

The Epistemology of Human Psychological Development

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Abstract- This article deals with some fundamental epistemological problems in psychology; especially connected to how the relationship between biology, psychology and culture may be described and explained. Theories explaining human development have to reflect the biological, psychological and cultural reality and specify the functional relationships between the various aspects during lifespan. The relationships between person and environment and between mind and brain have been recurrent questions in psychological epistemology. In recent years different proposals have been introduced to overcome the epistemological problems concerning these relationships and there are more models that integrate the contradictory positions. Some of the alternatives are presented in the article.

Keywords- *Mind; Brain; Culture; Systems Theory; Emergence*

I. INTRODUCTION

The inter-functional relationships between mind, brain and culture, how it changes during the course of ontogenetic development and how it manifests itself has been a persistent topic in philosophy and psychology for centuries [1]. There is a range of perspectives and paradigms describing the interface of biology and culture, culture and mind, and mind and brain. This has led to numerous meta-perspectives that try to accommodate the entire range of contributing levels. But there is no cohesive and accepted theory that addresses the inter-functionality between all levels. This paper presents and discusses a variety of different epistemological perspectives.

The conceptualization of the dialectical interactions between the contributing building blocks, mind, brain 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- and cognitive psychology and in neurosciences it is good reasons for claiming that higher psychological functions develop from a biological/genetic basis and that these functions change owing to mental and physical activity in a specific culture. Higher psychological functions are humanly constructed when individuals participate in social interaction and in cultural activity and acquire cultural characteristics. 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.

Human beings' psychological functions therefore depend on cultural artifacts and the humanized environment. Humans change themselves through changing their environment and adapting themselves to it. "There is a circular and historical causality between human beings and their environment. In this sense we are the most self-domesticated animals." [2: p. 334]. Lev Vygotsky also suggests that one's autonomy or self-determination consists not only in the self-control, but also in the capacity to control one's own environment, which recursively change one-self and that human psychological functions are realized in the loops between the individual and the humanized environment [3].

The importance of culture and cultural differences for most psychological functions has not been considered by mainstream psychological research until recently. Psychological universals, or core mental attributes shared by humans everywhere, have been a fundamental postulate of mainstream psychology. 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 [4]. 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 the environment or culture to affect psychological processes and the brain was widely ignored [5, 6]. 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 behaviors among human beings independent of their cultural background [7, 8]. 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 [9]); or they are cultural byproducts of naturally selected tendencies (such as religion [10]), or learned responses that serve a useful purpose everywhere, such as counting systems, calendars, writing, trading, and cognitions and behaviors associated with these inventions.

The 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 [7]. This seems to justify the widespread habit of exploring psychological processes with selective samples, namely graduate students at Western universities. According to Jeffrey Jensen Arnett conventional psychology has focused too narrowly on psychological characteristics among university students in the West [11]. They have been used as experimental subjects and the other 95% of the world’s population has been neglected. In this way the cultural context has been ignored. 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 and it cannot be justified any longer to assume that a theory developed on the basis of research on a tiny proportion of the world’s population can “apply to all of humanity”. It has been a grave error to import Western-based theories and results into other cultures in the world and assume that they were based on “laws” that applied equally well to all peoples [11].

Current research in cultural and cross-cultural psychology documents for instance numerous East-West psychological differences [12]. Culture is composed of cross-generationally transmitted values and associated behavioral patterns (i.e., practices). Most mind-brain-culture models are hypothesizing that the brain serves as a crucial site that accumulates effects of cultural experience, insofar as neural connectivity is likely modified through sustained engagement in cultural practices. Thus, culture is making the mind and the brain. On this basis recent research and models dealing with culture, mind, and the brain are discussed in the following.

II. INTEGRATING CULTURAL AND BIOLOGICAL PERSPECTIVES

Contemporary psychology is still concerned with the nature – nurture debate and how biology and culture are related. The history of psychology bears witness to the same epistemological conflicts we can see today. Metaphorically speaking, two associated pendulums, one swinging back and forth from nature to nurture and the other from brain to mind, have been running the clocks of developmental and cognitive inquiries for centuries. Most professionals today will agree that culture, mind and brain are related to one another. How this relation or inter-functionality happens and what are the characteristics are however still controversial and not revealed in any detail in mainstream psychology. The integration of biological and cultural perspectives should be a main topic for current psychological epistemology in order to prevent that they are presented as mutually exclusive explanations that are each sufficient in themselves [13].

The specific interpretation of the empirical evidence of relationship between mind, brain and culture is colored by a general view on the nature of the human species and especially the importance of the genetic outfit and culture respectively. The epistemology of human development therefore depends on a scientific paradigm, a philosophical and a theoretical orientation together with the associated methodology. The epistemological approach has to do with how human beings and their development are understood, described and explained. This is a theoretical question, not an empirical or methodological issue.

The cultural impact has since Lev Vygotsky and Alexander Luria established the cultural-historical approach been looked upon by cultural psychologist as crucial for an understanding of the higher psychological functions in humans [14]. Joan Miller’s point of departure is for instance “that culture serves as a symbolic medium for human development and that participation in culture is necessary for the emergence of all higher-order psychological processes. This position is unassailable in so far as a human environment is an absolute condition for human development” [13].

Contemporary psychology can be approached more critically if the science itself is studied in its development and with references to relevant theories and epistemologies from earlier periods. For the time being the problem in psychology dealing with the relation between the individual and culture is primarily a conceptual and theoretical challenge and only secondarily an empirical question [15]. Theories explaining human development have to reflect the biological, psychological and cultural reality and specify the functional relationships between the various aspects during lifespan [16]. Scientific facts are to a certain degree social constructions changing during history. As social constructed facts they are laden with social, cultural, and historical presuppositions and biases. This involves that truth and reality are themselves socially constructed [17].

III. HUMAN PSYCHOLOGICAL DEVELOPMENT

Development, continuity and change characterize human beings both phylogenetic and ontogenetic. *Homo sapiens* has changed over the evolutionary past, and each individual is developing during the ontogenesis. There is also a microgenetic change. To study change and development is therefore a prerequisite for understanding and explaining human beings. In psychology the emphasis is on ontogenetic change, i.e. the lifespan or the life history of the individual person. During the course of ontogenetic development the mind and the nervous system changes due to activity and communication in a culture and resulting in qualitatively new psychological and brain functions. The changes in the body (brain) and mind is related to external cultural impact as well as internal processes under the influence of regulatory genes. The interaction between various processes is not exclusively genetically determined. There is evidence that environmental events may influence regulatory, genetic processes [16, 18].

The development of human beings is much more intricate than following a deterministic causality, either genetic or

environmental. Genes form the starting point of embryogenesis and that the process of embryogenesis itself creates the conditions under which the organism's body plan comes about. Simply said, genes may code for the production of certain tissue, but once that tissue is formed, it may cause other tissues to develop, or it may cause certain genes to turn on or off. This basic idea, that the form of the body is literally constructed by the construction process itself – and is not specified in some pre-existing full instruction set, design or building plan – is known under the term epigenesis [19].

The genetic outfit is affected both by physical and symbolic environment created to a certain degree by humans (e.g. cultural creations such as writing, meaningful objects such as churches, traffic signs, cars, to name a few) [20]. What are cultural achievements appear however to human beings in their ontogenesis as if coming 'from outside', and socialization consists of an individual's appropriation of these cultural achievements in the course of their development or 'culturalization'. An individual internalizes externally given, culturally defined languages and rules of behavior, norms and values, and these cultural tools become part of the higher psychological outfit. This view was primarily introduced to psychology by Lev Vygotsky [21], and following Vygotsky different studies in cultural-historical or developmental psychology have demonstrated the close connection between sociocultural environment and cognitive development [22, 23]. Vygotsky conceived the history of behaviour as "a history of the development of the higher psychological functions". That was the title of his monograph from 1931 [24].

IV. FROM BIOLOGICAL ORGANISM TO A CULTURAL INDIVIDUAL

As human beings we develop from a biological organism into cultural individuals. We are permanently changing, and developing personal abilities and functions. 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 due to cultural impact, with another meaning and signification in the mind as well as in the brain. New concepts and activity develop our mind and understanding and due to the brain plasticity this also changes the brain by establishing new connections (synapses) between neurons. Even if psychological sensations and experiences are dealt with in the brain and activating electric connections between neurons, psychological functions cannot be reduced to electric impulses in the brain. There is a complex interrelation between the functioning of the biological brain and the psychological mind, both depending on culture.

Ontogenetic development is not solely change and alteration. It is also about continuity and conservation. All development in humans is at the same time characterized by a certain form of adjustment and stability. Earlier developments on domains of social-emotional as well as cognitive functioning, for instance "IQ", have systematic effects on later performance. The development of the language ability is an example of how the psychology and development is iterative and depending on the preceding state [19]. The concept of personality is also rooted in consistencies of reactions across time and situations. From some temperamental rudiments every individual acquire a personality from early age and even if there are changes during the lifetime there is at the same time constancy and persistence. There is also continuity in terms of the perception of the *self*, and of personal identity [16].

The words mean different things at different ages and with altered experiences. The words enter into new connections and our knowledge and understanding changes in accordance. The brain has to adapt to the elaboration of the mind and change its structure and function to represent the altering and developing mind. The brain can also change its structure and function without any conscious mind change. Experimental results have shown that even in case when presented information does not get into consciousness, it nevertheless can be successfully processed by brain and change brain structure. Thus, there is a consequence that logic of brain performance and logic of consciousness performance are different [25].

V. THE INTERFACE OF BIOLOGY, MIND AND CULTURE IN A DEVELOPMENTAL PERSPECTIVE

There is a range of perspectives and paradigms describing the interface of biology, mind and culture when dealing with human development. This has led to meta-perspectives that try to accommodate the entire range of levels from phylogenetic and ontogenetic to situational or microgenetic adjustments. But there is no cohesive theory that addresses concerns arising from all levels. "The main thrust of the argument is," as formulated by Keller et al., "that the three concepts of ontogenetic development, culture and biology are all related to one another. Even though the culture-development relationship and the biology-development relationship have received more attention in the literature than the biology-culture relationship, no single relationship is a priori more important than any other" [16: 399].

Developmental psychology has long maintained links to both biology and culture. Most often, however, human development has been presented as an either or phenomenon and developmental psychologists can be counted as belonging to one of two camps, one focusing on mind and culture the other focusing on brain and biology [16]. It is however pivotal to understand the interplay between mind, brain, culture and biology when dealing with ontogenetic development as an interactional processes between organism and the social, cultural and natural environment. The development is rooted in the biological makeup of the human species, including the elementary or lower psychological functions like instincts, reflexes and drives which humans share with other animals. This genetic or biological makeup is the starting point for every individual. But

during the ontological development these forces or potencies are converted to something else when affected by the environment and cultural forces. They develop in a dialectical or inter-functional manner and lose their significance as the guiding forces for human beings. The development is in this process changing from a Darwinian process to a cultural crated process, portrayed by Michael Cole in this way: “In so far as it is dominated by phylogenetic influences, development is a Darwinian process of natural selection operating on the random variation of genetic combinations created at conception. In acquiring culture (and especially, as both Piaget and Vygotsky emphasize, with the acquisition of culture’s most flexible form, language), culture becomes a ‘second nature’ which makes development a goal-directed process in a way in which phylogenetic change is not” [26]. According to Cole human beings are hybrids: “This hybrid nature is central to the process of postnatal development in a way that is not true before birth. Understanding this hybridity is, I suggest, necessary in order to understand if and how the principles of development change once children leave the womb and are precipitated into the social group” [27]. The “hybrid nature” is characterised by the contribution to human development from both nature (genes) and the environment (culture). This starts actually before birth. The impact from the environment and culture on the brain and the mind increases however dramatically after birth.

VI. PERSON - ENVIRONMENT, MIND - BRAIN, HOLISM - DUALISM

The relationships between person and environment and between mind and brain have been recurrent questions in psychological epistemology. The solution and claims has often been one of the two extreme positions: holism and dualism. Both positions pose major epistemological problems. Radical holism proposes an inseparable person/environment and also mind/brain unit. As a consequence, it does not enable thinking in terms of relationships or causation. Dualism, however, posits the radical, exclusive separation of the person and the environment and the mind and the brain which makes it difficult to consider interactions between the two elements and disregards their mutual interdependency.

In recent years different proposals have been introduced to overcome the epistemological problems concerning these relationships. There are more models that integrate the contradictory positions. Some of the alternatives will be presented in the following:

- Inclusive separation
- Systems theory
- Dynamic Systems Approach
- Bio-cultural co-constructivism
- Downward causation and emergence
- Supervenience and deductive irreducibility
- “Extended mind”

A. *Inclusive Separation - Relationship between Person and Environment*

Jaen Valsiner introduced the concept of ‘*inclusive separation*’ where the shortcomings of dualism are eliminated *a priori* [28]. In his model the person and the environment are *both separate and united*. The separation makes it possible to study their actual relationship as a process. The notion of unity becomes explicitly available for study, since the duality of the person-environment structure entails both unity and separation. Differentiation of the person and the environment makes it on the other hand possible to study the ways in which they are interdependent.

Duality, co-presence and relation of differentiated parts that function within the same whole are not dualism according to Valsiner. It is a form of *systemic organization* [28]. He contrasts the person and the environment on a conceptual or analytical level, and relates them on a functional level as interdependent. He thus avoids the problems of both extreme holism and extreme dualism. The relationship between the person and the environment becomes the primary investigative focus. Several issues remain to be addressed in Valsiner’s ‘*inclusive separation*’ suggestion. It has for instance been asked what the methodological consequences will be of positing both ‘unity’ and ‘separation’ and their mutual relation [20]. And how ‘environment’ and ‘person’ can be captured independently of each other? It is also a problem to think about processes between the person and the environment as dependent and independent at the same time [20]. This way of thinking requires a dialectical approach, something not common in Western philosophy and science. The intricate descriptions necessary for this kind of approach and methodology demonstrate the problems involved in expressing a dialectical process in Western language. Western science and philosophy is much more suited to characterizing linear development with cause and effect and either/or than to describe contradictions, dialectical interactions or inter-functionality as they occur over time.

B. *Systems Theory. Luhmann’s Version*

Some scholars have pointed to systems theory and dynamic systems approach (see next section) as a solution of the holism/dualism problem and how units are independent and related at the same time. Systems theory is fundamentally a developmental approach that describes and explains how a certain system evolves from one state to the next. The position fits well with the claims made by Jaen Valsiner and his ‘*inclusive separation*’ (see above) for a development-oriented psychology [29].

According to Thommen and Wettstein (2010) there are some theoretical and conceptual propositions in systems theory which could help to solve some of the problems dealing with dependence and independence in a dialectical manner [20]. They present a conceptualizing of the person–environment relationship, based primarily on Niklas Luhmann’s version of systems theory [30]. According to Luhmann, a human being is not a single homogeneous system but consists of different biological and psychological systems: brain and mind. Theoretical statements refer to both systems with their specific mode of operation. For each type of system (e.g. psychological), the other system (e.g. biological) forms its environment, and they evolve together (co-evolution). The biological brain is the environment for the mind, and vice versa.

Systems theories strongly emphasize on processes as a crucial characteristic of all systems, human beings as well. The dualism of structure versus function mirrors a classic polarity between static and dynamic world views which brought about far-reaching controversies even among the ancient Greek philosophers. For Luhmann, the structure of a system consists of a constant, recurring series of events and by positing structures as regular patterns of processes occurring in time, he overcomes the dualism of structure and function. Luhmann’s conception is to some extent compatible with the theory of Vygotsky [31], who posited psychological structure as a collection and series of psychological operations [20].

Humans are capable of developing representations of their environment (culture) and themselves through their semiotic processes. This capacity differentiates psychological systems qualitatively from biological systems. Luhmann defines the ability to reflect and represent the environment and culture by semiotic tools as *consciousness* [30]. Consciousness is linked to communication processes and has developed parallel to the development of the neural system (the big brain) and to social/cultural development. Language, the medium for communication, is the most important link between psychological and social/cultural systems. According to Luhmann, social/cultural systems are ‘nothing but communications’ and the communicative processes are constitutive of a social/cultural system. Language is a powerful medium for semiotic and communicative processes and it has a central function in all human and cultural systems.

Based on Luhmann’s systems theory and its implications for modern psychology, Maslov analyzes the relationship between human, environment, and culture [32]. To distinguish three types of systems (biological (brain), psychological (mind), and social (culture)) that function autonomously, is not sufficient. What is needed is to clarify how the three systems: mind, brain and culture function interdependently due to their structural connections. For example, psychological functions are dependent on bio-physiological conditions, since neural systems make cognitive, emotional and motivational processes possible. But psychological functions cannot be reduced to biological functions, nor are they determined 100 percent by them. Likewise, psychological processes are a precondition for communicative processes in social systems, but communicative processes have qualities that cannot be derived solely from psychological systems [20]. Each of the three systems, mind, brain and culture, can be considered as an environment for any other. As environments, they simultaneously enable and delimit the possibilities of the related systems. The conception of *systems as operating simultaneously and in parallel* makes this view possible and it stands in contrast to traditional notions of systems as hierarchically structured. It also opens up questions about how different systems evolve, and evolve in exchange with each other as inter-functional systems, or by *co-evolution*, a term suggested by Thommen and Wettstein [20] inspired by Luhmann [30].

When dealing with systems theory and the relation between a living system (for instance a person with mind and brain) and its environment, a dialectical process and causality has to be reconsidered since the relation is not deterministic or linear. Vygotsky repeatedly discussed this point in his writings as well: “Even when the environment remains the same, the very fact that the child changes in the process of development, results in a situation where the role and meaning of environmental factors, which seemingly have remained unchanged, play a different role because the child has changed; in other words, the child’s relation to these particular environmental factors has altered” [33, 34].

C. Dynamic Systems Approach

A system is basically any collection of phenomena, components, variables or whatever that we take from our universe of discourse that we are interested in. The collection is a system in as much as its components relate to one another. It is a dynamic system if its components affect and change one another in the course of time [19].

The dynamic approach assumes that developing organisms are complex systems composed of individual elements embedded within, and open to, a complex environment [35]. The dynamic system exhibit coherent behavior and the components are coordinated without a specific executive part. The coherence is a result of the inter-functionality of the components and the constraints and opportunities of the environment. No single element has causal priority, the dynamic system is characterized by the inter-active, dialectical development of elements open to influence from the (cultural) environment.

Psychological development involves an aspect of self-governed, internally driven change, but also an aspect of context dependency, of the necessity of an external support. Development is a highly particular process that cannot be reduced to a simple causal process driven by either internal or external conditions. One of the recurrent themes in the dynamic biological systems view is that development is characterized by an increase of complexity and by the creation of novel forms, that is, that were not explicitly specified or coded for in the initial state [19]. Another aspect that is often found in dynamic systems, namely that properties that at first seem trivial and irrelevant to the process at issue can nevertheless play an essential role

(which is not to say that all trivial properties are essential, of course, or that essential roles are always played by trivial properties) [19].

Once we have specified a dynamic system within our universe of discourse we have also implicitly specified another component, namely the system's environment. The system's environment is everything in the universe of discourse that does not belong to the system but nevertheless interacts with it. Dynamic systems are (often) non-linear, where non-linearity means that the effect of a dynamic process differs from the sum of its parts (it can be more but it can also be less, dependent on where in the process the effect is occurring).

A dynamic system – however it is defined – changes because it is affected by other systems (in short, the system's environment) and by itself. The latter aspect is of crucial importance. At any particular moment, the system is affected by what-ever environmental inflow occurs at this particular time, and, equally importantly, by the system's preceding state. This property turns the changes that the system undergoes into what is called an iterative process [19]. An iterative process takes the output of its preceding state (that is, the change it underwent in the immediately preceding moment) as the input of its next state. Although it is hard to conceive of a system that is not affected by its preceding state, this iterative property is hardly ever taken seriously in, let us say, standard approaches to development. It is likely that it is considered so trivial that almost no one ever expected anything interesting from it [19].

D. Bio-Cultural Co-Constructivism

Shu-Chen Li has proposed another model, called bicultural co-constructivism for the inter-functionality between biology-culture and brain-mind [36]. Instead of polarizing the inter-connection, Li has approached human development through the lens of a *crosslevel dynamic bio-cultural co-constructivism*. The key notion of the term is the effects of a series of interconnected feed-downward (culture- and context-driven) and feed-upward (neurobiology-driven) interactive processes. Developmental plasticity at different levels (hence, *cross-level*) are continuously accumulated via the individual's moment-to-moment experiences (hence, *dynamic*) so that, together, they implement concerted biological and cultural influences (hence, *bio-cultural co-constructivism*) in tuning cognitive and behavioral development [36].

Development is according to Li dependent on interactions between endogenous and exogenous processes. However, a general awareness of co-constructive notions is not enough in and of itself to resolve the nature–nurture and mind–brain controversies. These debates again intensified after the publication in 2001 of two working drafts of the sequence of the human genome was published [37]. The pendulum was swinging toward genetic and brain determinism [38, 39] and that makes it according to Li more in need to counter this tradition, and develop alternatives to the genome era [36].

Integration of experiential and cultural influences into the day-to-day research practices of behavioral genetics [40], neuroscience [41], and cognitive neuroscience [42] requires that interactive processes and mechanisms implementing bio-cultural co-construction of brain, mind, and behavior at different levels be further specified. The lack of such specifications has been one of the reasons why the nature - nurture and mind - brain debates have continued [43, 44]. The exact relationship between biological and environmental influences is still unclear; the old nature-nurture controversy will remain unresolved until the function of genes is better understood [45]. Therefore studies about brain structure, neural functioning and biochemical processes are essential [46].

Thus, a further critical aspect of reifying co-constructive conceptions to help integrate research from related subfields of developmental and life sciences is the need for detailed cross-level frameworks with which interactive processes and developmental plasticity across different levels and time scales can be linked and unified [36].

E. Downward Causation and Emergence

Also cognitive neuroscientists have developed models to describe person-environmental and mind-brain interaction. One of these versions is focusing on global to local determination (downward causation) also called 'emergence' on the neurophysiological level and used to describe an interlevel model of mind-brain interactions [47]. Mind represented as consciousness act as the global activity governing or constraining local interactions of neurons. This model seems to solve several difficulties with regard to descriptions of consciousness on a neurophysiological and mental level [47].

The notions of 'emergence' and 'downward causation' have been increasingly used as interlevel models of mind-body interactions from several perspectives. The emergentist strategy presents a novel and more ecological and interactional approach to the issue of mind-body, especially in contrast to models of mechanistic and linear explanation [47, 48].

Downward causation is the most frequent instantiation of emergence. The process stipulates that higher psychological functions (i.e., consciousness) can produce global-to-local determination, or *downward causation*, at the neurophysiological level. As long as these higher psychological properties are understood as large-scale, global activity of the system that governs local interactions, downward causation can be used as an alternative explanation to some models of cognition. For instance, with consciousness being at the core of the mind-body juxtaposition [49], downward causation of global properties (mental cause) onto local properties (neurological effect) could explain the bases of such complex interactions. This implies that the neurophysiological and mental levels can be approached bilaterally, that is to say *causally*, from top to bottom and vice versa [47].

In the mind-body relation, the notion of downward causation argues that emergent (mental) properties have an effect on a local (neurological or corporal) level. But the question remains as to how the mind can exert an effect on the brain [45]. The American neuropsychologist, neurobiologist and Nobel laureate Roger Sperry has marked his opinion about this phenomenon and he states that “the neurophysiology controls the mental effects, and the mental properties in turn control the neurophysiology” [50].

Dealing with the mind-body issue, emergence must reflect some essential properties, for instance the impossibility of thoroughly deducing the phenomenon from the separate analysis of its components, which is expressed by the notion of *supervenience* (see below) [51, 52, 53]. It also has to be accepted that there are “systemic” or “global” properties of the phenomenon [54] associated with local interactions, and that there must be an influence of the global properties on the local level, which implies a downward causation, i.e., a submergence or global-to-local action [47, 55].

The emergent approach has been criticized for mentioning just several characteristics of the psyche, mind and consciousness and not fully define what those entities are, coming to nothing more than enumerating some properties of those entities, intentionality, qualia etc. [25].

F. *Supervenience and Deductive Irreducibility*

Supervenience anticipates two simultaneous concepts. On the one hand is the idea that all “macro” properties depend or “supervene” on an inferior (basal) level. Water supervenes on molecules of hydrogen and oxygen, as the mind supervenes on a neurophysiological substrate. None of these macro properties can exist without their basal properties. On the other hand is the fact that macro properties cannot be entirely explained on these basal properties: they are not reducible to them. The “wateriness” of water is absent in its constituents (hydrogen and oxygen), neither is the intentionality of the mind present at the single neuron level. Each phenomenon acquires macro or basal roles relative to the context of its analysis. A cell is a macro property with respect to the organelles it contains, but is a basal property relative to the tissue to which it belongs. This understanding of supervenience relative to increasing levels of complexity is known as *mereological supervenience* [53]. This also characterizes certain varieties of systems theory.

Supervenience involves that macro properties are dependent on and simultaneously independent of their basal properties. The fact that the global properties depend on their basal properties is not contradictory with the insufficient capability of the latter to explain the macro properties. Therefore, supervenience is an indispensable and essential condition for the existence of emergent properties, but it does not specify their characteristics or qualities.

G. “Extended Mind” - Brain, Mind, Environment

According to Kono human mind functions as a part of the larger system of brain plus body plus environment, an environment created by human beings [2]. He therefore proposes as a new paradigm for psychology: an “extended mind approach” or an “ecological approach to humanized environment”. The “extended mind” approach takes into consideration the close connection between mind and environment/culture and the concept refers to an idea that mind is realized not only in the brain, but in the whole system of brain-body-environment. Higher psychological functions therefore are based on larger systems extending outside the skull and skins.

The word “extended mind” was first proposed at the end of the 1990s by among others A. Clark and D. Chalmers [56, 57]. Also Heidegger’s “Being-in-the-world”, Merleau-Ponty’s phenomenology of the body, Dewey’s pragmatism, James Jerome Gibson’s ecological psychology, Gregory Bateson’s ecology of mind, and Hilary Putnam’s externalism of meaning can be counted as precursors for the “extended mind” approach, according to Kono [2]. The main idea is that higher psychological functions depend upon and are embedded in the culture or humanized environment which includes tools and artifacts. They are realized as higher order emergent functions and cannot be reduced to its constitutive elements.

VII. CONCLUSIONS

The main focus in this article has been on the interaction between mind, brain and culture. The importance of culture and cultural differences for the higher psychological functions [24] and how cultural impact influence brain structure and functions; have been emphasized more than the genetic impact on mind and brain. Mind and brain accumulates effects of cultural experience and are modified through sustained engagement in cultural practices.

Concerning the genetic influence on brain, mind and behaviour it has been mentioned that the genetic or biological makeup is the starting point for every individual and that during the development the environment (culture) will influence genetic processes [16, 18]. In developmental biology the term epigenetics refer to the control of gene expression by the environment and in this article the interaction between genes and environment is taken for granted and not dealt with in detail. Gilbert Gottlieb holds in his probabilistic epigenesis that there are bidirectional influences between the genes, the neural activity, behavior and the physical, social and cultural environment [18].

The inter-functional relationships between mind and brain and the cultural influence on both mind and brain have been presented in seven different models or meta-perspectives above. There are both similarities and contradictions between the

perspectives. The models developed in recent years have revealed important aspects concerning the relationships between components influencing human psychology. Some of the meta-perspectives are referring to *systems theory*, dealing with how the elements are related to each other and function interdependently, due to their structural connections. Systems theory is a developmental approach focusing on emergent processes and change between local interactions.

The advanced form of dialectic systems thinking of something as separate and united at the same time is according to Jaan Valsiner a kind of *systemic organization* or *inclusive separation*. This model contrasts the individual and the environment on an *a priori* conceptual level and relates them on a functional level as interdependent.

The dynamic systems approach is dealing with how the system and its environment stand in a relationship of mutuality: one affects the other and vice versa. This mutuality is often responsible for much of the non-linearity that is so characteristic of developing systems in general [19]. Self-organization is another feature of dynamic systems and this process may create and develop cognitive abilities as well as basic emotions. The self-organizational process described by van Geert has many similarities with the principle of emergence since the consequences cannot be explained by any of the systems components alone but by their interaction.

Another dynamic and inter-functional model was also presented above: the bicultural constructivism explaining interaction between endogenous and exogenous factors in human psychological development. The model was partly a reaction on the tendency towards genetic determinism and an attempt to implement a comprehension of bio-cultural co-construction especially of the brain [34].

A model of downward causation or *emergence* has been presented for the mind-brain interaction. This approach postulates that the higher psychological functions (consciousness/mind) can produce downward causation and affect or determine activity and functions at the neurophysiological level. The emergent approach – the coming into existence of new forms through ongoing processes intrinsic to the system – explains the appearance of the system which could not have been explained or predicted on the assumption of former initial conditions alone [34].

The mind is dependent on the brain but cannot be explained by the structure or function of the brain or be reduced to brain activity. Brain is an indispensable condition for emergence of mind and consciousness, but is not the explanation of their activity. The advantage of emergentism is “the fact that the global properties depend on their basal properties is not contradictory with the insufficient capability of the latter to explain the macro properties” [47].

Many mental processes can be predicted and explained on a neurophysiological level but they cannot be completely reduced to one particular level of description (either “high” or “low”) when emergentism is assumed. When dealing with mind-brain issues the notion of emergence presents advantages over the reductionist-physicalist explanation since it sustains an overcoming of the mutual incompatibility of the two. It is therefore unnecessary to make statements about the reduction of mental processes to physical states, and the incoherence “either bodies or minds exist, but not both” is surpassed. Cognition and consciousness can be considered emergent properties of the organism and its environment, and not exclusively based on the internal mechanisms [47].

Also supervenience and deductive irreducibility [53] anticipates that macro properties, for instance the mind, depend on lower properties, for instance neurophysiological properties. The macro properties (the mind) cannot be entirely explained by these basal properties, they are not reducible to them. The extended mind model or the ecological approach anticipates that higher psychological functions are based on factors not only in the body but has to include the (cultural) environment. Human psychology depends on and is embedded in the culture including tools like language.

The key issue is that of downward causation of higher psychological phenomena, i.e. the question of how it is possible for consciousness to have an impact on the neurophysiological level. It seems obvious that such influence exists. There is no doubt that conscious experience can evoke changes in body activity and, particularly, in the activity of brain. A number of studies and experiments, including those on biofeedback [58], on imagery [59] can provide further evidence of that impact [47].

Searle has argued that it may be possible to solve the dilemma how the mind can exert effect on the brain if we accept that the mind and the brain are just two different levels of analysis of the same system [60]. In this sense, mental causality works because it is no longer the case that there are two different causal realities, but rather, one unique system with two different levels of description. Nevertheless, the use of the term “causality” raises other difficulties when we move away from dualism to accept the coexistence of mind and brain as different description levels of the same system. Traditional causality means that an entity A produces an effect on another entity B, and there is a temporary latency between the former and the latter. For example, one billiard ball causes another ball to move. The question is however if this notion is applicable to the causality between levels (upward and downward causation) [47]. Does the mind (cognitive processes) cause a neuronal reorganization in a way such that there is downward causation? This is still an unanswered question both in principle and how it happens in detail. But despite the many proposals to an answer there seem to be some compliance among most of the models presented in this paper that the mind-brain interaction can be understood as a dynamic system with self-organizing or emergence properties with cultural experience and consciousness affecting neural structures and at the same time dependent on these structures.

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