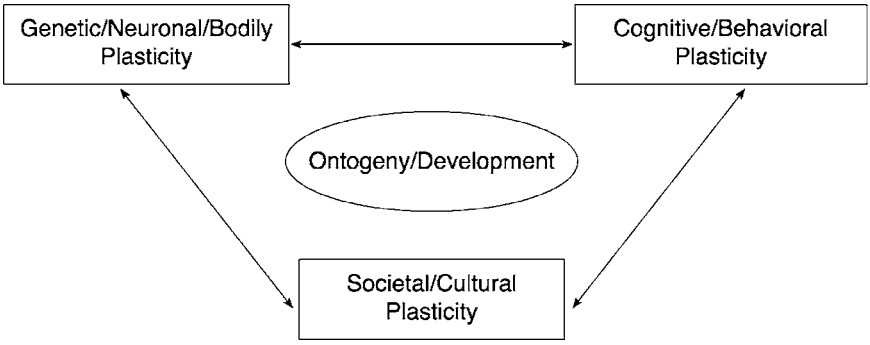

FIGURE 1.1. Biocultural co-constructivism in lifespan development: multidisciplinary concepts of plasticity as foundation (for further explanation, see also Baltes et al., 1998, 2006; Li, 2003).

different kinds of plasticity are interrelated, they are collaborative partners that over time and across contexts co-constructed the evolution and ontogeny of human behavior.

Figure 1.1 summarizes the general approach. Note that the concepts identified are not on the same level of analysis nor do they involve the same phenomena (Li, 2001). Here, the focus is on ontogenesis, that is, individual development from conception to old age. Furthermore, note that the basic assumption for each concept is the occurrence of a designed or naturally occurring change (alteration) in developmental conditions that set the stage and express plasticity, whether biochemical, experiential, physical-environmental, or societal in nature and composition. Such changes in the make-up of the genome and culture, and associated conditions of life and living, are necessary to understand the determining factors of plasticity, at whatever level of analysis. In the conceptual approach outlined here, the study of such changing developmental conditions is always intrinsically tied to changes in the biological, behavioral, and environmental conditions. The challenge is to identify such changes and to interrelate them to capture their joint operation at different levels of analysis and with varying dimensions of proximal and distal causality (Baltes et al., 1998; Li, 2003; Li, Lindenberger, & Sikström, 2001).

If one were to expand this categorization of plasticity in the direction of related "interactive" mechanisms that produce plasticity-based individual and societal development over time, the terms of "inheritance" that evolved within anthropological evolutionary thinking, such as genetic, epigenetic, cultural, and symbolic inheritance (Durham, 1991; Jablonka & Lamb, 2005), would come in handy. The multiple inheritance approach is one way to explicate biocultural co-construction; the use of learning principles would be another, one that appears especially useful for the case of ontogeny.