Cristina Sá Carvalho

7/2008 (14)

The development

For children and adolescents, life is continuous growth and change, aiming to achieve a better, a greater form of adaptation to the environment. In childhood and adolescence, biological processes produce changes in the body and underlie brain development, height and weight gains, motor skills, and puberty's hormonal changes. Genetic inheritance plays a large part but the individual experiences and learning opportunities are very important.

Brain based cognitive processes involve changes in the child's thinking, intelligence and language. Cognitive developmental processes enable a growing child to memorize a poem, imagine how to solve mathematical problem, come up with a creative strategy, or speak meaningful sentences. Socio-emotional processes involve changes in the child's relationships with other people, changes in emotion, and changes in personality. Parent's nurturance toward their child, a boy's aggressive attack on a peer, a girl's development of assertiveness, an adolescent's feelings of joy after getting good grades, all reflect socio-emotional processes in development.

Even if major developmental psychologist did not study directly the relations between body and mind, they do study the mind and the processes we use to build our self and identity. But, if we look carefully to their theories, we can find the role of body as a place in which development occurs and that's what we intend to show with this paper.

To expose this view, which we find so crucial to education, let us start by defining those words: body, place and development. The "body" is the physical substance of the human orga-

nism, composed of living cells and extra-cellular material and organized into tissues, organs and systems. Even so every organ and system are somehow involved with our behavior, the behavior, as the body, is controlled by the action of the central nervous system and emerges from the action of the glandules and muscles. It's preponderantly a response to inner and external stimuli captured in the reception or sensorial mechanisms. "Place" can be defined as a *locus*, from the Latin, a location, a situation, a center or a source. Finally, "development" refers to the changes – biological and/or psychological – that occur in human beings as the individual progresses from dependency to increasing autonomy. Developmental change may occur as a result of genetically-controlled processes known as maturation, or as a result of environmental factors and learning, but most commonly involves an interaction between the two. That mind development finds its source in the body, not only the body as physical substance and organic structure, but the body as a place for action upon the environment, is what we are going to discuss.

The mind and body problem

To understand the development as an interaction between genetics and environmental factors has not been an easy task to psychology, but to comprehend that the human mind is not separated from the body experience and the body structures, needed a long way in the western philosophical and religious tradition that conventionally and characteristically assumes the transcendence of mind over body. To live – and think – in our own culture is to inadvertently immerse in the metaphysical mind-body dualism that pervades our commonsense views of cognition, knowledge, language and values [1]. The center of

[1] "In Pauline Christianity and its successors, the body is earthly, fleshly, lustful and passionate; spirit is Godlike, everlasting; flesh is corruptible; spirit incorruptible. The body was conceived in terms of moral disparagement colored by supernatural religion. Since the body is material, the dyslogy extends to all that is material: the metaphysical discount put upon matter by Plato and Aristotle becomes in ascetic thought a moral and essential discount". J. Dewey, *Nature, Life and Body-Mind. From experience to nature*, 1925, In: L. Hickman, Th. Alexander (Eds.) *The Essential Dewey*, Vol. I, Indiana University Press, 1998, pp. 134-153 (p.135).

gravity of the Judeo-Christian, Greco-Roman, Western European and Anglo-American definition of reality has been the doctrine of rationality and the supremacy of the intellect. Within this tradition, the philosophical pantheon is crowded with Greek logicians and ethicists, Scholastic disputants, French encyclopedists, and German idealists. Even so, those devoted to the understanding of learning and development processes, or those who have educational responsibilities, long fought for the need to understand development as a global process because, when people behave, they behave globally.

Until quite recently, only a small group of philosophers, such as Baruch Spinoza, Friedrich Nietzsche, Charles Pierce, William James, John Dewey and Maurice Merleau-Ponty, outspokenly embraced the non-dualistic view of mind. But expressions like «embodied mind» or «embodied cognition» have became buzzwords in psychology, and others disciplines. We all can feel this unseparateness and interdependency of the psychological and biological, of mind and body, when we are, let us find a common experience, stressed. Stress is one of the health disorders categorized as psychosomatic, a somatic [2] disorder which comprehends a not contingent psychological intervening factor, which strongly and directly contributes to the physical disease [3].

In 1890, William James, an influential American psychologist, produced his two volumes *Principles of Psychology. He a*dvocated that psychology develops around a cognitive psychology of consciousness, a field within which we become aware of objects that are in focus [4]. James explained consciousness as

[2] *Def*. Relating to, or affecting, the body, especially as distinguished from a body part, the mind, or the environment; Something corporeal or physical; also related to a disorder having physical symptoms but originating from mental or emotional causes; also concerned with the influence of the mind on the body. Heinroth, who introduces the term psychosomatic, also introduces the term somato-psychic, when a corporal factor induces a modification on the mind state, also pertaining to the mind-body relationship

[3] In the American Psychiatric Association (DSM-IV, 2002), “psychosomatic” definition was substituted by psychological factors that affects medical condition.

[4] But the *Principles* also contained another center of gravity, one that emphasized the fact that there is also a margin, a penumbra or halo that surrounds all our thoughts, warming our bare cognitions and making them our own. This is the domain of the emotions, largely hidden from view, the reservoir of our habits

a high level psychological phenomenon that has a major influence on – and suffers from – the influence of the inferior level of physiological processes. Our emotions are tied in with our bodily experiences, even so the physiological processes are modeled by the social and psychological phenomena. This notion leads us to a major problem, which is going to be present in all subsequent psychology*: how to fill the abyss between the internal and the external world* or, as we usual interpret it, *the abyss between the subjective experience and the physical brain*. Consciousness is the feeling of what happens – the normal mental condition of the awaking state of humans, characterized by the experience of perceptions, thoughts, feelings, awareness of the external world, and self-awareness – our mind noticing the body's reactions to the world and responding to that experience. Without our bodies, there can be no consciousness, which is an essential mechanism for survival that engages the body, emotion and mind in the spiral of human life.

For John Dewey,

> When life and mind are recognized to be characters of the highly complex and extensive interactions of events, it is possible to give natural existential status to qualities, without falling in the mistake of Greek science [5]. Psycho-physical phenomena and higher mental phenomena may be admitted in their full empirical reality, without recourse to dualistic breach in history, existential continuity. … Every "mind" that we are empirically acquainted with, is found in connection with some organized body. Every such body exits in a natural medium to which it sustains some adaptive connection … the "purest" mind would not continue without them. The thing essential to bear in mind is that living as an empirical affair is not something which goes on below the skin-surface of an organism: it is always an inclusive affair involving connection, interaction of what is within the organic body and what lives outside in space and time, and with higher organisms, far outside" [6].

---

and reflexes, and also the source of our intuitions. Here James hinted at nothing less than what has since been called the reality of the unconscious.

[5] "The error of Greek science lay (…) in misconceiving the locus of their efficacy. It attributed to qualities apart from organic action efficiencies which qualities possess only through the medium of an organized activity of life and mind". J. Dewey, *Nature, Life and Body-Mind. From experience to nature*, op. cit., p. 141.

[6] Ibidem, p. 141, 145, 147.

More recently, the neuroscientist António Damasio has woven some familiar, even if undervalued facts, together into a vision of the brain and its parts that really makes sense, biologically, psychologically, and philosophically, building a new theory of the nature of consciousness and the construction of the self. In *Descartes' Error*[7] Damasio revealed the critical importance of emotion in the making of reason. For him, as the sensory mechanisms (vision, audition, tact, smell, and taste) show us the world around us through nervous processes, the emotions are nervous activation patterns which keep up a correspondence to inner states. Emotions are cognitive representations of corporal states or conditions. This particular concept of emotion lead Damasio to view the organism as a totality in constant interaction with the internal and the external environment, *body, brain and mind working together because they are only one reality*.

The Damasio's vision in itself is not totally original as its key elements can be discerned in Aristotle's, in Nietzsche's, and most recently in Humphrey's 1992 work, *A History of the Mind*[8], an essay on how human consciousness may have evolved. But with the neuro-anatomical details he offers us his experiences with neurological patients affected by brain damage, showing how the absence of emotion and feelings can break down rationality. "Nature appears to have built the apparatus of rationality not just on top of the apparatus of biological regulation, but also *from* it and *with* it"[9].

Failure to see this, is Descartes' error, Damasio says. Far from there being a separation, sharp or ragged, between mind and body, mind cannot exist or operate at all without body. The body's needs set the pace and indirectly drive the brain's decisions is not new. The older, blood-based systems interlink with the "more modern and plastic ones" in the nervous system, via

[7] Cf. A. Damásio, *Descartes' Error: Emotion, Reason, and the Human Brain*, Putnam Adult, New York, 1994.

[8] Cf. N. Humphrey, *History of the Mind*, *Evolution and the Birth of Consciousness*, Copernicus, Springer-Verlag, New York, 1999 (1992). For Humphrey, the mind-body problem is the problem of explaining how the states of consciousness arise in human brains. "More specifically … it is the problem of explaining how subjective feelings arise in human brains" (p. 25).

[9] A. Damásio, *Descartes' Error: Emotion, Reason, and the Human Brain*, op. cit., p. 128.

a host of feedback loops, and that thereby “the goodness and badness of situations is regularly signaled” to the nervous system. As organisms acquired greater complexity, ‘brain-caused’ actions require more intermediate processing. Other neurons were interpolated between the stimulus neuron and the response neuron, and varied parallel circuits were thus set up, but it did not follow that the organisms with that more complicated brain necessarily had a mind. Brains can have many intervening steps in the circuits mediating between stimulus and response, and still have no mind, if they do not meet an essential condition: the ability to display images internally and to order those images in a process called thought [10]. Also, Damasio was able to offer a novel perspective on the nature of feelings as a direct sensing of our own body states and a link between the body and consciousness [11].

Mind and body in a developmental perspective

The mind and body problem is still open and arises many stimulating questions about how we know what is our place in the world; questions that are deep and complex and require many contributions from many disciplines, including philosophy, psychology and neurosciences. Some would argue that the contribution of theology is also very important because the study of consciousness, and the unconscious, necessarily point out to a redefinition of human nature and its place in reality.

But, if we have developmental/educational questions to pose to the body and mind problem, as it is the case, it seems more practical to use a psychological point of view. Psychology is the study of behavior and mental processes, whereas the developmental psychology is devoted to understanding the constancy

[10] Ibidem, p. 89.

[11] A. Damásio, *The feeling of what Happens: Body and Emotion and the Making of Consciousness*, Harcourt, New Cork, 1999. In *Looking for Spinoza* the author looks about the biological underpinnings of feelings and their ramifications for human behavior. His enterprise is to show how integrating are body and mind, thought and feeling, individual survival and altruism, humanity and nature, ethics and evolution, demonstrating how feelings, and the emotions that undermine them, support human survival and enable the spirit’s greatest creations. A. Damásio, *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*, Harvest Books, Orlando, Fla., 2003.

and change that occur throughout the human lifespan. Its main goal is to identify those factors that influence consistencies and transformations of human life from the conception to death. It is a crucial tool for psychologists and educators, allowing them to understand the origins and the structures of the behavior, the mental processes that enable behavior and the ways that behavior and metal processes can be perfected through education. This approach will lead us to understand the major role body plays in development as a true locus for complex activities as well as maturational and developmental processes.

Heinz Werner, a Gestalt psychologist who embraced a genuine and holistic approach to human development, searched to understand the entirety of the acting and feeling organism. This position maintains that we should study psychological processes as they occur within the whole, acting, feeling, striving organism. For him, development involves changes in structure, from a relative lack of differentiation to a state of increasing differentiation and hierarchic integration [12]. As behavior becomes differentiated, becomes under control of higher regulating centers.

Werner was particularly interested in the process of self-object differentiation, the gradual process by which children separate themselves from the environment. At the sensorimotor-affective level, infants hardly experience an outside world apart from their own immediate actions, sensations, and feelings. There is little sense of objects existing apart from oneself. Gradually, children come to function on a more purely perceptual level, perceiving things “out there”, apart from themselves. Still, their perceptions remain strongly bound up with their actions, needs and feelings. We must rise to a conceptual level of thought to gain a most detached objective view of the world, beginning to think in very general and abstract dimensions. This does not mean that once we develop conceptual modes of thought we must rely on them alone. If this was the case – Werner points out – our lives would become empty, abstract, and unfruitful. To avoid it, we need those earlier kinds of thinking in which images are tied to feelings, sensations, and

[12] H. Werner, B. Kaplan, *The Development from a Comparative and Organismic Point of View*, In: D.B. Harris (Ed.) *The concept of Development*, Minneapolis, University of Minnesota Press, 1956, p. 866, cit. W. Craine, *Theories of Development, Concepts and Applications*, New Jersey, Pearsons – Prentice Hall, p. 91.

actions, in other words, directly attached to our body because complex mental processes such as perception and cognition emerge from contexts in which they are fused with actions, sensations, and feelings.

Werner wanted to avoid compartmentalized research which is very problematic when we study children's development, for which the various processes are far less differentiated: for example, child's perception is strongly fused with motor action and emotion.

> When we examine and measure the child's "form perception" as an isolate activity … we miss out the chance to see how it is distinctive in the child's experience. We examine form perception as if it were differentiated from action and emotion, which is not the case [13].

Werner acknowledged that even symbolic activities initially emerge out of bodily-organism activities-motor activities, physical and vocal gestures, and feelings as crying, pointing, naming, imitating and expressing. In fact the earliest symbols children use are motor imitations and even children's speech as a physiognomic quality because it depicts the active, expressive aspects of things. These symbolic activities emerge earlier and better in a supporting emotional context that enables children to feel safe in the world, a primary condition for taking a lively interest in describing and understanding it.

Jean Piaget forged the single most comprehensive and compelling theory of intellectual development. Along with W. James and J. Dewey, he had the current vision of children as active, constructive thinkers [14]. He recognized that children pass through his stages at different rates in an invariant stage sequence. Because he proposed and invariant stage sequence,

---

[13] W. Craine, *Theories of Development, Concepts and Applications*, op. cit., p. 93.

[14] More recently, some researchers argue that newborns begin life with a set of biases for attending to certain information and with general-purpose learning procedures, such as powerful techniques for analyzing complex perceptual information. These capacities enable infants to construct a wide variety of schemes; some others are convinced that infants start out with impressive understanding, a set of innate knowledge systems, a core domain of thought. Each of these pre-wired understandings permits a ready grasp of new information and supports early fast development. L. Berk, *Development Trough the Lifespan*, Boston 2007, Allyn and Bacon – Pearson Education Inc., p. 158.

some scholars have assumed that he was a maturationist, but he was not. Maturationists believe that stage sequences are wired in the genes and the stages unfold according to an inner timetable, but Piaget did not think his stages are genetically determined; they simple represent increasingly comprehensive ways of thinking. Children are just constantly exploring, manipulating and trying to make sense out the environment. In this process they actively construct new and more elaborate structures for dealing with it. Piaget identified four factors that influence us to do this: biological maturation, changes that genetically programmed in each human being at conception; activity, because with physical maturation comes the increasing ability to act on the environment and learn from it; social transmission, or learning from others, plays it's part, or we would need to reinvent all the knowledge already offer by our culture; and equilibration, the mental act of searching for a cognitive balance between cognitive schemes and information from the environment.

Piaget did make use of biological concepts in a limited way, as the concept of adaptation: just as structures of the body are adapted to fit with the environment, so structures of the mind develop to better fit with, or represent, the external world. In addition, sometimes characterized children's activities in terms of biological tendencies that are found in all organisms, using the terms of: assimilation (taking in; in the intellectual sphere, we have a need to assimilate objects and information into our cognitive structures, using our current schemes to interpret the external world), accommodation (changes occur in our structures, as some objects do not quite fit into existing ones; we create new ones or adjust the old ones after noticing that our current way of thinking does not capture the environment completely), and organization (a combination of actions due to our need to be constantly trying to organize our ideas into coherent systems, to create a strongly interconnected cognitive system). But Piaget did not believe that stages are wired into the genetic code, but constructed by children themselves. Nevertheless, he did discuss this process of construction in terms of biological tendencies.

For him, children must interact with the environment to develop and adapt to their world, building new cognitive structures. So, development is an active construction process, in

which the children, sense-making beings, through their own activities, build increasingly differentiated and comprehensive cognitive structures. When Piaget talked about the infant's action-structures, he used the term *scheme* or *schema*. A scheme can be any action pattern for dealing with the environment, such as looking, grasping, hitting, or kicking, so the schemes are sensorimotor action patterns. Along with the development process, schemes became mental representations that organize knowledge.

He observed that small babies inherit the innate reflexes we mentioned before, such as the sucking reflex. Piaget saw newborn reflexes as the building blocks of sensor-motor intelligence. If baby first schemes are inborn reflexes, they very soon became a part of the human infant's self-initiated activity, simple actions – and then, more and more elaborated ones – the baby performed on objects. Older children have schemes that include strategies and plans for solving problems.

The circular reaction provides the baby with a special means of adapting their first schemes. It involves stumbling onto to a new experience caused by the baby's own motor activity. Babies start to gain voluntary control over their actions through the primary circular reaction, by repeating chance behaviors largely motivated by basic, body-centered needs. This leads to some simple motor habits, soon adapted to various stimuli. The infants perform a single action to obtain a single result – to make an interesting sigh last. Later, they will try to repeat interesting events caused by their own actions, the secondary circular reaction: they perform two separate actions to obtain a single result. And, by 8-12 months, babies combine new schemes into new, more complex action sequences, goal-directed and intentional behavior, deliberately coordinating schemes to solve simple problems. They experiment very different actions to observe the different outcomes.

By the end of sensorimotor period, the child as developed efficient and well-organizes actions dealing with the immediate environment. The child continues to use sensorimotor skills throughout life, but the next period – preoperational thought, is marked by a major change: the child's mind rapidly advances to a new plane, that of symbols. Children begin to use symbols when they use one object or action to represent a subsequent one. Deferred imitation involves some kind of internal represen-

tation of past events, an emerging brain located memory. Piaget believed that deferred imitation also initially involves motoric images, and he emphasized that the first symbols are motoric, not linguistic [15]. We also find examples of motoric symbols in play and make-believe play: the play is symbolic because the child uses one object to represent an absent one, even if language is the major source of symbols.

If some psychologists believe that children learn to think more logically as they master language, Piaget, however, disagreed. Language is tremendously important but does not itself provide the structure of logical thinking. Logic, instead, stems from actions. Infants develop logically coherent actions systems during sensorimotor period, before they talk, and later logic is simply organized actions of a more internal kind [16]. To study how internal actions form logical systems, Piaget gave children various scientific tasks all thought to involve the mastery of the same logical concepts – identity, inversion and compensation. He found out that at the level of concrete operations, children can handle this problems and think logically and systematically only as long they refer to tangible objects that can be subjected to real – bodily – activity. It's only adolescents who already attained formal operations that can think into the realm of the purely abstract and hypothetical.

Physical growth, development and performance in childhood Babies and toddlers

As we said before, major developmental psychologist did not study directly the relations between the body and mind, but their theories point out to a major role of body mostly seen as organism. The body, or the organism, also have is own developmental patterns. New born infants have a remarkable set of capacities that are crucial for survival and, as they relate to the physical world and build social relations, they are active from the first moment. Reflexes are the newborn's most obvious

[15] Cf. W. Crain, *Theories of Development, Concepts and Applications*, op. cit., p. 120.

[16] Cf. J. Piaget, B. Inhelder, *The psychology of the child*, New York 1969, Basic Books, pp. 86-90.

organized pattern, automatic responses to a particular form of stimulation. Some have survival value, some others form the basis for complex motor skills that will develop later and there are also some reflexes that help the babies establish gratifying interactions.

Individual infants can be identified by the unique vocal “signature” of their cry and crying is the first way that babies communicate, letting adults know they need food, comfort, or stimulation, usually because of physical needs, as hunger, but also in response to a sudden temperature change, noise or a painful stimulus. Babies are also very sensible to touch and pain, especially around the mouth, on the palms and the soles of the feet, and the genital area. If touch helps stimulate early physical growth and emotional development, pain sets up a strong physical response with a dramatic rise of heart rate, blood pressure, palm sweat, pupil dilatation and muscle tension.

Newborns distinguish several basic tastes, and at four days of age, breastfed babies prefer the smell of their own mother’s breast, and they can hear a wide variety of sounds. At birth they prefer complex sounds, as noise and voices, and listen longer to human speech, detecting the sounds of any human language. Vision is the least developed of the newborn’s senses because visual structures in both the eye and the brain are not yet fully formed. They cannot focus their eyes well, and visual acuity is limited. Although, they actively explore their environment by scanning it for interesting sights and tracking moving objects.

During infancy and toddlerhood, babies acquire new motor skills in individual ways, by building on previously capacities, eager as they are to explore the world of objects and spaces. Once they figure out how to move on their own, they will make dramatic strides understanding the surroundings. They undergo increase in body size, growing in little spurts, but different parts of the body grow at different rates: the cephalocaudal trend means the head develops more rapidly than the lower part of the body, and the proximodistal trend means growth proceeds from the center of the body outward.

At birth, the brain is nearer to its adult size than other physical structures and continuous to develop at an astonishing pace throughout infancy and toddlerhood. Appropriate stimulation of the child’s brain is vital during infancy because synapses forma-

tion is at its peak. Strong increases in neural fibers and myelination are responsible, during the two first years, for the swift gain in overall size of the brain, a process that accelerates again in adolescence. Because the cerebral cortex is the last brain structure to stop growing, it is the most sensitive to environmental influences and for a much longer period then any other part of the brain. The general order in wish cortical regions develop corresponds to the order in which various capacities emerge: the auditory and visual cortexes and in areas responsible for body movement over the first year, language areas from late infancy to preschool years. But regions with the most extended period of development are the frontal lobes, responsible for thought, in particular, consciousness, inhibition of impulses, integration of information, and regulation of behavior through planning.

Lateralization/specialization and plasticity of the cortex are strongly connected because it permits a wider array of functions to be carried out effectively. At birth the hemispheres have already begun to specialize, but experience greatly influences the organization of the cerebral cortex, showing, during the two first years, that this is the life period in wish the brain is more plastic, supporting young children ability to learn, fundamental to their survival. So, appropriate stimulation during the early years is essential, taking place around age-appropriate play materials and in daily routines. No evidence exists for a sensitive period in the first few years of life for mastering skills that depend on an extensive training, as reading, or musical performance, or gymnastics.

Babies' motor achievements have a powerful effect on their social relations because motor skills, social competencies, cognition, and language develop together and supported one another. In motor control a cephalocaudal trend is evident since head control comes before arms and trunk control and later comes the legs. A proximodistal trend is also observable: head, trunk and arms control precedes coordination of the hands and fingers. Each skill is a product of earlier motor attainments and a contribution to new ones and is a joint product of four factors necessarily combined to allow learning stability and the motivation to explore: central nervous system development, body's movement capacities, the goal the child has in mind, environment supports. The mastery of motor skills involves an increasingly complex system of action: separate abilities work and co-

operate together to produce more effective behavior, allowing the child to explore and control the environment.

Of all motor skills, reaching may play the greatest role in infant cognitive development because it opens up a whole new way of exploring the environment. To learn about sights, sounds and the feeling of each object, the child needs to grasp things, manipulate them and see what happens. Reaching and grasping starts out as a gross and diffuse activity and move to a mastery of fine movements that evolutes from motor reflexes to more complex adjustments – eye gaze, head and shoulder control, arm independence – finally organized in a better reaching for moving objects. When the children begin to sit up they coordinate both hands in exploring objects, and at the end of the first year, infants use a well-coordinated pincer grasp.

Motor development goes along with perceptual development, the first step to thinking development, specially the hearing and vision skills. Babies have a sense of musical preference – Mozart – and, at the end of the first year, they can recognize the same melody when is played in different keys. Responsiveness to sound provides support for exploration through sight and touch. This responsiveness is also crucial to acquire language: as infants continue to listen to the talk of people around them, they learn to focus on meaningful sound variations and later focus on large speech segments, starting to recognize familiar words in spoken passages and beginning to perceive the speech stream in wordlike units. They have a powerful ability to extract regularities from continuous verbal stimulation and because communication is often multisensory – verbal, visual and tactile – they receive much support from other senses.

But, for exploring the environment, humans depend on vision more than any other sense. As babies explore their visual field, they figure out the characteristics of objects and how they are arranged in the space. Visual development, a combination of depth perception and pattern perception, undergoes extraordinary changes by the 7 or 8 first months, supported by rapid maturation of the eye and the cerebral cortex visual centers. Depth perception is the ability to judge the distance of objects from one another and from ourselves, and plays a major role in guiding motor activity. Motion is the first depth cue infants use but independent movement promotes additional aspects of three-dimensional understanding. Babies also have perception

preferences and they prefer patterns than plain stimuli, and as they grow preference goes to more complex patterns, showing that they are sensitive to contrast between visual stimuli. This tendency to search for structure in a patterned stimulus also applies to face perception: newborns prefer lo look at simple, facelike stimuli features and show a tendency to look longer at faces judged by adults as attractive, behavior that may reflect a built-in capacity to orient toward the members of the same species, an important condition to build attachment.

And, as our world provides rich, continuous intermodal stimulation, it's important to understand how intermodal perception works on infants. Studies show that babies expect sight, sound and touch to go simultaneously. Young infants seem biologically primed to focus on amodal information. Their detection of amodal relations may provide the basis for detecting more specific intermodal matches, such as a person face and the sound of her voice or between an object and its verbal label. Intermodal sensitivity is crucial for development because, when much stimulation is unfamiliar and confusing, it allows the baby to notice meaningful correlations between sensory inputs and make sense of the surroundings.

Preschool years

Preschool years are, indeed, the play years because the child explores the environment and achieves many complex developmental patterns throughout playing activities. The first thing we notice in body development is the rapid rate of body growth and how the children gradually become thinner. The skeletal changes of infancy continue and the many growth centers in which cartilage hardens into bone emerge in various parts of the skeleton. By the end of the preschool years, children start to lose their primary teeth. The genitals develop slowly from birth to age four and they change little throughout middle childhood, and then grow rapidly during adolescence. In contrast, the lymph glands grow at an astounding pace in infancy and childhood, but decline in adolescence.

Between the age of 2 and 6, the brain increases from 70 percent of its adult weight to 90 percent; many parts of the cerebral cortex have overproduced synapses and the cerebral blood

flow peaks due to the energy need. As the formation of synapses, cells' death, myelination and synaptic pruning occur, the improvement of a variety of skills is notorious: physical coordination, perception, attention, memory, language, thinking and imagination. This is a time for marked gains on tasks that depend on the frontal cortex, ones that require inhibiting impulses and substituting thoughtful responses. Language competencies increase at an astonishing pace and they support increasing control over behavior. Spatial skills development – giving directions, drawing skills, and recognizing geometric shapes, develop gradually over childhood and adolescence, while the cortex hemispheres continue to lateralize, process that reflects on handedness, the hand preference children display and is supported by a greater capacity on one side of the brain, and that gradually extends to a wider range of skills.

Fibers linking the cerebellum (a structure that aids in balance and control of body movement) to the cerebral cortex, grow and myelinate from birth through pre preschool years, contributing to very important gains in motor coordination. These connections also support thinking, memory, planning in language. As the reticular formation (a structure that maintains alertness and consciousness) myelinates throughout childhood and adolescence it contributes to the improvement of attention span. The corpus callosum (a large bundle of fibers connecting the two cortical hemispheres) located production of synapses and myelination peak between the age of 3 and 6, and then continue at a slower pace through adolescence. The corpus callosum supports coordination of movements between both sides of the body and allows the integration of many aspects of thinking in complex tasks that need communication involving the hemispheres (high level perception, attention, memory, language and problem solving).

During the preschool years, children continue to integrate previously acquired skills into more dynamic systems. They need to revise each skill as the body grows and gets stronger, as the nervous system maturates. As the body becomes more streamlined, the centre of gravity shifts downward, toward the trunk and balance improves significantly. Movements become smooth and rhythmic, secure enough to leave the ground and run, jump, gallop and skip. As children become steadier on their feet, their arms and torsos are freed to experiment new move-

ments – throwing and catching balls, steering tricycles. The upper and lower-body skills combine into more refined and flexible actions that move the whole body, and movement is performed with increasing speed and endurance.

Fine motor skills take a giant leap forward as control of the hands and fingers improves. This progress is most apparent in children's care of their own bodies (dressing, feeding) and in drawing and painting activities. Shoe tying is the most complex help-self skill of early childhood and shows how close the connection between motor and cognitive development is: requires a longer attention span, memory for intricate series of hand movements, and the dexterity to perform them. Drawing and writing also show this intimate connection, as a preschoolers' ability to mentally represent the world expands and the marks on the paper take on meaning. These include the realization that pictures can serve as symbols, improved planning and spatial understanding, and the emphasis that the child's culture places on artistic expression.

School years

The physical growth in the school years continues at the same slow pace as in the early childhood. Because the lower part of the body is growing faster, the children may appear disproportionally long-legged. Children are now unusually flexible, so they can turn cartwheels and perform handstands, because the bones and the body lengthen and broaden, but ligaments are not very firmly attached to bones. As the bodies become stronger many children experience a greater desire for physical exercise. It is also time when the primary teeth are replaced with the permanent ones.

During school years, running, jumping, hopping and ball skills become more refine. Children love to race, jump quickly and engage to elaborate patterns of hopscotch, kick and dribble balls. These shills reflect, once more, the gains in basic motor capabilities: flexibility/elasticity, improved balance, agility (quicker and more accurate movements) and force. More efficient information processing plays a vital role in improved motor performance: gains in reaction time and the capacity to react to, and only, relevant information takes place.

Fine motor development also improves and children play often with yo-yos, Lego, models to assemble, as they made experiences on writing and drawing, with increasing legibility and the mastery of small curves, uniform spacing and the ability to copy many two-dimensional shapes that are also easily integrate in drawings. Around 9 or 10 years the third dimension is clearly evident through overlapping objects, diagonal placement, and convergent lines. The considerable detail in drawings shows that children can relate many different parts within an organized whole.

Motor activity and physical play seems to show a shadow of our evolutionary past through friendly chasing and fighting, a rough-and-tumble play that emerges in preschool years and resembles the social behavior learning in the course of fighting experiences of many other young mammals. This play helps children, especially boys, establish a hierarchy of dominance that predicts who will win when conflict arises maintaining a safe context to assess strength without damage. In puberty, as individual differences become apparent, teenage rough-and-tumble players hurt the opponent and the play is clearly infused with aggression in a context for hostility.

Adolescence

Adolescence is a transition between childhood and adulthood. In industrialize societies, the skills young people must master are so complex and the choices confronting them so diverse that adolescence is greatly extended. The beginning of adolescence is marked by puberty, a flood of biological events leading to an adult-sized body and sexual maturity.

The complex hormonal changes that underline puberty (secretions of growth hormone and thyroxine) occur gradually, leading to tremendous gains in body size and attainment of skeletal maturity. Sexual maturation is controlled by the sex hormones. In boys, testes release large quantities of the androgen testosterone, which leads to muscle growth, body and facial hair, and other male sex characteristics. Estrogens released by girl's ovaries cause's breasts, uterus and vagina maturation, and fat to accumulate. They also contribute to the first occurrence of the menstrual cycle.

The first outward sign of puberty is the rapid gain in height and weight know as growth spur. During puberty, the cephalocaudal growth trend of infancy and childhood reverses. The hands, legs, and feet accelerate first, followed by the torso, which accounts for most of the adolescent height gain. This pattern helps explain why early adolescents often appear awkward and out of proportion, ling-legged and with giant feet and hands. Noticeable discrepancies in body proportions appear between the sexes, caused by the action of sex hormones on the skeleton. Boys' shoulders broaden relative to the hips, whereas girls' hips broaden relative to the shoulders and waist. Boys also end up larger then girls because they have two extra years of pre-adolescent growth, when the legs are growing the fastest.

Around the age of 8, girls start to add fat on their arms, legs, and trunk, a trend that accelerates between ages 11 and 16, but in adolescent boy's decreases. Both sexes gain in muscle, but this increase is much greater in boys, who develop larger skeletal muscles, hearts, and lung capacity and also the number of red blood cells. Puberty brings steady improvement in gross motor performance, but changes differ for boys and girls. Girls' gains are slow and gradual, but boys show a dramatic spurt in length, speed, and endurance. Among boys, athletic competence is strongly related to peer admiration and self-esteem.

Accompanying rapid body growth are changes in physical features related to sexual functioning. The primary sexual characteristics development involve the reproductive organs (ovaries, uterus, and vagina, in females; penis, scrotum, and testes in males). The secondary sexual characteristics changes are external and serve as additional signs of sexual maturity. Female puberty usually begins with the budding of the breast, pubic hair growth and the growth spurt. Menarche typically happens around age 12-13 in the Western countries, but the age range is wide.

The first sign of boys' puberty is the enlargement of the testes, accompanied by changes in the texture and colour of the scrotum. Soon after, pubic hair emerges and the penis begins to enlarge and the prostate gland and seminal vesicles enlarge. Facial and body hair emerge after the peak in body growth. The voices get deeper as the larynx enlarges and the vocal cords lengthen. Around age 13-14 first ejaculation occurs (spermarche).

The physical transformation of adolescence includes major changes in the brain. With continued pruning of unused synapses, especially in the frontal lobes (control of though and action) and growth and myelination of stimulated neural fibers accelerates, strengthening connections among various brain regions. Linkages between the frontal lobes and other brain areas expand and attain rapid communication, supporting diverse cognitive advances (attention, planning, capacity to integrate information, and self-regulation). Also the neuronal sensitivity to certain chemical messages changes and the enhanced responsiveness to excitatory neurotransmitters enables the adolescent to react more to stressful events and to experience pleasurable stimuli more intensely.

Some educational implications

Werner and Piaget did not compose treaties on the education of normal children, but their general orientations are quite relevant when policymakers are pressing for formal academic instruction at very younger ages, just because we live in a world mainly focused and dominated by science and technique achievements. We have come to view the world almost exclusively through the mental categories of logic, number, and mechanistic connection.

> Taking the computer as our model, we have translated mental life into flow charts and decisions trees, and we have made precision, objectivity, and rationality our ultimate goals. In the process ... we have lost touch with non-rational modes of experience. We have cut ourselves off from the fluid world of dreams, emotions, and intuitions and the organic rhythms of the body. Simultaneously, we have lost our feeling for nature, reducing her to mere physical matter to be exploited and controlled [17].

Doing so, we just turned the organic world into an artificial, lifeless, sterile, environment.

[17] W. Crain, *Theories of Development, Concepts and Applications*, op. cit., p. 110, evaluating Werner educational contribution, following Theodore Roszak social criticism; he quotes T. Roszak, *Where the wasteland ends*, Garden City, New York, Anchor (Doubleday), 1973.

Werner, however, observed how children physiognomically perceive the expressive qualities in the outer world and how this perception is developed by artists. His holistic perspective suggests that educators should not focus precociously on any specific intellectual process, without considering the broader context of its development. Today's kindergartens, and even preschools, are so dominated by formal academic instruction that there's little time for children to engage in make-believe play, or to draw, sing or swap stories. It is crucial, for individual as well as society's development, that we rediscover this sensitivity; this connection between body-based mind experiences and our rational understanding of reality.

Piaget, the cognitive constructivist, did have some recommendations to educators, whom he considered as facilitators and guiders to the children learning process, adults able to provide support for children to explore their world and discover knowledge. For him, learning is something that comes from children, not something handed down by the teacher. It's rather a process of spontaneous invention and discovery. Children make incredible intellectual progress simply by exploring and manipulating their environment. So, education should not try to impose knowledge but challenge the child's drive for sensory and motor activity, for action, trough interesting materials. As David Elkind, a well know American Piagetian, pointed out, we must understand that educational programs must stimulate young children to learn primarily through play and sensory contact with the environment, filling the gap between their body and mind developmental processes. Child's curiosity is too often stifled by education, but real learning comes from experiences that arouses children's curiosity and give them opportunities to work out solutions on their own. If the mind is curious, the body activity is one way to respond to it.

By the time Werner and Piaget set up their theories, little was know about how the brain changes as children develop. Recently, it has been discovered that brain has considerable plasticity, the ability to change, and that its development depends on experience. If, as saw in Werner's and Piaget's theories, what children's do changes the quality of their intelligence, neurosciences have recently demonstrated that what they do also changes their brain, which complies with the Piaget's theory of the stages of development.

As we saw before, the number and size of the brain's nerve endings continue grow at least until adolescence, in particular due to myelination, the process of encasing many cells in the brain with a myelin sheath. This increases the speed at which information travels through the nervous system. The implications for teaching are that young children will have difficulty focusing their attention in early childhood, but their attention will improve with brain development. The most extensive increase in myelination in the brain's frontal lobes, where reasoning and thinking occur, takes place during adolescence, just before the attainment of formal operational thinking.

Another important aspect of the brain's development is the increase in synapses, where connections between neurons are made. The visual, auditory and prefrontal cortex areas of the brain show a dramatic growth in pruning synapses between birth and adolescence. The areas are critical for higher-order cognitive functioning such as learning, memory and reasoning. Santrock says that

> one of the most fascinating recent discoveries about the adolescent's brain focuses on developmental changes in areas involving emotion and higher-level cognitive functioning [18],

as the amygdale. The amygdale is the brain's region that processes information about emotion, wish matures earlier than the prefrontal cortex (higher-level cognitive functioning), showing why it's so difficult to the adolescent to understand, and then, modulate, his or her recently discovered strong feelings.

Another aspect of brain functioning that has implications for cognitive development and learning is that, even though areas of the cortex are somewhat specialized, they must work together.

> ... many areas of the cortex are necessary in processing language. To answer a question, you must first hear it. This involves the primary auditory cortex. Movements controlled by the motor cortex are required to speak your response. Broca's area … has a role in setting up a grammatically correct way of expressing an idea, and Wernicke's area … is necessary for connecting meaning with particular words [19].

[18] J. Santrock, *Educational Psychology*, Boston 2008, Mc Graw-Hill, pp. 35, 36.

[19] A. Woolfolk, *Educational Psychology*, Boston 1995, Allyn and Bacon, p. 27.

Developmental psychologists are also concerned about when lateralization occurs, because before specializations are established in particular areas of the brain, the brain is very adaptable, or, as we saw, plastic. That is important when a young child experiences brain damage as well as in the situations of stimuli deprivation.

The learning and development are brain-based, and the education involves bringing about change to the brain. The brain is a complex collection of systems working together to construct understanding, detect patterns, create rules, and make sense of experiences. If so, education will be more effective if educators can understand how the brain senses, processes, storages, and retrieves information. When children are in safe and familiar, well known situations, they will seek for new experiences because their brain is seeking for novelty. If the new information is provided trough a global experience and affects the emotional parts of their brain, the learning and development processes will be major achievements because the cognitive parts of the brain will be ultimately activated.

Piaget's fundamental insight was that individuals construct their own understanding, and the learning is a constructive process. Hence the school must give pupils a chance to experience the world; this experience should not be limited to the physical manipulation of objects, also open to mental manipulation of ideas that arise from projects and experiments taking place in an emotionally rich environment. In doing so, all the brain will be actively involved as the place for the mind to emerge – a strong, sensible and rich mind.

→ **KEYWORDS** – INFANT, CHILD, BODY, DEVELOPMENT, MIND