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Inter-Functionality Between Mind, Biology and Culture: Some Epistemological Issues Concerning Human Psychological Development

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1. Introduction

The relationship between biology and culture, how it changes during the course of ontogenetic development, how it manifests itself and how it should be explained has been a persistent topic in developmental psychology. The conceptualization of the dialectical interactions between biology, mind and culture is crucial for psychological theorizing in general and for establishing a reasonable psychological epistemology. On the basis of recent research and empirical findings in cultural, cognitive and neurosciences, this chapter focuses on how higher psychological functions develop from a biological basis and how the mind and brain change owing to mental and physical activity. The higher psychological functions are humanly constructed when individuals participate in social interaction in a specific culture. The development of higher psychological functions as well as the development of the brain (its function and structure), cannot be explained without focusing on human activity and communication in a particular culture.

The relative weight assigned to nature versus nurture in different historical eras has varied. There are historical periods and recent traditions in which there was no place for any interaction, as if biology and culture were independent entities in terms of human development. The misleading character of such a dichotomous formulation has come to be recognized (Jahoda, 2002). The former sharp distinction between biology and culture is giving way to the recognition of their interrelationship, though its exact nature is still to be clarified and discussed. The inseparability of the two aspects and how we should understand human development as a result of their mutual interdependences is the topic considered in this chapter, which takes historical-cultural psychology as its point of departure.

Greenfield (2002) argues that there are different relations between cultural environment and biological nature in human development (i) Culture reinforces biology; (ii) Culture appropriates biology; (iii) Culture and biology are mutually adapted for survival; (iv) Culture selects from biology (The biological substrate provides the foundation for more than one capacity and the environment can reinforce one capacity more than another, for instance individualism more than interdependence); (v) Culture respects biology (Culture has sets of artifacts and practices that respect and stimulate sensitive times of cognitive and neural

development); (vi) Culture shapes and actualizes biological potential. These relations constitute ways in which culture and biology define and influence each other in development. These relationships make it clear that it is much too simplistic to think of biology on the inside and culture on the outside. The importance of the external culture depends on the internal biological capacity and the culture creep inside and establishes new human nature in brain and in mind.

A developmental perspective has often been lacking in theoretical discussions of biology and culture (Keller, Poortinga & Schölmerich, 2002). The relationships between biology, mind and culture can however only be explained if studied in a developmental and inter-functional, dialectic perspective as something changing and growing. Since this chapter focuses on the epistemology of developmental psychology it starts with a short presentation and a discussion of how humans have been described in recent cognitive psychology; characterized by a focus on humans as a machine and the brain as a computer.

2. The computer metaphor and the machine paradigm

According to popular metaphor, information processing in a human mind is analogous to the information processing that takes place in a computer. This *computer metaphor* has given rise to some basic – often implicit – assumptions (Bender & Beller, 2011; Block, 1995; Norenzayan & Heine, 2005) for instance that the brain's structure is fixed and hardwired. 'Localizationism', the idea that the brain is made up of parts, each of which performs a specific mental function is related to the computer metaphor (Doidge, 2007) but has proven to be misleading. According to Yaroshevsky, Vygotsky revised the traditional conceptions of the localization of psychological functions in the brain. "He rejected the view according to which each function (perception, speech, etc.) is represented by a definite area of the cortex. This view stemmed from the old notion of the independent manifestation of each separate function, of its production by the brain according to the same model as the functions of other body organs, and from the fact that a function is not subject to qualitative changes in its development" (Yaroshevsky, 1989: 257).

Descartes's idea of the brain as a complex machine culminated in our current idea of the brain as a computer and in localizationism. Mainstream psychology has relied heavily on these ideas (Block, 1995). The analogy between a computer and the human brain became fashionable with cognitive psychology in the 1980s and it was strengthened by neuroscience and brain research in the 1990s (the 'decade of the brain').

Psychological universals, or core mental attributes shared by humans everywhere, were also a fundamental postulate of psychology until recently. The 'psychic unity of humankind' holds that, irrespective of their cultural background, all humans have at their disposal the same psychological outfit. This position experienced a huge resurgence with the cognitive revolution which studied the 'inside' of humankind independent of external influence (Miller, 2003). This concentration on internal mental phenomena disregarded external factors with potential influence on psychological processes and up to the end of the twentieth century the potential of culture to affect cognitive processes was widely ignored (Bang et al., 2007; Henrich, Heine & Norenzayan, 2010). There were, however, also some studies on cultural effects in cognitive development by authors with a socio-cultural perspective, such as Barbara Rogoff and Michael Cole, among others.

There are of course similarities in psychological functions and behaviours among human beings independent of their cultural background. (See Norenzayan & Heine, 2005; and Poortinga & Soudjin, 2002 for a discussion of universalism and cultural relativism). Humans are strikingly similar in their genes and some universal behaviour arises from their biological/genetic similarity. Other psychological functions are universal because they are the result of innate, naturally selected, psychological tendencies that emerge everywhere in the same ontogenetic sequence (such as language acquisition; Pinker & Bloom, 1992), or they are cultural byproducts of naturally selected tendencies (such as religion, e.g., Atran & Norenzayan, 2004), or learned responses that serve a useful purpose everywhere, such as counting systems, calendars, writing, trading, and cognitions and behaviours associated with these inventions.

This often unstated assumption of human 'psychic unity' was strengthened by the influence of biology and the focus on instinctive or lower psychological functions also found in other species without language abilities and a complex culture. The biological heritage of psychology presupposes that psychological mechanisms are not only shared by (other) animals, they are also human universals (Norenzayan & Heine, 2005). This seems to justify the widespread habit of exploring psychological processes with selective samples, namely graduate students. If cognitive processes are universal, a North American student should be as good a subject for their exploration as anybody else. This assumption about universalism has however been challenged by recent cultural and cross-cultural research.

Cultural psychology first revealed that all higher psychological functions were influenced and actually created by cultural activity and communication. More recently it has been accepted that cultural tools and cultural practices have powerful influences on brain structures as well. Recurrent, active long-term engagement in a cultural setting can powerfully shape the mind and modify brain pathways (Chiao & Ambady, 2007; Chiao et al., 2010; Fiske, 2009; Han & Northoff, 2008; Kitayama & Park, 2010; Park & Gutches, 2006).

As human beings we develop from a biological organism into cultural people. We are permanently changing, influencing each other and ourselves. Qualities are transformed, reshaped and new patterns or configurations are created all the time, both in the mind and in the brain. Separate elements which intervene create new elements, functions and phenomena and they again influence each other. Old functions or elements, for instance biological instincts, are still part of a human being, but the elements have changed to another form, with another meaning and signification in the mind as well as in the brain. The machine paradigm and the computer metaphor therefore do not offer a relevant frame for understanding how and why humans develops, and it is a significant task for an understanding of human developmental psychology to clarify how biology, culture and mind interact in a dialectical, inter-functional manner.

3. The alternative – The development of mind and brain

Human development is both biological and psychological; one cannot take place without the other. The biological brain is part of human psychology, and if the mind changes and differs from one culture to another, the brain has to change and be different as well. The brain internalizes the impact from its environment within its parameters of innate and developmental constraints. That the mind and brain changes and depend on cultural signs

has been documented in numerous empirical studies since the year 2000. Some of these studies and results will be referred to in this chapter. However, the main aim is to discuss what the new knowledge means for the epistemology of (developmental) psychology. What kind of paradigm is suitable and can incorporate the empirical facts? The epistemological question is to answer on the basis of empirical data, how mind, brain and culture are related, and how the documented interaction, inter-functionality and development can be conceptualized, described and explained.

The machine/computer paradigm is based on Western philosophy and epistemology, emphasizing a simple, deterministic world, focusing on salient objects instead of dialectical relationships. In this Western epistemology there is also a prohibition against contradiction. There is no place for quantitative development to create qualitative changes for new inter-functionality by combining components. Contemporary human sciences have inherited the Western focus on analyzing isolated single elements or variables representing isolated elements. They are knitted together in an additive or interactional way by multivariate statistics and linear mathematics, and this represents a mechanistic way of constituting a human being, not a dialectical or 'organic' way. Humankind as a machine has been not only a metaphor, but a model. Gaining knowledge about complex living organisms by treating them and their context in this way gives distorted knowledge about real human beings and this epistemology has to be rejected.

3.1 Natural sciences as a model for psychology, the importance of the environment, and the principle of inter-functionality

To criticize the machine model and the computer metaphor as paradigm for human psychology does not imply that psychology should not be inspired by (recent) natural sciences. Psychology should not, however, focus on essentialism or universalism if it is to become 'real (natural) science', since most natural 'laws' are dependent on the environment. The structure and functions of the elements and how they relate to each other (their function) cannot be explained without taking the environment into consideration. The combination of Oxygen and Hydrogen has quite different structures (and functions) depending on temperature and pressure. The mixture of the two elements has different states, ice below zero degrees Celsius, water between zero and 100 degrees Celsius, and vapour when the temperature is above 100 degrees Celsius (depending also on the atmospheric pressure). This is an example of a natural phenomenon heavily dependent on the environment. The same is the case for most elements, their structure and functions. Carbon is *coal* with one molecular structure when established in one environment and *diamond* with a totally different structure if established under other environmental circumstances and in another inter-functionality. The same element acquires a unique structure and function owing to the impact of other elements and the environment. It also changes structure and function through time. The human mind and brain are no exceptions in this respect.

Water also illustrates another important fact in nature, that a combination of elements does not have the same properties or qualities as its components. By combining elements with specific functions, the new inter-functionality can become totally different from the functions of its components. This is an example of the inter-functional, dialectical principle of development: when two qualities combine there will not be a simple addition of their

qualities, but often a totally new functionality that cannot be found in their constituents. Water has other properties than the elements of oxygen and hydrogen. Oxygen is necessary for fire and hydrogen is combustible, whereas water is used to extinguish fire. H₂O is an example of a new inter-functionality, with its structure and function also depending on the environment. Human nature also develops in the ontogenesis in this way, establishing a new inter-functionality by combining biological and cultural components, constantly changing structure and functionality owing to physical and mental activity in a specific culture. This is an alternative epistemology of psychological development and more generally a paradigm for understanding human beings and their development.

4. Phylogenetic and ontogenetic development

The phylogenetic development of humans followed the principle of natural evolution. During this evolution humans acquired the *possibility* of speech and thought owing to the increased size of the brain and the voice-tube. These two abilities, language and thought, were combined at a certain stage of development and the language ability combined with thinking initiated a new era for humans: the cultural era, where psychological functions were no longer dependent to the same degree on the lower instinctive reactions. Gradually consciousness developed so that the instinctive biological forces were set aside. The acquired abilities changed human's further development radically.

Evolutionary biologists have for many years wondered why *Homo sapiens* became a new species so different from its animal ancestors. Usually they have looked for anatomical or morphological characteristics, for instance the size of the brain, the functional benefits of bipedalism, or the hand with opposite thumb able to seize. The unique ability to use language and symbolic systems is rarely mentioned. Because of this the relationship between biological and cultural development has not been analysed.

Language and other cultural tools are however a major contribution to human development. No species can accumulate progress across generations as smartly as humans owing, amongst other things, to the invention of written language. We can pass our experiences and transmit information and innovations across time and place to the future generations in a unique way. The *Neanderthals*, in many ways similar to *Homo sapiens* from a biological point of view, did not develop in the same way. They lacked the voice-tube and could not develop spoken language as did *Homo sapiens*. The voice-tube represented an enormous enhancement in flexibility concerning production of sounds and the improvement of communication and was responsible for human beings and the higher psychological functions as we know them today.

What had been a natural evolution of *Homo sapiens* became a cultural evolution for every individual. Human culture influences every individual's psychology and biology (especially the brain), and culture creates higher psychological functions, i.e. human perception, cognition, memory, motivation, emotions etc., all the functions with which psychologists deal.

4.1 Culture

Everybody is born into a specific culture that *cultivates* (from the Latin grow, cultivate) every human being. Culture is a term that has been given many meanings. In 1952, Alfred Kroeber

and Clyde Kluckhohn presented in their article '*Culture: A Critical Review of Concepts and Definitions*' more than 150 definitions and the number has increased since then. There is a general consensus that culture is organized by ideas (Kroeber & Kluckhohn, 1952), either in terms of explicitly shared knowledge, beliefs and values or by implicit or hidden assumptions inscribed in daily practices and institutionalized in routines, conventions, and societal norms (D'Andrade, 1995; Kitayama & Park, 2010; Shweder, 1991).

One might define culture as the shared knowledge, values, norms, morals, beliefs, and practices among a group of people living in geographical proximity who share a history, a language, and cultural identification (Atran et al., Ross, 2005). A more recent definition of culture introduced by social anthropologists is a '*body of background traits that are automatically imprinted and expressed in every individual of a certain culture*' (Vogele & Roepstorff, 2009).

5. Cultural psychology: Culture makes us different

Many studies show that psychological functions or dimensions previously thought to be universal actually vary widely with culture (Cohen, 2001). Cross-cultural and cultural psychology have examined differences in psychological functions and provided accumulating evidence for the diversity of human cognition and behaviour across cultures, including perceptual processing, attention, attribution, motivation, language, number representation and mental calculation. What (and how) we perceive, think and feel actually depend on the culture in which we socialize. It also seeps much deeper into the structures of the mind than previously thought, sometimes bypassing the conscious mind altogether (Cohen, 1997).

From cultural and cross-cultural psychology we know that there are subtle differences in how people process information (Park & Huang, 2010). According to Nisbett and colleagues (2001), Westerners have a tendency to process central objects and organize information via rules and categories. In contrast, East Asians tend to view themselves as part of a larger whole, which results in holistic information-processing in which object and contextual information are jointly encoded.

The cultural dimension of individualism–collectivism has been shown reliably to affect a wide variety of mental processes at a behavioural level, including self-concept, motivation, perception, emotion and cognition (Markus & Kitayama, 1991; Triandis, 1995). Individualism refers to when individuals construe themselves as separate from and independent of each other, whereas collectivism refers to when individuals construe themselves as highly interconnected and defined by their relations and social context. Western cultures place more value on independence and individuality than do Eastern cultures, resulting in an attentional bias toward individual objects in an analytical, context-free manner and with less regard for relationships between items. In contrast, East Asian cultures emphasize interdependent relationships and monitoring of context, relationships and backgrounds (Chua et al., 2005; Nisbett & Miyamoto, 2005), resulting in an attentional bias toward contextual, relational processing of information (Nisbett, 2003; Nisbett & Masuda, 2003; Nisbett et al., 2001). The differences between individualistic and collectivistic cultures, originally studied by Hofstede (1980), are sometimes presented as a dichotomy. Most cultures and therefore also individuals, however, employ a unique blend of

independent and interdependent self-appraisal, which represent a composite mix of the individualistic and collective elements in each culture (Kolstad & Horpestad, 2009).

The human brain is not designed for objective registration. The experience of a sense impression depends on the context, former experiences and expectations. The same sense impression can be explained in different ways, at different times, in different cultures and from person to person. That happens for instance when we are explaining behaviour. The 'fundamental attribution error', the tendency to explain others' behaviour as arising from dispositions (personality) while neglecting situational causality, is more pronounced for Americans than for members of other cultures. South and East Asians, for instance, give more weight to situational forces in explaining the causes of people's actions (Nisbett, 2003).

Cultural experience can exert its effects from early infancy, perhaps even in the womb, as is the case for discriminating speech sounds (Polka & Werker, 1994), and throughout adulthood. Many innate tendencies undergo maturational development and may not emerge at all until later when the child's mind is already fully immersed in and dependent on a cultural environment.

The two decades since the 1990s have witnessed an explosion of research on cultural psychology and exploring cognitive diversity between cultures has become one of the hot topics in the field (Cohen, 2001; Gentner, 2010; Lloyd, 2007). Norenzayan & Heine (2005) have reviewed evidence of cultural influence on the nature of basic psychological processes. They cite the following studies indicating that some phenomena are less evident or appear in significantly divergent forms in other cultures. They include, from cognitive psychology, memory for and categorization of focal colours (Roberson, Davidoff, Davies, & Shapiro, 2004; Roberson, Davies, & Davidoff, 2000), spatial reasoning (Levinson, 1996), certain aspects of category-based inductive reasoning (Bailenson, Shum, Atran, Medin, & Coley, 2002; Medin & Atran, 2004), some perceptual illusions (e.g., Segall, Campbell, & Herskovits, 1963), perceptual habits (e.g., Masuda & Nisbett, 2001), habitual strategies for reasoning and categorization (e.g., Nisbett, Peng, Choi, & Norenzayan, 2001; Norenzayan, in press), the relation between thinking and speaking (e.g., Kim, 2002), and certain aspects of numerical reasoning (Gordon, 2004; K. F. Miller & Paredes, 1996); from judgment and decision making, preferred decisions in the ultimatum game (e.g., Henrich et al., in press) and risk preferences in decision making (Hsee & Weber, 1999); from social and personality psychology, independent self-concepts (e.g., Markus & Kitayama, 1991), the similarity-attraction effect (e.g., Heine & Renshaw, 2002), motivations for uniqueness (e.g., Kim & Markus, 1999), approach-avoidance motivations (e.g., Elliot, Chirkov, Kim, & Sheldon, 2001), the fundamental attribution error (e.g., Choi & Nisbett, 1998; J. G. Miller, 1984; Morris & Peng, 1994; Norenzayan & Nisbett, 2000), self-enhancing motivations (e.g., Heine, Lehman, Markus, & Kitayama, 1999), predilections for violence in response to insults (e.g., Nisbett & Cohen, 1996), high subjective well-being and positive affect (e.g., Diener, Diener, & Diener, 1995; Kitayama, Markus, & Kurokawa, 2000), feelings of control (e.g., Morling, Kitayama, & Miyamoto, 2002), communication styles (e.g., Sanchez-Burks et al., 2003), consistent selfviews (e.g., Suh, 2002), and emotion (e.g., Elfenbein & Ambady, 2002; Mesquita, 2001); from clinical psychology, the prevalence of major depression (Weissman et al., 1996), depression as centered on negative mood (e.g., Kleinman, 1982; Ryder, 2004), social anxiety (Okazaki, 1997), the prevalence of eating disorders such as anorexia nervosa and bulimia (e.g., Lee, 1995), and a number of other indigenous syndromes that have not yet received

much attention in the West (e.g., *agonias* among Azoreans, S. James, 2002; *ataque de nervios* among Latino populations, Liebowitz, Salma'n, Jusino, & Garfinkel, 1994; *hikikomori* among Japanese, Masataka, 2002; and *whakama* among the Maori, Sachdev, 1990); and from developmental psychology, the noun bias in language learning (Tardif, 1996), moral reasoning (e.g., A. B. Cohen & Rozin, 2001; J. G. Miller & Bersoff, 1992; Shweder, Much, Mahapatra, & Park, 1997), the prevalence of different attachment styles (e.g., Grossmann, Grossmann, Spangler, Suess, & Unzer, 1985), and the tumult and violence associated with adolescence, Schlegel & Barry, 1991).

Conclusive evidence for deep cultural impacts not only on cognition and psychological functions (mind), but on the very architecture of the brain is provided by cultural neuroscience (Ambady & Bharucha, 2009; Kitayama & Uskul, 2011). Cultural neuroscience increasingly provides evidence for the assumption that the brain is altered by learning and experience, organized by culture: 'The important message is that social interactions among humans shape neural connections, i.e. the fine-tuning of the brain... these interactions occur at a variety of neurophysiological and behavioural levels and are domain specific' (Keller, 2002: 216).

To the extent that sociocultural practices diverge, so will the psychological functions (Cole, 1996; Vygotsky, 1978), leading to neural specialization of culturally acquired abilities (Polk et al., 2002). How this develops in humans is described below.

6. The development of the brain (its plasticity)

The human brain adapts to what the senses and the mind acquire during socialization in a specific culture. This capacity is known as 'neuroplasticity'. Plasticity is the capacity a substance has to change and to preserve the tracks of an alteration. The brain can change owing to all kinds of influence and it keeps track of the alterations if the stimuli causing them are sufficiently strong or they are repeated enough times. The brain's structure changes according to its use and the impact from the environment. This change may take the form of the growth of new neurons, the creation of new networks and structures, or change within network structures.

This special characteristic allows the brain's estimated 100 billion nerve cells, also called neurons (aka 'grey matter'), to constantly lay down new pathways for neural communication and to rearrange existing ones and adapt to the experiences of the mind. Depending on which tasks are pursued and practised, very different patterns of neural activities are likely to be induced. These neural activities will eventually be over-learned, thus, becoming well connected and automatic. In other words, brain pathways will be modified and neural activities will be culturally patterned as a result (Kitayama & Park, 2010).

Neuroplasticity is not a trait found in a single brain structure, nor does it consist of just one simple type of physical or chemical event. Plasticity works throughout the brain in the normal processes of learning and adaptation. All parts of the brain change, develop and increase its capacity (Doidge, 2007). Production of new connections between neurons in many part of the brain occurs not only in the first few years of life, but also later in life as well. Neurogenesis can continue virtually throughout life in some areas of the brain (Kitayama & Park, 2010).

There is a wealth of evidence that experiences sculpt both brain and behaviour. Recent work in cognitive neuroscience has provided clear evidence that sustained experience changes neural structures. For example, London taxi drivers who engage in sustained route finding show more grey matter in the posterior hippocampus, with the magnitude of the effect increasing with experience, suggesting experience is the causal mechanism (Maguire et al., 2000). Canadian postal workers spend thousands of hours sorting postal codes by letters and numbers jointly, and this experience changes the categorical representation of these two symbolic systems into a single more unitary system (Polk & Farah, 1998). Sustained practice in learning to juggle increases the volume of cortical tissue in the bilateral mid-temporal area and left posterior intraparietal sulcus (Draganski et al., 2004); the effect also generalizes to older adults (Boyke et al., 2008).

In response to a new experience or novel information, neuroplasticity allows either an alteration to the structure of existing connections between neurons, or forms brand-new connections between neurons; the latter leads to an increase in overall synaptic density, whereas the former merely makes existing pathways more efficient or suitable. In either case, the brain is remoulded to take in these new data. The new information or sensory experience is cemented into what seems to be the most useful and efficient location within the massive neurocommunication network. Further repetition of the same information or experience may lead to more modifications in the connections that house it, or an increase in the number of connections that can access it – again, as a result of the amazing plasticity of our brains. New research suggests that, beyond modifying pathways and forming new ones between existing neurons, the human brain is even able to generate entirely new brain *cells* in some parts of the brain.

How it happens that the brain changes and develops its capacity by being used is not the topic of this chapter. It is however much more intricate than establishing new connections between neurons and increase ‘grey matter’. There are electrochemical connections which use electrolytic neurotransmitters more complicated than our simple models and metaphors can describe and explain. We know only a few of the chemical neurotransmitters and do not know in detail how the brain functions and changes its function, working together and interdependently with the mind and supporting the higher psychological functions.

A simple way of illustrating how the brain develops is to say that the connection between the neurons (the synapses) is a sort of road transporting information from one cell to another by means of the electrical current in chemicals. At birth there are certain highways established by the genetic outfit and experiences in the womb. The genes certainly play a role in establishing the brain’s ability to develop and function at birth; the environment and culture become however more and more influential in how the brain and the mind develop. Every day a newborn’s brain is flooded with new information from the environment, grasped by the baby’s sense organs. The neurons are responsible for sending that input to the part of the brain best equipped to handle it. This requires that each neuron ‘knows’ the proper pathways. To make this mental roadmap work, each neuron develops an axon to send information to other brain cells via electrical impulses, and also develops many connections to other neurons so that it can receive information from them. The genes have, at birth, laid down the basic directions for neurons to follow and built major ‘highways’ between the basic areas of the brain. Environmental influence plays a key role in forging a denser and more complex network of interconnections. Short-term exposure to an enriched

environment leads to a striking increase in new synapses (Kempermann et al., 2002). These smaller avenues and side-roads make the transfer of information between neurons more efficient and rich situation-specific detail. This is clearly evidenced by the rapid increase in synaptic density that can be seen in a normally developing human. At birth, each neuron has approximately 2,500 synapses or connections. By the age of two or three, sensory stimulation and environmental experience have taken full advantage of the brain's plasticity; each neuron now boasts around 15,000 synapses (Gopnick et al., 1999). This number will have declined somewhat by the time we enter adulthood, as many of the more ineffective or rarely used connections – formed during the early years, when neuroplasticity is at its peak – are done away with.

The brain plasticity is a well-documented fact, and in the following I present how culture changes the brain's structure and functions.

7. Cultural neuroscience

Cultural neuroscience examines the influence of culture on brain and behaviour and how cultural values, practices and beliefs shape brain function, develops brain structure, and affects the neural architecture (Chiao & Ambady, 2007; Chiao, et al., 2010; Gutchess, et al., 2006). Cultural neuroscience represents a novel empirical approach to the study of interactions between culture and biology by integrating theory and methods from cultural psychology (Kitayama & Cohen, 2007) and neuroscience (Chiao, et al., 2010; Fiske, 2009; Gazzaniga, Ivry & Mangun, 2002; Han & Northoff, 2008).

Cultural psychology and neuroscience might seem to inhabit opposite ends of the scientific spectrum (Ames & Fiske, 2010). They have evolved as separate disciplines but, in reality, cultural values, beliefs, and practices must be important to brain functioning. Culture is, after all, stored in people's brains. The human brain has uniquely evolved to acquire basic cultural capacities, such as language (Chomsky, 1965) and morality (Mikhail, 2007). On the other hand, without the requisite neurobiological capabilities, culture could not function.

Cultural neuroscience is motivated by an intriguing question about human nature: how do cultural traits (e.g. values, beliefs, practices) shape neurobiology (e.g. genetic and neural processes) and behaviour or, more generally, how do we describe and explain the mutual construction of brain, mind and culture, especially from a developmental perspective?

An arsenal of techniques for mapping neural processes to psychological processes has been adopted (Chiao, et al., 2010). Ten years ago, functional magnetic resonance imaging (fMRI) studies were published for the first time in order to investigate the impact of culture on the brain (Phelps et al., 2000). Since then the number of publications using this procedure has increased tremendously. The results have shown how cultural traits may shape the emergence of neurobiological and psychological processes and facilitate complex social experience and higher psychological functions, such as perception and cognition (Chiao et al., 2010).

In a functional magnetic resonance imaging (fMRI) study (Gutchess et al., 2006), Chinese and American participants judged various pictures of objects, backgrounds, and their combinations. Consistent with prior behavioural studies suggesting greater object-focused processing among Westerners, American participants (compared with Chinese participants)

demonstrated stronger and more distributed neural activations during object processing. Specifically, Americans more often recruited the middle temporal gyrus (implicated in semantic knowledge retrieval during object perception; (Martin et al., 1996), right superior temporal/supramarginal gyrus (important for the encoding of spatial information; Aguirre & D'Esposito, 1997; Ungerleider, 1995), and superior parietal lobule (which tracks successful encoding of object locations) (Sommer et al., 2005).

It is reasonable to posit that sustained exposure to a set of cultural experience and behavioural practices will affect neural structure and function (Park & Huang, 2010). The collectivistic and individualistic biases of East Asian and Western cultures, respectively, discussed earlier, also affect neural structure and activity (Chiao et al., 2008; Park & Huang, 2010). People who endorse individualistic cultural values show greater medial prefrontal cortex (MPFC) activation to general self-descriptions, whereas people who endorse collectivistic cultural values show greater MPFC activation to contextual self-descriptions. The results reveal two kinds of neural representations of self (e.g. a general self and a contextual self) within MPFC and demonstrate how cultural values of individualism and collectivism shape these neural representations (Chiao, et al., 2009).

Differences in cognitive processes related to processing information holistically (East Asians) or analytically (Westerners) are also accompanied by differences in brain structure. Cultural variation in preference for social hierarchy also leads to increased engagement of specific brain regions (Cheon, et al., 2011). Different languages create different brains. The brain activity of native English speakers is different from that of native Chinese speakers (Tang et al., 2006). The findings could be attributed to exposures to different visual patterns owing to the visual-spatial nature of the Chinese language and activation of language areas for English speakers.

7.1 Self-representations in the brains

People from different cultures may have divergent perceptions of the self. People from Western cultures tend to value uniqueness and view the self as independent of others, whereas people from South East Asian cultures tend to value social harmony and adherence to group norms and view the self as interconnected and interdependent with others. One of the first social-cultural topics to be explored in neuroscience was how people represent the self (Craik et al., 1999). Across a wide range of studies, including both Western (Kelley et al., 2002) and Eastern (Zhang et al., 2006) participants, an area of the ventral mPFC/anterior cingulate cortex (ACC) appeared to be activated more for thinking about the self than about other people. Given the cultural differences in self-other construal, however, particular differences in Western independent views of the self as distinct from others and Eastern interdependent views of the self as fundamentally related to others (Markus & Kitayama, 1991) also emerge at the level of the brain. This finding (Zhu et al., 2007) supports previous theoretical assertions that Easterners view close others (and their relationships with those close others) as part of the self, whereas Westerners tend to conceive of the self as an independent entity. Representation of self shapes neural activations, making a compelling case for cultural values determining neural function (Kitayama & Park, 2010; Park & Huang, 2010).

In the domain of perception, several studies suggest that Westerners tend to focus on objects whereas East Asians tend to focus on contextual and background information (Hedden et

al., 2008). A similar pattern showing cultural effects on perception and neural activation was found by Gutchess et al. (2006).

Given the evidence described above showing that experiences affect the volume of neural structures and category organization, it is reasonable to posit that sustained exposure to a set of cultural experiences and behavioural practices will affect neural structure and function (Park & Huang, 2010). The discovery of an alteration in the brain's macroscopic structure contradicts the traditionally held view that cortical plasticity is associated with functional rather than anatomical changes (Draganski et al., 2004). Culture's influences on the brain result from participation and engagement in culture's conventions, routines, and socially shared scripts for action (Goh & Park, 2009; Han & Northoff, 2008; Nisbett & Masuda, 2003; Nisbett et al., 2001; Park & Huang, 2010). There is conclusive evidence for deep cultural impacts not only on cognition but on the very architecture of the brain, provided by cultural neuroscience (Ambady & Bharucha, 2009; Kitayama & Uskul, 2011).

All examples of how culture affects the brain are related to higher psychological functions, not lower. The higher functions are developed by experience and activity in a culture. The brain growth increases its capacity for higher psychological functions.

8. Cultural-historical psychology: How culture overrules biology in humans

The cultural-historical tradition in social and developmental psychology was founded by the Russian psychologist Lev Vygotsky in the 1920s. He and his Russian colleague Alexander Luria were impressed, and at the same time dissatisfied, with the 'psychological' research on classical conditioning by their fellow countryman Ivan Pavlov. Although Pavlov's scientific methods were appreciated, Pavlov and other associationists and behaviourists were criticized for not studying the most important subject in psychology: the human mind and consciousness. Pavlov's work was, quite literally, 'thoughtless'. The ancient picture of a human as a being moulded out of soul and body still coloured scientific thought. The alternative solution at which radical reflexologists and behaviourists arrived was simple: they wanted to put an end to consciousness by finding bodily equivalents for it in the organism's reaction to external stimuli. It was assumed that psychology would be able to establish its laws by studying the behaviour of animals: white rats, cats, dogs, monkeys, and so on. Psychology was 'zoologised'. To reveal that animals could be conditioned to learn through associations did not expose anything about the specific and most interesting ability in humans; the capability to think, to use a language, to behave volitionally and to adhere to cultural norms and values. The development of the higher psychological functions acquired in a cultural setting had to be the main topic for understanding human psychology: 'Pavlov's theory stopped short of the higher forms of behaviour, the forms inherent in man the personality, not just man the organism' (Yaroshevsky, 1989: 216).

From recent empirical research in cultural psychology and cultural neuroscience we can conclude that all higher psychological phenomena, including perception, cognition, emotion, memory, self-appraisal, motivation, etc. have a cultural character. They are humanly constructed as individuals participate in social interaction and employ cultural/psychological tools. Brains and mind are shaped by experiences in the culture in which humans develop and live. Culture becomes part of each person's nature, stored in their mind and brain. The (higher) psychological functions are socio-cultural and historical

in origin. The structure of psychological activity – not just content but also the general forms – changes in the course of historical and ontogenetic development. From a phylogenetic point of view ‘...man differs from the adaptation and development of animals because the process of mental development in man is part of the total process of the historical development of humanity’ (Vygotsky, 1997: 39).

Humans are at the same time biological organisms from nature, however, and Vygotsky saw the contradictions between the natural and the cultural as the ‘locomotive’ of the history of the child; he wanted to clarify the dialectics of that history and human development in general. Ontogenetic development can only be understood as the history of behaviour, represented by the development of the higher psychological functions. It was from this position that Vygotsky embarked on the study of ontogenesis. According to Miller (2002: 142), culture is a ‘symbolic medium for human development and participation in this medium is necessary for the emergence of all higher-order psychological processes’.

8.1 Evolution made us for culture

These higher-order functions became a possibility since natural evolution made thinking and language appropriation possible, and because we established human cultures which developed higher psychological functions in each individual whatever culture they were born into (Fiske et al., 1998). When human beings participate in social interactions and employ tools, for instance language and other cultural signs, they develop, construct and create their higher psychological functions, ways of thinking, feeling, remembering, their sensation and perception. These functions are not natural or inborn processes in human adults as they are in animals and human neonates. ‘Most basic is the fact that man not only develops (naturally); he also constructs himself’ (Vygotsky, 1989: 65). Therefore there are qualitative differences between the psyche of humans and that of animals. Unlike animals the key to human’s psychological functions is sociogenesis (the transformation of social relations, through interiorization, into the individual’s psychological functions).

Understanding how biology and culture interact, how this transformation of elementary, biological functions progresses into higher cultural functions, and especially how the relationships between mind, brain and culture develop is an epistemological task focused on the following.

8.2 ‘Second nature’

The young child is a pre-cultural biological organism, which becomes transformed by a series of cultural devices such as language, tools and artefacts into a cultural being and thereby acquires the higher psychological functions. In fact the acculturation starts even earlier since culture is present at conception and also in mothers’ practices, such as her feeding and rest during pregnancy. As Michael Cole has said, the babies are born bathed in amniotic fluid and in culture. At the same time there is no clear dividing line between ‘natural’ and ‘cultural’, especially with regard to the brain. Cultural differences are persistent because our native culture is learned and fastened in our brains. It becomes ‘second nature’ seemingly as ‘natural’ as many of the instincts we were born with. We do not distinguish our ‘second nature’ from our ‘original nature’ since the neuroplastic brain, once rewired, develops a new second nature, every bit as biological as the original (Doidge,

2007). There is no hardwired 'nature' in the brain that last a lifetime. The distinction between nature and culture is not easy to draw on the psychological level either, partly because the cultural becomes natural in the brain's structure.

The tastes our culture creates – in foods, in type of family, in love, in work – often seem 'natural' and obvious, even though they may be acquired tastes. Nonverbal communication – how close we stand to other people, the rhythms and volume of our speech, how long we wait before interrupting conversation – all seem 'natural' to us, because the behaviours are deeply wired into the brain's 'new' nature. When we change cultures, however, we are shocked to learn that these customs are not natural at all but characterize a particular culture (Doidge, 2007).

8.3 Biology and the socio-cultural

Psychology involves and includes natural, biological processes, such as neuronal and hormonal activity, just as it involves breathing air. Just as breathing air is a precondition of psychology which plays no specific determining role in the form, content, mechanisms, and function of psychology, however, so other natural biological processes play no specific determining role either. Their role is analogous to that of breathing. Without breathing, hormones, and the brain, psychological activity would cease; however, with them it is only potentiated, not determined (Ratner, 2011).

The role of biology in psychology and behaviour changes from animals to humans. Biology, instincts and drives determine animal behaviour in natural environments; for human psychological functions and social behaviour biology changes to a potentiating, energizing function. As Ratner (2011: 50) claims 'This is only logical, and it is Darwinian, for we have seen that the fundamental principle of Darwinism is that organismic behaviour is a function of environment. Culture is a radically different environment from nature; therefore cultural behaviour and its mechanisms must be radically different from natural behavioural mechanisms of animals'. The different role played by biology is not a difference in degree between animals and humans, but in principle, as formulated by Vygotsky and Luria (1930/1993: 170): 'behaviour becomes social and cultural not only in its contents [i.e., what we think about] but also in its mechanisms, in its means...A huge inventory of psychological mechanisms -- skills, forms of behaviour, cultural signs and devices -- has evolved in the process of cultural development'.

Biology has lost its determining function in human behaviour. To live in a human constructed culture calls for socially constructed, designed, voluntary, changeable behaviour. Culture determines the form, content, and conditions of behaviour. In contrast, the form, content, and conditions of animal behaviour are determined by natural, biological elements. Elementary, natural mechanisms are antithetical to cultural-psychological mechanisms and features. Biological processes and lower, elementary psychological functions therefore have to recede into the background as a general potentiating substratum of behaviour (Ratner, 2011). The driving forces of biological evolution within the animal world lose their decisive importance as soon as we pass on to the historical development of man. New laws regulating the course of human history which cover the entire process of the material and mental development of human society now take their place (Vygotsky & Luria, 1930/1993). The biological and elementary functions have not disappeared but they have

changed their function and importance as they mingle with higher cultural functions. There is an inter-functionality between the organic maturation and cultural learning which characterize the merging and the development of a child into a culture. Cultural learning and the acquisition of cultural tools involve a fusion with the processes of organic maturation. The two contributions to development – the natural and the cultural – coincide and mingle with one another; they penetrate one another and essentially form a single line of sociobiological formation of the child as a cultural human being, developed from a biological being.

The psychology of humans is not something laid down inside humans by birth, but it is created by activity and communication in a culture. The human mind is therefore socially mediated, or as asserted by Vygotsky, 'Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter-psychological) and the inside the child (intra-psychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All higher functions originate as actual relationships between individuals' (Vygotsky, 1978: 57).

8.4 The lower and the higher psychological functions

Vygotsky distinguished between 'lower' or natural psychological functions and 'higher' or cultural functions. The lower functions are biological mechanisms, such as the blind reactions to stimuli that we see in all animals. They do not involve conscious experience. Over time, these lower functions are transformed, and are controlled by higher 'cultural' functions (Van der Veer & Valsiner, 1991, 1994). There are important distinctions between the lower or elementary functions and higher psychological functions. The latter develop from the former and at the same time change the lower ones to something different, absorbing them into new functions by the principle of developing inter-functionality. The elementary functions do not disappear but are changed (and usually reduced in importance) when combined with cultural components in the human mind and brain.

Higher mental functions are not simply a continuation of elementary functions and are not their mechanical combination but a qualitatively new formation that develops according to completely special laws and is subject to completely different patterns. They actually stimulate neuronal growth in particular directions and create their own biological mediations, restructuring the brain, becoming second nature (Vygotsky, 1986; Wertsch, 2008). This position does not, as we have seen, leave out biological factors or disregard biological influences. Quite the contrary; according to cultural-historical psychology, biological phenomena provide the framework for mental phenomena but do not directly determine them. This leaves psychological activity as something to be built up from, rather than reduced to, a biological substratum. To be human means to have surpassed a level of functioning that the biological traits would otherwise dictate (Van der Veer & van Uzendoorn, 1985). The genetic or instinctive driving forces are overruled by what is acquired during socialization in a particular culture. The number of human activities under biological control is greatly reduced in comparison with animals. Conscious behaviour is only possible if the elementary lower functions are set aside from their original function. Psychological phenomena, including perception, cognition, emotion, memory, motivation, personality, and identity are humanly constructed when individuals participate in social interaction. The most peculiar aspect of humans compared with other living species is that

humans are created by a culture that they have created. Their higher psychological functions are acquired in a human culture using symbols and signs (language).

The elementary natural processes operate in different ways from cultural conscious processes and therefore the former cannot govern the latter. They do not even serve as the basis of the latter. The lower or elementary natural processes are actually inimical to cultural conscious processes since they are automatic, mechanical, involuntary, physical processes; which directly impel non-volitional, unconscious behaviour. The division of the presocial, lower (natural) functions from the higher (cultural) ones illustrates the difference between animal and human and defines the human psyche as a special system for conscious, volitional regulation of the behaviour of the human organism whose individual development (unlike the organism of the animal) integrates the biological and the socio-cultural.

Natural processes operate in hummingbirds, for example. to automatically impel them to fly toward red-coloured flowers; or they impel male dogs involuntarily and mechanically to mount and mate with a female dog that emits a particular scent during the fertile period. Hummingbirds and dogs do not think about what they are doing, they cannot control it, they cannot plan it or imagine it, or remember (relive) it in specific detail; they do not appreciate the object of their behaviour, as a human male appreciates his sexual partner or appreciates a beautiful sunset or painting. This is why elementary natural processes cannot determine psychology in the same way that they determine behaviour of birds and dogs (Ratner, 2011).

The lower psychological functions, those automatic, instinctive kinds of behaviour are automatic and not controlled by consciousness. To be a human, however, means to reduce the automatic, instinctive behaviour and become a conscious being, able to decide, choose, and think with language as a cultural and psychological tool. Humans' higher psychological functions, their language and thinking, have to be the core of human psychology. Scientific psychology cannot ignore the volitional and conscious mind. It has to be a significant topic in psychology.

'Freud, following Darwin, also divided the brain into 'lower' parts that we share with animals, and that process our brute animal instincts, and 'higher' parts that are uniquely human' (Doidge, 2007: 297). Freud believed that civilization rests on the partial inhibition of lower functions such as sexual and aggressive instincts. He also believed we could go too far in repressing our instincts, leading us to develop neuroses (Doidge, 2007).

The new developments in cultural psychology and cultural neuroscience and the technological advances that make mapping of brain cell activity and brain structure possible are extending interest in higher-order psychological functions. Cultural psychology is highlighting the role of cultural meanings and practices in completing the self and in effecting the form of basic psychological processes (Miller, 2002).

8.5 A social relation is translated into a psychological one

When human beings participate in social interactions they develop, construct and create their psychological substance, ways of thinking, feeling, remembering, their sensation and perception, etc. In this way culture becomes part of a person's nature. The socio-cultural

environment created by humans develops higher psychological functions. If, however, human psychology is socially and cultural determined, does this mean that the individual is reduced to an automaton that passively receives social influences and that psychological functions are simple projections of socio-cultural relations? Quite the contrary: 'The child begins to see the external world not simply with his eye as a perceiving and conducting apparatus - the child sees with all of his previous experience...' (Vygotsky & Luria, 1930/1993: 148). The higher psychological functions, based on psychological or cultural tools, are created by the individual in cultural/social interaction and communication. They are acquired in an active and creative manner in the historical and cultural context and are unique to every individual, depending alike on genetic features, lower psychological functions and socio-cultural experience.

How does this transformation happen? How does reflex attention become volitional? How does mechanical memory become logical, conditioned action conscious and volitional? How is the socio-cultural experience translated into something psychological inside every individual? The principle of interiorization or transference of the external into the internal has to be explained in more detail. The question is how the psychological function, originally a social function, is mediated by a cultural sign and becomes intra-psychical (Yaroshevsky, 1989).

Vygotsky often quotes Marx's dictum: "Peter only establishes his own identity as a man by first comparing himself with Paul as a being of like kind" (Marx, 1978: 61). The real story of the individual in the story about Peter and Paul lies in transferring a social relation (a relation between men) into a psychological one (within the individual). Personality as a reality does not exist "in itself" from the beginning. Personality emerges only through the individual "revealing to others his own in himself". Accordingly, personality development, which can be called cultural development of the individual psyche, emerges from collective life, and from the processes taking place there. The basis of these processes is interaction between people.

The development of mind and other psychological functions involves the overcoming of two forms of reductionism: biological (which sees development as the maturing of an organism) and sociological (which reduces development to the 'appropriation' by the child of socio-cultural characteristics. As regards sociological reductionism, it completely ignores the proper inner logic of the transformations which a child's inner life goes through with the changes of the 'seasons of life' (Yaroshevsky, 1989: 277).

8.6 Signs, words and language

Cultural signs as a psychological tool are important elements in the stimulus-reaction connection for humans. This tool has become the principal instrument for transforming elementary functions into higher ones. Originally, though, it was used in communication, direct and open communication between individuals. Higher psychological functions are therefore just as cultural as they are social in origin. Each higher psychological function, appears twice: first in communication between humans, and only then does it 'move inside' (is interiorized), becoming the subject's property and inalienable from him/her.

Vygotsky said that the greatest drama of development was played out in the very first words of a child - the conflict between the natural and the socio-historical. Penetration of

the plot of that drama and its motive forces led Vygotsky to his principal theory – the theory of the development of the higher psychological functions (Yaroshevsky, 1989). Language is the most important sign. The hallmark of humans is our capacity to learn and use psychological tools like language.

From the very beginning a child is led along the path of psychological development by adults. Communication serves as a necessary condition for each new turn of a child's thought. Communication assumes understanding, and the instrument of understanding is the word. The word's 'adult' meaning, however, cannot be poured into the head of a little child together with the sign of the language; the word's meaning will change during development and new words or concepts develop our understanding and enter into new connections, and our knowledge and understanding increase with the relation the word enters into.

The tools for the mind, for example language, are also changing the brain's function and structure. The tools are situated in and belong to the culture, and they are internalized and become psychological tools during socialization. People in different cultures, with different tools such as different languages also have different higher psychological functions, and different perceptions, motivations, emotions, and cognitions, in short everything that psychologists are interested in.

The architecture of the neurosystem changes fundamentally with the inclusion of symbols and signs in the mental organization. The brain has to follow this development of the mind using more words and concepts, acquired in communications with others, and has to change its structure and function to represent the communication experiences and the mind. When we learn to read and write our functional cognitive architecture changes and mental functions are reorganized.

Language is not created by the subject. It exists independently of it. The task with which the subject is concerned is the use of a ready-made sign system (not one she/he creates on his own) in communication, cognition or action in the surrounding world. We often hear that 'language is a tool of thought'. This is a familiar expression among psychologists but language is much more than a tool for thought. The word also has a volitional function. Humans' locomotive apparatus is subordinate to it. The word has power over the real actions of humans' bodily structure and their psychological functions (Yaroshevsky, 1989).

8.7 Final considerations: Hegel's dialectic and inter-functionality: A systemic approach

As described above the inter-functionalities of the lower and higher psychological functions are related in a dialectical way. With the appearance of psychological functions of a higher order, the lower functions are transformed, becoming elements of a new fusion and being retained in a sublated form. The sublation can be conceived in Hegelian fashion as a dialectical transformation. 'Lower' instincts and higher cognitive cerebral parts of the brain and the mind create a new inter-functionality and are the source of development of the 'lower' instincts.

Another important aspect of the higher psychological functions is their systemic character. They do not function separately but form an articulate whole. Each of them can therefore be

scientifically explained only if the dynamics of its interrelations with the other functions are considered. On the other hand, psychological functions are not a separate homogeneous form of consciousness, such as perception, thinking, imagination or will. The study of the psyche must therefore be focused on the system of functions as a whole rather than on one separate function tied to a separate centre in the brain. The psyche is a functional system that should be grasped in its development, which acquires a socio-historical character in the transition from the animal organism to the human one.

The study of how biologically determined elementary functions in a child operating with such a tool as language are transformed into higher functions is a central topic in developmental psychology: it can explain how a biological organism becomes conscious and volitional. Cultural historical psychology represents a dialectical and inter-functional understanding of human development. It focuses on how humans' higher psychological functions are created and how they relate to lower functions (biology) and the cultural context. Why these interrelations are crucial for an understanding of human development and the analysis of developmental processes allows us to understand the interaction between biological predispositions and environmental information with respect to the initiation of culturally informed developmental pathways (Keller, 2002). The biological heritage and the cultural present are components of the same developmental processes.

In mainstream psychology there is no place for dialectical thinking, inter-functionality and contradictions. The deterministic, non-dialectical way of thinking is a typical Western way of reasoning, emphasizing a simple, deterministic world, and focusing on salient objects instead of dialectical relationships and the whole or totality. In Western epistemology there is a prohibition against contradictions. There is no place for quantitative development to create qualitative changes and new inter-functionality by combining components. Contemporary psychology has inherited the Western focus on analyzing isolated single elements or variables representing isolated elements. They are knitted together in a mechanical, additive or interactional way by multivariate statistics and linear mathematics. This represents a mechanistic way of constituting a human being, not a dialectical or systemic way. Humans have to be understood by a systemic, dialectical paradigm more than a mechanical and analytic epistemology.

The cultural-historical approach to psychology is fundamentally *systemic*. That means a simultaneous search for (i) elements of a structure, (ii) relationships and emerging wholes, (iii) development. The cultural-historical approach seeks for unified understanding of the human culturally shaped mind as a semiotically mediated functional system. Different levels of explanation must be dealt with in explicit complementary relationships and the unified understanding at each level of explanation has to be related to the systemic properties of a whole. No analytic study can make sense unless conducted with an understanding of the place each element has in a whole. The cultural-historical approach seeks understanding of the mind from biological, psychological and socio-cultural perspective simultaneously.

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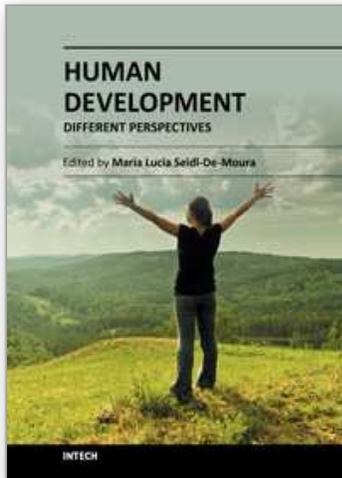
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Human development has different meanings depending on the area we focus on. To the psychologists it is the ontogenetic process of individual development. It considers systematic psychological changes that occur in human beings over the course of their life span. To sociologists and economists, among others, the main consideration is the macro-level of countries or regions and their development conditions related to human needs. Our book has two parts. The first one is entitled "Development in the ontogenesis" and it consists of three chapters whilst the second is "Human development: contextual factors", also including 3 chapters. Together, the two parts give the readers a panoramic view of very complex subjects and complement each other. Researchers of ontogenetic development cannot ignore that contextual factors are the basis of this process. On the other hand, social scientists worried about the macro variables need to remember that they are dealing with people, who are affected one way or another by those variables and whose development is the product of biology and culture.

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