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Ontogenic Parenting: A Paleoanthropological Approach

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Abstract

There are many parenting styles, however, there could be a model common to every Homo sapiens, allowing understanding behavior and needs of neurodevelopment stimulation in early childhood. An anthropological approach could become very useful. Among main strategies of evolution, Neoteny, allowed births through standing and narrow pelvis leading to immature brains, requiring completing its development in a post-natal environment:"altricial development". This highly dependent newborn, will gradually increase in weight/size/brain until achieving maximal encephalization quotient ever reached in nature. During first years, ontogenic process would replicate those events happening in phylogeny. Tactile, thermal and vestibular-proprioceptive stimuli were essential. Thus, portage using Kapulanas (ancestral slings) would have been decisive. In addition, animal protein, long-chain polyunsaturated fatty acids, and brain-sensitive trace elements in diet also had a predominant role. This knowledge and promotion of strategies based on these mechanisms could stimulate neurodevelopment in early stages according to human species requirements.

Keywords: Ontegenic parenting; Anthropology; Parenting; Raising; Trophic contact; Touch; Parental attachment; Bonding; Ontogeny; Altricial development; Evolutionary medicine

Introduction

Is another parenting model required, considering that there are as many as cultures that promote them? Children's primary care professionals agree that there is ignorance of normal processes in newborns and young infants, assuming as pathological many of these behaviors, overloading primary care and emergency centers [1]. The lack of evidence leads to insecurity in parents and caregivers [2]. The same applies to neurodevelopment stimulation in younger infants, early exposed to electronic devices and screens, following the promises of technology offering great benefits on the brain and cognitive development [3]. Research has not shown benefits in language [4], learning and school performance either [5]. So far, electronic stimulation does not overcome human interaction as the main tool of development [6]. Therefore, the statement of the American Academy million years of Pediatrics that discourages the use of screens remains in force [7]. For these reasons, pediatric health care providers and parents are not able to interpret children, do not understand their behaviors or how to stimulate their neurodevelopment, since evidence has invalidated all these technological choices promising the best results.

In 21st century, theories arose proposing a parallelism between Phylogeny and Ontogeny, trying to understand the processes of early neurodevelopment. The most influential one was Biogenic Law, supported by Darwin and von Baer, and communicated by Haeckel [8,9]. It included the "Recapitulation law" stating that ontogenetic processes reproduce phylogenetic ones, from the anatomical to the functional features [10,11]. Sometime later, these theories were discredited [12], since comparisons were made between individuals far away in the zoological scale, focusing them on the embryonic development [8,10] without analyzing the primitive anthropogenic processes that led to the development of modern *Homo sapiens*; here is certainly likely to find answers to the raised questions. This could be relevant in the development of behavior as Freud and Piaget proposed [13,14]. Some researchers postulate that certain applicability is plausible [15], considering two relevant principles:

✓ The more recent a phylogenetic characteristic is, the later it develops in ontogeny.

✓ The greater the evolutionary proximity, the longer the sequence of characteristics developed in the ontogenetic processes.

Therefore, from the phylogeny it would be possible to make inferences about certain ontogenetic processes [16]. Many keys to early development and behavior could be found in the late phylogenetic stages of Homo. Consequently, we should wonder: what we are today, does it depend on the last 50 years of technology or on the 3 million years (My) of evolution?

In summary, we propose to reconsider the old naturalist approach, in which certain phylogenic processes are replicated in the ontogeny of each individual. Knowing these determining processes in human evolution can help to understand and support this hypothesis.

Important processes of hominization in our species

Significant climatic changes more than 8 Million years ago, led to a decline in African forests, for this reason, many primates disappeared while others adapted to originate new species, such as Australopithecus afarensis ("Lucy") with 3 Million years, and later, the Australopithecus anamnesis with 4.2 Million years his/her possible ancestor [17]. The first "Homo" would have appeared 2.8-3.3 Million years ago [18]. A subsequent sequence to early Homo could be:*Homo erectus* (1.8-0.5 Million years), *Homo heidelbergensis* (0.5 Million years), from which the *Homo neanderthalis*, denisova and sapiens would be derived. These last three would have coexisted and interbreed beetween them, although finally only modern sapiens were able to survive. In short, human evolution did not result from a linear progression, but from a process of transitions [19].

Standing, locomotion, hair loss, brain and pelvis

The first hominid (bipedal) after the divergence from the anthropomorphic primates (chimpanzees, gorillas and orangutans), appeared in East Africa, Orrorin tuginensis [20]. The bipedal process evolved early, and later, hair loss, possibly associated with thermoregulation costs in warm and open habitats [21]. The bipedal locomotion allowed the long-distance races, which was a fundamental

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adaptation for the survival of the species [22]. This originated the "obstetric dilemma" hypothesis, because of a large fetal brain requires a wide pelvis to pass through, while an efficient standing woman has a narrow one [23]. Humans are unique in walking and running long distances in hot conditions. This ability, allowed them to take their prey to hyperthermia, since they are adapted for long distances rather than speed, and to dissipate heat instead of retaining it [24].

Human brain evolution

A large encephalic volume is the most characteristic phenotype of the human species [25]. About 4 million years ago, Australopithecus appears. 2 Million years later, his brain has grown to a volume of 500 cm^3. This is considerable compared to a chimpanzee (pantroglodite) with 300-350 cm^3 [26]. About 2.8-3.0 Ma ago, the first representatives of the genus Homo (*Homo Habilis, H. Rudolfensis*) appear, with approximately 700 cm^3. Subsequently, 1.5 Million years back, *Homo* Erectus emerged (and its European equivalent, *Homo Ergaster*) with a brain size of 1000 cm^3, followed by *Homo Heidelberguensis* (c 0.4 Million years), who would have been the precursor of the last two species with greater brain development: *Homo Neanderthalis* and *Homo sapiens*, who would have coexisted during hundreds thousands years, both with a volume of 1300-1500 cm3 [27]. It should be noted that *Homo sapiens* also developed a functionally more advanced brain [28], but this is not the aim of this analysis.

This high level of encephalization was critical for human survival and arose among hominids in the last 2 Million years. The difficulty in giving birth to large head neonates through a narrow birth canal ("obstetric dilemma"), was solved with Neotenia, which consists of being born with a small and immature brain but a high rate of post natal neurocranial growth. This allowed a large final brain volume and greater cognitive development ("altricial development"), but requiring a complex social structure giving to children the appropriate care during this high dependency period [29].

In summary, the most important evolutionary milestones:

- Two-feet Locomotion
- Skeletal-pelvic structural change
- Hair loss
- Great increase in Encephalization quotient.

It has been hypothesized that these circuits configured during evolution should emerge in an innate way, as a primitive computational connection in the brain ("developmental chip") [30].

Nutrition and encephalization

Docosahexaenoic acid (DHA) is essential in brain-retinal development, and is not found in significant amounts in other primates. Equally important are the brain-sensitive minerals, iodine, iron, zinc, copper and selenium, which are abundant in coastal diets based on fish, seafoods, crustaceans, frogs, bird eggs and aquatic plants [31]. The key role of DHA on neuronal migration, neurogenesis and expression of those genes involved in brain growth and functioning were essential in the evolution of *Homo sapiens* [32]. This happened 2 Million years ago when accessing to the eastern Africa lakes ecosystems, rich in these essential fatty acids [33]. Also very important was the incorporation of animal protein in early stages of hominid development allowing initial brain expansion [34]. In summary, meat intake initiated the brain expansion process, which continued to increase significantly by incorporation of brain-sensitive trace elements and DHA/EPA/ARA, associated with coastal marine and lacustrine feeding.

Touch and synaptogenesis

This great brain expansion and associated neurogenesis, required a large number of synaptic connections.

The early hair loss and the use of carrying devices for small children and newborns ("kapulanas", its African ancestral name), considered one of the oldest and most influential inventions in development, would have been decisive in evolution [35]. There is evidence of its use since 2 Million years, and would have favored the development of an infectious cutaneous ecosystem, which promoted greater hair loss by prolonging the corporal baldness of the neotenic process, in order to facilitate epidermal cleansing. This more widespread neoteny would have allowed a longer altricial development [36]. *Homo erectus* brain at birth is quite similar to that in modern human newborn, although final volume is different (315/880 cc, 35% *vs* 350/1250 cc, 28%). In chimpanzees, this ratio is approximately 40%. Thus, from birth to adulthood, the human brain expands by a factor of 3.3 compared to 2.5 in chimpanzees [37]. Neurogenesis is greater in the first three months, and since 2 Million years at this stage, the hairless children were carried in a sling (kapulana) for a large part of the day, exposing themselves to a constant and extensive tactile and thermal stimulation. In this sort of contact, the low-threshold C-tactile million years elevated fibers, able to moderate the aspects of soft touch, are involved [38]. These fibers could provide stimuli to this rapidly growing brain. Hypothetically, this could have happened, contributing such tactile inputs to synaptogenesis, as would be vestibular-proprioceptive ones [39].

Role of skin and touch in newborns and young infants

These million years elevated neurons lead inferences from areas of hairy skin, related to slow and soft touch associated with affective features, contributing to the socio-emotional development. It is known as "affective touch", thus skin is considered a "social organ". It does not fulfill any role in fine and discriminative tact, but it is important in group and affective interactions [40] and is mediated by endogenous opioids [41]. Temperature also plays a role in affective bonding, the theory of "social thermoregulation" where opiates participate as well [42]. Vestibular-proprioceptive inputs are important in the influence of environment, social signals, sensory-motor processing and sense of self, are necessary to understand the actions of others [43]. Finally, mention must be made on the stabilizing role of the skin on thermal, respiratory, hemodynamic, metabolic, psychological and galactopoietic aspects in the neonatal period [44] and when carrying using kapulana [45]. For this reason, tactile contact is a fundamental form of communication and interaction in phylogeny and ontogeny.

Final Hypothesis

There would be evidence to support that some early ontogenetic landmarks replicate key processes of phylogeny. Plausibility of this approach would allow facing complex questions about child development and growth, analyzing these problems "from the cave". This would motivate knowledge and study of *Homo sapiens* developing processes. It allowed delivery in unfavorable pelvic condition, in a species needed of bigger brains without increasing maternal size. Therefore, immature brains, poorly autonomous and highly dependent children, requiring great post-natal encephalic growth and development (altricial development), this demanded more intelligent parents, with greater brain, and hence, more altricial descendants [46].

Breastfeeding provides main nutrients for neurogenesis and transport in kapulanas, promotes tactile, thermal and vestibular-proprioceptive contact needed for synaptogenesis. Both conditions are essential in the altricial development of brain during first months of life. Plausibility of this approach should warn us about risks associated with the effects of inappropriate input at early stages on brain development, which is already beginning to be observed in some studies [47].

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