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***Nurture becomes nature:  
the evolving place of  
psychology in the theory of  
evolution***

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*To my three mentors:*

*Ernst Haeckel*

*who recapitulated the Body until the two columns of the Soul World.*

*Ex Deo Nascimur.*

*Carl G. Jung*

*who individuated the Soul until the threshold of the Spirit World.*

*In Christo Morimur.*

*Rudolf Steiner*

*who freed the Human Spirit in the lap of the World Spirit.*

*Per Spiritum Sanctum Reviviscimus.*

## **Background to the thesis here presented**

At the beginning of this PhD project I focused my research on the status of the so called Extended Synthesis (ES). Taking as the main reference the book *Evolution – The Extended Synthesis* edited by Massimo Pigliucci and Gerd Müller (2010). The first phase of this work consisted in the bibliographical research necessary to tackle the caveats of the ES while the second phase was aimed to acknowledge its theoretical aspects so to integrate it in the current theory of evolution.

Delving deeper into this aspect I and Sara Baccei, a PhD student of Biology at the Zoo.Plant.Lab. of the Biology Department at the University Milan-Bicocca, did a research that could bound together an empirical perspective with a theoretical one. So Baccei added her knowledge in molecular biology to my philosophical perspective on evolvability, or the “evolution of evolution”, a central theme in the ES (Pigliucci, 2008). We decided to apply this combined approach to a case study: the phylogeny of crustaceans. Comparing insects and crustaceans, it emerges that insects are in fact a terrestrial group of crustaceans. Our combined efforts culminated in a still unpublished paper “The adaptive radiation of Crustacea: success by means of evolvability” and in a lesson given for the Epistemology course of my former tutor, the philosopher of biology, Prof. Telmo Pievani.

I decided to do this preliminary but foundational research because nowadays many models applied in humanities are taken from the theory of evolution as originally thought in biology. Looking at how these models are implemented in sciences such as, sociology, economy, anthropology and psychology made me realize that a better correspondence is needed between the theory of evolution as understood in biology and its modelizations in other areas of knowledge such as the humanities.

## **Why?**

My aim is to improve the dialogue between natural and human sciences that would be fecund for both sides of human knowledge. Their future fusion in a new natural-human science, was forethought in the renaissance and romantic period and later hypothesized by scientists such as Julian Huxley, Edward O. Wilson and Lynn Margulis.

The efforts to bring together this two polarized opposites are now justified by unexpected convergences arisen in the course of their parallel histories. To reconcile the opposites of natural and human sciences is to give birth to a new epistemological paradigm. This new holistic science is now finally emerging, and once brought to its maturity it will completely revolutionize human culture. Under this philosophical perspective I focused on the relationship between the theory of evolution and psychology: how evolutionary models were applied outside the context of biological evolution in Evolutionary Psychology and memetics. My attempt in this thesis is to build a bridge between psychology and the ES.

## **The biology of the Evolutionary Extended Synthesis**

### **Introduction: recapitulating evolutionary thinking until now**

Before attempting any interpretation of its relationship with psychology it is important to understand that the theory of evolution underwent a process of maturation like any other subject, and also contain different ideas bound together by a structure of explanations.

The theory of evolution is now part of the collective imagination. If on one hand it gathers interest for its vast consequences, on the other it has been victim of a media circus. Evolutionary concepts are now often applied in other subjects, allowing the opening of new perspectives but at the cost of oversimplification and reductionism. Evolution has also been the center of the crossfire of religious fundamentalism and its take on the so called “creationism”.

The public wars between evolutionists and creationists had an extensive news and media coverage, branded as the “controversy about evolution”, but in fact this controversy was just the distorted version of the sound process of scientific debate among specialists of the field, namely evolutionary biologists. The internal debates of the evolutionary theory were exaggerated and exploited in order to make the evolution appear as decadent, “just a theory” and not a living, ongoing scientific project.

On the other hand some evolutionists, spearheaded by Richard Dawkins, rose against creationism branding themselves as the “new atheists”, also known as “Brights”. They bounded together anti-religiosity and evolution adding fuel to the fire of the heated clash, not only between religious fundamentalists and atheist fundamentalists, but also among those that had more balanced position in the middle of this two caricatural extremes.

A good antidote to these misunderstandings is to briefly recapitulate the history of evolutionary thought, so to have a glimpse that history of science is itself an ongoing dialectical process: the

contemporary theory of evolution passed different phases before coming to the present form. Three processes, more than others, helped shaping the theory: 1) giving up essentialistic positions derived from classic philosophy; 2) acquiring of independent proof from different collateral sciences; 3) gathering of quantitative and descriptive sciences.

It was just 150 years ago that the concept of descent with modification was introduced by Charles Darwin in *On the Origin of Species* (1859). While the idea of a transformation of the inorganic into organic matter and of one organism into another had been already proposed by classical philosophers and their followers such as Aristotle and Averroes, Epicurus and Lucretius, Goethe with the doctrine of metamorphosis (1790), Lamarck with the transformism (1809); the mechanism on how this transformation occurred was still lingering.

The idea of natural selection was the beginning of the paradigm shift that took place in biological sciences. The great evolutionist and ornithologist Ernst Mayr pointed this out in his *One Long Argument* (1991), stating that the revolutionary character of descent with modification resided not in evolution itself but in natural selection and its population thinking. Natural selection forces us to consider the quantitative aspect of Nature and not only its overabundant qualitative aspect: populations of organisms become the directly observable reality and their imperfections the proof of their gradual evolution in the history of life on Earth. It indeed a long argument that goes from Linnaeus' defining mottos "*Tot numeramus species quot a principio creavit infinitum Ens*" and "*Varietates laevissimas non curat botanicus*" (1735) to their reversal in the ever transforming world of the descent with modifications of Darwin:

*"There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or*

*into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."*

An important step in the definition of the mechanism of evolution was taken by August Weismann when, at the beginning of the twentieth century, reinforced the idea of "hard inheritance", or the "inheritance of innate characters", necessary for the selective mechanism implied by Darwin. He demonstrated the impossibility of "soft inheritance" or inheritance of acquired characteristics, implied instead in Lamarckian evolution (even though we now know that there are many exceptions to the so called Weismann barrier). This form of Darwinism became known as Neodarwinism: a Darwinism more Darwinist than Darwin himself, since he did not exclude soft inheritance.

The evolution of the theory of evolution slowed down after Darwin's death. Once the idea of evolution was ingested and digested by the scientific community, the question remained over the mechanism that made it work. Different schools of thought were born, often with a strong theoretical orientation and scarce empirical enquiry: saltationism (endorsed by Goldschmidt and Wöese) proposed that evolutionary change was not an accumulation of small selected changes, but a sudden change from one generation to another that produced the so called "hopeful monsters"; mutationism (endorsed by Morgan and De Vries among others) proposed instead the absence of a selective mechanism, attributing the appearance of adaptation to simple statistical distribution; orthogenesis (of Rosa and De Chardin) paralleled evolution to embryological development, and so the history of life was a foreordained progress from simplicity to complexity due to internal cellular mechanisms. All of these approaches were extremizations of what was already comprised in the nutshell of

evolution: only in modern times we understood what was still acceptable of those theories and what not.

To put order into this chaos of incompatible theories a new generation of scientists, during the forties of the twentieth century put together a new vision, what was later called the Modern Synthesis (MS) born out of the efforts of the ornithologist Ernst Mayr, the paleontologist George G. Simpson and the geneticist Theodor Dobzhansky: the role of the MS was to incorporate experimental and quantitative data in the new genetic paradigm, both at the cellular and the population level, and putting these together with the naturalistic and descriptive aspect of biology, derived from immense species catalogues of botany, zoology, and paleontological records. The MS became the new evolutionary paradigm after the crisis of neodarwinism, expanding the synthetic, explicative, predictive power of the theory of evolution.

The MS articulated around the strong core of natural selection, reformulated under genetics terms, and common descent: beyond these simple assumptions, there are attached other satellite concepts: gradualism (or gradual evolution, small changes accumulated through time); macroevolution as an extrapolation in time of microevolution (macroevolution “is just” microevolution in deep time); adaptationism (the characteristics of organisms are mostly adaptations for survival). Also random mutation is implied, the initial random variation is the chaotic *prima materia* under which then natural selection acts in order to produce adaptations.

The MS remained stable until the seventies were new developments in theoretical matters exploded even publicly in the “evolution wars”: the internal debate made its way to the public scene with the transoceanic tit-for-tat between the American paleontologist Stephen J. Gould and the British ethologist Richard Dawkins about the role of natural selection and the unit upon which selection acts. Their visions polarized the two natures of the core MS: on one hand

Gould stressed the importance of the paleontological record, geographical mechanisms of speciation and its history of “contingency”. He and Eldredge proposed the model of punctuated equilibria, in which speciation occur in small, secluded geographical areas where small changes are accumulated rapidly, and then the new species supplants the older one. For them the unit of selection is the individual organism. Doing so, they theorized the descriptive, naturalistic side of the MS.

Vice versa Dawkins gave more weight to the genetic component of evolution, proposing the gene’s-eye view: in many cases it is the gene that is the unit of selection, where natural selection is not a passive sorting of multiple species, but the only shaper of adaptive change through the accumulation of adaptive traits. He theorized the quantitative, genetic side of the MS.

The evolution wars had their apex in the nineties and continued until the beginning of the twenty-first century with the premature death of Gould in 2002. At the end of the wars, Dawkins wrote an eulogy of his academic adversary, stating that despite all the differences, their thinking was still more similar than anything creationism proposed and that they contributed to fight. But, nevertheless, the “teach the controversy” argument of creationists began as a distortion of the evolution wars themselves.

Coming to the most recent developments, the addition of molecular biology between the sixties and eighties to the evolutionary studies allowed the emergence of previously unexpected and unthought discrepancies between the study of biological form (morphology) and molecules. Especially molecular phylogenies clashed with the established morphological ones. The debate that sprung between morphologists and molecular biologists right at the end of the evolution wars allowed the marriage of the historic and paleontologic side of the debate with the molecular and neontologic side, giving birth to new subjects able to investigate areas that were

still quite obscure: evolvability (or the capacity of evolution to evolve over time), the evolution of complexity, the evolutionary developmental biology (or evo-devo), hierarchical selection and the new genetic mechanisms of epigenetics.

These new developments led many biologists to announce the arrival of an extension of the theory of evolution, the Extended Synthesis (ES), but at the same time, still lingering because of the the persistent state of fragmentation of the theoretical apparatus of these recent experimental developments. See Figure 1 below.

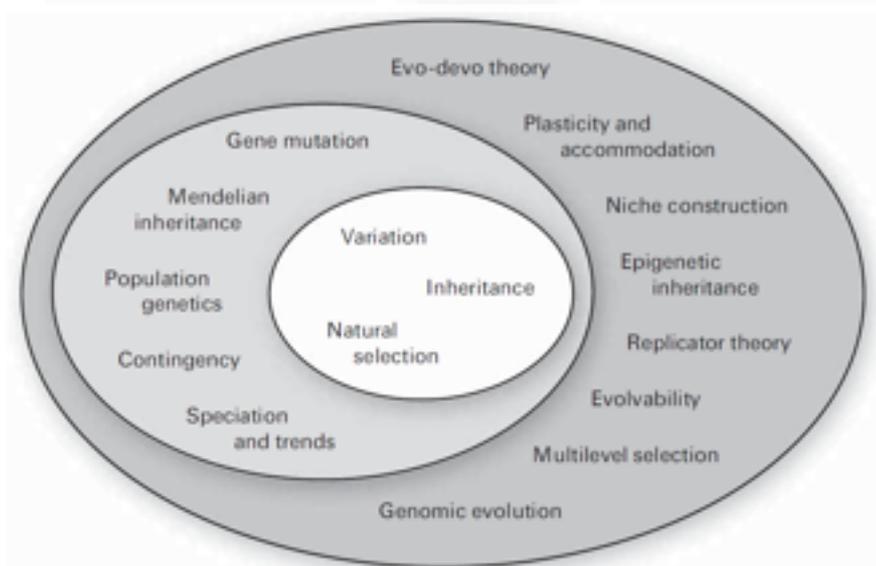


Figure 1: taken from *The Extended Synthesis* by Pigliucci and Müller (2010). The original theory of Darwin is shown in the white set, while the Modern Synthesis is shown in pale grey. Finally the dark grey set is for the Extended Synthesis. Each set is perfectly contained in the successive one showing an overall progress in the evolutionary theory.

The new and hoped for ES would have at its core the same assumptions of the MS but extended: 1) variation upon which natural selection acts is both genetic and epigenetic; 2) selection acts on many different levels of selection each with its unit of selection; 3) structural aspects not due to selective pressures; 4) existence of macroevolutionary mechanisms that do not pertain to the microevolutionary dimension. Through this extension of the MS, the

theory of evolution would reach “evolutionary pluralism” that is realized through: 1) the plurality of rhythms of evolution, between the two extremes, gradualism and punctuated equilibria; 2) plurality of the units of selection (from genes to clades); and 3) the plurality of ways in which the form of living organisms is produced (form-function dialectics).

### **What is epigenetics?**

Epigenetics was foresighted by Waddington in 1942, in order to describe the hypothetical direct interaction between environment and genes, forming the portmanteau from epigenesis (the additional differentiation of organism during development) and genetics. The actualization of this (Riggs et al., 1996) is the field of biology that investigates the mechanisms of phenotype change that do not involve a change in the genotypic counterpart of the DNA: so epigenetics changes occur upon (the prefix epi-) the DNA without an actual mutation of nucleotides. Interestingly enough these changes can be inherited, thus resurrecting from the much scorned grave of discarded theories Lamarck’s heredity of acquired characteristics rephrased as “epigenetic inheritance”,. The main genetic mechanism under which the whole of epigenetics works is DNA methylation: it acts by regulating gene expression by attaching a methyl group to specific regions of the DNA called silencer regions. Then, these modifications are passed down to successive generation of cells, through normal cell division (either mitosis or meiosis) causing a different expression of a character in the body of the organism affected by methylation. The main example is how different cell types (epitheliums, muscle fibers, neurons etc.) are maintained in the body, originally differentiating from the zygote and multiplying down through the whole ontogenesis. A proper analogy describes DNA as a complete archive of files, while DNA methylation would selectively hid some

files so that they become inaccessible, making them unreadable. See Figure 2 below.

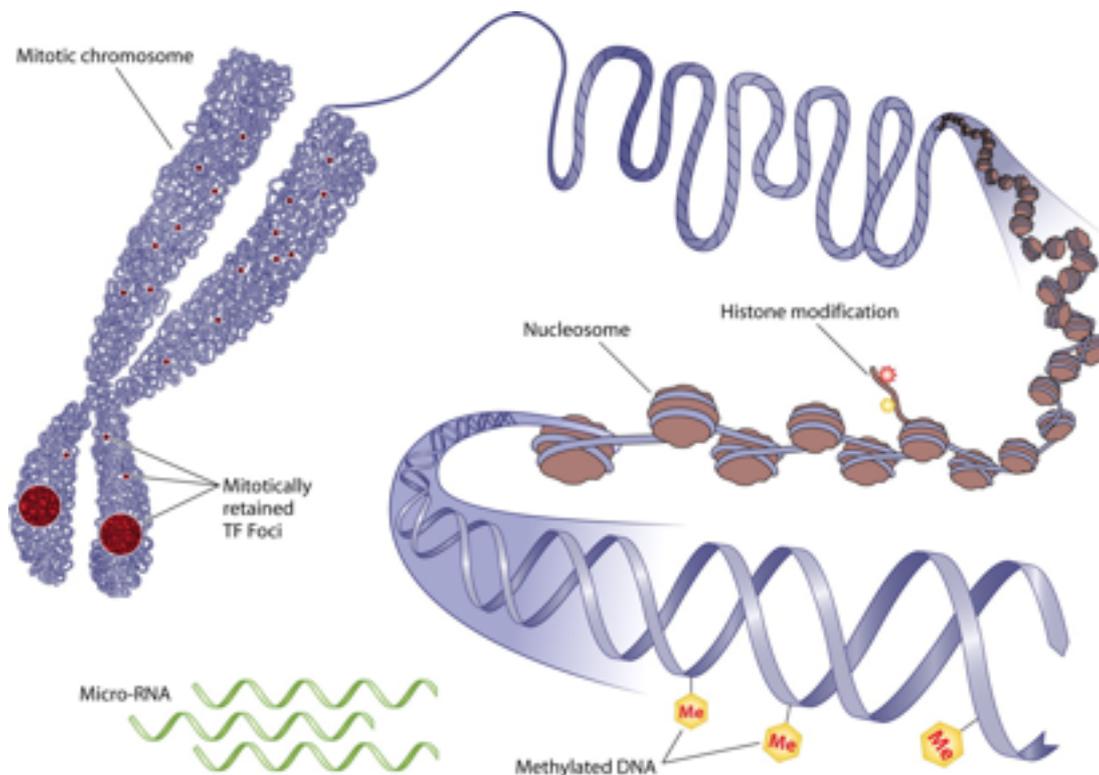


Figure 2: Epigenetic mutations do not modify the DNA itself, but instead methyl groups are attached to DNA, activating or deactivating gene expression. Micro-RNA is a newly discovered epigenetic mechanism. Image taken from: <http://episona.com/short-introduction-epigenetics/>

This has been a conceptual breakthrough in biology, for it reinstated a useful concept originally brought in by sheer observation of the changes of living beings through generations in their proper context, Nature. From the breaking of this taboo a the new concept of epigenome was born: there is a parallel sequence to the literal genome, composed of the nucleotidic sequence of DNA, that is written in an epigenetic code composed by all the features exhibited in the phenotype by a cell. It's the set of chemical markers responsible for the activation and silencing of genes. In epigenetics, DNA become the potential, while only the epigenome is the real thing. This epigenome can be arranged in epigenomic maps in order to visualize all the gene expressions regulated by DNA methylation.

### **So, what are the consequences of epigenetics?**

Apart from the mere conceptual shift in biology (a huge one), the main consequence of epigenetics is in the field of developmental biology. Somatic epigenetic inheritance is responsible for the whole development of eukaryotic multicellular organisms: without it is simply impossible to have the differentiation of cells and of these into tissues, that equals the impossibility of having multicellular organisms. It is the process of morphogenesis that coordinate the silencing or activating of genes thanks to DNA methylation. While many other animal phyla retain the ability to regenerate their parts or the whole body, in mammals the differentiation of cell types is permanent with the exception of stem cells which remain able to differentiate in other types of cell (totipotency). Notably, nerves and limbs are not able to regenerate when cut off. Instead the majority of plant cells remain able to differentiate or even produce a new plant. Medicine will benefit the most from this new biological point of view: many genetically determined diseases can be understood and eventually cured. The same capital importance is in the study of cancer.

Epigenetic changes can be at any time during life if the environmental conditions are met (Campbell, 2011). Studies conducted on monozygotic twins demonstrated that the changes accumulate progressively, so that younger twins have less epigenetic changes and later in life their epigenome differs greatly than in infancy (Fraga et al. 2005). Also the effects of epigenetic changes can be inherited by meiotic division from parents to children, it follows that newborns are not genetically neutral but bear epigenetic changes mediated by their parents environments. See Figure 3 below.

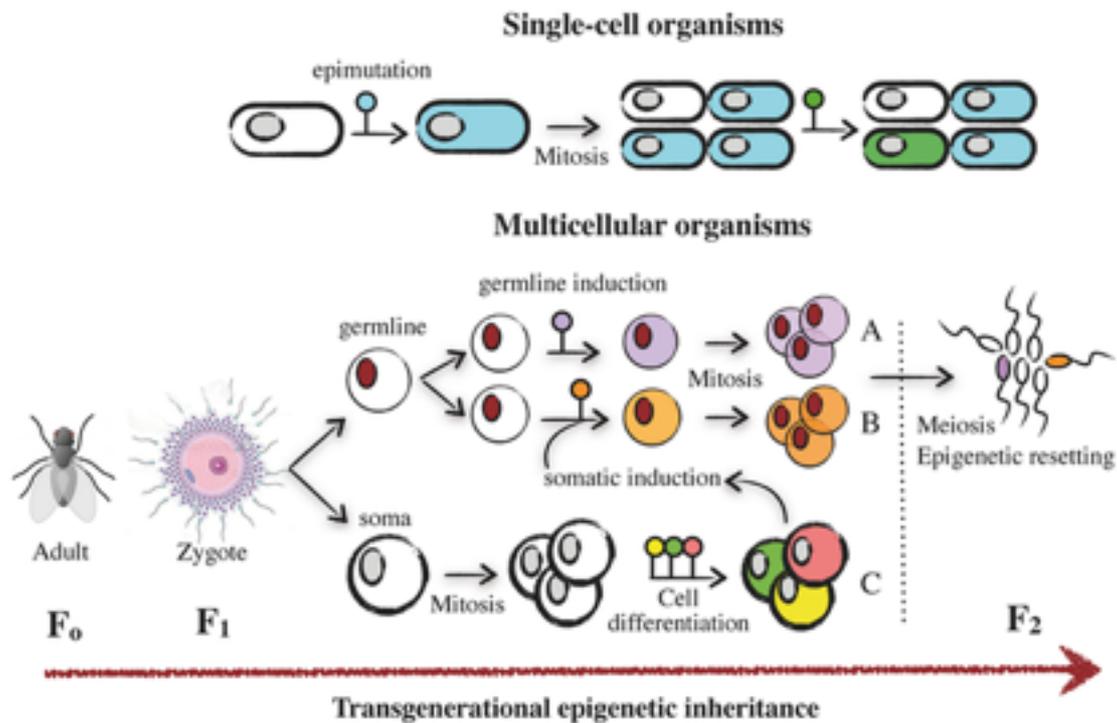


Figure 3: Epigenetic mutations can be inherited from one generation to the other either of a somatic or germ cell on the same organism via mitosis, or onto different generations via meiosis. Image taken from: <http://www.plospathogens.org/article/info:doi/10.1371/journal.ppat.1003007>

But the main interest for the current study is the impact on evolutionary theory, especially in the form of the MS (Jablonka and Lamb, 2005). Being mediated by the environment, epigenetic mutation is not the result of chance, as staple mutations are. The Weismann barrier has been the hallmark of evolutionary theory since the birth of neodarwinism, but now epigenetic mechanisms cracks it: the barrier is not absolute and epigenetic inheritance is the norm in plants, microbes and many animals. Epigenetic rates of mutation are much higher than mutation rates (Rando & Verstepen, 2007). All of this implies that epigenetic changes have adaptive roles despite the denial phase of many biologists (Lynch, 2007). Even if epimutations are more easily reversible than mutations (Lancaster & Masel, 2009) any epigenetic characteristic can be a short-term adaptation able to allow a lineage to survive the necessary time for the genetical assimilation of that same adaptive change. This in turn allows a wider

margin for evolvability, or the ability to of evolve, a key concept in the ES, to increase further as the lineage evolves (Griswold & Masel, 2009). Also this is the biological phrasing of the Baldwin effect or ontogenetic evolution proposed by the psychologist James M. Baldwin in 1896, in which general learning ability is pushed continuously before in ontogenetic development of positively selected offspring, so that the behaviour of a species (or group) is the driver of that species evolution. This is especially interesting for this study since it can potentially glue together the study objects of memetics (memes) and of evolutionary psychology (the EPMs, evolved psychological mechanisms), so we will return on this later.

### **Epigenetics and psychology**

The importance of epigenetics in psychology is increasing, with two intertwined levels of studies: on compares animal and human behavior, while the other is building the epistemological structure of the underlying biological mechanisms of psychology.

Behavioral epigenetics (Miller, 2010) studies how gene regulation modifies animal behavior. Epigenetic mutation affect the growth of neurons in ontogenesis (Juliandi et al., 2010) and the activity of the neurons in an adult brain (Ma et al., 2010). The pioneering work of this field was conducted on rats (Weaver et al., 2004): different type of mother-offspring interaction affected how the adult rat responded to stress situations. Less nurturing brings a decreased expression of glucocorticoid receptors and thus higher sensitivity to stress in adult life of rats. The differential expression is due to the epigenetic regulation of the glucocorticoid receptor gene that affects the hormone levels in the brain. After this study, one on humans followed: it compared two different groups of suicide subjects, one that suffered child abuse and one that didn't. The study found that abused suicide victims had less expression of glucocorticoid receptors than non-abused suicide victims and non-

suicidal subjects. This study confirmed the findings of the first rat study (McGowan et al., 2009) and at the same time suggests a deeper relationship between epigenetics and psychology.

The first studies to specifically account for humans focused on the differences between monozygotic twins, for example epigenetic variation linked to risk-taking behavior and anxiety levels, were correlated to choices in life, the abuse of alcohol, traveling and career. Nonetheless the same study affirmed that epigenetic variations could influence lifestyles but cannot predict complex decision making (Kaminsky et al., 2008). Another study focused on the prenatal effect of maternal depression: the prenatal exposure to depression or anxiety in mothers resulted in an increase of DNA methylation of the glucocorticoid receptor gene (Oberlander et al., 2008).

Other studies focused on mental health studying the epigenetic effect of drug and alcohol addiction. Generically, a stressful environment pushes toward substance abuse, this in turn generate a cascade of epigenetic mutations that might account for addiction-specific behavioral changes (Wong et al., 2011; Maze & Nestler, 2011), like repetitive habits with increased disease risk, individual and social problems, need for immediate gratification, high risk of relapse even after treatment, loss of control (Marlatt et al., 1988). The epigenetically active substances comprise alcohol, nicotine, opiate, cocaine and amphetamines. The behavioral mechanism is a positive feedback, the more consumed, the more the craving, exploiting brain pleasure and reward areas (Renthal & Nestler, 2008). The epigenetic alterations can be long-term, and relapsing in the addiction assures epigenetic mutation to be maintained. Other areas of research includes memory decline, eating disorders, obesity, bipolar disorder and schizophrenia, all somewhat linked to epigenetic mutations.

The boundaries between nature and nurture softens as the Weismann barrier cracks, and so from the comparison of animal and

humans, we arrive at the core of this study, how nurture becomes nature (Powledge, 2011) envisioning an epigenetic psychology. Some researches list epigenetic changes as a possible mechanisms to the effects of psychotherapy (Masterpasqua, 2009): the “reprogramming of DNA” through psychotherapy might not be a sci-fi fantasy after all. The expression of genes is mediated by the interaction between the individual and the environment, making a direct connection between heredity and psychological experiences. Different schools of psychotherapy create different environments for the psyche in which the dialectics between patient and therapist, conscious and unconscious, can induce positive changes to the epigenome, thus acting directly on the biochemical machinery of DNA. This a watershed that involves biology and psychology as well.

### **The limits of epigenetic psychology**

The most obvious limitation of a new born field of study is its own infancy. The human specific studies barely reach past the 2010, with some initial findings in the 2008 study on suicide victims (McGowan et al., 2009). It might be too early to speak of this incipient science and further speculation offered in this study will rely on other branches of biology and psychology, in order to circumscribe the matter properly.

Another constrain is that many studies are too narrow and focus on just one gene (Baum & Contrada, 2010) even though interactions between them are more important in influencing psychological traits (Kalant, 2010). Multigenerational studies are also limited. Also the direct access to human samples is a huge challenge to statistics on epigenetic neurological researches (Powledge, 2011), not counting that other tissues may respond differently to epigenetic mutations (Albert, 2010) making such investigations even more complex.

The comparison between animal and humans is also useful, but also too tempting. The extrapolation and projection of conclusions in

animals onto humans must not be automatic (Miller, 2010; Kalant, 2010) just because these studies are so reductionist in their scope that the holistic complexity of the animal, and moreover human individual, can easily be neglected.

### **What is evolvability?**

Evolvability is the ability to evolve or the capacity of an evolving system to generate adaptive evolution (Colegrave & Collins, 2008). The concept of evolvability is part of the ES and one of the main new additions to the MS. A biological system is evolvable if it shows: 1) heritable genetic (and epigenetic) variation; 2) if natural selection or other mechanisms (such as the Baldwin effect) can act on that variation; 3) these variations are adaptive (Wagner, 2005). Evolvability works at least among three different time scales (Pigliucci, 2008), that span from the time scale studied by quantitative genetics, then population genetics and finally on a macroevolution scale. Evolvability is strictly dependent on the interaction between genotype and phenotype and thus depends on both mutation and epigenetic mutation (Wagner & Altenberg, 1996).

During the history of evolution, as lineages evolved new adaptations, their genome (and possibly, epigenome) became more and more capable of harness positively selected mutations, so that evolvability increased in the course of the history of life benefiting not only single individuals, but also entire lineages which in turn were positively selected. If a lineage can produce more phenotypic variation (or phenotypic plasticity), either through genetic or epigenetic mutations, it will have a higher degree of evolvability. The combination of genetic and epigenetic mutations amplify the effect of variation, and this is especially evident in pleiotropic genes, that affect more than one phenotypic trait (Olson-Manning et al., 2012). Modularity, or the presence of functional modules in organisms, is an important premise for evolvability: from several repeated modules,

differentiation occurs. A mutation can be expressed in one module and not affecting others, so freeing adaptation from the constraints of multiple mutation in different functional regions of the body (Draghi & Wagner, 2008). See Figure 4 below.

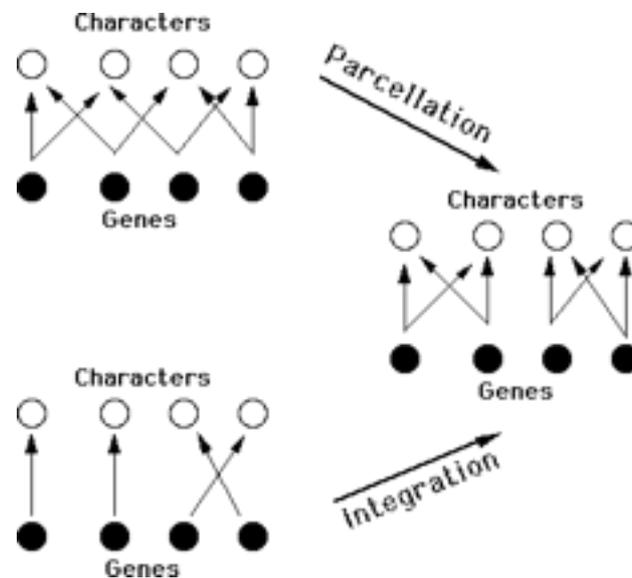


Figure 4: the general pattern of evolution from homogeneity to modularity, both at the phenotypic (characters) and genetic (genes) level through the mechanisms of parcellation and integration. Parcellation is the division of modules, integration is the cross regulations between one gene and different characters (pleiotropy). Image taken from: Gunter P. Wagner and Lee Altenberg (1996), "Complex Adaptations and the Evolution of Evolvability", *Evolution* 50 (3): 967-976.

Sexual reproduction, through meiotic division, generates more variation than asexual reproduction, and so the short-term energetic cost of sex would be compensated by more evolvability in the long term.

Another source of variation viable for evolvability is stress, that induces mutations and epimutations even though the majority of this are negatively selected (Ram et al., 2012) . But the negative mutations can be silenced. In fact variation is accumulated by organisms (evolutionary capacitance) and can be selectively released with the help of molecular mechanisms called evolutionary capacitors. These molecules are able to activate or deactivate epigenetic variation, so that allow organisms to generate more variation when required by the environment. When a variation is

adaptive, it this fixed with genetic assimilation, while the negative variation is again deactivated so to exploit the new trait without bear the burden of others (Bergman & Siegal, 2003).

The Baldwin effect can also increase evolvability by the learning process: several behavior act like a source of phenotype variation used to explore possibilities of surviving in the environment, that are later incorporated in the specific behavior of a species via selection and genetic assimilation (Hinton & Nowlan, 1987). Then, various mechanisms act to adjust the total variation, such as: mutation to the previous state, sexual and asexual reproduction, inbreeding and outbreeding, dispersal in the environment. Some mechanisms, instead creating more variation, just amplify the magnitude of existing variation so that selection can work more intensively (Olson-Manning et al., 2012).

### **What is evo-devo?**

Evo-devo is a relatively new field in biology, it compares different developmental sequences found in different species trying to reconstruct the primitive sequence of ontogeny that later gave rise to divergence through evolution. The difference in the development of organisms, studied at the molecular level, should reveal the mechanisms under which the evolutionary change occurred. It underlies the importance of developmental plasticity and the common evolutionary origin of mechanisms and structures (homology) as opposed to similar mechanisms and structures evolved independently (analogy and homoplasy) (Hall, 2000). The first studies in this regards were conducted by the early morphologists such as the french school of Lamarck and Saint-Hilaire for invertebrates, and Cuvier in compared anatomy of vertebrates. Goethe was the father of the germanic tradition, and coined the word “morphology” (1790) as the study of pure forms, in both the living and non-living world.

Two contrasting tendencies has been discovered: one at the molecular level, the other at the morphological one. At the molecular level there is a tendency towards a molecular economy or the rearrangement of old genes into new genes, while at the morphological level there is an opposing tendency to create novelties, new shapes and forms (Palmer, 2004). See Figure 5 below.

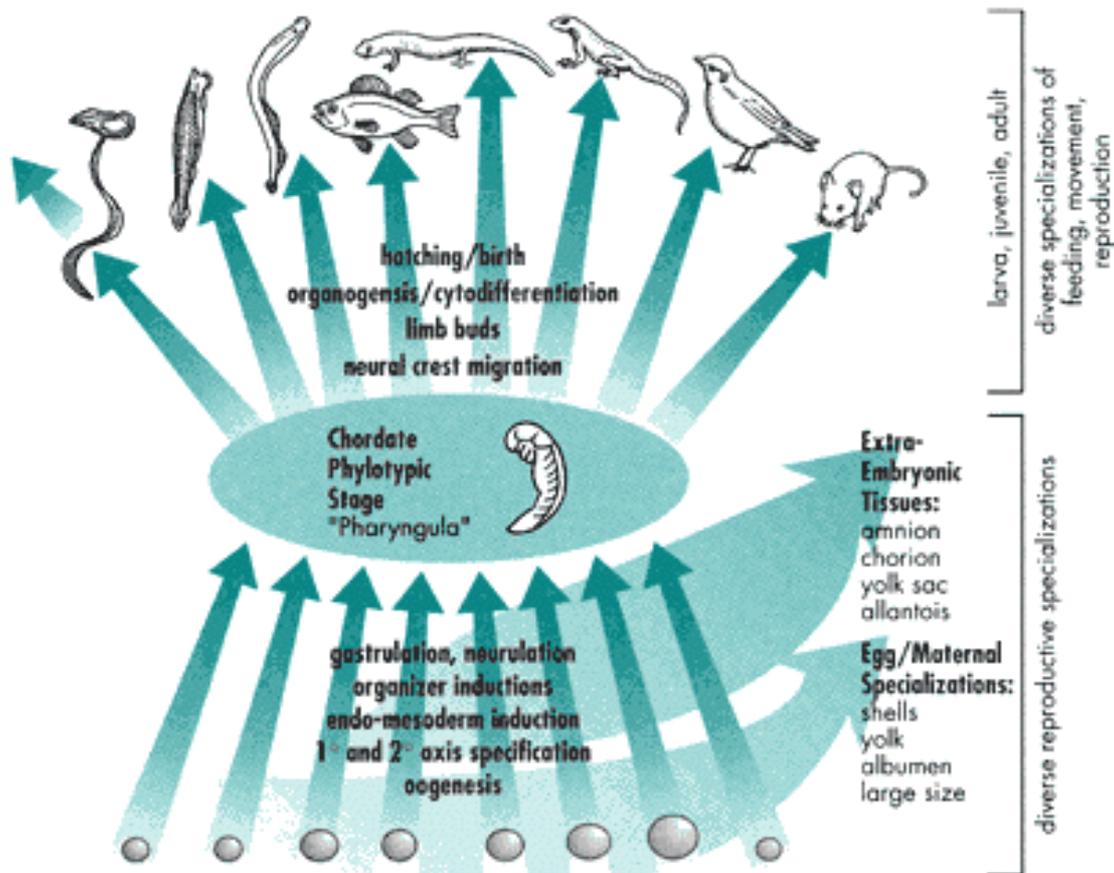


Figure 5: Evo-Devo studies the origin of the body plans (*baupläne*) of living beings. In the case of vertebrates, while their shape as a zygote is similar, they then develop into many different adult forms, passing through a common stage called pharyngula. Image taken from: <http://scienceblogs.com/pharyngula/2006/08/24/the-politically-incorrect-guid/>

### The concept of developmental-genetic toolkit

Evo-devo revolves around the concept of developmental-genetic-toolkit. During experiments with various organisms chosen as models for developmental studies, it has been observed a relatively small set of genes that regulate the entire development. This toolkit of

genes is highly conserved across living organisms (both in animals and plants, albeit in a different way), and the alteration of the activation of this toolkit leads to dramatic alteration of the body plan of the organism, leading to malformations. See Figure 6 below.

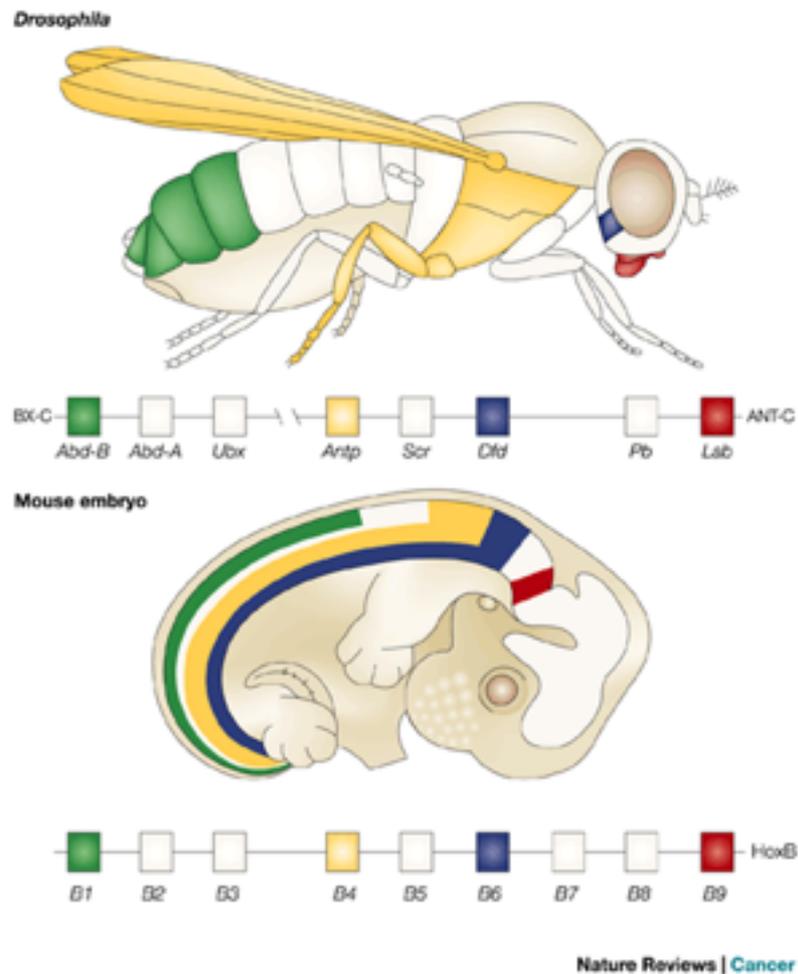


Figure 6: *Drosophila* and vertebrates (mouse embryo) share the same basic arrangement of the genetic tool-kit (here HOX genes are shown). Colors show the correspondence between the body plan and the actual gene sequence. These genes are in fact positioned on the DNA in the very same sequence in which their phenotypic products are to be found on the organism itself. Image taken from: [http://www.nature.com/nrc/journal/v2/n10/box/nrc907\\_BX2.html](http://www.nature.com/nrc/journal/v2/n10/box/nrc907_BX2.html)

So a great deal of the evolution of form is under the control of the expression of the genetic toolkit. This led to the paradox aforementioned in which the diversity of body plans in living organisms is not mirrored by a diversity of genes in their genome. Thus at the population level, the process of speciation, or the birth of

a new species, is not linked to the evolution of a new gene, adding to genetic variation, but the different expression of older genes. This is why epigenetic mechanisms are important for evolution: for they first introduce variation expressed in the regulation of genes and then they become assimilated in the genome as genetic mutations. It is possible that ancient multicellular organisms were more prone to epigenetic mutation than modern organisms, allowing for a greater variance of forms that through the process of macroevolution led to the first experiments in the history of life (Müller & Newman, 2003).

### **Nurture interpreted by nature**

When psyche and culture are interpreted under a biological paradigm, the results are: an evolutionary interpretation of instincts, such is evolutionary psychology; and an evolutionary interpretation of concepts as living beings, such is memetics. But there are several missing links required to understand this transition, steps that lead from the core of evolutionary biology, directly into the origin of psychotherapy.

### **Which place takes psychology in evolution?**

Taking as a lead the great questions in philosophy of biology as posed in the book *Contemporary Debates in Philosophy of Biology*, edited by Ayala and Arp (2010), the question which this project dares to answer is: which place takes psychology in evolution?”. The answer to this question needs to be sought in the complex relationship that emerged historically between psychology and evolution. First of all it is possible to recognize two starting points: one is Freud’s “psychosexual development theory” of Freud and Jung’s “theory of archetypes”. As noted by psychologists Francesco F. Pieri and Anthony Stevens, and biologist Stephen J. Gould, Mario di Gregorio and Robert John Richards; Freud’s psychoanalysis and Jung’s analytical psychology are linked to two parallel perspectives in biology, the same perspectives that dominated ‘900 biology and which lay at their very core. The first is the ontogenetic perspective of the development of one individual since the fecundation of the ovum, and the second is the phylogenetic perspective of the evolution of a species from the first common universal ancestor to one species. Starting from this premises these two authors came to quite different epistemological conclusions: Freud’s psychology strives to answer the existential question of “*Where do you come from?*”, thus pointing to one’s past, while Jung’s psychology strives instead to answer “*Where are you going?*” thus pointing to one’s future.

The dualism implied by these two psychologies, is a mirror reflection of the dualism that lied deep in Ernst Haeckel's theory of recapitulation, a central notion of '900 biology as pointed out in Gould's *Ontogeny and Phylogeny* (1976). "Ontogeny recapitulates phylogeny" is the haeckelian aphorism: the strong version of this theory stated that during individual development (ontogeny), the living being repeated the main sequence of evolutionary novelties that its ancestors evolved first in the history of life (phylogeny). The theory of recapitulation can be considered true, even if in a less absolute manner, when framed in broader complex of embryological mechanisms. See Figure 7 below:

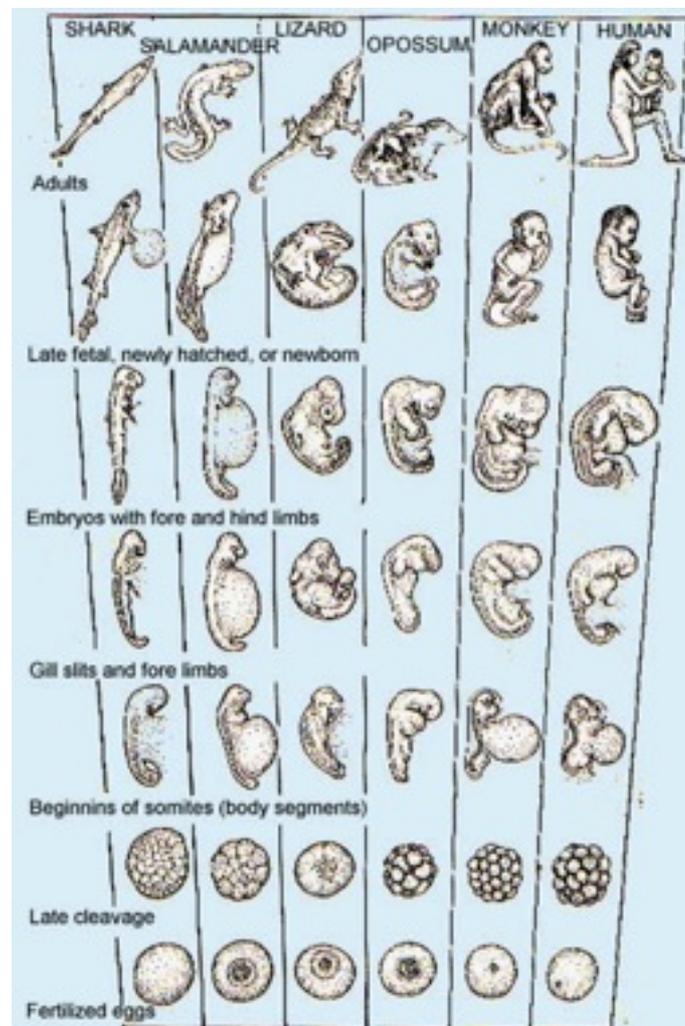


Figure 7: Vertebrates show a high level of similarity in their ontogeny despite their diverging adult form. Image taken from: <http://ideonexus.com/wp-content/uploads/2010/01/evolutionembryos.jpg>

The relationship between development and evolution is one of the main areas of research of the ES: the evo-devo or evolutionary developmental biology. As we saw, it compares the embryological development of different organisms, so to discover the common mechanism of both individual development and phylogenetic evolution.

### **The bridge between biology and psychology: human ethology**

Ethology deals with the behavior of an animal species in its natural or in an artificial environment. Historically it was founded by Konrad Lorenz and Niko Tinbergen in the 1930s: they expanded the evolutionary theory from the study of biological form and structure to behavioral patterns, especially through studies on innate behavior, defining what is now known as instinct.

Tinbergen formalized the basic questions for any ethological research, both animal or human: 1) function (adaptation): what is the adaptive function of a behavior? 2) causation (mechanism): which stimuli are required for the behavior to manifest? 3) development (ontogeny): does the behavior change in time, and if yes how? 4) evolution (phylogeny): how does the same behavior appear in related species? How might it have evolved in the first place? (Tinbergen, 1963). See Figure 8 below.

		Object of Explanation is...	
		<b>Developmental</b> Explanation of current form in terms of a sequence	<b>Single-Form</b> Explanation of one form of a species
Question is...	<b>Proximate</b> "How" questions	<b>Ontogeny</b>  Description of the development of a behavior and its genetic basis	<b>Mechanism</b>  Description structures and functions related to behavior
	<b>Ultimate</b> "Why" questions	<b>Phylogeny</b>  Reconstructed history of the behavior, both within and across the species	<b>Adaptation</b>  Selective advantage(s) of a behavior

Figure 8: Following Tinbergen, any evolutionary question can be pinned down to one of these four possible questions out of the combination of question and object of study. These are the same causes Aristotle dealt with: ontogeny is the formal cause; mechanism the material cause; phylogeny the efficient cause; adaptation the final cause. Image taken from: [http://www.reed.edu/biology/professors/srenn/pages/teaching/web\\_2010/anglerfish\\_MFS/index.html](http://www.reed.edu/biology/professors/srenn/pages/teaching/web_2010/anglerfish_MFS/index.html)

The focus moves from the adaptive nature of the behavior of a single species to its evolutionary origin when comparing different but related species. Answering all these questions brings to an ethological history of a species or group of species, completing one other. Human ethology expands this species-wide interest to the human species and its behavior.

The first attempt to root human behavior in ethology was conducted by John Bowlby and Mary Ainsworth (Ainsworth & Bowlby,

1991). They used the ethological perspective to understand the relationship between infant and mother, developing the attachment theory. The theory used evolution to explain child behavior such as crying, babbling and smiling while looking at the face of the mother: they interpreted these actions as instincts, even present in deaf infants, used to communicate with the mother or a surrogate caregiver, eliciting her attention. On the other hand, adults are adapted to notice typical juvenile characteristics, especially in body and head proportions: the cuteness of an infant creates affection in the adult, so that they become their protectors. These are present to some extent in both apes and humans. 6-9 months are required for the attachment to be stable: this relationship model defines all the other relationships that will come later in adulthood. See Figure 9 below.

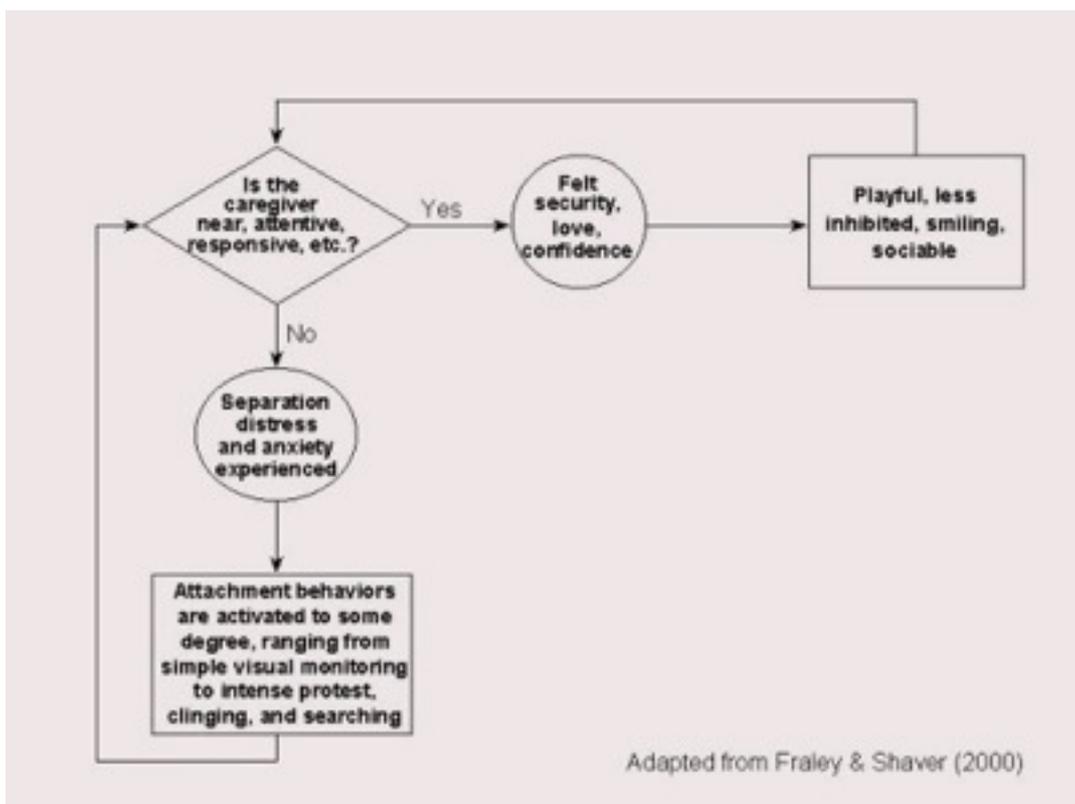


Figure 9: Bowlby's attachment theory is based on a single main question: is the caregiver attentive toward the child? The outcomes of this yes/no question are then shown as psychological developmental patterns. Image taken from: <http://internal.psychology.illinois.edu/~rcfraley/attachment.htm>

From these simple observations sprung several assumptions about “human nature”: family, groups and nation are all based on a common social instinct. Man is a social animal. Society builds up on the attachment bond, extended and telescoped in adulthood. Society grows in a stable and specific environment, fostering culture through language and altruism. On the other hand, aggression serves as a means to deal with other indirectly related human groups which might compete for the same resources and towards which the “struggle for survival” is directed (Lorenz, 1974).

Human ethology considers the biological basis of behavior as rather unchanged since the evolution of *Homo sapiens*, so it starts with the analysis of everyday behavior and breaks it in simpler units, trying to retrace their evolutionary history. Sociality, language, gestures, are especially investigated as basis of all human behavior and a link with other closely related animal species, apes. The evolution of humans from primate ancestors is seen as a product of natural and cultural selection, and DNA is seen as a repository of the past of the species, which can be reconstructed through comparison (Eibl-Eibesfeldt, 1989).

Lorenz stressed on the automatic and passive response to stimuli: different instincts are organized in fixed action patterns that help the individual to survive in stable environments where the same stimuli are repeated and so the same action is required. The opposite of instinct is learned behavior, typical of humans. For Lorenz, the infant human passes from a more instinctual behavior to a more learned behavior in adulthood. This has been the dominant view in the beginnings of ethology. But Bowlby instead stressed a different interpretation of human behavior stating that humans respond actively to environmental stimuli, and even act spontaneously to seek for food, help since infancy and then for mating in adulthood.

This new view of Bowlby resulted in the definition of “motivational states”, which are complementary to Lorenz’s external stimuli: a combination of a positive motivational state and a stimulus is then called an appetitive behavior. This was the first breakaway from the animal ethological paradigm that subsequently led to the formulation of a series of hypothesis on the evolution of human behavior not just based on a passive response to the environment but on active patterns present since birth, the evolved psychological mechanisms.

### **What is evolutionary psychology?**

Evolutionary psychology is a fairly recent approach in psychology that aims to interpret human behavior in terms of adaptation to the environment. In this fusion of psychological and evolutionary studies, human psyche turns out to be a product of a process of darwinian selection, either natural or sexual. Thus darwinian selection is responsible for our “human nature”. At the very foundation of the psyche rests a complex of modules, analogous to organs in the body, able to work together in order to solve recurring problems that the ancestral human beings encountered in the primordial environment where they evolved. This modules are psychological adaptations or evolved psychological mechanisms (EPM) that occur in all human cultures around the world independently by specific environmental circumstances. Such EPMs include cooperation, empathy and the recognition of kin and possible partners (Pinker, 2002; Durrant & Ellis, 2003; Buss, 2005; Tooby & Cosmides, 2005; Confer et al. 2010).

This evolutionary approach is constantly growing in its pervasive interpretation of human psychology (Wright 1995; Schacter et al. 2007), especially due to its successful prediction when applied in subjects such as economy and management. This recent successes in such crucial subjects, at least for our economy-driven society, led

evolutionary psychologist to state that an evolutionary approach to human psyche is the only possible metatheoretical framework of psychology able at the same time to produce convincing predictions in the same way it does for biology (Cosmides & Tooby, 1997; Duntley & Buss, 2008; Carmen et al. 2013).

Despite these bold statements, or possibly because of them, evolutionary psychology has been also the target of criticism and harsh controversies, ranging from exquisitely theoretical doubts about the testability of such studies to political issues due to some questionable ethical conclusions that followed dubious studies (Rose; 2000).

### **The core of evolutionary psychology**

Evolutionary psychology is an attempt to integrate different human disciplines in a logical scientific research program able to reach testable conclusions about human nature. This means the repositioning of psychology inside the natural sciences nesting it inside anthropology and anthropology in primatology and so on. The “theoretical glue” for this synthesis being the evolutionary theory (Tooby & Cosmides; 2005).

The evolutionary theory comes in a large set of hypotheses (Pinker, 1997) that work together to explain the complexities and seemingly contradiction of human behavior. The vast majority of evolutionary psychologists base their understanding of the evolutionary theory in a particular form called gene-level selection also known as gene’s-eye view of evolution or, less poetically, genetic reductionism. This view has been popularized by Richard Dawkins in his bestseller *The selfish gene* (1976) but it was developed some ten years before by his mentor, William D. Hamilton (1964). It states that the unit of darwinian selection and thus of evolution is the “gene”, or the smallest unit of information contained in the entire DNA sequence, or genome, of an organism. The organism is a vehicle for

genes that strive to replicate themselves. Genes or replicators achieve this by building suitable vehicle for themselves and their replication, biological machines like human beings or animals, or plants or any other living being.

The same reductionist view is somehow reflected in how evolutionary psychologists handle the human mind: their understanding is in fact based on the computational theory of the mind. This theory put in modern form by Hilary Putnam in the sixties, was then developed and popularized by Jerry Fodor until the eighties (Putnam, Hilary, 1961; Horst, Steven, 2005). Despite being considered as a limited philosophical approach it still thrives in cognitive psychology and, through its mediation it has been borrowed in evolutionary psychology where it became dominant. It states that the brain is a computer, the hardware, while the mind is a software run by the brain itself (Block, 1995). Mental processes are computational operations that are neurologically processed, so that an input coming from the outside world requires an appropriate behavioral output. Simplistic as it may seem, this analogy allowed an unparalleled domino effect in the modelizations of human mind.

### **Evolved psychological mechanisms**

Evolutionary psychologists developed an analogy between the body as a complex of organs and the mind as a complex of mechanisms. Just like human body is shared among all member of the human species so is the mind. The reason for this equivalence resides in the same evolutionary mechanism that developed both structures: darwinian selection. So both body and mind have the same reasons to exist: the survival and the reproduction of the fittest individual. As the human body evolved through the course of hundred millions of years, so has the mind.

EPMs include the empathy toward other's emotions, the recognition of kinship, the ability to cooperate in small groups,

altruism and couple forming. The role of kin selection in the emergence of EPMs is thus stressed in order to explain the ubiquitous presence of social behavior in humans in the face of competition or the “struggle for survival”, as posed by darwinian mechanisms of selection (Grafen, 1984).

Other than social behavior, there are EPMs for associating taste with nutritional value, like in the case of savory, sweet, bitter and acid; and possibly some fears like the ones for animals such as snakes, spiders and rats or heights and dark. Some EPMs are considered obligate, more connected to strict survival independently by immediate environmental variation (like the repulsive response to physical pain); while others are considered facultative and thus become active only when some conditions are met in the environment during the development of the individual (like trust and lasting bonds with others). This latter EPMs that are activated by succession of events in time are the main focus of evolutionary developmental psychology, that adds the ontogenetic perspective to the phylogenetic one already addressed by the main evolutionary psychology.

There are also sex related EPMs, that are paralleled to sexual dimorphism in biology. Among these lie some of the most controversial statements made by evolutionary psychologist such as a greater lust attributed to males in order to maximize their reproductive success while females exhibit coyness and romantic feelings in order to attract males able to fertilize them and capable of rear them and their offspring (Symons, 1979). The more these parallels delve into gene’s-eye view the more they become controversial, disregarding the particular conclusions of social sciences (Barkow et al., 1992).

Nonetheless not all EPMs are adaptations: evolutionary psychology already tried to counter the adaptationist risk of the “just so stories”, *ad hoc* hypothesis just as persuasive as shallow. Among the EPMs there are in fact both Gould and Lewontin’s exaptations

and spandrels (1979) that are in fact the opposite of adaptations. While an adaptation is a trait of an organism evolved for a specific function, an exaptation is an ancient adaptation that later changed its function into another. Finally, a spandrel is a by-product of an adaptation that has no current function, like vestigial organs. One of the main tasks of an evolutionary psychology is thus to be able to distinguish and classify among these three different classes of EPs (Williams, 1966) through at least three criteria: universality (present in all humans), complexity (part of a complex of simpler traits) and functionality (is able to perform a task useful for survival). But this is indeed the most difficult task for a psychology so deep entangled in genetic reductionism and hardware/software analogy.

### **Environment of evolutionary adaptedness**

Just as the environment poses problems to be solved, human mind is able to solve them because it is a product of that environment. It is therefore crucial, evolutionarily speaking, to understand the ancestral environment in which the mind evolved: this is what is referred as environment of evolutionary adaptedness (EEA) (Rubin, 2003). This idea was first brought up by John Bowlby in the late sixties, in developing his attachment theory (Bowlby, 1969) but later developed in a more ecological fashion as a portion of the space-time where recurring selective pressure concurred to form adaptations.

Compared researches in paleontology, paleoanthropology and archaeology suggested that the long lost EEA might belong at the time when the genus *Homo* evolved, between 1.5 and 2.5 millions of years ago roughly at the beginning of the Pleistocene (set 1.8 millions years ago and ended 12.000 years at the end of the Ice Age) (Symons, 1992). Evolutionary psychologists hold that this was the period when most EPs evolved and where fixed by means of natural selection so that human mind is essentially a “pleistocenic

mind” thus able to solve “pleistocenic problems” such as mating, parenting, coupling, social relationships.

This EEA was very different by the environment in which humans lived subsequently until now. Pleistocene humans had a small society composed by small groups, composed by hunter-gatherers that fought for resources and territories with other small groups. Modern hunter-gatherer groups are used as relict examples of that pleistocenic mind, backed-up by primatological and ethological studies of the great apes (chimpanzees, bonobos, gorillas and orangutans) (Wright, 1995). See Figure 10 below.

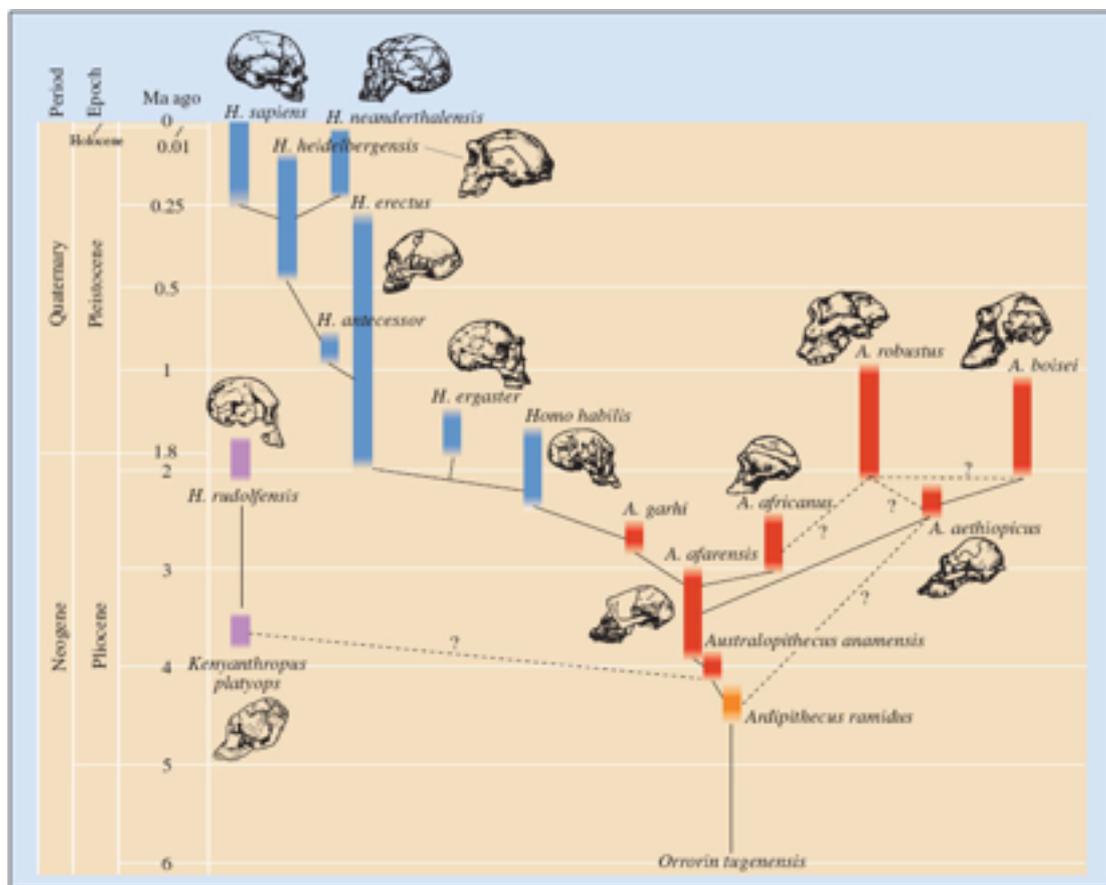


Figure 10: Human fossil record and possible evolutionary relationships. Under evolutionary psychology, the Pleistocene is the geologic epoch in which the EEA forged the so called “pleistocenic mind”. Image taken from: [http://open.jorum.ac.uk/xmlui/bitstream/handle/10949/918/Items/S182\\_10\\_section4.html#FIG010\\_003](http://open.jorum.ac.uk/xmlui/bitstream/handle/10949/918/Items/S182_10_section4.html#FIG010_003)

But just because there is a striking difference between the hypothesized EEA and the changes later occurred in environment where humans lived, especially in the more technologically advanced countries, a mismatch was created among human mind and the modern environment. This new and alien environment poses questions and risks that the pleistocenic mind is not able to answer properly if not at all, resulting in behavioral abnormalities or mental diseases. One of the most famous examples is the fear for snakes and spiders that, despite being way less dangerous than guns, provoke a fear response that is more widespread than the fear of guns (Ohman, Mineka, 2001). This is because snakes and spiders were present in the EEA while guns were not. Also, the food industry use supernormal stimuluses, such as flashy colors, sounds and visuals, in order to trigger hunger, thirst or need for fat, salt, sugar that are already abundant in our diet (Barrett, 2007). While advertisement uses sex coupled with unrelated subjects in order to make the non-sexy subject sexy itself (like car and women, for example), or family and “good feelings” to project a sense of protection on other goods (Barrett, 2010). The mismatch thus poses the greatest risks for the pleistocenic mind, that can be exploited or exposed to risks without even being able to recognize them.

### **Research methods**

In accordance with the intrinsic heuristic power of the evolutionary theory, evolutionary psychology test hypotheses are formulated using a wide array of methods aimed to detect the presence of an EPM, instead of spandrels or simply random variations in the population. Buss (2011) lists the main methods. The first is “cross-cultural consistency”: it refers to the presence of some traits in different cultures. Smiling, crying and laughing are universal among humans and thus trespass cultural boundaries making them EPMs. Generally, the more a trait is close to be universally spread

among different individual across different human populations (the so called “cultural universals”), the more is regarded as a good example of EPM (Buss, 2011).

Other two methods comprise the relationship between form and function: one approach starts from the problem leading to the solution, or “function to form” a fact in human behavior is thus interpreted as adaptive. Vice-versa the other approach starts with the solution and reconstruct the original problem, and is called “function to form” or reverse-engineering. An example of the former is “paternity insecurity”: males are not able to recognize their offspring, therefore their jealousy would be directed to sexual infidelity of females rather than emotional. While an example of the former is morning sickness and aversion to some foods during pregnancy, that might be an adaptation to prevent the eating poisonous food. The last approach in discovering EPMs is the study of neurological modules, so that a neurology can explain how a mechanism works while evolutionary psychology why it evolved in the first place.

Data testing includes animal behavioral experiments, comparison with paleontological and archaeological discoveries, ethonologic studies of relict and conservative societies, psychological tests (Buss, 2004). But a more modern approach mainly uses mathematical models and computer simulations (Omar et al., 2006, 2008; Lima et al., 2009).

### **The problems with evolutionary psychology**

Since the beginning of evolutionary psychological studies there has been a degree of criticism around both the premises and the conclusion of such studies (Rose, 2000). The implications of confounding theoretical and factual instances in evolutionary psychology studies led to ethical issues.

From an ethical perspective evolutionary psychology can be interpreted as ideology-laden especially on the issues of gender and

race equality. Some questionable hypotheses on sex behavior, the most infamous being rape as an alternative mate choice for poorly fitted individuals (Thornhill & Palmer, 2000), have also sparked harsh criticism (Richardson, 2007) not devoid of reasonable justifications. Evolutionary psychologists came up with the counter-argument of the so-called “naturalistic fallacy” (that somewhat ironically is an EPM itself): it states that “natural equals good” and so that their definition of rape as an EPM does not necessarily imply its justifiability. But this naturalistic fallacy has been so overused that in fact becomes a way to avoid any ethical discussions on such matters (Wilson et al., 2003).

Evolutionary psychologists often propose their theory in opposition to the explanation given within the so-called standard social science model (SSSM). SSSM is, in their own words, the “blank state” of human mind that sees mind as a cultural product, completely devoid of innate tendencies (Pinker, 2002). In the evolutionary psychology literature this is regarded as the dominant view of social sciences until the arrival of evolutionary psychology itself. But critics from the social sciences consider this statement as an overtly oversimplification of their subject in order to create a straw man argument (Levy, 2004; Richardson, 2007).

Another source of criticism comes from evolutionary biologists that sees the genetic reductionism and determinism implied in EP (Maiers, 2003). Often studies are unable to address the complexity of human behavior by simply considering only the general patterns in human behavior, neglecting individual experience and being unable to describe individual cases. Evolutionary psychologists argue that discover and describe universal behavior is precisely the scope of EP, and its focus is not on proximate causes (i.e. how) but on ultimate causes or why a certain behavior might be evolutionarily advantageous or not.

Also EP hypothesis seem to suffer from a degree of difficulty in testing, if not an impossibility altogether. This puts EP under the

scrutiny of epistemological studies, trying to debunk it as pseudoscience (Schacter et al., 2007). The hypothesized EEA in particular is heavily criticized as being vague and too speculative as a premise to yield a strong basis for further theoretical elaborations. But this is a bias that afflicts any evolutionary study: evolutionary studies rely on the accumulation of data derived from a range of disciplines in order to circumscribe an observation then explained by an hypothesis that is confronted with other similar cases (Buss, 2005).

One final criticism concerns the analogy between the modularity of the body and the mind (Kurzban, 2011) somewhat resurrecting the core idea of phrenologists. EP posits that modularity is more evolutionarily advantageous because of its plasticity in coping with different input at the same time (for the same reason that parallel multiple computational processors are more efficient than one big central processor). But again, EP critics see this multiplication and subdivision of EPs as a theoretical artifact because the neural structures of the brain allow for more general processes that are subsequently adapted for the specific case and not a variety of structures each with a single function.

### **What is evolutionary developmental psychology?**

As the synthesis of evolutionary biology with developmental biology led to evo-devo in the '90s; and the synthesis of this latter with psychology was somewhat implicit, and led to evolutionary developmental psychology EDP during the '00s. The analogy rests as on the recapitulation theory as usual: if evolution (phylogeny) can explain why development (ontogeny) is so, and if development involves also the organs of cognition, there must be a degree of dependence between the development of the mind (psyche) to the one of the body (soma).

EDP holds some evolutionary assumptions as well as developmental: 1) all the characteristics of an organism arise out of

an individual development, towards the somewhat fixed adult form, so the whole development is the object of study. 2) the interaction between genes and environment is the dynamic source out of which evolved characteristics sprung; 3) the constraints of this dynamic process are genetic, environmental and cultural. The developmental assumptions are: 1) humans need an extended childhood in order to learn how to behave in a complex environment; 2) many childhood traits (like playfulness, curiosity etc.) serve as preparatory stages for future adult activities and are the product of evolution (deferred adaptation); 3) other traits are childhood specific and do not serve adulthood (ontogenetic adaptations); 4) during development, humans pass from a stage of maximum behavioral plasticity (childhood) to a minimum (old age).

So the mind of the developing adult is the end product of a process of natural selection. As we will see later, it involves both genetic (mutation) and epigenetic changes (DNA methylation). The way the developing mind works would be predicted by a complete evolutionary history of the species: “why” things are as they are is the key to “how” things work as they work.

EDP somewhat tries to put the focus on the child, countering the adult-centered focus of much evolutionary psychology. Also, they tried to counter the strong genetic reductionism and determinism, source of the major debates of evolution, and out of which evo-devo itself was born in the first place. The internal debate is the same as EP, the prevalence of domain-specific EM over domain-general EM or vice versa capable to explain how the human mind works.

## **What is memetics?**

When Dawkins popularized his gene's-eye view of evolution, he also proposed, almost as an mere example of what he meant, the concept of "meme" or cultural replicator (Dawkins, 1976). From that single eleventh chapter the whole analogy between genome and culture literally exploded, giving birth to a whole theory, aptly named "memetics", itself an analogy to genetics. The whole dawkinsian analogy runs along the line of the replication of biological and cultural information. Genes are units of information in biology and so memes are in the study of culture. Just like genes are hosted by their living vehicles, memes are hosted by minds.

Memes can be replicated from mind to mind mainly through the mechanism of imitation, in all its various aspects, one of which is the process of teaching and learning. For this reason the meme is also a unit of imitation (Dawkins, 1989) and is precisely in the possibility of a meme to be replicated that resides the difference between a meme and a mere idea, which can sit silently in the mind, it can come and go in a mind totally unnoticed by others.

The similarities between cultures can then be explained by an endless chain of memes running through generations of minds through imitation. Imitation allows information from the outside world to be internalized in a mind, while sense organs mediate between the inner and the outer world, the brain stores memes. Memes can also be stored in other "retention systems", a general term in memetics for describing books, electronic memories, and recordings of information. Once stored in a repository, being organic or not, memes can be imitated or copied again and so on, actively replicating in minds or other retention systems.

Just like genes, can be inherited and changes through time displaying both a certain degree of consistency (for example through traditions, learning by heart or written documents) and evolution (or change in time, for example through conscious innovation or

serendipity). The rate of mutation of memes is high and can occur both in a generation (in a lamarckian way) or across generations (in a darwinian way). Blackmore (1999) adds that mutations are also introduced in a darwinian fashion by imitating the structure of a meme (copying the instructions) or in a lamarckian fashion by imitating what a meme produces (copying the product).

Memes survive one generation passing down to others, and thus they achieve the same kind of “immortality” attributed by Dawkins to genes: even if the individual host, the vehicle, is not immortal, the information carried by vehicles, the replicator has this potential. In other words, a book survives as the author dies. Also, many memes thrive thanks to the benefits of single strong memes by piggybacking their replication success, this creates meme complexes or memplexes. Memes that replicate well together coadapt and coevolve in new organized whole, that on its turn creates a suitable environment for new memes that can attach themselves to the core memes of the memplex. Memes that are satellites, accessorial or fringe in respect of a memplex can be excluded eventually forming other memplexes. Human culture is the sum of all memplexes.

Some memes are more suited for replication than others, and memes that are good at being copied spread and thrive in culture, while other less able memes linger as minority and then disappears over time. This is defined as memetic selection. But in the place of natural selection that positively selects only the genes that serve some degree of usefulness to their hosts (or that pass unnoticed by the selection process), memetics posits that memetic selection does not necessarily select for the advantage their hosts but mostly of memes themselves.

In fact the reproductive success of a meme does not lie necessarily in its content of “truth”, but mostly on the “grip” on the host’s mind. Most of this grip derives from very basic biological instincts and needs (such as hunger, thirst, fear, lust, power and so

on) but others are more subtle and imply complex behavior, these mechanisms comprise the actual demonstration that a meme works in reality (for example the concept of wheel) or in a formal context (for example mathematical theorems); the answer to a question (such as religious answers to existential questions, or political answers to people needs and demands); threat and reward (or the carrot and stick method) as a consequence of spreading or not spreading a meme. The more a meme is discussed, subject to dedication by a group of people, the more it becomes word of mouth, thus enhancing its replication rate.

Some authors stress the aspect of memes as “mind viruses” able to spread in minds through “thought contagions” (Lynch, 1996; Blackmore, 1999). Mass hysteria, copycat crimes and suicide, urban legends represent extreme examples of memes as mind viruses that can spread by the media even just announcing the news.

In this way, memetics aspires to explain all cultural systems, including controversial subjects such as political ideologies or religious beliefs. The meme, memetics and all the concepts implied in the study of memes are considered memes themselves, thus susceptible to the same mechanisms of other memes.

### **What is a meme?**

Being a replicator, memes have the three properties originally defined by Dawkins and later by Dennet (1991). In order to qualify as a replicator, any unit of information must display: 1) variation, or change in time of its qualities; 2) heredity, the ability to replicate copies of the same unit; 3) fitness, a differential in its suitability to a certain environment. In Dawkins words, whenever this three properties come together, there is evolution. It follows that if these conditions are not only met by biological systems, but also by cultural systems.

Wilkins formally described a meme as “the least unit of sociocultural information relative to a selection process that has favourable or unfavourable selection bias that exceeds its endogenous tendency to change.” (Wilkins, 1998). This definition avoids both the most troubling aspect of memes: the quantitative aspect (“how big is a meme?”) and the qualitative aspect (“what’s the biological structure of a meme?”). Blackmore (1999) states that a meme cannot be defined in quantity since they are units of imitation, how much of an idea is imitated depends on the idea itself. She gives the example of Beethoven’s Fifth Symphony, the related meme can be defined as the whole symphony or just the most famous initial notes. Nonetheless there has been an effort in describing how memes can be stored in brains using neuroimaging techniques (McNamara, 2011) so to map patterns of activity and connectivity between the various regions of the brain.

### **What to do with memes?**

The meme-gene analogy proved its heuristic power in various contexts. Some authors, like Blackmore (1999) and Dennett (1995), uses memes as a worldview, a meme’s-eye view useful to both describe and to some extent predict the way in which culture evolves. The second way strives to prove the material basis for memes in the human brain (Aunger, 2002; Edmonds, 2009). The third way uses memes to describe how the mind works within the theory of the mind, the evolution of language and the sense of self (Blackmore 1999, Poulshock, 2002). For example Blackmore applied memetics to the concept of self-identity defining the self as the ultimate memeplex, named “selfplex”, which comprise the whole collection of stories regarding a the biography of an individual.

Moreover, Blackmore proposes a mechanism for the peculiar evolution of man: given the fact that man is a case of heterochrony, of displacement of ontogenetic development, more specifically neoteny,

in which the adult man resembles more the infant stages of his primate cousin, the chimpanzee, than its adult stage. See Figures 11 and 12 below.

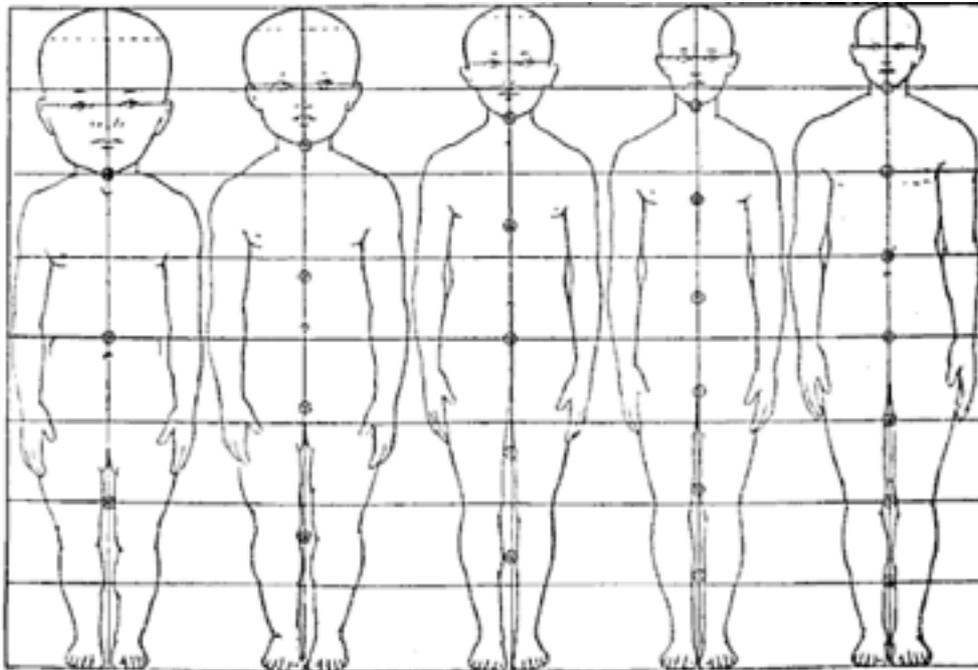


Figure 11: Neoteny in human beings. The relative proportion of the head in respect to the whole body shows that humans are in fact enlarged babies. Image taken from: *Journal of Heredity* (1921) Volume 12, pg 421.

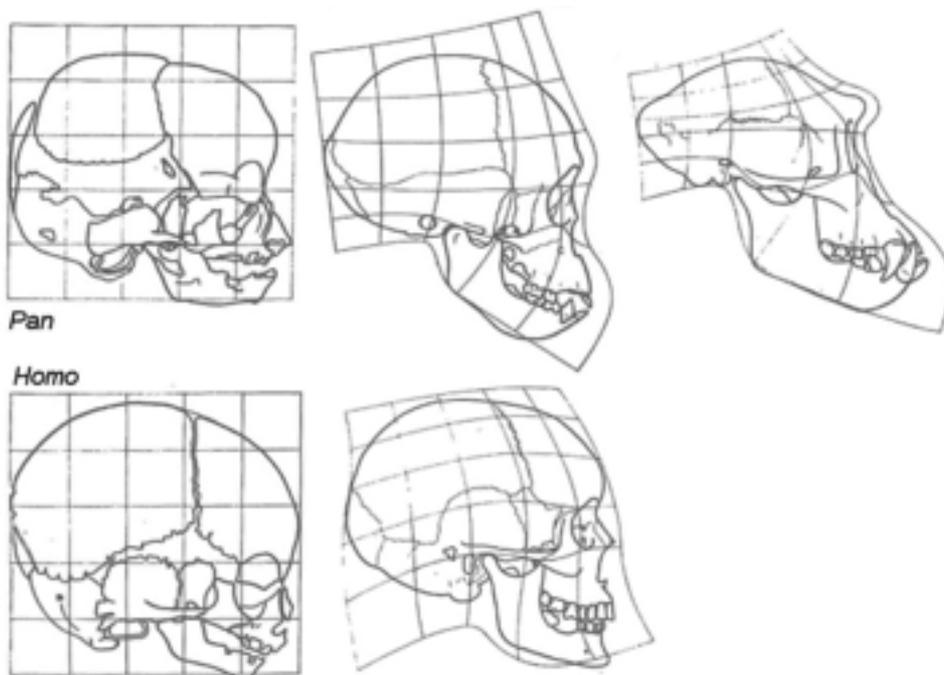


Figure 12: Neoteny in human beings in respect to the chimpanzee. The adult man is more similar to the juvenile chimpanzee than the adult chimpanzee. Image taken from: [http://www.mun.ca/biology/scarr/Neoteny\\_in\\_humans.htm](http://www.mun.ca/biology/scarr/Neoteny_in_humans.htm)

This enabled man to evolutionarily retain not only juvenile morphological characteristics when sexually mature (i.e. the absence of fur, high forehead, pointy nose, subcutaneous fat etc.), but also an ever-delayed ethological and psychological maturity, so that the newborns are born totally hapless and the adult still retain the potential to learn, a feature rarely seen in animals, but more often in domesticated animals (which, unsurprisingly, are the outcome of artificial selection for tameness, and so neoteny). Given this premise, Blackmore proposed that the “memetic drive” is the mechanism through which man acquired neoteny. It is an interesting hypothesis based on the exponential increase in burial rituals, cave art and tool-making since their appearance, and language acquisition. Sexual selection acted in such a way that humans chose partners for their memetic potential, their ability to imitate patterns and create culture. The more the partner could learn, the more he or she was attractive and this acted selecting for a neotenic pattern of development. Blackmore also retraces this memetic drive in the critical period hypothesis of language learning.

The memetic discourse works well within semi-closed contexts of religious belief, political ideologies and scientific theories. Dawkins (1976) proposed to apply the concept to religions, in order to avoid group-selection thinking linked to the theoretical advantage given by belief systems in human populations. In this view memes are selfish replicators as if seeking their own ways to replicate even despite their human hosts. Lynch (1996) went on analyzing the modes of memetic transmission built in religious memplexes: some religions encourage proselytism thus fostering the “spread the word”; others stress the importance of punishments, for example condemning behaviors that contrast meme replication such as apostasy; on the opposite heavenly reward reinforces the idea of intrinsic goodness of such deeds. Blackmore (1999) elaborated on this concept adding that

religious memplexes contain both defensive mechanisms for their survival and replication, such as preaching faith in order to hijack critical thinking, rituals involving the cyclical repetition of excerpts from sacred texts or by being kind to others in order to link religion with benevolence.

Science and memetics itself is not spared by this caustic process of analyses, so that religious traits can be seen in the scientific communities that refer to one or few authorities such as Freud regarding his psychoanalysis and Darwin in the context of natural selection. Racism was interpreted using memetics by Balkin (1998), arguing that racist ideologies are memetic narratives that develop in small communities: when a relatively closed community encounters another, the two identity-defining narratives are often incompatible. Competing for or trading the same resources ends in a cultural clash that fosters the hate for the other community seen then as an enemy.

Memetics has also been used to explain literary, artistic styles, or architectural styles. Dawkins (1976) originally used the example of arches as a meme that was a technique imitated for its engineering value. While the urbanist Salingaros (2008) used memes to explain how buildings are receptacles of shape memes that can be either adaptive or maladaptive for humans. Architectural structures and forms bear memes as instructions for their own construction. Even if lacking meaning or functionality, these memes act unconsciously on humans that end up reproducing those same forms. The more simple they are the more they powerful is their reproductive advantage.

A recent but nonetheless application of the concept of meme comes from Internet culture (Schuber, 2007). The way information spread on social sites such as Twitter, Facebook or YouTube is sufficient to generate a continuous flow of images, videos or messages that replicate. The site Know Your Meme (<http://knowyourmeme.com>) is dedicated to track those internet memes

providing a historic background to their birth, spreading and death. TV Tropes (<http://tvtropes.org>) is instead dedicated to the analyses of memes contained in works of fiction, either in tv, movies, books, comics. See Figure 13 below.

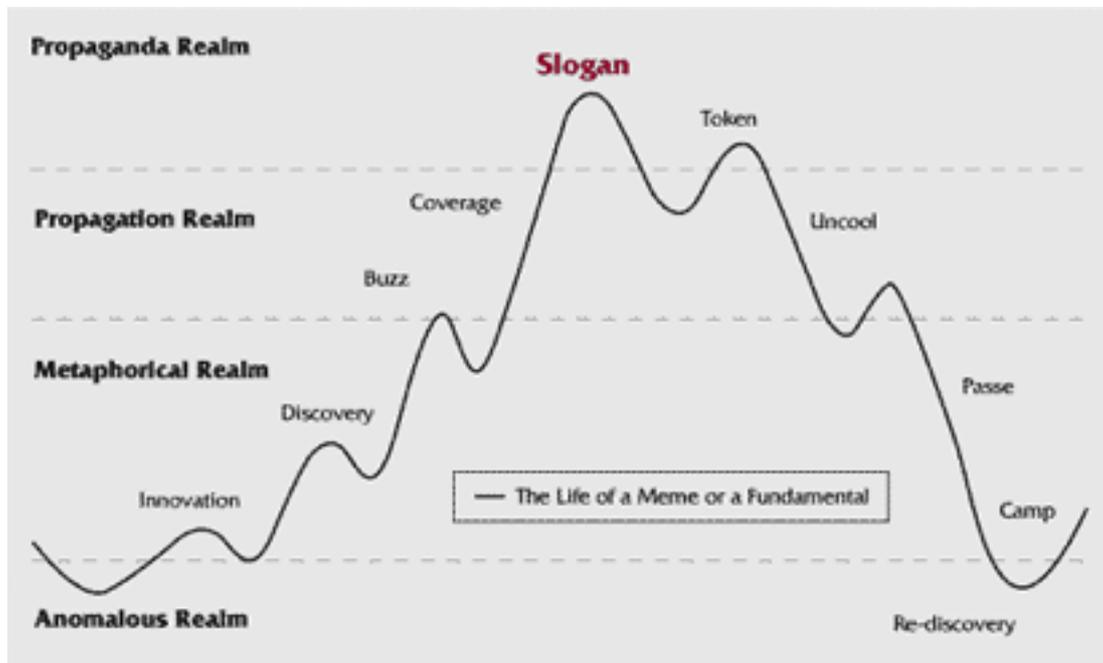


Figure 13: Memetics is used in marketing as a means to measure the popularity of a meme on the internet and other media, this is called the “life of the meme”. Image taken from: [http://www.marketsemiotics.com/triunity\\_mind.cfm](http://www.marketsemiotics.com/triunity_mind.cfm)

Internet search engines, like Google, has been used to check the diffusion of memes through the counting of the resulting pages for the same word under which the meme is known (Dawkins, 2003). Other ways to track memes are the so called meme maps, analemma-shaped graphs represent the life cycle of memes in time and space (Paull, 2009) while memes regarding the identity of an individual were mapped by Robertson (2010, 2011): the identity defining memes of individuals were coded and transposed in a graph, in order to contrast between different cultures or even to depict the definition of self at various stages of psychotherapy.

### The problems with memetics

Memetics affirms that memes, being a mind structures, must reside in the brain. The way they replicate implies a certain degree of independence from their hosts because meme transmission is independent by a physical medium, that genes requires instead. But memes themselves, as structures or even more as “things” cannot be observed directly but only by their indirect phenotypic effect. Extending the gene-meme analogy to its criticism, it would be like studying genes only by their expression in protein trying to backtrack the underlying mechanisms of replication.

For this reason some critics view memetics as pseudoscientific dogma (Polichak, 2002, Benitez-Bribiesca, 2001); a secular fundamentalist religion comparable to Intelligent Design (Gray, 2008) or protoscience at best. For these less harsh critics the protoscience of memetics corresponds more or less to mendelian genetics and it will never achieve its full potential until the hard evidence for the neurological basis of memes is nowhere to be found. Blackmore (1999) in probably the best compendium of memetics available, *The Meme Machine*, argues that even though we cannot define memes quantitatively, the hard evidence for memes is already available and consists of any cultural trait that can be imitated and passed on from mind to mind. Burman (2012) contrasted this reification of memes, arguing that the popularization of memes as “things” that jump from mind to mind is a misunderstanding that started since Dawkins’ *The Selfish Gene* (1976), but he accepts memes as a philosophical view useful to describe how ideas spread in certain contexts.

Midgley, a long critic of Dawkins and reductionism in general, apart from questioning the ontological nature of memes, commented that the atomization of culture in units of information would not help to understand culture and its evolution. For Midgley culture is a continuous flow of information conditioned by history. The accusation of extreme reductionism came also from Fracchia and Lewontin (2005).

Also, from the point of view of semiotics, memes are interpreted as incomplete signs, capable of being copied (Kull, 2000). Thus the meme, being a crippled theoretical concept, cannot be the basis for the science of memetics because if memes were to be defined correctly they would be signs, and the study of signs is in fact semiotics itself.

Evolutionary psychologists and anthropologists such as Atran (2002) argued that there is a conflict between the notion of the modularity of mind, deduced by EPMs and dominant in EP, and how memetics describe memes and their evolution. In EP the mind involves mainly inferential processes, thus unable to replicate ideas with high-fidelity. A mind is solicited by the interaction with other minds to infer ideas just by their apparent and communicable part and not by their obsessive imitation. In some experiments, it clearly emerged that meaning, for example of poems or the Ten Commandments, is largely interpreted by normal individuals, while it is reiterated as such only by autistic individuals that in fact acts like “meme machines” (Atran, 2002).

Other criticism comes from the mechanism of mutation of memes, in fact imitation seems to be too unstable that allows a low accuracy of replication and at the same time, a high mutation rate so that any individual copying a meme, would copy it in an individual way. The high mutation rate would imply the randomization of the evolutionary process in culture, making memetic evolution chaotic and non-explanatory at all (Benitez-Bribiesca, 2001). In other words, there is no balance between the memetic selection pressure and the memetic mutation rate (Sterelny & Griffiths, 1999) a balance that is instead present in biological evolution.

### **Nature interpreted by nurture**

Once psychotherapy understood the links between the modern man and the ancient animal that resides deep in him, psychology took a step back into biology, understanding the role of patterns of development that emerge from the deep unconscious to structure the conscious. Here the boundaries between what one considers individual and collective fade, and the psyche finds again a connection with nature.

### **Which place takes evolution in psychology?**

Paralleling the progress in biology, at some point in the development of what is now the Extended Synthesis, psychology borrowed two biological paradigms and put them at work in their own epistemological boundary: evolutionary psychology and memetics. Both point to evolutionary thinking to explain psychological phenomena, but their formulation is somewhat reductionist, genetic reductionism in the case of evolutionary psychology, and apprehended reductionism in the case of memetics. This extreme polarization of their epistemological domains and affirmations, ended in the discontentment in both biologists and psychologists. But there is way of saving both disciplines from their own extreme conclusions and it relies in mediating between what is innate and what is apprehended. Doing this is allowing two great cross-discipline efforts, between natural and human sciences, to enter the grand discourse of the contemporary theory of evolution.

This is precisely what Anthony Stevens proposed in his book *the Archetype Revisited* (2002). The main effort of Stevens is to widen the epistemological boundary of evolutionary psychology by linking it with the jungian theory of archetypes, at the same time allowing the return of the archetypes in the scientific discourse. The evolutionary revisitation of archetypes mediates between the innatism of evolutionary psychology and the empiricism of memetics. Archetypes

would be then patterns of development of the psyche: having their roots in from the genome, they mediate the apprehension through preferred pathways in a similar way to developmental patterns of evo-devo.

### **What is the archetypal theory?**

The archetypal theory of the unconscious was developed by Carl G. Jung as the foundation for his analytical psychology also known as jungian psychology. It is a description of the development of the psyche of both the collectivity and the individual. Jung developed the theory while distancing himself from the freudian theory of psychosexual development itself the basis for Freud's psychoanalysis. Both this schools have their epistemological foundation in the unconscious and are therefore part of depth psychology as defined by Eugen Bleuler (Chalquist, 2007).

Jung regarded the scientific-naturalistic approach of Freud too reductionist to describe the observations that he made while treating schizophrenic patients and moreover to describe his own experiences in matter of dreams and visions. In his view the structure unconscious was both the epistemological foundation of the psychotherapeutic work and the boundless, unfathomable, untouchable, especially by direct experiments and even by the rational discourse of science and philosophy. Jung relied more on empirical observations in order to find processes and patters that let him find order into the apparent chaos of the unconscious. In this regard, Jung collected phenomena as they were before even trying to formulate hypothesis on the content of these facts of the psyche.

Working on both his patients and his own unconscious he began to recognize recurring patterns of organization of unconscious material of dreams, that integrated waking consciousness experiences to express themselves. These patterns, despite their superficial differences, are shared among all humans and Jung put a

considerable effort in retrieving those same patterns in mythologies, sacred texts and esoteric traditions all around the world. He especially dedicated his research to the extensive study of the *I Ching*, alchemy, greek mythology and christianity.

From an undifferentiated whole, the unconscious structures itself in dialectical relationship with the conscious, building symbolic images that express themselves in art, literature, dreams, religions and in the course of everyday life. The conscious retrieving of such images in the unconscious, either individual or collective, is the goal of the process of what Jung called "individuation". The process of "becoming a one and a whole" expresses in the alignment between the everyday Ego and the Self, whose unfolding is necessary for this process to take place. Both the Ego and the Self are archetypes, the first of the individual waking consciousness, the other as the keystone on which the psyche centers its life and development. They are bound by the transcendent function, which ties dynamically the conscious and unconscious.

We could say that while freudian psychotherapy is aimed to normalize the patient in the existing environment, jungian approach is aimed to individualize the patient creating a new environment.

Since the psyche is an ever evolving entity it strives to adapt itself through a continuous self-regulation, autopoiesis and to some extent, autotherapy. When this process is halted the Ego and the Self are not aligned, the libido or psychic energy that bounds these two polar archetypes stops or flows in the opposite directions, causing a regressive development in which neurosis or psychosis occur. For Jung an unbalanced relationship between conscious and unconscious, results in neurosis which is a failed individual attempt to resolve a more general conflict. Neurosis manifests as depression, anxiety, obsessions, phobias etc.

But when the unconscious floods the conscious Ego, it creates multiple sub-centers of organizations ("sub-egos"), or complexes,

causing schizophrenia or in the most severe cases, “multiple personality disorder” (“alter egos”). In this case the contact with reality is lost. Jung understood that these abnormal states of mind are caused by different degrees of maladaptation of the psyche while confronting internal or external pressures. The psyche reacts using different mechanisms such as denial, projection, integration or even using this redirected libido in order to express the psyche’s turmoil through the creative process. Ultimately for this reason, Jung regards illness itself as a part of the creative process if not creative itself.

### **What’s the difference between individual and collective unconscious?**

Jung proposed the concept of collective unconscious in order to explain recurring images and symbols both in the dreams of his patients and in mythology, folklore and religion all over the world. The notion of a collective unconscious was itself an expansion and exploration of what Freud called the “archaic remnants”, mental forms that are not explainable by the individual experiences and that are atavistic in nature (Jung, 1964).

While the individual unconscious is personal and stores experiences from the biography of a single individual, the collective unconscious is impersonal because it is common to all members of a particular species, and can run even deeper. Jung went on, regarding the collective unconscious to be common to all life on Earth, and ultimately, contiguous with the inorganic substrate of all matter. Thus the collective unconscious is an inherited characteristic of the mind, and therefore depends on the genetic makeup of the human species. It contains preexistent patterns of behavior, the archetypes, that are activated by conscious experiences (Jung, 1981).

Among Jungian theorists there are at least two different interpretations of the collective unconscious, the minimalist and maximalist interpretations. The minimalist interpretation regards the

collective unconscious as the foundations of the structure of the human mind, a common, general plan that is inherited genetically much like the bone structure of the body (Gooch, 1975). Nevertheless Jung also stressed the so called numinous quality of this collective unconscious, as defined by Rudolf Otto in his *The Idea of the Holy* (1923): he regarded archetypes as the source for spiritual experiences and ultimately the recognizable patterns of the one-world or *unus mundus*, where all existence began and where all existence returns. The *unus mundus* underlies all phenomena and the connection between events as seen in Jung's synchronicity is also part of the manifestation of this archetypal world (Cook, 1987). Von Franz reconnects this idea to the monopsychism or that the collective unconscious is the World-Soul, the *anima mundi* of neoplatonic traditions and alchemy (von Franz, 1985). See Figure 14 below.

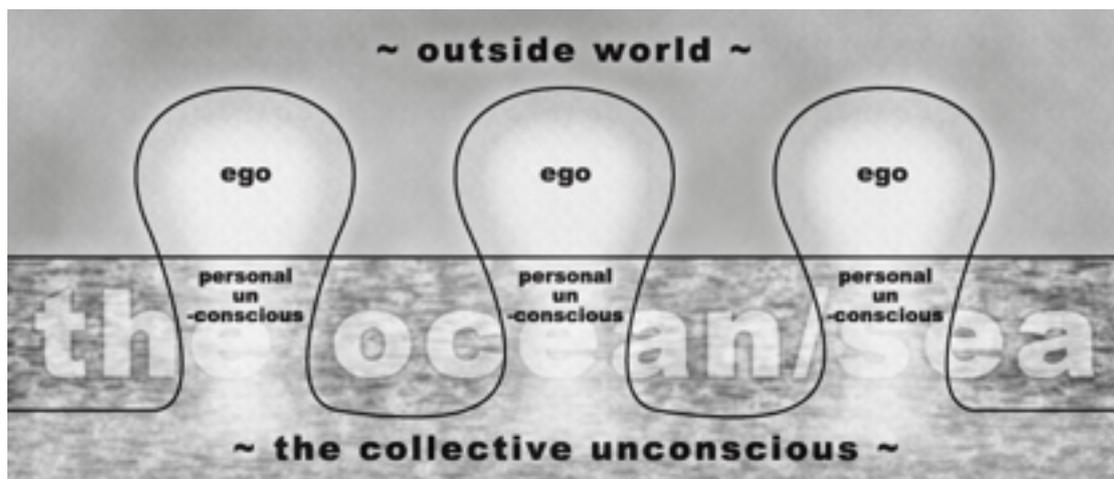


Figure 14: Jung imagined the Ego as an individual production under which the sea of the unconscious, the *unus mundus*, worked its way into daily consciousness. Image taken from: <http://tigerleo.com/?p=382>

### **What are the archetypes?**

Jung rejected the notion that man was born as a tabula rasa, devoid of innate structures (Jung, 1985). Evolution produced *a priori* patterns that give order to human life, while unconscious these patterns are passive and without content, but once filled with experience they activate and act in conscious life in return (Jung,

1966). When they activate, they produce an abundance of images and symbols that take hold of the psyche. While the archetype cannot be apprehended, the images and symbols can and are. Studying the mythopoietic production of an individual mind, such as dreams, spiritual or artistic experiences, it is possible to go back to their source. Archetypes are permanent and limited in number, but their expression is limitless, and source of the creative process. They persist as in culture as in nature even if they clothe under different, suitable garments each time they manifest. The most common expressions are archetypal figures or stereotypes in fiction, such as the hero, the witch, the princess, the virgin etc. Jung regarded Freud's Oedipus complex as the first ever archetype discovered (Evans, 1979).

Some archetypes recur in human experiences more than others. Jung discussed five main archetypes (Murray, 1998): the Self, the Shadow, the Anima, the Animus, the Persona. The Self is the all-organizing principle of the psyche, it is the sense of being "I" and therefore represents all that is individual to the individual. Despite its singularity, the Self's existence depends on the other archetypes and these in turn depend on the existence of the Self. The Self is also an evolving archetype which unfolds as the individual biography is laid out. For this reason it is both the subject and the main object of individuation from which the transcendent function becomes conscious Ego (Murray, 1998).

The Shadow refers to a repressed trait that rests deep in the unconscious. The characteristics of the Shadow are opposite to those identified by the conscious Ego. Being all that is contrary to apparent identity it is often projected onto others so to create scapegoats that alleviate the stress of integrating such problematic archetypes. Facing the Shadow is an essential part of the process of individuation. The Anima is the archetype of femininity or eternal feminine as described in Goethe's words. It is the inner representation of femininity in males and it has the role of the

mediator between conscious and unconscious (Jung & von Franz, 1964). The counterpart of the Anima is the Animus: it is the representation of masculinity in females and it mediates between female and males. The Persona was described by Jung as a functional complex (Jung & von Franz, 1964), that is the socially functional and accepted part of the Ego, the mask which the Ego present to the world. The Persona actually contain as many masks as social environments or public situations. See Figure 15 below.

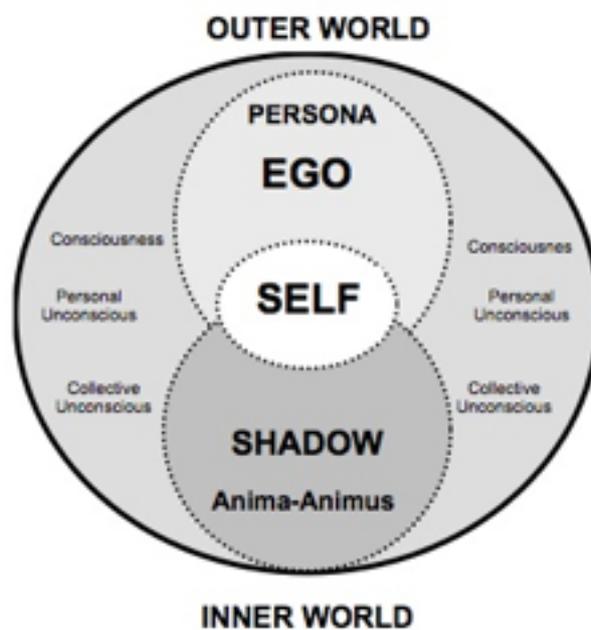


Figure 15: Jung imagined human psyche as multi layered. The Ego is just the last emerged of these layers, under which the life of the unconscious thrives and manifests itself through archetypal images. The Self is the true source of all that will be manifested in the individual life. The way that leads from the Ego to the Self, recapitulates all the collective archetypes up to the collective unconscious. Image taken from: <http://www.psychicdonut.com/wp-content/uploads/2013/05/PSYCHO.jpg>

These five archetypes are those mainly involved in jungian psychotherapy but there are a huge number of archetypes-as-such that represent the pattern in which we form representations of the objects of the world, such as the various types of animals, or plants or rocks (Stevens, 2006). These other functional archetypes allows

humans to interpret the world even before actually encountering these objects: such is the origin of the innate fear of mice, spiders and snakes (a correspondence to the EPMs found by EP). The same applies for attributes of archetypal figures, such as the “resurrection of the savior”, or the “wickedness of the witch”, the “the sacrifice of the hero”, “the damsel in distress” and so on.

The degree of actualization of the series of archetypes that activate in one’s life, determine the path of individuation. The active archetypes actualize in complexes, so that there is a parallel between the human species and the biography of the individual: archetypes are the functional units of the collective unconscious of humans in the same way complexes are the functional (or dysfunctional) units of the individual unconscious. Jung thought the archetypes had resonance forms in the outer world: the so called “psychoid archetype” extended its function from the individual psyche to nature, in its species aspects at first, and then biologically, until reaching the chemical and physical foundation of its own pattern. Archetypes ordain the life of all living organisms and how the chemical reactions work in matter. The archetypes mediate the conscious and the unconscious, the organic and the inorganic, spirit and matter. This is the hermetic principle of the “as above, so below”, or principle of correspondence of the microcosm with the macrocosm that together form the *unus mundus*. This was the reason why Wolfgang Pauli underwent psychotherapy with Jung and ended writing an essay with him about the relationship between the mind of the scientist that studies matter and the behavior of matter itself.

### **Criticism of the archetypal theory**

The first source of criticism regards the possibility of inherit such archetypal patterns, but this stems from a misconception about archetypes themselves: Jung stressed that archetype are not content-related but pattern-related. So the human psyche inherited

the propensity of following that patterns, unconsciously organizing the acquired ideas of culture (Jung, 1951). This specification allows the theory to avoid relying on the lamarckian inheritance of acquired characteristics while endorsing darwinian inheritance of innate characteristics. This was a reasonable doubt at Jung's time but epigenetics was still waiting for hard proof.

Lacan criticized the whole concept as an unnecessary ripoff of Freud's "archaic remnants": for Lacan all archetypes are just shades of instinctive knowledge of animals, that rest on more primitive layers of the psyche that evolved through the series of our animal ancestors. He thought that Jung purportedly separated the archetypes and made them "alive" so to repudiate the original concept of freudian libido (Lacan, 1994). This stance seems more an effect of the "return to Freud" made by Lacan during the development of his psychology than a substantiated criticism, given the fact that Jung distinguished archetypes by instincts, both too generally lumped in Freud's archaic remnants.

Even accepting the possibility of innate propensities contained in archetypes, other critics attacked the ambiguity of the concept of collective unconscious and especially its maximal interpretation as *anima mundi* (Cook, 1987). Jung was clearly tempted by such maximal interpretation probably because of his own experiences as expressed in his famously mysterious *Red Book*, also known as the *Liber Novus*, but in the end he took the agnostic stance while treating the subject academically (Jung & von Franz, 1964). In this regard Jung falls short of a pure phenomenological approach in the goethian idealistic tradition: his empiricism was paired to a strong hypothesis making process that still remains firmly in his psychotherapeutic tradition.

The last source of criticism comes from the exquisitely psychotherapeutic aspect of recognizing in the analysand's biography: realizing a universal and timeless aspect of individual

struggles can either downplay the meaning of individual experiences (Goldenberg, 1993); inflate the psyche of the analysand telescoping his experiences in a mythical dimension (Jacoby, 1984) or become a refuge for fragile individuals who avoid the personal involvement and sufferings of going through psychotherapy (Lessing, 1973).

### **What is the archetype revisited?**

Ever since Jung proposed the archetypal theory, it remained as a specific tool to interpret the productions of the unconscious, being them dreams or visions. It was only later, through the mediation of Campbell's *The Hero with a Thousand Faces* (1949) and later of Pearson's *The Hero Within* (1986) that archetypal theory was used first to reconstruct the so-called "monomyth" of humanity or the journey of the hero, and later as a technical tool for writing screenplays, storytelling and self-improvement.

But again, archetypal theory lingered in the area of knowledge where art and expertise meet, traditionally looked upon with suspect by scientists who find the caveats of theoretical models way more attractive than the heuristic methods of a direct approach. While in this shadow area, evolutionary biology matured from being a young promising science to a full fledged explanation on how living beings appear as they are. With all the good and bad of a historical approach, until the lowest point of the "just-so-stories" used to explain every single adaptation without knowing much (Gould & Lewontin, 1979).

Archetypal theory gained attention again at the end of the '90s, when both evolutionary psychology and memetics reached their peak in popularity. These as aggressive as unilateral theories had broken into humanities with such an impetus that they were pushed back by philosophers and psychologists as unjustly usurpers from without. The debate sparked, ranging from pure invectives to healthy criticism,

and this allowed for a refinement of the most dubious parts of those new theories.

In the meantime, an entirely different approach was chosen by Stevens who understood the explanatory power of evolutionary psychology and, through its eye, he revisited the archetypal theory: even though the jungian concept of archetypes was born out of the original core of the evolutionary theory, i.e. Haeckel's recapitulation theory, philosophically speaking, their epistemology remained unchanged until this recent revision.

Some jungians, despite Jung's attempts, actively promote the independence of archetypes from any organic substratum (Pietikainen, 1998), making them pure symbolic forms, conflating archetypes and symbols, and while doing so reverting human mind to the *tabula rasa* condition. But they are in fact declaring an epistemological war to evolutionary biology and its epidemic invasiveness: they prefer to declare independence of action than to allow room for evolution into jungian theories.

But as previously stated, the whole theory of psychodynamics stemmed from the statement that ontogeny is a product of phylogeny. And by relegating archetypes just in the symbolic language, they remove the archetypes mediation power between biology and psychology, making them a postmodernist version of memes. Stevens (2002) instead worked in the opposite direction, by linking archetypes to evolutionary biology. Doing so, he further strengthened the bridge between psychology and biology. Even though this costed him accusations of being an adaptationist, he was incarnating a more integrated view of the human being, one that does not shuts its eyes in front of natural sciences.

## **And finally, nurture becomes nature**

### **The three levels of the evolution of knowledge: an analysis**

After this long premise, it is possible to proceed with the core of the thesis here presented. I will start with an epistemological analysis of all the views presented (evolutionary psychology, memetics and archetypes) and end with a synthetic conclusion, following the *solve et coagula* of the spagyric art (again, from the greek *σπάω* “extract” and *ἀγείρω* “gather” as a paracelsian synonym of alchemy).

Following what Rudolf Steiner’s started in his foundational book, the *Philosophy of Freedom* (1916) and much of his further works on the understanding of both society (the social three-folding) and the individual (head, rhythmic system and limbs), the epistemological analysis of ideas can be conducted following a tripartition. This is a similar idea promoted by Hegel in *The Phenomenology of the Spirit* with the addition of an organic comparison between the three levels of thesis, antithesis and synthesis.

In Steiner’s view this three-folding comes directly out of the foundation of man himself, which is composed by body, soul (the *psyche*) and spirit (the *pneuma*). So for Steiner the human head, brain and nerves, correspond to the thinking activity which is mirrored in the cultural sphere of society (human spirit); the beating of the heart and the respiration of the lungs correspond to feeling which is essentially a love-hate rhythm and is mirrored in the economic sphere of society (human soul); and finally the limbs and the metabolic system (digestive and absorption) correspond to willing which is the ultimate source of action in the material world and is mirrored in the political-juridical sphere of society (human body).

Steiner thus established a parallelism among a multitude of levels of understanding, potentially capable of underpinning epistemologically every phenomenon. In fact his epistemological approach suits my parallelism of biology and psychology, with an

addition of a mediatory level, i.e. archetypes. So following this three-folded view, there are three discernible epistemological levels onto which it is possible to conduct the epistemological analysis on the nature vs. nurture debate. The first level is the cellular or nuclear level. The second level is the individual or psychological level. The third and last level is what can be termed the cultural or the theoretical level.

1. Cellular or nuclear level;
2. Individual or psychological level;
3. Cultural or theoretical level.

More generically speaking, the first level can be considered internal, the second median and the third external. The internal level pertains to what happens inside a unitary system (either a theory, an individual or the cell) the median to what mediates between the inside and outside (the patterns of internalization and expression), the external to what comes from without or is expressed (either culture, language or the phenotype).

These three levels run in parallel but nonetheless are connected. The connections between these three levels of knowledge go from the mere analogy, to identification. Analogy links the cultural level to the individual and the individual to its parts, the cells. For example: evolutionary psychology is expressed in human culture (cultural level) as EPMS are expressed in social life (individual level) and as the genotype expresses itself in the phenotype (cellular level).

Between the extreme terms of these levels, the internal and the external terms, always exists a middle term that mediates between the previous two and is always active in the translation of messages, either inputs in outputs or outputs in inputs. This is the archetypal level that plays the role of “healer” between the two apparently irreconcilable terms. These in turn recapitulate the difference between nature and nurture.

To meet in this middle ground a generalization of the specific jargon of these three levels is required.

It is therefore possible to schematize the three epistemological levels of understanding in the following way. See Table 1 below for a schematic representation of this epistemological analysis. Descriptions of each level will follow the table. See Figure 16 below.

	<b>Cultural or theoretical level</b>	<b>Individual or psychic level</b>	<b>Cellular or nuclear level</b>
<b>Internal</b>	Evolutionary psychology	Instincts (evolved psychological mechanisms)	Genotype
<b>Median</b>	Archetype revisited	Collective archetypes	Epigenotype
<b>External</b>	Memetics	Symbolic culture (memes)	Phenotype

Figure 16: the three levels of understanding of the nurture vs. nature debate.

### **The cultural or theoretical level**

1. Internal: evolutionary psychology;
2. Median: archetype revisited;
3. External: memetics.

Evolutionary psychology is concerned with what is innate (innatism) and unchangeable or fixed by either genes or brain structures. As a theory it deals with atomized functions of the mind (the evolved psychological mechanisms or EPMS) these, taken individually, have little significance being ad-hoc-hypothesis. But these functions, when properly seen as functional complexes, build up to form “personified” patterns, the archetypes.

Memetics instead is concerned with what is apprehended (empiricism) and changeable, always subject to change if the external conditions change.

As a theory, it deals with the epidemiology of words, concepts and instructions, the sum of what is produced by other human beings, or culture.

The archetype revisited mediates allowing the dialogue between EPMs and memes, between nature and nurture. See Figure 17 below.

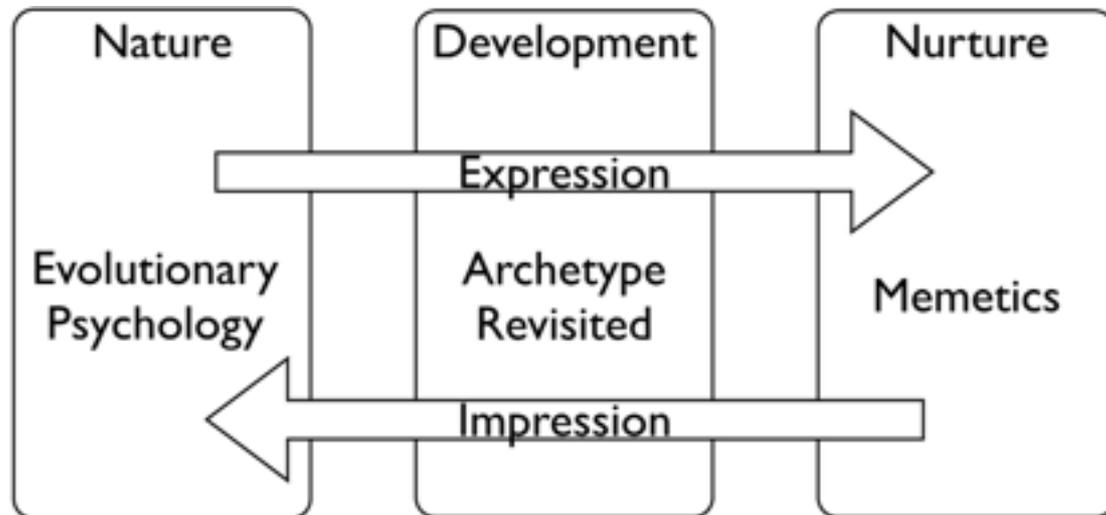


Figure 17: The cultural or theoretical level.

### **The individual or psychic level**

1. Internal: instincts (evolved psychological mechanisms);
2. Median: collective archetypes;
3. External: symbolic culture (memes).

EPMs are what ethologists and other psychologists call “instincts”. Instincts are adaptive or had been adaptive at some point in the past, but they still express themselves as drives. EPMs are just fragments of archetypes, instincts that bring forth the same environment that produced them.

Memes are another way of looking at symbolic culture, in fact it is through memes that culture can be communicated via imitation and passed down through generation.

The collective archetypes describe the natural history of the development of the self: they are patterns of development that give meaning to what comes from without, culture, and from within, drives. The outward

movement can also be called “individuation”, in a jungian way, the inward movement “comprehension”.

Both EPMs and memes remain meaningless until organized and “personified” by archetypes. Instincts without archetypes would be random sequences of inconsistent actions. Memes without archetypes would be just word without any meaning or semantic content. For this reason archetypes are mediators and at the same time the fundamental structures of the psyche. See Figure 18 below.

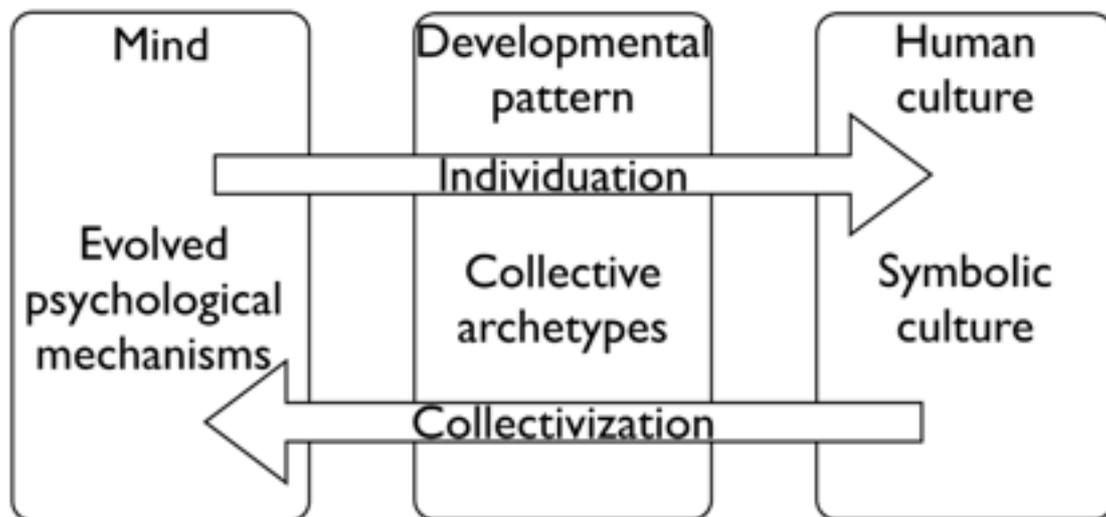


Figure 18: The individual or psychic level.

### **The cellular or nuclear level**

1. Internal: genotype;
2. Median: epigenotype;
3. External: phenotype.

The genotype contains all the potential information to build a cell and so the cells associated together, translate their genotypes to synthesize proteins. The sum of all the expressions of the genotypes of the cells in a body gives the phenotype.

But it is the epigenotype that gives the “meaning” of what is possible to translate in proteins: because of epimutations not all the possible genes present in a genotype will be translated into actual phenotypes. The epigenotype is the pattern of activation, dependent on the environment external to the cell (the phenotype and its

interactions). In this regard its role is analogous to archetypes. See Figure 19 below.

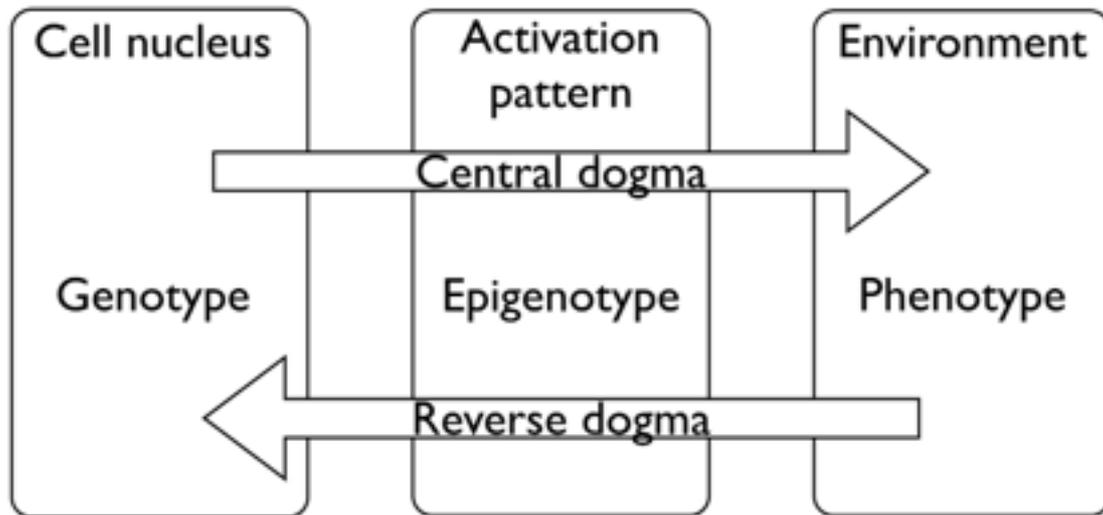


Figure 19: The cellular or nuclear level.

### **The dual transformation model: a synthesis**

This new light shed on the archetypes, along with the new extensions of the evolutionary synthesis, into an integrated model of transformation that comprehends both the genetic and the epigenetic mechanisms and, at the same time, reconcile nature and nurture. Archetypes interpreted as patterns of action, act as mediators of both psychic and organic developments in the individual that is the newest last leaf of a tree that extends back in time, being it the evolutionary history of life (phylogeny) or the history of the psyche, from the collective unconscious, to a more and more individualized and conscious form.

It is possible to combine all these notions together in a coherent model that shows how genes and memes, biology and psychology, nature and nurture are deeply interrelated.

As there is a movement going outward, from genes to proteins (the central dogma) that is the expression of the biological nature, there exists a movement going inward, from symbolic culture (memes, symbols, language etc.) right into the genetic code via epigenetic mechanisms. It is a “reverse dogma”. As it is clear,

epigenetic mutations are the effect of daily behaviors and choices, and can be inherited first as reversible molecular capacitors and then incorporated in the genetic code via genetic assimilation in the DNA sequence.

In this way, culture or nurture, enters directly in contact with the genetic core of nature, DNA, and it becomes literally inscribed in it. Through the assimilation of epigenetic mutations, EPMs are slowly but relentlessly inscribed in human mind by symbolic culture, orchestrated by archetypes or the patterns of human behavior. Far from being fixed to the paleolithic, human psyche recapitulates his phylogeny while it develops in an individual, from the collective unconscious through the individualized mind until, eventually but not necessarily, reaches the point of expressing something new. That novelty in turn becomes culture and again re-enters the the dual transformation cycle while adding up terminal stages to the collective development.

This continuous double flux, from inside to outside and from outside inside, is also the basis for the high level of cultural evolvability shown by humans coupled with an unspecialized body, itself a product of neoteny, suitable for imitation and complex tasks.

Every time a new niche of knowledge is opened, countless new insights are being discovered and allow the creative process to work on new sets of rules. Then the intellectual insight is translated into action, on our bodies or other artifacts, such as technology.

This is also true for the rearrangement of cells in tissues, that express just part of their genes through the mediation of their epigenotype, producing one single type of cell. Living tissues are born from a complex of chemical cross signaling between cells with the same epigenome. But when epimutations change, or are altogether altered, like in a totipotent cell, a whole range of new arrangements and developments become possible.

It is a continuous cascade of evolutionary changes telescoped in space and time and, from the evolved form, back to its own origin.

### **Conclusion**

This is indeed a syncretic way at looking at both biology and psychology. But if it is true that both psyche and life coexist in the actual human being, it must be also true that if there is an epistemological wall between psychology and biology, it must be the side-effect of a narrow way of thinking. Under this light, the thesis here presented is an attempt to break that illusory wall.

The illusory nature of this wall is composed by the difference between reality and concepts: concepts are used to grasp and define an often elusive reality, but paradoxically as they become more defined, they become less and less descriptive of that same reality. So, in order to enter more directly into the nature of reality, is necessary to press the boundaries created by those rigid concepts, better if from either sides of the wall.

If the division is to be maintained, the inflated side will prevail, projecting his shadow on the other repressed side, the darker the inflated. Such is our society of rational and materialistic perseverance, driven by economic interests far beyond the point of nonsense. Health is a state of dynamic balance. If a system, either organic or cultural, shows the stigmata of separation there is illness.

This is what happened to the Universal Man of the Renaissance, which still lives five hundreds years back inside our psyche. When alchemical thought came to an end, the final shear was thrust: alchemy became phantasy and chemistry reality. At the doorstep of Illuminism, Goethe and Newton confronted. Even though they were both well versed in alchemical symbolism, Newton hid his phenomenological side, while Goethe went all the way to prove his point. He even sided with Lamarck and Geoffroy Saint-Hilaire in the quest for evolution against Georges Cuvier's catastrophist

interpretation of the Bible, which strictly required that God could not let evolution happen. This is not the case.

But finally, Newton's rational approach prevailed against Goethe's phenomenological approach, epitomized in their apparently contrasting theories of color. So if we want to arrive at a holistic approach in natural science, it is impossible without the help of the human sciences, or better phrased: natural and human sciences will be a single holistic science when both at the same time will lean their epistemological head on the wise heart of one another.

The quest for healing is the question of the human being. Man is the focal center, the receiver of this healing answer. Healing is the measure of our understanding.

The division between natural and human sciences has to be overcome. Both from the natural and the human side. The next groundbreaking "discoveries" in the realm knowledge will be all therapeutic acts aimed to heal the open and infected wound that newtonian materialism, and all that went out of which, inflicted upon Western culture. Our culture is suffering from one-sidedness of an hypertrophic rational ego, at the expense of the more integrative, as much rational as imaginative, path of the Self. This is the same path paved by individualities like Paracelsus, Goethe, Jung and Rudolf Steiner, just to cite a few scattered in the history of humanity.

Epigenetics applied to psychology pressed against the limits of the prematurely proclaimed central dogma of genetics: not only from DNA to proteins, but also from proteins to DNA. Evolutionary psychology insisted that humans are not born blank but with definite base instincts. Memetics instead stressed that culture can shape our behavior literally in the way we phrase ourselves. Finally a properly revised archetypal theory allowed for the unification of the outer world of nature with the inner world of psyche, inherited and apprehended, mediating between instincts that expresses themselves from inside out and culture that enters from outside in.

It is in the light of those universal men that I propose this unifying thesis.

A step beyond the known is done when what is already known under different ways is rephrased in a single new way. Facts return to be phenomena when they comprise both the extremes of the inside and the outside. Both the emotional and the rational side of reality. Theories return to be ideas when they encompass both the specific and the general context. *“What is the universal? The single case. What is the particular? Millions of cases.”* justly wrote Goethe. So when facts and theories come together they produce a paradigm, but when phenomena and ideas come together they give us a vision, a light shed on what awaits beyond the next threshold.

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