There in Evolution and Back Again: Evolutionary Dialectics of Ontogeny and Phylogeny through Developmental Psychology and Biology of Cognition

Matheus Henrique da Mota Ferreira
(Biology Student in Universidade Federal do Rio de Janeiro)
matheushmf01@gmail.com

Abstract

There are many different senses for the word evolution or its derivative, evolutionary. The early debates have led to a concept of evolution that would be considered misorienting or lacking refinement for many evolutionary biologists nowadays. This said, I would like to reconsider the perhaps not so clear division between development and evolution (or ontogeny and phylogeny). The way I plan to do this is by comparing the Theory of Autopoiesis and the Biology of Cognition from Humberto Maturana and Francisco Varela with the ideas from some of the main authors in Developmental Psychology, namely Jean Piaget, Lev Vygotsky and Henri Wallon. Through this process, I intend to show the convergences and divergences between these two approaches and, simultaneously, to endorse an old view of evolution which sees ontogeny and phylogeny as two processes in a gradually oriented contiguity instead of two completely independent and differentiated processes. This “old” view has been recently reclaimed as not so much of a rebuttal to current hegemonic evolutionary thought, but instead as a complexification and complementation of the current dominant view about evolution. Some of these ideas will only be marginally explored, given the limitations of time and scope of this particular work. It is also important to state that this work has been inspired by the common confusion and medley made around Developmental and Evolutionary Psychology, which in Portuguese as well as in Spanish, may both be called “Psicologia Evolutiva”. In a first attempt to discern these two, it is possible to notice that the early so-called Developmental psychologists were indeed using the ideas of development (ontogenetic unfolding) and evolution (phylogenetic transformation) as somewhat of a syncretic mesh. Rescuing this particular view, I conclude by showing that the contributions of these five authors to biological, psychological and sociological thought are important for the project of complexifying evolutionary thinking today and for furthering transdisciplinary knowledge on this field of growing relevance, which is Evolution.

Introduction

Evolution is a complex word. It could be considered as an umbrella-term that conjoins a wide set of ideas, which under further scrutiny would resist being lumped together. Where did these come from? How did Evolution come to mean the change of the allele frequency through time for some, the unfolding of life forms and processes for others, and even the strife towards some ultimate perfected goal for many? I'll start this discussion with a somewhat simple and probably biased historical overlook, that will cover some initial ideas and discussions in the history of evolutionary theory and how these were translated to a Latin-american (mostly Brazilian) context. Through these I intend to differentiate the ideas
of Evolution (phylogenesis), Development (ontogenesis) and Progress (orthogenesis in the sense of a predetermined trajectory, not of a constraint- or choice-oriented one), emphasizing how they were imbricated with each other and how many of the discussions in evolutionary theory went along these axes. Along this journey, Developmental Psychology (often called Psicologia Evolutiva in older texts written in Portuguese) and the Biology of Cognition will be my partners. Jean Piaget, Henri Wallon, Lev Vygotsky, Humberto Maturana and Francisco Varela will help me out in this process, illustrating some relevant points in an ontogeny-phylogeny conjoined view of evolution, which nowadays is more and more pointed out as a relevant review of the old evolutionary conceptual framework.

Wallon will start helping me out with his model for conceptual evolution during child development as applied to scientific thinking (Galvão, 1995) and reinterpreted for the understanding of the evolution of the term Evolution: starting with a confusing and obscuring understanding of reality, the first ideas about any subject would be mostly syncretic, progressing as a result of analytical conflict and not of pacific accumulation of more information; the second stage, the categorical one, would allow the differentiation of concepts, their analysis, comparison, generalization and synthesis; and the third stage would be the dialectical or dialogical (in Morin’s view, 2003) one, when, after the different categories being well established, it is possible to syncretically mix them up in a way to produce unseen relations and creative theoretical innovations that could help making sense of a reality that is continuously escaping the capacity of our theories to grasp it. As superposed to the history of evolutionary thought, these stages would roughly correspond to: the origins of evolutionary thinking until the forging of the Synthesis with all the enriching conflicts between competing currents; from the time of the Synthesis towards the end of the twentieth century, as it became the hegemonic and even dogmatic form of evolutionary thought; and the last half a century, mostly the last twenty years, when new findings plus the rescue of a variety of different forgotten ideas fed lots of independent (and also related) claims for an Expanded Evolutionary Synthesis (Pigliucci, 2010; Kutschera, 2009) or of a pluralistic view of Evolution (Almeida, 2010; Vane-Wright, 2016; Doolittle, 2009).

There in Evolution: From Syncretic Origins

The root of the word Evolution comes from Latin, evolvere, meaning the unfolding (of a scroll). The same root (or possibly a parallel one in Germanic or Celtic languages) is claimed for the word Development, going to English through the French développer. This already explains why they should have similar meanings or be associated with a similar set of ideas in common language. The unfolding of a scroll, the revelation of its content was metaphorically bound to a process that would reveal a previously organized form, or a previously set intention. In early scientific debates, the word evolution was used by preformationists (Richards, 1994) in the sense of embryological development, meaning the unfolding of an already formed organism into its future adult form.

There was some sort of intentionality or guiding plan for this evolution/development. Also, the embryological process had a clear beginning, as well as a somewhat clear ending in the form of the mature organism. Such a process determined a way, a path through which someone could walk forward. Hence, the connection with Progress, from the Latin, progressus, an action of walking forward.

Richards (1994) highlights three moments in the early history of the word evolution: its use to describe embryological development (first by the preformationists, then by much embryological research); its bridging function in the principle of recapitulation; and its theoretically weighted deployment to refer to species change.

The bridging function in the principle of recapitulation refers to the parallels between species evolution and individual evolution, indicating that some sort of developmental laws
should be at work in both cases. In the form of the Meckel-Serres Law, the principle of recapitulation would be filled with a progressive view of nature, one which considered early embryos of “higher” organisms as similar to adult “lower” organisms. The Meckel-Serres Law would assert that the differences between species or classes would be oriented through a progressive line recapitulated in the developmental process of the embryo. Other forms of the principle of recapitulation were not as charged with a progressive view of nature as that of Meckel and Serres (see Von Baer and Haeckel). Nonetheless most of the work in this field was associated with some idea of a progressive evolution of species reflected in the progressive development of embryos.

What Richards (1994) stresses out in his research is that the term evolution being used for the transformation or transmutation of species by most authors, including Darwin himself, would index a transmission of the progressive view of embryological development (ontogenesis) to phylogenesis.

From then on, ontogenesis, phylogenesis and orthogenesis would be bound together by a common set of ideas and principles (even if only implicitly) shared by the as of yet in the process of being established community of evolutionary researchers. Even Darwin himself, with his variational (as opposed to transformationist), populational (as opposed to typological) and materialist (as opposed to idealist or vitalist) view of evolution as descent with modification by the action of natural selection (and some possible other processes), would still incur in such a syncretic mélange of these ideas. Even orthogenesis or progressive evolution towards an end-goal makes a presence: "as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection" (1859a, p.489 apud Richards, 1994).

In reading Richards (1994), we could even come to the conclusion that Darwin’s idea of evolution was imbricated with that of recapitulation, which served to connect three components of his early theory: the embryological model of evolution, the idea that the purpose of generation was progressive adaptation, and the assumption of common descent.

Through different readings, misreadings and rereadings, the word “evolution” would follow a semantic pathway historically constrained by such humble and confusing beginnings.

**Evolution, Analysed Through the Modern Synthesis**

The Modern Evolutionary Synthesis is more of a "treaty" than a theory: it was not a scientific revolution in the kuhnian sense, neither a revolutionary discovery, concept nor theory, but more like a super-, hyper- or metatheory of the ideas in circulation at the time (Callebaut, 2010). For Callebaut (referencing the works of Gould and Provine), the Synthesis could be divided in three phases: 1- the Fisher-Haldane-Wright phase, marked by the fusion of Mendelism and Darwinism, or the darwinian theory of evolution plus Mendel’s laws of inheritance; 2- Provine’s evolutionary constriction (1992) of the 1930s, that cut off many previous possible complementary views of evolution, producing an agreement about population genetics’s variables as the most important ones (if not the only ones) for the understanding of evolution; 3- Gould’s famous “hardening” (1983) of the Modern Synthesis towards a selectionist interpretation during the late 1940s and 1950s.

By the end of this process, evolutionary biology would have cleansed itself of most of the ideas that came to be regarded as anti-darwinian thinking. The term Evolution as phylogenesis (and nothing else) was purified for the by now very well established community of evolutionary biologists, although it kept its connections to ontogenesis and orthogenesis inside other communities of biological researchers excluded from the synthesis (like embryologists and natural historians), in countries outside the mostly teuto-anglo-
American axis (Sapp, 1987; Domingues, 2003; Miranda, 2005; Helmreich, 2004) and even in common language (Shelomi, 2012; Wilber, 2001; Vieira, 2012). In the supersessionist genetically-minded historiography of evolutionary theory, the contributions of the structuralists/morphologists/embryologists was regarded as old, of little relevance, inconsequential or even counter-productive to evolutionary theory; while these researchers were often considered transcendentalists, idealists, vitalists or lamarckists (Amundson, 2005; Amundson, 1998; Gilbert, 1998; Almeida, 2010). And all reference to some sort of orthogenetic process was related to spiritualist, creationist or anti-scientific views by the dominant evolutionary tradition. Evolution became the change in allele frequencies over time. It was only concerned with genes (or DNA molecules after Watson, Crick and Franklin’s discovery of the DNA structure and the beginning of the molecular age) and their function for the adaptability of living organisms. The processes of evolution were separated from the processes of living (Vane-Wright, 2016) and organisms were nothing more than the “vehicles for the genetic replicants” (Dawkins, 2016).

Brazilian Evolution of Evolution

When the concept of Evolution got to Brazil during the nineteenth century, it was received in such a way as to mix together the ideas from very different authors like Lamarck, Auguste Comte, Darwin, Herbert Spencer and Ernst Haeckel (Waizbort, 2016). This already points out to how ontogenesis, phylogenesis and orthogenesis were very strongly implicated with each other in the conceptual frameworks of early Brazilian evolutionary thinkers. For a long period of time, the predominant influence in Brazilian intellectual thought was from French origins, which may also help explain why Evolution in Brazil was seen through strong Neo-Lamarckian lenses (Sapp, 1987), being, in a Spencerian social-darwinist form, even used to justify hygienist social reforms or racial whitening (branqueamento) as a way to “evolve” and “improve” Brazilian population towards a white European superior status (Domingues, 2003; Miranda, 2005; Helmreich, 2004). Marcel Blanc (1990), in speaking of France with clear possibility of extrapolation for the Brazilian case, also raises the issue of how a Neo-lamarckian evolutionary view, with little space for chance and an idea of a constant progression towards superior forms, was more compatible with a catholic society, or with a deistic illuminist (or positivist, especially in the case of late nineteenth and early twentieth century Brazilian intellectual class) worldview, than a Darwinian or Neo-Darwinian evolutionary view.

Through the imbrication of phylogenesis, ontogenesis and orthogenesis applied to social sciences’ thinking, infantile traits were associated to less evolved in a progressive historical line, and therefore, were considered inferior, which justified racist and sexist views by the description of women and many non-european peoples as infantile, hence, inferior and requiring supervision and paternalistic help for their own beneficial development (Turchetto, 2014).

We, in Brazil, developed our own process of coming to terms with Evolution through the Modern Synthesis period, which was basically an intrinsically local phenomenon, as put by Krementsov (2007). This followed a complex pattern through which, most of the few brazilian life scientists of the time were either naturalists/taxonomists or medical doctors, both more concerned with empirical practice than with their theoretical implications for the whole of Biology. This pattern was not exclusive of this country, if we consider Wilson's account of a generation of young evolutionists not connected to the central theory during the forties to the sixties (1975). It would be later on, with the organization of a common core formation in the Biological sciences in Brazilian Universities, which started including
population and molecular genetics, that most of the Neo-darwinian or Modern thinking would be more deeply incorporated. Though, to this day, although Darwinism is a common core or cornerstone of biological thought, population thinking is not as well ingrained, having failed to establish mutualistic relations with the historical evolutionary studies (Callebaut, 2010).

**Back Again in Evolution: A Dialogue between Ontogenesis and Phylogenesis**

In following the Wallonian model for the evolution of concepts, we come at last to the dialectical synthesis (or the dialogical syncretism) that could allow some freshening of the evolutionary orthodoxy, in accordance with the view of many pro-Expanded Synthesis research groups.

The authors highlighted in the introduction all share this integrative or pluralistic view of evolutionary processes. Maturana sees evolutionary change as occurring when a new lineage is constituted by changing its way of life, that is conserved in a reproductive succession (Maturana, 2001). Evolution would then be associated with the coupling between organisms and their environments or between each other to produce reproductive communities with certain unity in phylogenetic and ontogenetic terms. In the integrative conception of Maturana and Varela, evolution is like the conservation of a coupling to the environment where there are constant perturbations transforming this coupling, in a continuous process along ontogenesis and phylogenesis. The same is true for the three authors from Developmental Psychology (or Psicologia Evolutiva, as is commonly called in Brazil): Piaget, Vygotsky and Wallon. In a more or less explicit way, usually refer to Evolution as both a developmental unfolding (ontogenesis) and the transformation of species (phylogenesis). In Wallon as well as in Vygotsky, there is an active attempt to close the gap between the history of the human species and of the individual human being. Starting from the by now well established presupposition (although not without contest) that many diverse taxa include emotional, conscious, cognitively capable and socially interactive animals (Pankseep, 2012; Low, 2012; Barron, 2016; Vane-Wright, 2016; Bekoff, 2009; de Waals, 2010; Haraway, 2016), many of their arguments will be extrapolated to complex animal forms in general.

Piaget was a biologist and, although under the mostly Neo-Lamarckian evolutionary view of French speaking communities by his time, he followed the work of other biologists. He was highly influenced by the ideas of C. H. Waddington (McCarthy Gallagher, 1977), a biologist connected to the cybernetics movement which intended to reunite genetics and developmental biology, being recognized by many as a precursor of the Evo-Devo research. Piaget takes his ideas about the process of organization of knowledge from Waddington, in a very productive analogy to the functioning of organisms through the concepts of assimilation and adaptation. Piaget himself took part in the Cybernetics movements. With a transdisciplinary nature, this movement included engineers, medical doctors, biologists, sociologists, anthropologists, psychologists and many other. We can observe the influence of this movements in may of his and Waddington’s ideas, like the one of self-regulation.

The study of self-regulatory systems with their so-called negative feedbacks, which means, of systems which possessed the capacity to compensate perturbations and keep their regulation, their original purpose, was an important part of the Cybernetics’s agenda.

Piaget’s focus in his Developmental Psychology and/or Genetic Epistemology is clearly the individual’s development and the development of his cognitive capacities, therefore, it is more concerned with ontogenesis than with phylogenesis. Nonetheless, his view of the complementarity between an organism and its environment for the developmental processes into mature forms, of the importance of learning and goal-oriented
behaviour, of the recursive niche construction in the environment, of the idea of multilevel integrated webs of processes constituting organisms, and his calling his own position a tertium between Lamarckism and Neo-Darwinism in evolutionary terms seem like more than enough to position him among post-Darwinian, epigenetic or constructionist evolutionary thinkers (Trager 2014; Almeida 2014; Campanella, 2015).

While Piaget speaks of the acquisition of knowledge as a self-regulated process through disequilibrating and reequilibrating, Maturana and Varela, who took part in the second generation of cyberneticists (the so-called Second Order Cybernetics), self-regulation becomes self-production: their central and most renowned idea of Autopoiesis. Autopoiesis is the production of a being by itself. It requires a circular causation. Living organisms are autopoietic, “their organization is such that their only products are themselves, not existing a separation between producer and product. Being and making of an autopoietic unity are inseparable” and “all cognition is an action from the one which knows. All knowing depends on the structure of the one which knows” (Maturana and Varela, 1995).

Autopoietic subjects, therefore, produce their own knowledge inside and in the function of their already situated cognitive structures; and they produce it through acting and reproduce it when they are coupled to other organisms-subjects or when they summon it to new action over the environment to which they are coupled. In the view of the Biology of Cognition, epistemology and biology are imbricated. Previous knowledge is preserved in a species as it conservs its structural coupling to its environment. These processes are rooted in the organization of living beings, as they are inserted in a given environment, assimilating it and adapting themselves to it, structuring their cognition in a dynamic way in their own biological organization - knowledge is then incorporated, incarnated in the structure and mode of organization of the living being.

For these three authors, action is the basis of knowing and all cognitive processes. Piaget will convey the idea that, without motor exploratory behaviour, ontogenesis and the genesis of knowledge will be impossible, as the individual constructs itself through its interactions with the environment.

For Vygotsky and Wallon, both very eclectic thinkers following a dialectical-materialist tradition, the environment, which will be often referred to as social environment, is in a constant dialectical relationship with the organism. There is a coconstructive process. Through work, understood as transformative action, nature and organism are both changed in a view highly similar to niche construction (Lucci, 2006). Wallon considers the relation between self and other during early development, emphasizing how this distinction is not yet clear for infants and how the other will be necessary for the differentiation and delimitation of self, for material and affective nurturing, and also for the development of important psychological functions (Guedes, 2007; Ferreira, 2010; Pereira, 2012; Malrieu, 1979).

In reinforcing Wallon’s complex and dialectical view of evolution, it is interesting to highlight his frequent use of the expression “child evolution”. This understanding of evolution as development is common among his works, in which psychogenesis, or the ontogenetic development of the person (a concept that in my view could be applied to any conscious and socially situates organism) and its psychological functions, is figured as a dynamic process of constant integrations and differentiations (Guedes, 2007; Galvão, 2011).

Vygotsky also values the dialectical conflicts as essential for the developmental process. In his view, development is a non-linear process, in which occurs the social sublation of elementary mental functions towards higher ones. (Lucci, 2006) through a constant process of meeting obstacles and dialectically overcoming them in a qualitative leap of the psychological functions (Vygotsky, 2011). Vygotskian development is a long process
marked by three main qualitative leaps: from phylogenesis to sociogenesis; from sociogenesis to ontogenesis; and from ontogenesis to microgenesis. The functioning of the brain is molded along the story of the species (phylogenesis) and individual development (ontogenesis), as a product of the interaction between the physical and the social environments (sociogenesis) (Lucci, 2006).

Two other dialectical processes are important for both Wallon and Vygotsky: the dialectics of organic and social functions along psychological development; and the dialectics of interpersonal relations in the educational process. Regarding the first dialectical pair: for Vygotsky, cerebral activity is nervous activity and also the internalization of social meanings derived from symbolically mediated cultural activity, which means that the brain is the node for the dialectical synthesis of organic and social functions; while for Wallon emotion, at the origins of consciousness (Pankseep, 2012) is the most important factor operating the passage from organic to social, from physiological to psychological activity, as an early non-intentional way of contagious communication of infants with other organisms, regulated by the central nervous system.

Now considering the second dialectical pair, it gets clear in Vygotsky’s oeuvre the importance he gives to education, considering that learning widens the field of development, which in turn actualizes the learning possibilities in a generative and recursive manner. Two developmental levels are underscored: an individual one, including what the organism can achieve by itself; and a potential one, which refer to what an organism may construct with the help of a more knowledgeable organism. This second level consists in the Vygotskian teaching-learning process (обучение; obucheniye), through which learners-teachers transform each other, enabling qualitative developmental leaps. In Wallon the interpersonal relations will start during the infant’s evolution with an affective symbiosis, required by the organism for its further development. In the educational context, learning is always a self-other relational process (being this other the environment in and of itself or the social environment with purposive social agents); and in the familial context, it will underscore the idea of familial constellation as the process of functional recognition of the different familial elements, by which the infant begins to enframe himself in a conjuncture that delimits its person (Guedes, 2007; Malrieu, 1979).

In Maturana and Varela’s conception, development and teaching-learning processes are not differentiated, being both part of a coupling process between different organisms, in which their ontogenesis are overlap and interact in a communicative manner. Organisms that interact in a recursive manner throughout their ontogenies are coupled through communication, defined as “the coordinated conducts, mutually caused, between members of a social unit” (Maturana e Varela, 1995). Transgenerationally stable conducts are called cultural. While communicative and ontogenetic conducts are called linguistic by the authors. These linguistic conducts guarantee the structural coupling of organisms in a social level, and occur as the learning of consensual conducts along the ontogenies that establish the linguistic domains in which the organisms will keep their social coupling.

For the three developmental psychologists, language is also extremely important, as thought and language modify and restructure each other in complex relations, not existing a reality anterior to or outside of language (Pereira, 2012). If we understand some sort of linguistic and/or symbolic thinking and communicative process in many different animals across different taxa (Hauser, 2002; Slobodchikoff, 2012; Ribeiro, 2007), we are able to extrapolate these considerations, making this semiotic process an intrinsic part of the evolutionary (phylogenetic process). A different and also very interesting argument for evolution as a semiotic process (which widens the scope of the previous argument) is made by Kull (2014).
The semiotic agent has an important degree of freedom in relation to choosing and making its own evolution. This agent, or subject is called person by Wallon. He is the one thinker among this set that will best elaborate on the dialectical idea of totality, a recursive whole that is made by its parts and makes them. The person is one of the four functional domains stressed by Wallon, which also include: affection, cognition and motricity. Although each of the aspects has its own structural and functional identities differentiated, they are so integrated that each one is a constitutive part of the other, resonating with each other and with the whole, the fourth domain: the person, which simultaneously guarantees this integration and is its result (Mahoney, 2005). The idea that the person should be thought of as a whole, has a direct parallel to the idea of thinking of the organism as a whole, including emotional/cognitive/motor aspects, but also ontogenetic/phylogenetic aspects or even the evolutionary and living processes (Vane-Wright, 2014). The cointeractions of such processes make the organism, which has to be understood as a complex whole historically developed in a given environment. Only this multicausal process would be able to produce the final phenotype, which then would be subject to selection, making it impossible for the genotype to be understood without the complex ontogenetic development of the final phenotype, and, hence, making it impossible for the phylogenesis to be understood separated from the ontogenesis of the organism.

**Conclusion**

Following a Wallonian conceptual evolution, we went from a syncretism between Evolution, Development and Progress through a differentiation of Evolution (as only phylogenesis), Development (ontogenesis) and Progress (orthogenesis) to a dialectical synthesis of phylogenesis and ontogenesis as one continuous and interacting Evolutionary process, a new idea free of the Progressive orthogenesis, but imbricated with a directional vector that should not be confused with a spiritual or moral progression nor with a pathway towards ideal perfection, but should be thought of as a dynamical process of complexifying adaptability in search of keeping its coupling to the environment, being it through canalization, spontaneous order, crystallisation of life, developmental biases, non-random production of variants, synergy, agency, teleonomy, behavioural choices or semiosis.

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