12 Ethology, Evolutionary Psychology, Sociobiology, and Evolutionary Psychiatry

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12.1 Introduction

The theory of evolution of species is one of the most celebrated pieces of science through the centuries. Although similar thoughts existed since antiquity, it was Charles Robert Darwin (1809–1882; Fig. 12.1) who established that all species of life have descended over time from common ancestors with his 1859 book *On the Origin of Species* (Darwin 1859). The theory of evolution is important not only because of its mere scientific value; it serves as a paradigm of what a scientific theory is and how it is developed in sharp contrast with religious or ideologically driven beliefs. Its effect on culture and society is so profound that it has been the focus of debate for more than a century and even the subject of a trial (the Scopes Monkey Trial in 1925). It is interesting that currently it is not taught in most medical schools not even in the frame of biology or genetics, while there is a significant number of academics who support the divine or "intelligent" design theory which does not meet the criteria to be considered a scientific theory.

Its scientific importance lies to the fact that it connects cellular biology, physiology, molecular biology, genetics, immunology, anatomy, microbiology, and literally every life science. It provides a conceptual framework which obeys to the laws of science and includes all Earth environment and all disciplines of human knowledge and activity. It suggests that while Earth itself is about 4.6 billion years old, there were molecules with the ability to self-duplicate since 4 billion years ago and single-celled organisms (prokaryotic) since 3.5 billion years ago. Multicellular organisms (eukaryotic) appeared some 1.7 billion years ago, while the first ancestors of humans evolved probably 2 million years ago (Fig. 12.2). It is very interesting to know that the genetic material of modern humans but also of all modern living beings is the end product of ancient natural experiments and loans from

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Fig. 12.1 Charles Robert Darwin (1809–1882)

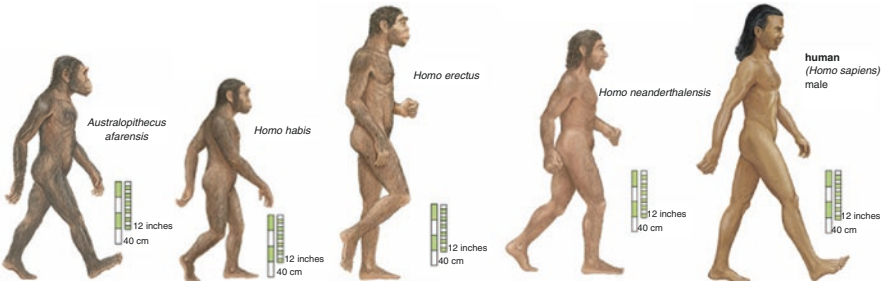

Fig. 12.2 Evolution of modern humans (*Homo sapiens sapiens*). Modified from http://imgarcade.com/1/evolution-of-man-names-of-stages

other species and other kingdoms of life and not simply random mutations as a product of influence of external factors. Approximately 10% of the genes of modern humans come from retroviruses whose genetic material was insinuated into germ cells millions of years ago.

The Darwinian or evolutionary approach is of proven utility when we try to understand how behaviors evolved in parallel with genetic structure. In fact, genetics, environment, and behavior seem to be closely related since genetics determine

behavior which serves adaptation to the environment, but the feedback loops between these three domains are extremely complex and dynamic.

One important characteristic of the evolutionary approach to behavior and social structure is that it utilizes a somewhat "cynical" approach to interpret and understand things. This is often in contrast with the ethical-philosophical or even religious beliefs and concepts the average lay person but also probably the majority of the scientific community have. Phenomena like homicide or rape are considered under the concept that in order to exist, there must had been some evolutionary advantage in the far past for those who committed them, or at least they constitute residual out of frame behaviors. These approaches might bother since they seemingly deprive the ethical load of these acts and they seemingly justify and provide support or excuse for those engaging in similar behaviors. The source of individual differences is another such example of sociopolitically sensitive issues. Often individual differences are seen as a reason or a cause of social and hierarchical inequality, which is indeed not unusual in human society. The big question, however, is whether sociopolitical and ideological forces should dictate the outcome of scientific research. The reader should have in mind that the scientific method tries to elucidate the roots and the sources of behaviors without the bias that might come with millennia of social evolution and organization. This is the way science works in all fields, and this is why science was able to make the significant progress that changed human life in the last few centuries, prolonged life expectancy, improved quality of life, and reduced poverty. Also this is the way through which science might be able to reduce the manifestation of these unwanted behaviors and help to improve the humanity. After all, humanity is only partially a matter of genes; modern humans and chimpanzees differ in less than 5% of total genome (Varki and Altheide 2005), yet human and chimpanzee societies are radically different.

It is the cognitive and metacognitive processes that define what we are, how we see ourselves and the others, how we consider and respect them and their rights, and what we believe it is our place in the universe and among other species. These qualities made human beings aware of their existential dilemmas and tragedies and raised them above and beyond the basic instincts and biological pressure.

12.1.1 Ethology

The discipline of ethology concerns the study of animal behavior. It usually considers it to be an evolutionarily adaptive trait. The term "ethology" comes from the Greek word *Ἦθος* (ethos meaning "character") and *–λογία* (–logia meaning "the study or knowledge of"). The first to use the term was John Stuart Mill (1806–1873). In his 1843 book *System of Logic*, he advised the development of ethology as a field of science for the study of individual and national differences in character (Robson 1974). As the discipline we know today, it was introduced in 1902 by William Morton Wheeler (1865–1937), an American myrmecologist (he was studying ants) (Matthews and Matthews 2010). Typically, ethology studies a type of behavior across species rather than behaviors specific to a single specific species

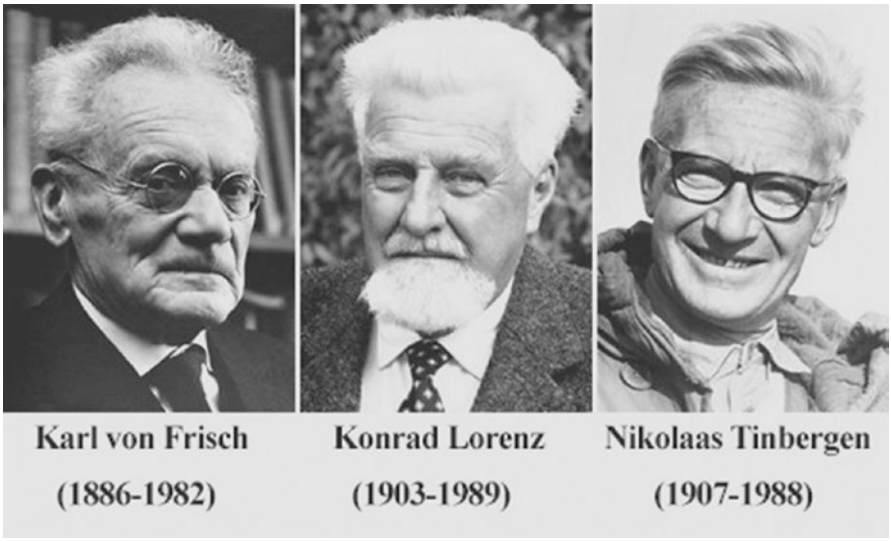

Fig. 12.3 1973 Nobel Prize in physiology or medicine

and in relationship to the known animal anatomy, physiology, neurobiology, and phylogenetic history.

Ethology was part of Darwin's work but was advanced mainly through the works of Charles Otis Whitman (1842–1910), Oskar Heinroth (1871–1945), and Wallace Craig (1876–1954) which were ornithologists. The discipline reached its highest fame when three scientists, Nikolaas Tinbergen (1907–1988), Konrad Lorenz (1903–1989), and Karl von Frisch (1886–1982), were awarded the 1973 Nobel Prize in Physiology or Medicine (Fig. 12.3).

12.1.2 Evolutionary Psychology

In this frame, evolutionary psychology studies behavior and psychological function from an evolutionary perspective. It assumes that human psychology and behavior is a direct product of evolutionary processes and constitute evolved adaptations, which follow the laws of Darwinian theory through natural or sexual selection (Williams 1966). This implies that not only the brain but also the mind and behavior follow these laws and rules and therefore evolutionary psychology can serve as a unifying theoretical approach for the behavioral sciences by putting research of psychological function in the frame of the human evolutionary past.

This concept has a number of other implications; it considers psychology to be part of biology rather than theoretical sciences and philosophy, which is true if one considers the fact that modern psychology emerged from anthropology and

the study of individual differences in the early nineteenth century. It also views the mind in the frame of computational theory and considers mental processes to be computational operations as responses to the environment. It utilizes elements and concepts from cognitive psychology, artificial intelligence, evolutionary biology, genetics, behavioral ecology and ethology, anthropology, archaeology, and zoology.

This computational approach to mind also suggests that every psychological function has evolved to solve a problem and that the complexity of needs and subsequently of evolved adaptations and solutions to these needs gave birth to broader psychological processes like reason, intelligence, emotion, or impulses and not vice versa as many philosophers imply. It also implies that modern humans have minds, which were evolved and are specifically equipped for behavioral adjustment and survival in the environment humans were facing during the Pleistocene and the Stone Age and not necessarily for the modern environment.

There is a number of behaviors, abilities, and psychological traits which could be good candidates to be considered as results of evolutionary procedures. They occur universally, that is, in all cultures and across the globe, and they concern basic cognitive abilities like expression, recognition, and interpretation of emotions and their behavioral dimensions including facial and hand gestures, discern kin from nonkin, select healthier and more fit mates, and cooperate with other members of the group or tribe. This approach has important although controversial applications in economic and political theory, health, law, and mental health among others (Dunbar and Barret 2007; Buss 2005).

12.1.3 Sociobiology

Sociobiology was introduced as a term in 1975 by Edward Osborne Wilson (1929–) (Wilson 1975). This constituted the highlight of a long process which took place in the late 1960s and early 1970s and attempted to bridge psychology, sociology, ethology, evolutionary and population biology, ecology, anthropology, game theory, and genetics (Barash 2003b). Among other issues, the word "psychobiology" has some political implications, and therefore the alternative term "behavioral ecology" is also used. Essentially, sociobiology differs very little from evolutionary psychology. At times and especially in the beginning, there was severe and vicious ideological criticism which included the broader spectrum of evolutionary psychology and sociobiology.

One major feature in the sociobiological approach is that natural selection occurs among genes, not at the level of groups or species. This has been shown among others by George C. Williams (1926–), William Donald Hamilton (1936–2000), and John Maynard Smith (1920–2004). Their work also introduced the term "inclusive fitness" to denote the sum of accumulated reproductive success of individual genes within family lines by passing the generations.

12.1.4 Evolutionary (Darwinian) Psychiatry

The Darwinian theory had a major influence on how health and disease are conceptualized and what might constitute the best treatment option. A number of medical conditions including obesity, anemias, autoimmune diseases, and hypertension were put in an evolutionary frame (Gluckman et al. 2009). According to this approach, mental health and disease should be understood as the end result of the interaction between the organism and the environment, with the addition that abnormal behaviors and symptoms could reflect either an extreme form of otherwise adaptive behaviors or the triggering of them in an out-of-frame or proportion way and under inappropriate conditions.

This is somehow different from the standard approach in clinical psychiatry and psychopathology where connections with recent events and reaction to recent problems in the frame of the individual patient's and core family are considered (proximate mechanisms). In contrast, evolutionary psychiatry stresses that variation (including variation in behavior) is not only normal but evolutionarily necessary and is concerned with the misfit of preexisting normal coping mechanisms which could cause maladjustment or disease if triggered in an inappropriate way or persist for longer than expected and especially in an environment and with social demands extremely different from those encountered by humans during the Pleistocene and the Stone Age (Fabrega 2002).

12.2 Historical Overview

The theory of evolution has a long history and roots in the antiquity. It exists in the teachings of the pre-Socratic Greek philosophers, especially Anaximander (610–546 BC) and Empedocles (495–430 BC), with his work *Περί φύσεως* (De rerum natura; *On the Nature of Things*). However, in contrast to them, Aristotle (384–322 BC; Fig. 12.4) utilized the idea of fixed natural unchanged and preexisting patterns, known as *μορφή* (morfi meaning form) or *είδος* (idos meaning species). He rejected any idea of changing or evolving forms and species and suggested that all naturally existing living or nonliving things were actually incomplete reflections of these preexisting ideal forms. He also introduced the concept of *ιεραρχική κλίμακα* (scala naturae; hierarchical scale), according to which both living beings and nonliving things are classified on an ideal pyramid with simple nonliving things at the base, plants and simpler animals at the lower levels, and humans at the top (Fig. 12.5). These ideas can be considered to be the early conceptualization of the "intelligent design theory"; they demand some kind of divine top-down cosmic order and in combination with Christianity came to dominate the western world until relatively recently.

With the Renaissance and since the seventeenth century, the method of modern science became gradually dominant and demanded the application of the same physical laws for all visible things without the contribution of any divine cosmic order. An important advance was the classification of plants and animals

Fig. 12.4 Aristotle (384–322 BC)

in 1735 by Carl Linnaeus (1707–1778; Fig. 12.6) which showed the presence of a hierarchical nature in living organisms with the use of scientific method. Soon afterward in 1751, Pierre Louis Maupertuis (1658–1759) argued that natural changes that occur during reproduction could accumulate over several generations and eventually new species emerge, while Georges-Louis Leclerc, Comte de Buffon (1707–1788) proposed that the opposite could also happen, that is, a single "higher" species could degenerate into several "lower" species in the classification hierarchy. The grandfather of Charles Darwin, Erasmus Darwin (1731–1802), was the first to clearly propose that all animals could come from a single microorganism (filament). Jean-Baptiste Lamarck (1744–1829) developed his "transmutation theory" in 1809, which was based on the assumption that animal organs change because of use or disuse and these changes are inherited from parents to children (a theory called later "Lamarckism"). In sharp contrast, the English clergyman William Paley (1743–1805) in his 1802 book *Natural Theology or Evidences of the Existence and Attributes of the Deity* elaborated on the theory of the divine design (Paley 1802). Eventually the theory of evolution of species through natural selection was formulated by Charles Robert Darwin (1809–1882; Fig. 12.1) in his 1859 book *On the Origin of Species* (Darwin 1859). Probably Alfred Russel Wallace (1823–1913) had arrived at a similar theory

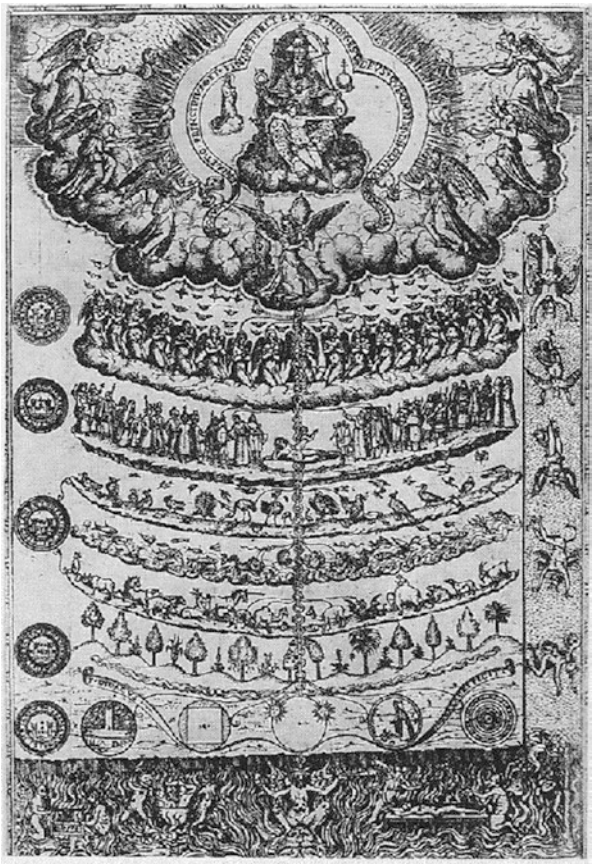

Fig. 12.5 Ιεραρχική κλίμακα (scala naturae; hierarchical scale of nature): Drawing from *Retórica cristiana* by Fray Diego Valadés (1579)

more or less simultaneously with Darwin. Thomas Henry Huxley (1825–1895) also known as "Darwin's bulldog" for his support to the theory of Darwin provided evidence that humans and apes shared a common ancestry. This latter caused much criticism and disturbance since it was directly implying that neither humans as a species nor any specific human race have any special place in the universe; this was in sharp contrast with the religious and sociopolitical beliefs and ideas of the time.

Later, in the 1920s and 1930s but especially after the discovery of the DNA by James Watson (1928–) and Francis Crick (1916–2004) in 1953, the accumulated knowledge permitted a resolution of conflicts and discrepancies and the development of a revised and unified theory of evolution that applied generally to all branches of biology.

Essentially it was Charles Darwin who implied for the first time that behavior could obey to the same laws of evolution like biology, thus giving birth to evolutionary psychology. Two of his books concerned animal emotions and psychology (Darwin 1871, 1872).

Fig. 12.6 Carl Linnaeus (1707–1778)

In the 1930s ethology emerged from the works of Nikolaas Tinbergen (1907–1988), Konrad Lorenz (1903–1989), and Karl von Frisch (1886–1982) which were awarded the 1973 Nobel Prize in Physiology or Medicine (Fig. 12.3). In 1975, Edward O. Wilson (1929–) introduced psychobiology (Wilson 1975, 2000, 1978), while mating and sexuality became the focus of evolutionary research during the 1980s and 1990s with the works of Donald Symons (1942–), Leda Cosmides (1957–), and John Tooby (1952–) (Barkow et al. 1995). In the 1970s Robert Ardrey compared human and animal behavior as similar in quality and directly comparable and relevant (Ardrey 2014).

12.3 Ethology

There is a variety of behaviors which are essential for the survival of the individual animal but also for the survival of the species. While usually behaviors serving the survival of the individual serve also the survival of the species, this is not always the case.

As a general rule, it can be said that animals learn to respond to stimuli which are relevant and neglect those which are irrelevant. This prerequisites that it is possible to distinguish between relevant and irrelevant stimuli, and as a consequence, new behaviors are learned and established. One possible mechanism through which these new behaviors are learned is associative learning as shown by Ivan Pavlov

(1849–1936). However, after repetition and by passing the time, responses tend to reduce in intensity with the emerging of habituation toward the stimuli.

Among the abilities and behaviors which are important for survival is the ability to recognize and discriminate the members of one's own species. This is fundamental and functions as a platform for a number of behaviors including collaboration, forming alliances, and mating.

Several animals if not most tend to live in groups of variable sizes. This gives birth to social behavior and requires advanced cognitive abilities. The end result is social life in groups which provides with better chances of survival and development. Living in groups provides better defense against predators, while predators could seek and attack their victims more easily. Searching for food is more efficient since larger areas can be covered and information can be exchanged concerning the location of resources.

Probably learning to identify one's own species only takes place in a very limited period of time. Konrad Lorenz called it "imprinting," after discovering it following extended observations in geese and other birds. He noticed that the young of birds follow their mothers spontaneously almost immediately after they are hatched. He also observed that this response could be triggered by an object other than the mother if it is presented instead of the mother during this critical period and for a few days after hatching. His photo walking and followed by young geese is iconic in the history of science (Fig. 12.7).

Another way of obtaining new behaviors and enriching one's own repertoire is "observational learning." Its simplest form is "imitation" which concerns the exact

Fig. 12.7 The iconic image of Konrad Lorenz walking and followed by young geese

replication of an observed behavior. Usually the observed behavior is carried out by an individual with a higher status in the hierarchy of the group, usually an elder one. In this frame, the behavior is obtained by young low status and inexperienced members of the group, by copying the behaviors of elderly, high status, and experienced members (Horner et al. 2010). However, often there is targeted teaching which demands the "teacher" to deliberately modify its behavior so as to increase the probability the "pupil" will copy and imitate the observed behavior. Indeed the basic principles of teaching do exist in the animal kingdom (Hoppitt et al. 2008).

However, in the frame of group or social life, there is often conflict between members concerning social supremacy. Supremacy gives priority to resources but also to mating and therefore increases further the chances for survival and reproduction. On the other hand, group life has its disadvantages; it facilitates the spreading of disease and parasites, causes continuous conflict, and demands negotiations for the distribution of resources and privileges within the group.

There are also several unanswered questions concerning the existence of sterile subgroups within societies (e.g., in bees) as this seems to contradict essential rules of evolution as we understand it. Also several behaviors including altruism, self-sacrifice, or revenge are difficult to incorporate in a narrow theory of evolution. These behaviors demand to consider evolution not only at the level of the individual animal but also at the level of the species and for a time duration that exceeds the natural life of the individual and spreads across several generations. These proposed mechanisms are complex and currently not well understood; however, it seems that there exist mechanisms that under specific conditions put the interest of the group above the interest of the individual (Cummings et al. 1991).

There is much discussion and controversy on whether there is an optimal group size and how this could be defined. Animal groups tend to increase in size, but after exceeding a certain size, the benefits of social life degrade, and an equilibrium is achieved through the balance of benefits and conflicts (Sibley 1983).

12.4 Evolutionary Psychology

At the core of evolutionary psychology is the assumption that natural selection has provided humans with many psychological adaptations. This has happened with the same mechanisms and processes human anatomy and physiology adapted. In these adaptations the environment and the specific needs that stem from it are the determining factors.

12.4.1 Products of Evolution: Adaptations, Exaptations, By-Products, and Random Variation

The main task of evolutionary psychology is to understand how specific psychological mechanisms developed and exactly how they serve the survival of the species. These psychological mechanisms include also neurocognitive abilities like

understanding and interpreting gestures and emotions, discerning kin from nonkin, forming groups and developing cooperation and hierarchy, and identifying and preferring healthier mates, but also they include the involving in conflicts with mates, relatives, and other members of the group.

In general, it is expected that these mechanisms are either innate or easy to learn, and they are spread across cultures in a worldwide fashion. According to George C. Williams (1926–2010), an "adaptation" is characterized by an improbable complexity, species universality, and adaptive functionality (Williams 1966). Behaviors or traits that occur in all human societies and cultures universally around the world are good candidates to be evolutionary adaptations (Brown 1991). These are traits and behaviors related to language, neurocognition, and social and gender skills and roles (Smith 2011; Berent et al. 2008; Chomsky 2005; Sugiyama 2003; Schwartz et al. 2003). It is uncertain whether it is generally obligate or facultative (i.e., resistant or sensitive to typical environmental variation), but it is certain that at least some of them are shaped to a certain degree by the specific contemporary environment (Buss 2005; Barash and Lipton 2001).

Often, behavioral traits are not the products of evolutionary adaptation, but, peculiarly, they constitute by-products of some other behaviors with an adaptation essence. These by-products are called "exaptations" or "spandrels," and they manifest a random variation between individual persons (Buss et al. 1998).

12.4.2 Environment of Evolutionary Adaptedness

The set of recurring selection pressures which cause a specific adaptation to emerge are collectively called "environment of evolutionary adaptedness" (EEA) (Bowlby 1969).

The *Homo* genus appeared 2.5–1.5 million years ago while *Homo sapiens* 1.8–0.2 million years ago (Fig. 12.2). This time period is part of the Pleistocene, which is often colloquially referred to as the Ice Age and lasted from 2.5 million to 12,000 years ago. Its end corresponds to the end of the last glacial period, and its name comes from the Greek *πλείστος* and *καινός* meaning "mostly new." It is divided into four general stages or ages, the Gelasian, Calabrian, Ionian, and Tarantian. During that period, the Earth's climate was characterized by recurrent glacial cycles, and ice came to cover almost one third of the total Earth's surface. A large permafrost zone existed. The entrapment of large quantities of water in the glaciers caused a significant drop in the sea level which at times reached 100 m in comparison to the modern sea level. As a result the coastline was much different than today, and passages existed connecting lands which today are separated by sea (Fig. 12.8). Also the collective memory of cataclysms which survive in ancient myths, from Gilgamesh to Defkalion and to Noah, probably reflect abrupt changes in coastal line in the Mediterranean Basin, in the Black and Caspian Sea, as well as in the Red Sea and the Persian Gulf, because of glacier melting. It is to be noted that at that time, deserts were drier and more extensive.

Fig. 12.8 The coastline during the Pleistocene with sea level 100 m lower than contemporary one. Large strips of land existed where today are sea, and there were passages connecting lands which today are separated by sea. Note the coastline in the Mediterranean Basin, the Black and the Caspian Sea, as well as around the Arabian Peninsula. These areas were probably land at the time and were probably the sites where catastrophic cataclysms occurred when the glaciers melted (image modified from http://www.genesisveracityfoundation.com/Iceage.html after permission). Modified from http://www.genesisveracityfoundation.com/Iceage.html

A major element in evolutionary psychology is the assumption that most of human psychological mechanisms evolved during the Pleistocene and constitute adaptations to survival and reproductive problems caused by the environment of that period. That environment both natural and social was radically different from the modern environment, and the societal structure and the needs were much different from contemporary needs. Humans lived in small hunter-gatherer groups with more stable group features, interpersonal interactions, and identity characteristics, and they were exclusively concerned with food selection and acquisition, selection of territory and physical shelter, as well as avoiding predators and environmental threats (Buss 2011). Differences in gender roles at that time might be behind the higher visuospatial cognitive capacity of males and the higher social cognition of females (Gaulin and McBurney 2003).

As a consequence to the fact that human psychological traits were developed in an environment much different from the modern one and with much different needs, often human psychology exhibits "mismatches" to the modern environment, which, however, is designed and constructed according to the needs and wishes of humanity. These mismatches can take the form of thoughts and biased beliefs but also behaviors (Ohman and Mineka 2001; Pinker 1999; Hagen and Hammerstein 2006). For example, present-day humans are inclined to trace patterns in a series of events even in cases such patterns do not really exist (in a series of random events) and to identify cheating rather than any other irregularity in the events (Gaulin and McBurney 2003).

Maybe several modern conditions including working in large anonymous bureaucratic groups and modern management methods could reflect mismatch and exploitation of instincts (Van Vugt and Ahuja 2011; Van Vugt and Ronay 2014). Another consequence similar to mismatch is the phenomenon of supernormal stimuli. Such a stimulus elicits a response which is far stronger than the same response when elicited by the specific stimulus for which it has originally been evolved. The concept was coined by Niko Tinbergen to refer to nonhuman animal behavior, but later Deirdre Barrett (1954–) carried it to modern human behavior. In this frame, television is a supernormal stimulus for social behavior and attention-grabbing action, junk food for the intake of important nutrients, and pornography of sexual behavior (Barrett 2007, 2010; Hagen and Hammerstein 2006).

12.4.3 Life History Theory

The life history theory starts with the obvious fact that each individual, no matter animal or human, does not have infinite time and energy budgets; on the contrary these are quite finite and precious. Thus, investing effort to solve one problem often precludes the investment in another. In oversimplified terms, the most contrasting investments are the investment in one's bodily growth, safety, and maintenance vs. parenting and kin investment. The first increases the chances of personal survival; the latter increases the reproductive success of genetic relatives. Therefore a trade-off between costs and benefits is always in place, while often investment in complex behaviors increases the success in the solving of more than one adaptive problems (Gadgil and Bossert 1970; Kaplan and Gangestad 2005; Roff 1992; Stearns 1992).

Individual features and characteristics determine the outcome of the trade-off between different investments. These characteristics include total energy, perceived life expectancy, and individual talents and preferences. Individuals might prefer parenting over mating or vice versa, while a perceived short life expectancy might push toward a strategy of immediate expenditure of resources, intense competition, and risk taking for mating (Daly and Wilson 2005a). Biological factors including hormonal might play a role in this trade-off. It is not clear whether it is cause or effect, but it has been reported that male testosterone levels drop with commitment in mateship and levels even fall further after the birth of children (Burnham et al. 2003).

12.4.4 Costly Signaling Theory

Communication is essential in all kinds of social interaction but also for interaction necessary for basic biological functions among members of the same species. Thus individuals also compete on how successfully they will communicate with others in order to be more successful in establishing alliances, achieving social status, and also mating. The reliability of the messages which individuals communicate to others is questionable since there is often an attempt to deceit; by this, the individual

might fulfill goals which otherwise would be out of their league. The ways of communication as well as the ability to understand and to trace deceit constitute important adaptations (McAndrew 2002; Miller 2000a; Zahavi 2006).

In this frame, costly signals tend to be honest signals (Zahavi 1975, 2006), since they are demanding in terms of investment and sent only by those who can afford. Activities like fighting or any type of physical contests for males or sex-analogous activities for females serve the purpose to send a honest and reliable message to the opposite sex about the condition of the individual. Complex and difficult to explain behaviors including generosity and altruism could be viewed in this frame (Miller 2007).

The costly signaling theory is linked to life history theory since the quality of the signal which an individual can communicate defines the individual's life history and the strategies he will adopt.

12.4.5 Balancing Selection

Balancing selection refers to a condition when selection does not choose a single solution to a problem and eliminates all others, but instead it permits genetic variation. This leads to the manifestation of different levels of adaptation to a specific environment or the same level of adaptation to different environments (Penke et al. 2007).

One mechanism of balancing selection is through environmental heterogeneity in fitness optima, that is, different environments favor the evolution of different behavioral patterns through a complex selection process including migration (Ebstein 2006; Penke et al. 2007; Chen et al. 1999; Eisenberg et al. 2008).

Another mechanism is frequency-dependent selection. This refers to the situation when two or more different strategies concerning the same adaptation problem are maintained within the same population, and they exist at a particular frequency relative to each other. This means also that the overall fitness of each strategy decreases with its increasing frequency of use in the population. An example of such a strategy is cheating, that is, using deceit to achieve adaptation goals (Mealey 1995).

12.4.6 Mutation Load

Genetic mutations are common and can be neutral or disruptive and could concern any body system or function. On average individual humans carry at least 500 brain-disruptive mutations each (Keller and Miller 2006). Through the process of natural selection, individual mutations or combination patterns could be eliminated through time; however purging is never complete, and mildly harmful mutations could survive for many generations. Most reflect older mutations, inherited from ancestors (Keller and Miller 2006), but the effect of increasing parental age in combination with very low infant mortality and the increasing rate of cesarean sections during the last few decades remain to be seen.

Random mutations and the genetic load they create could be the source of noise or variations in behavior (Buss 2006), and adaptive traits with an important role especially in mating, including emotional stability, conscientiousness, or intelligence, could be disrupted, or alternative facets or traits could manifest (Buss 2006).

12.4.7 Contingent Shifts According to Environmental and Phenotypic Conditions

While natural selection pushes toward the preference for a specific heritable trait which is adaptive for a specific environment, contingent shifts refer to the selection of psychological mechanisms which are flexibly responsive to changes in environmental or cultural conditions (Belsky 1999; Gangestad et al. 2006). This is related to the life history theory since this theory predicts changes in behavior after changes in environment or in personal achievements, e.g., parenting, but also as a response to individual characteristics, e.g., physical size and strength (Tooby and Cosmides 1990; Ishikawa et al. 2001).

12.4.8 Evolution of Emotion

As described in Chap. 1, affects and emotions serve two main aims:

- The first concerns the internal functioning of the individual and provides the individual with fast decisions which serve the survival of the individual but also of the species. Some of these decisions are easy to understand (e.g., fear of animals), but others are incomprehensible at least with a superficial approach (e.g., aesthetics and attraction to the opposite sex). In the same frame, emotions provide feedback concerning the behavior of the individual, and in this way, they enhance the expression of the specific behavior or preclude its future manifestations. For example, sadness constitutes the emotional response to loss, defeat, disappointment, or other adversities. Its adaptive function includes permitting withdrawal to conserve resources, asking for support from significant others and the autonomic arousal which might be present facilitates the search for the lost object or an appropriate substitute.
- The second aim is to communicate the internal emotional state of the individual to others, and this is achieved through facial expressions, gestures, bodily movements and posture, and verbal and nonverbal elements of voice. These ways of communicating emotions vary between cultures, but most of the repertoire is universal for human beings. They constitute a main source for the interaction with others, since the emotions of an individual influence the emotions, thoughts, and behaviors of others, produce positive or negative feedback, and give birth to circles of future interactions and reciprocal influence.

A modern understanding of the issue goes through a basic approach to brain function which could suggest that there are two distinct mental processes: logical thinking and emotions. While emotions are present also in animals, logical thinking is present primarily in humans, while some elements are also evident in the behavior of primates.

Emotional processes are evolutionary older and are characterized by speed and dominance. They lead to fast decision-making, on the basis of predetermined strong assumptions concerning the gross characteristics of the situation. For example, fear is triggered immediately and almost before conscious recognition of the stimuli, and it leads to the fast manifestation of a specific adaptive behavior (fight or flight). A snake will always trigger fear, no matter whether it is poisonous or not. On the contrary, logical thinking is slow, requires the conscious elaboration on the stimuli, and demands concentration and effort, and it is not as strong as emotions are, concerning the effect on behavior. Emotion is biased toward the triggering of those behaviors that serve the survival of the individual and the species, while logical thinking aims toward an "objective" assessment of the situation. In the language of artificial intelligence, the closest description which can be made today is that of "fuzzy" vs. "digital" systems.

The database of assumptions which the emotions use is of unknown origin, probably partially inherited and partially acquired through experience, and possibly it is characteristic of the species. Logical thinking is based mainly on training. Decisions based on emotions are stronger than those based on logical thinking, and when they are in conflict, the person faces a difficult dilemma, since it is very difficult for logical thinking to override emotional pressure.

The two processes, although independent in principle, they interact and influence each other. The emotional status causes bias in logical thinking, and logical analysis triggers emotions depending on the positive or negative outcome. This interaction is likely to happen at multiple levels (e.g., selective memory recall, reinforcement through new analysis, biased selection of possible solutions, etc.).

The interest in emotions from an evolutionary perspective was triggered by the publication of the book *The Expression of the Emotions in Man and Animals* by Charles Darwin in 1872 (Fig. 12.9). In that book, Darwin stresses the universal nature of emotions and the connection of mental states to the neurological organization of movement. Central to his understanding was a shared human and animal ancestry. This was in sharp contrast to the contemporary claims that there were divinely created human muscles to express uniquely human feelings. Darwin's original suggestion was that emotions evolved via natural selection and therefore have cross-culturally universal counterparts; a proposal confirmed almost a century later by the works of Paul Ekman (Ekman 1965, 1980, 1992a, b, 1993, 1994, 2003, 2009, 2016; Ekman and Friesen 1967, 1971; Ekman et al. 1969, 1987). According to Ekman humans share at least five basic emotions: fear, sadness, happiness, anger, and disgust. Furthermore, animals undergo emotions comparable to those of humans. It seems that social interaction based on emotions influences motivation and stimulates the reward systems (Belke and Garland 2007).

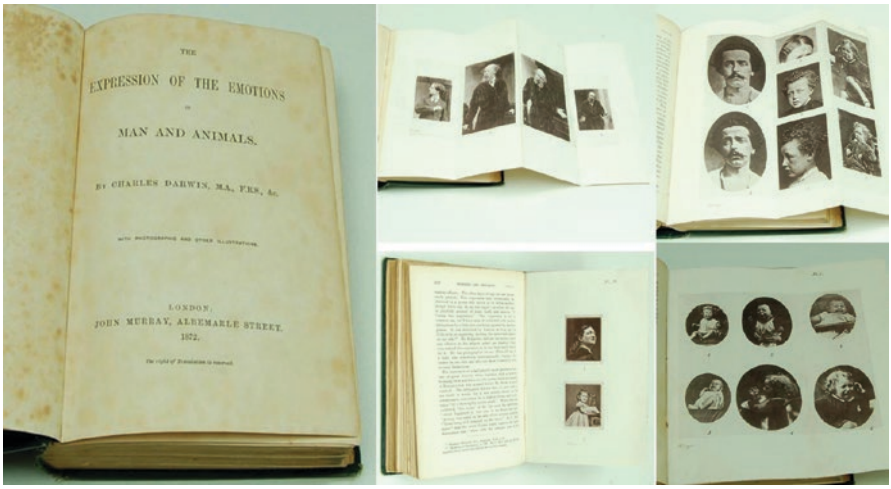

Fig. 12.9 The book *Expression of the Emotions in Man and Animals* by Charles Darwin (1872) (images from Botterweg Auctions Amsterdam, after permission)

12.4.9 Mating and Parenting

Sexual function and mating are important for the survival of the species and more particular for the genes of the individual person. However the strategies to achieve this goal vary considerably among species and genders. According to the r/K selection theory (Huey and Pianka 1977) and the life history theory (Roff 1992; Stearns 1992), some species have many offspring, while on the contrary, others choose to have fewer offspring but invest much more in each one. Humans belong to the second category.

Angus John Bateman (1919–1996) argued that in most species, anisogamy, that is, the fact that males are able to produce millions of sperm cells while females only a relatively small number of eggs, results in different sexual behavior between genders. Females also spend many months in pregnancy. As a consequence, females are the limiting factor of parental investment. Males will compete for this limited female ability to give birth which is combined with higher nurturance of the offspring. Males themselves will overall invest less on the offspring (Bateman 1948). On the contrary, females exercise the ability to have high-quality males (choosiness). Additionally, human females exhibit concealed ovulation ("hidden estrus") which means that it is impossible for the male to know when the female is fertile. Subsequently, frequent mating and stable relationships are necessary to ensure paternity. The erectile ability from the part of the male might provide information concerning his health status, and because of this, it influences the mating choice of the female (Abbot et al. 2011).

This essentially means that females tend to choose males who care for the family and the offspring and its nurture and raising (Barash and Lipton 2001). In 1972

Robert Trivers (1943–) developed the parental investment theory (Trivers and Willard 1973; Trivers 1972) which further built on Bateman's principle. He suggested that there are different levels of parental investment between the sexes. According to his theory, females initially invest more, and this difference leads to different mating and reproductive strategies between males and females and eventually to sexual conflict in the form of sexual dimorphisms in mate choice (differences in behavior between the two sexes beyond the differences in sexual organs), sexual reproductive competition, and courtship displays (Barash and Lipton 2001). There are evolved mechanisms to attract select and secure mates (Workman and Reader 2008; Buss and Barnes 1986; Li et al. 2002; Schmitt and Buss 2001; Buss 1988), but there is also conflict between the sexes (Conroy-Beam et al. 2015; Peters et al. 2002; Botwin et al. 1997). Under specific conditions, females could adopt sexual behavior closer to that to males, but this is rather the exception (Buss 1989).

Same-sex sexual behavior or homosexuality seems impossible under a Darwinian point of view since it is related with low rates of reproduction and constitutes a "Darwinian paradox." However it is not a solely human phenomenon since it has been documented in hundreds of species (Garcia-Cardenas et al. 2015; Gunst et al. 2015; Leca et al. 2015; MacFarlane and Vasey 2016; Triana-Del Rio et al. 2015; Ungerfeld et al. 2014; Vasey et al. 2014). Its frequency is rather low, but the rates seem rather stable in all human populations. The role of environmental factors seems to be weak although there seems to exist some specific environmental conditions that may encourage transient homosexual behavior, e.g., captivity. On the other hand, there are data suggesting the influence of genetic factors, and some studies have pointed out relevant asymmetries in the distribution of both male homosexuality and female fecundity in the parental lines of homosexual vs. heterosexual males.

A number of hypotheses have been proposed to explain this paradox, although none of them has gained the full support of the scientific community. The following are the most important:

1. "Kin selection" which suggests that childless homosexuals might put more effort into helping raise nieces or nephews.
2. "Overdominance" which suggests the presence of a gene which when the person is heterozygous leads to a reproductive advantage (e.g., by increased female fertility or increased sperm motility) but when homozygous leads to homosexuality.
3. The "maternal effects hypothesis" suggests a fetus is influenced by the environment of the mother's womb, resulting in changes that predispose one toward homosexuality.
4. The "sexually antagonistic selection" hypothesis has the highest support from evidence currently. It suggests that there exist genes which are spread throughout the human population and they work by providing the one sex with a specific reproductive advantage while disadvantaging the opposite sex. Such a gene would promote fertility and subsequently reproductory fitness in females but homosexuality in males and vice versa (Camperio Ciani et al. 2008).

5. In animal species, in which the recognition cues of females and males overlap to a certain degree, homosexuality could be a consequence of an adaptive discrimination strategy to avoid the costs of making rejection errors (Engel et al. 2015).

In general it is supposed that the parents' investment depends on the probability of the offspring to survive. Furthermore, according to the Robert Trivers (1943–) and Dan Willard hypothesis (Trivers and Willard 1973), parents in good conditions tend to invest more on sons (who are best able to take advantage of good conditions), while parents in poor conditions tend to invest more in daughters (who are best able to have successful offspring even in poor conditions) (Veller et al. 2016; van Bodegom et al. 2013; Kaptijn et al. 2013; Kolk and Schnettler 2013; Venero Fernandez et al. 2011; Zadzinska et al. 2011; Cameron and Dalerum 2009; Cronk 2007; Koziel and Ulijaszek 2001; Chacon-Puignau and Jaffe 1996; Anderson and Crawford 1993).

According to Buss and Schmitt's sexual strategies theory and strategic interference theory, the differential parental investment observed in males and females led to the evolution of sexually dimorphic behaviors. When the strategies, priorities, and behaviors differ, then conflict between the sexes occurs, and as a result, emotional responses including anger or jealousy emerge (Buss and Schmitt 1993). Females generally react more negatively to emotional infidelity, while males will react more to sexual infidelity, especially also because fatherhood could not be proven until recently (Galperin et al. 2013; Buss 1995; Buss et al. 1992).

The "parental investment theory" is a branch of the "life history theory." It is evident that reproduction in general is costly for both sexes but especially for women. It demands the investment of significant resources, both in the form of time but also of material as well as of social resources (alliances and interactions). As a result the survival and the future reproductive output of the offspring are maximized at the cost of other options the parents have for their overall somatic health, fitness, reduced mating opportunities, and securing survival (Trivers 1972; Clutton-Brock and Vincent 1991; Hamilton 1964a, b). Step parental care could often be problematic because of priorities in favor of the biological child (the Cinderella effect) (Miller 2000b; Daly and Wilson 2005b, 1987 1991).

Evolution concerns the survival and proliferation of genes, and in this sense, the evolutionary success depends on the number of offspring, but this approach cannot explain a number of very frequent and important behaviors, e.g., altruism and self-sacrifice. In 1964, William D. Hamilton (1936–2000) proposed the inclusive fitness theory. In this theory he suggested that behaviors which harm the individual (e.g., self-sacrifice) could be considered to be adaptive in the frame of the group the individual belongs to, and in this way, they increase the chances of survival of the genes of the individual through the survival of family or relatives. Inclusive fitness is the sum of an organism's classical fitness (how many of its own offspring it produces and supports) and the number of equivalents of its own offspring it can add to the population by supporting others (Hamilton 1964a, b, 2001). It also explains our attitude toward more close to us species. This theory proposes an answer to the question concerning "altruism" in the frame of evolution. There is a number of

behaviors which are complex and difficult to understand in the frame of the classical evolution theory, and altruism is such an example. To explain their existence, a number of theories have been developed including evolutionary game theory, tit-for-tat reciprocity, and generalized reciprocity (Burt and Trivers 2006; Comins et al. 1980; Hamilton 1970, 1964a; Orlove and Wood 1978; Durand et al. 2011; Ferriere and Michod 2011; Abbot et al. 2011; Michod and Herron 2006; Michod 2006, 1996; Nedelcu and Michod 2006; Michod and Nedelcu 2003).

To further elaborate on the issue of non-selfish behaviors, one should consider the fact that from offspring to the wider family and eventually to wider groups, gene sharing and kinship are not an all or none phenomenon, but on the contrary, they spread on a continuum from close to distant relatives. Kin recognition is a complex ability with unknown characteristics, but it is well known that humans act generally more altruistically to close genetic kin compared to genetic nonkin (Lieberman et al. 2007). But this does not preclude collaboration with nonkin which can be achieved and maintained via mutually beneficial reciprocity. In this frame, natural selection favors strategies which improve the reputation and increase the chances of support from others. These strategies include a repertoire of social behaviors and emotions, including morality, guilt and friendship, as well as the ability to identify non-reciprocators (cheaters) (Fowler 2005).

12.4.10 Evolution of Language

An interesting ability of modern humans is the ability to speak, read, and write. Children learn to speak early without any specific training or intervention, and they are taught to read and write after specific training but again early and rather easily. However reading/writing and maybe speaking were not innate abilities of ancestral humans, although the use of sounds and gestures/behaviors is a common way for animals to communicate and to exchange crucial information.

There are several theories describing evolutionary pathways and mechanisms for the evolution of language, but all remain controversial (Workman and Reader 2008; Fitch 2010; Deacon 1997). The well-documented fact about language is that it is a universal characteristic of the human species and that children are not born with this ability, but seemingly effortlessly and without systematic training they learn to speak and comprehend language between years 1 and 4. These characteristics of language clearly suggest it is a distinctly human psychological adaptation, and it evolved in parallel with the body organs that support it (Pinker and Bloom 1990).

There are different theoretical approaches on the components and the foundation on which language evolved. Steven Pinker suggests the presence of an innate capacity of language in children (Pinker 1994), which is in accord with the ideas of Noam Chomsky (1928–) concerning the innate presence of a basic universal grammar. However, Pinker suggests that the acquisition of language is an adaptation while Chomsky suggests it is a spandrel (Workman and Reader 2008). Pinker argues that language is unique and characterizes only humans, it is an innate human ability rather than an invention, and it is separate from general intelligence and is based on

a distinct specialized mental module. On the other hand, Chomsky rejects the radical behaviorism of Skinner which argues that the brain is a "tabula rasa" (blank sheet) and subsequently language is fully acquired and taught. Also he argues that language is unique to humans and different from the ways of communication animals use (Chomsky and McGilvray 2012).

However although human languages share many common elements and structure, the universality of the nature of language has not been proved beyond doubt, and there are reports on the contrary. This debate is still unresolved. Additionally it is wrong to consider human language in the frame of the human species alone, and the idea of Chomsky that human language is completely different from the ways animals use to communicate with each other is an unproven and probably an extreme concept.

Animal communication is not identical with animal language, and it does not imply the presence of a language. However, animals use a variety of sounds or movements to communicate, and often they are complex enough to be considered as a form of language. It is important to note that the higher a species' position in the scale of evolution, the more specialized are the somatic organs which produce the sounds or the movements and of course the more evolved are the neurocognitive function and the content of communication. Almost all animals have specifically developed vocal cords in order to produce specific sounds. Therefore, language should be considered in the frame of extremely advanced general cognitive abilities which make possible the use of already existing organs (cords, fingers) for novel tasks in a creative way, which is easily passed from generation to generation through learning, but it is essential based on the innate ability to express and externalize mental procedures through their reflection on these sounds and movements (Fitch 2010; Deacon 1997). Such an expression could be considered to be a kind of "universal grammar" but in a less narrow definition. Although there was probably a selection pressure concerning language, it is unlikely such a pressure existed for reading/writing (Mabry 1995).

It is obvious that animal "language" lacks key elements which characterize the human language, but this depends on the species and how evolved they are. Some primates are even able to use lexigrams under experimental conditions (Gardner and Gardner 1969; Ward 1983), but normally the animal communication lacks the abstractive nature, the symbolism, the complex content, and the creativity which characterize human language. However it is not uncommon in nature that a quantitative difference, if extreme, could lead to a qualitative difference (Di Vincenzo and Manzi 2013; Traxler et al. 2012; Grodzinsky 2006, 2000; Fitch et al. 2005; Pinker and Jackendoff 2005; Hauser et al. 2002), while the continuum of language evolution is supported by research in primates which showed the presence of at least some human elements in their language (Ward 1983; Gardner and Gardner 1969; Patterson and Linden 1981).

12.4.11 Consciousness

Consciousness is another interesting neurobiological and psychological phenomenon. On one hand, it meets the criteria of species universality and of complexity as

determined by George Williams (Nichols and Grantham 2000), and on the other hand, its presence probably increases the overall fitness and survival (Herron and Freeman 2013). It is likely to be the end result of a number of highly adaptive evolutions in brain function (Eccles 1992), and it is not an all-or-none phenomenon. Its main purpose is to put the individual in a perspective concerning the place, the time, and the others, and therefore it is probably present in simpler forms and with somewhat more primitive and incomplete features and functioning also in pre-mammalian species (Baars 1993) with variable complexity and functionality (Gaulin and McBurney 2003).

Self-esteem is not part of consciousness per se, but it reflects self-awareness, that is, cognition about self at a second level. In evolutionary terms, it is essential as an estimation the individual makes concerning its place in social hierarchy. While consciousness positions the individual in terms of place, time, and the others, self-esteem positions the individual among humans and within the scale of social hierarchy. One approach could be that it constitutes a self-assessment in order to choose targets for the allocation of resources. The result is the so-called assortative mating, that is, mating with an individual of the opposite sex with similar qualities.

12.4.12 Personality

The description of temperament, character, and personality is beyond the scope of the present chapter and constitutes a very complex issue (Fountoulakis and Kaprinis 2006; Fountoulakis et al. 2016). Personality reflects individual differences between persons in terms of behavior, and individual behavior in humans manifests significant heterogeneity. These individual differences have been well documented in terms of social behavior, mating and other areas (Sugiyama 2005; Nettle 2006; Ozer and Benet-Martinez 2006; Thornhill and Gangestad 2008), and also in nonhuman species (Wolf et al. 2007; Gosling 2001), and they seem to be heritable to a significant extend (Plomin et al. 2008).

The question whether animals have these characteristics is still a matter of debate, although it is certain that individual differences exist also between individual animals in terms of behavior (D'Eath et al. 2009; Martin and Reale 2008; Reale et al. 2007; King et al. 2006; Whitney 1970). They seem to appear especially in social species, and this might mean that by presenting complex problems, it is the social environment that demands their existence and plays an essential role in manifestation as behaviors (Penke et al. 2007; Perilloux and Buss 2008).

Individual differences constitute an oxymoron for the evolutionary approach because heterogeneity is considered rather as the substrate on which natural selection acts or a starting point rather than the end product of natural selection itself (Gaulin and McBurney 2003). A general concept is that natural selection reduces rather than promotes individual differences. Therefore, the understanding of personality traits in the frame of evolutionary psychology manifests a number of important problems (Buss 1984, 1991, 2009) and has been relatively neglected, with some important exceptions (Buss 1984, 1991, 2009; Sheldon

et al. 2007; Segal and MacDonald 1998; MacDonald 1995; Nettle 2006; Wilson 1994; Wilson et al. 1996). On the other hand, when competition exists, individual differences are what matters, and they determine winners and losers. The ability to better monitor and assess these individual differences is also the product of adaptation (Buss 1996). Differences in personality among individuals could be considered as alternative strategies for the solving of adaptive problems which tend to recur (Buss 1996; Denissen and Penke 2008a, b; Hawley 1999; Nettle 2006).

For too long, individual differences were considered to be "noise" rather than "signal" in the big picture of evolution (Tooby and Cosmides 1990), but recent developments challenged this (Nettle 2006; Keller 2007). Apart from the standard life history, costly signaling, balancing selection, and contingent shift theories, a number of additional unique theories were developed specifically to deal with individual differences, such as social contract theory (Cosmides and Tooby 2005), sexual strategies theory (Buss and Schmitt 1993), error management theory (Haselton and Buss 2000), and adaptive cognitive biases (Haselton et al. 2005).

Individual differences are influenced by sex since, for example, it is reported that in the rhesus macaques, males are more aggressive, less socially affiliative, more impulsive, more prone to taking risks, and with higher mortality rates (Mehlman et al. 1994, 1997; Higley and Linnoila 1997; Higley et al. 1991, 1992). In mating, the strategies used differ not only between sexes but also among individuals of the same sex with some pursuing lifelong monogamy while others prefer frequent partner switching (Gangestad and Simpson 1990). Of course mixed strategies also exist. Similar differences exist concerning the pursuit of social status and the preference for a specific rank in social hierarchy (Hawley 1999; Lund et al. 2007b) as well as in the ability to detect deceit and cheaters (Ekman et al. 1999; Buss and Duntley 2008).

According to the life history theory which can provide a conceptual frame for the understanding of personality traits and their evolution (Figueredo et al. 2005; Kaplan and Gangestad 2005; Wolf et al. 2007), individuals make investments to solve adaptation problems, and the optimal trade-off between different allocations of resources depends on individual differences (Daly and Wilson 2005a). In this frame, personality disorders could be considered as behaviors stemming from perceiving different adaptational problems or from the presence of different qualities and resources which dictate different strategies (Daly and Wilson 2005a).

In a similar way, the costly signaling theory (Miller 2007) and the balancing selection with its key components "fitness optima" and "frequency-dependent selection" (Penke et al. 2007) could be also useful. It is reasonable to assume that some environments favor a risk-taking behaviors while others on the contrary favor more cautious harm avoidance behaviors (Camperio Ciani et al. 2007). A specific genetic substrate probably plays a role too (Ebstein 2006; Penke et al. 2007; Chen et al. 1999; Eisenberg et al. 2008). On the other hand, the mutation load theory is rather problematic since it tends to consider individual differences as random noise rather than alternative solution proposals, although there are opinions suggesting a more creative role in general for the mutation load (Buss 2006).

One personality which has been specifically the focus of research is psychopathy which corresponds to aspects of antisocial personality disorder. Frequency-dependent selection has been suggested as a mechanism which can explain the evolution of these traits and their survival in modern humans (Mealey 1995). The core characteristic of this personality is cheating with disregard of social norms and social solidarity. In this way these individuals exploit the strategy of cooperation the majority has. It is more frequent in males, and among other things, it involves the short-term seduction and abandonment of females (Mealey 1995). Another characteristic is the ability to identify potential victims (Buss and Duntley 2008).

More interesting is the way individual differences and personality traits could be understood in the frame of the theory of contingent shifts according to environmental and phenotypic conditions (Belsky 1999; Gangestad et al. 2006). Changes in behavior could come as a response to changing environment such as more aggression and higher risk taking in environment with few resources or mating opportunities or with more co-cooperativeness in dangerous environments. Such changes or facilitation of behaviors and psychological traits can also happen, not because of the environment but because of the emerging individual characteristics, a phenomenon called "reactive heritability" (Tooby and Cosmides 1990). Such an example is body size which tends to determine higher aggression in persons with large body sizes and more pacificity in individuals with small body size (Ishikawa et al. 2001). Another such example are the later-born children which are often more rebellious and less conscientious (Sulloway 1996).

The way individuals copy with the challenges posed by their participation in large groups is also variable and differs significantly from person to person. The position in social hierarchy is usually pursuit with prosocial and coercive strategies, depending on the personality (Hawley 1999). These strategies include deception and manipulation or, on the contrary, communication of positive personal characteristics and also with industriousness (Lund et al. 2007a), and to a significant extent, they correspond to the five-factor personality model (Buss 1992; Costa and McCrae 1985; McCrae et al. 2005). These personality factors were also viewed as motivational forces for the choice of specific strategies (Denissen and Penke 2008a, b).

Interestingly, the five-factor model was developed on the basis of the lexical theory of Gordon Allport (1897–1967) and Henry Odbert (Allport and Odbert 1936). The first such attempt had been made by Franziska Baumgarten-Tramer (1883–1970), who identified 1093 separate words in the German language as reflecting personality traits and mental disorders. This was of course incomplete as Gordon Allport and Henry S. Odbert showed in 1936, when they identified 17,953 such words in the English language and separated them into four categories or "columns." According to them, the first column included 4504 words that reflect personality descriptions. The second column with 4541 words reflected emotions, while the third column with 5226 words reflected social and pragmatic but not psychological evaluations of an individual and its position in society and its hierarchy. The last column with 3682 words included words with miscellaneous meanings and use. This theory is based on the assumption that the natural human language constitutes an important source for the identification of personality traits, because as Raymond Cattell

(1905–1998) suggested, in the course of the evolution of human culture, any behavior or personality concept which would be of importance in human social interaction should have been registered in language since it was the content of communication. The 16 Personality Factor Questionnaire (16PF) (Cattell et al. 1970) and the five-factor personality theory (Costa and McCrae 1985; McCrae et al. 2005) are both products of the lexical hypothesis. The main criticism argues that these imprints in human language are biased lay peoples trivial and superficial descriptions.

12.5 Evolutionary Social Psychology

Evolutionary social psychology is a rather recently developed scientific field and tries to understand the complex area of social behavior in the frame of evolutionary psychology and biology (Santrock 2005; Schaller et al. 2006). Essentially it constitutes the expansion of evolutionary psychology in the social domain.

Social psychology concerns the study of thoughts, feelings, and behaviors in a social environment, that is, in the actual, imagined, or implied presence of others (Allport 1985). Thus, it bridges psychology with sociology and pays attention to the phenomena that occur at the individual but also at the group level (Moscovici and Markova 2006). Its appearance followed the development of sociology in the late nineteenth century and emerged as a new discipline in the early twentieth century although some thoughts in this field existed already in the Arab scholar literature (Gergen 1973). At the core of its existence is the assumption that human behavior and social phenomena can be the focus of scientific research which follows the universal rules of science. One of the pivotal historical cases of social psychology was in the 1960s, the case of the Stanley Milgram (1933–1984) experiments on obedience to authority.

The basic concept in social psychology is "attitude" which is defined as a learned global evaluation of a person, object, place, or issue, and it determines action. It reflects approval or disapproval, favorability or unfavorability, or, in simple words, likes and dislikes (Bem 1970). Attitudes influence behavior, but they are often poor predictors of it. They could be conscious or unconscious (implicit), and they concern most of social interactions. The question whether attitudes are determined genetically or culturally and through learning and to what extent remains unanswered. Another important concept is "persuasion" which refers to the influencing of people by rational or emotive means in order to adopt a specific attitude (Myers 2010).

Social cognition and theory of mind is a field of research concerning the neurocognitive basis of social behavior. This refers to the ability of individuals to process and interpret stimuli relevant to the behavior of others, that is, their intentions, desires, and abilities, but also concerning the prediction of their future behavior. Collectively this is called "attribution" and can be ascribed as an internal (personality, character, etc.) or external (environmental) locus (Reisenzein 2015; Dunfield and Johnson 2015; Schreiber 2012; Seidel et al. 2010; Santiago and Tarantino 2002; Andrews 2001; Klin 2000; Block and Funder 1986; Kruglanski 1986).

A number of biases and errors in the attribution process have been described, and probably all of them are the product of evolution. These biases and errors include the tendency to overestimate the role of personality and underestimate the role of situations, to attribute dispositional causes for successes and failure and blaming victims for their suffering. Also bias is considered the false memory of having predicted events or the overestimation of true predictions after the outcome is known. Confirmation bias leads to search for information or interpretations that confirm preconceptions and disregard the others. All these protect the person from feeling vulnerable and mortal. It seems there is a kind of "white lies" everybody tells himself as a defense mechanism in order to keep psychological well-being, and maybe these "adjustment lies" are not functioning in depression (Andrews 2001). However biases are not identical with errors. Biases can help quick adaptation, but they could constitute errors under specific conditions. This is because the human brain utilizes heuristics in order to arrive at fast decisions to complex and demanding problems. Heuristics are cognitive shortcuts, and the whole procedure is based on the comparison of the situation faced with a prototype situation the people know of. This often demands a simplified and straightforward interpretation of the complex reality and the development of generalized mental representations called schemas. Schemas organize knowledge and guide information processing but often lead to the development of a generalized set of beliefs about groups of people or situations. If this comparison leads to a successful solution, then the bias and the schema lead to adaptation; if not it leads to an error or to a problematic stereotype and prejudice.

Another important concept is that of "social influence" which refers to the persuasive effects people have on each other and includes conformity (act or think like other members of a group), compliance (change in behavior due to a request or suggestion from another person), and obedience (change in behavior as a result of a direct command from another person). An interesting form of social influence is the so-called self-fulfilling prophecy which refers to the situation when a prediction is made; the person's behavior actually causes it to happen, e.g., when expecting hostility from others; the behavior of the person itself actually causes it, while it did not preexist.

Apart from the interaction between individuals and between individuals and groups, groups also interact with each other since they possess a distinct identity, rules to follow, and solidarity among members. A related phenomenon is the behavior of crowds which often leads to deindividuation, a term reflecting a state of altered self-awareness caused by feelings of anonymity (including large crowds, disguise, and online anonymity). This is associated with uninhibited and maybe dangerous behavior.

To put social psychology in an evolutionary perspective is both challenging and rewarding. An essential first observation is that there seems to be a lot of common features that link human cultures from around the world irrespective of how isolated they are from each other and similarities are more than differences (Brown 1991; Rosch 1973). For example, in all human cultures and societies, there are systems to recon kinship and treat individuals according to kinship status (Daly et al. 1997). While this is not the case for the vast majority of mammals, all human societies have

some kind of marital bond for the sharing of parenting (Daly and Wilson 1983; Broude 1994; Geary 1998). These cultural similarities exist alongside many cultural variations, which often seem very peculiar like the mating customs of the aboriginal tribe of Tiwi in Australia who manifests an interesting interplay between general human mating preferences and a particular social ecology (Hart and Pillig 1960).

Another example is that historically, in most cultures there is polygyny (one man and more than one wife), while a few permit polyandry (one woman and more than one husband). It is interesting that in spite of this modern societies are monogamous. It is standard procedure that when biologists find variations across species in behavior, they search for correlations with ecological factors (Alcock 2001). In general polyandry, though rare, can be explained by the presence of an environment with limited resources. In such environments (e.g., in the high Himalayas), it needs more than one male to support a female and her offspring successfully. In such places, often brothers marry the same woman (Platek and Shackelford 2007; Salmon and Shackelford 2008). On the contrary, in places rich in resources, the opposite phenomenon, that is, polygyny, is observed. Extreme polygyny is manifested in harems, and they are associated with societies with strict hierarchy in a rich environment (Crook and Crook 1988). However other factors apart from the physical environment play a role in the quality and characteristics of the marital bond. One such factor is the ratio males-to-females which can change because of war, migration, and other similar causes. In excess of females, later marriage, more divorce, and permissive sexual norms are observed. In excess of males, males are committed to more stable monogamy (Gangestad and Buss 1994; Kenrick et al. 2003).

It is interesting to note that in the great apes, all kinds of social organization are seen, from monogamy in gibbons to unimale polygyny in orangutans and gorillas and to multimale polygyny (or polygynandry) in chimpanzees where a group of males defends a group of females and their offspring (Foley and Lewin 2013; Lewin 2009).

In all human cultures, also the presence of status hierarchies is a basic characteristic of society with separations of casts and groups and variable restrictions and rules (Brown 1991). Anthropological and archaeological data suggest that originally, humans were living in small groups of hunter-gatherers with the size of 50–80 individuals on average and the members of each group were biologically related. These groups were characterized by less strict social hierarchy, members knew very well each other, and they were connected with (actual or fictive) bonds of kinship and were occupying large territories in an exclusive way (Barnard 1999; Maryanski and Turner 1992).

Within these groups, the genetic relatedness together with the long-term reciprocal exchanges usually developed trust and cooperation rather than market-like reciprocal exchange (Fiske 1992). Stigmas concerning disability or disease probably reflect fear of threat not only to the psychology of the individual but also to the collective group welfare (Kurzban and Leary 2001; Neuberg et al. 2000).

Also, an unknown individual not belonging to the group was considered to be a potential enemy, and although cordial exchange relationships with other groups were in place, outsiders were always considered to be a threat in terms of stealing,

kidnapping females, rape, or homicide (Chagnon 1988; Radcliffe-Brown 1913). Therefore it seems that evolution could have made humans to be cognitively inclined to divide other people into "with us" and "not with us" and to perceive the later as a source of danger and threat (Krebs and Denton 1997; Wilson 1978). However, since outsiders often did not constitute a threat but on the contrary they constituted opportunities for trade and development, a flexible response system would be more adaptive in comparison to a rigid one that would reject all outsiders. Such a flexible system would recognize the true value of the outsider and its place in the complex environment of the group (Kenrick 1994; Kenrick et al. 1994).

12.6 Sociobiology

Sociobiology attempts to predict social behavior by utilizing the tools and theories of evolutionary psychology (Haig 2002). Social life is the preferred mode of living in many species in nature. They prefer to live in groups and manifest characteristics of social life, some of them very complex, but the complexity of human societies is exceptional. This complexity is such that many individuals find it difficult to adjust to its demands and subsequently are concerned more with keeping up with the rules and laws of the society than with survival itself, which these rules are supposed to serve. According to Jean-Jacques Rousseau (1712–1778), "*social institutions are those that best know how to denature man, to take his absolute existence from him in order to give him a relative one and transport the I into the common unity*" (Rousseau 1979).

Through the history of human societies and since the strong prosocial teachings of Socrates (470–399 BC) and Confucius (551–479 BC), a number of theories evolved, which essentially were attacking the very concept of social organization itself, from the philosophical ideas of Jean-Jacques Rousseau to the anarchist political ideology of William Godwin (1756–1836) and Mikhail Alexandrovich Bakunin (1814–1876).

But one of the most fascinating ideas which appeared in the twentieth century was that of the "Noble Savage" which enjoyed wide acceptance, especially in the frame of the civil rights movement after WWII. It referred to an ideal human being, living in peace with nature and his neighbors, with no negative thoughts or feelings. It was preached by Margaret Mead (1901–1978) who claimed that she had found a tribe in Samoa with an ideal psychological and social behavior and lacked things like jealousy or rigid sex roles (Mead 1928). Her reports were proved to be completely false and biased (Shankman 2009; Freeman 1983). However this idea was appealing, since it suggested that humans are inherently good and moral and modern civilization was the cause of all negative things (a convenient external locus). This is of course very close to the ideas of Jean-Jacques Rousseau and his 1762 book *Emil* (Rousseau 1979). Around the same time Margaret Mead was developing her ideas, another concept, that of the "Blank Slate," was widespread. This suggested that all people were able to learn anything with an equal amount of effort and that there were no biological predispositions or inclinations. This reflected a

concept of radical equality at all levels and aspects, which took the step from civil rights equality to consider individuals being not only equal but essentially identical in all aspects. This was also suggesting that all individual differences were the product of social forces rather than inherent traits. This has its roots in Aristotle (384–322 BC), but it was shaped with the concept of "tabula rasa" by John Locke (1632–1704), although in a different frame and purpose. However the modern concept has important modern political implications. According to the modern concept of the "Blank Slate," in cases of state failure or in non-state societies, people organize in group for protection, and concepts like revenge and honor become extremely important (Pinker 2002; Rose 2001). This is in sharp contrast to the very influential collectivist anarchism theories developed by Mikhail Alexandrovich Bakunin.

Research has proved that humans have a strong predisposition to learn some behaviors over others and that individual differences do exist (Buss 2001). Therefore, it is pretty evident that as every living organism on Earth has a repertoire of "hard-wired" behaviors and instincts which serve survival, so do humans. For all species, these traits are evolutionary developed and determined. For humans, this evolution took place mainly during the Pleistocene, and contemporary behaviors constitute more abstract and refined versions of basic adaptation strategies (e.g., friendship evolved from sharing of resources) (Kenrick et al. 2003). All aspects of human mental life were developed during that period, and their properties, advantages, and problems can be traced back to then, from differences in cognitive function between sexes to the selective and representative but imprecise way memories are retrieved (Klein et al. 2002).

Social life is characterized by a way of life and behaviors which are often sharply different from a solitude way of life. Thus there is a constant conflict between the needs of the one vs. the needs of the many, and this is a problem evolutionary sociobiology needs to address, but it is often very difficult. The behaviors and restrictions when being part of a group might reduce that reproductive success or induce harm or even death to the individual. Eventually, however, through inclusive fitness, the survival and adaptation of the group and the society as a whole increase. The term "reciprocity" refers to the behaviors with which individuals exchange favors. The issue of altruism and other non-selfish or self-harming behaviors in the frame of inclusive fitness theory has been described above. Issues pertaining mating and polygamy have also been discussed above. The ability for empathy is a rapid way to induce cooperation and to facilitate reciprocal altruism (Burt and Trivers 2006; Dawkins 1976). The same holds for communication and "cheating." Reciprocity is essential for humans; failure to reciprocate reduces, while on the contrary, the reliable reciprocation increases social reputation. Especially for the study of reciprocal systems and cheating, the game theory paradigm known as the "Prisoner's dilemma" tries to model the development of cooperation among independently acting egoists (Barash 2003b).

It has been estimated that in order for the human fetus to be fully developed like the fetuses of other mammals and great apes, a gestation period of 18–21 months would be necessary. The reason why it has been restricted to only 9 months has been considered to be a side effect of upright bipedal walking which leads to a small

pelvis size which in turn limits the size of the fetus the human female can carry (Weiner et al. 2008; Charnov and Ernest 2006). This was called the "obstetrical dilemma," a term coined in 1960 by Sherwood Larned Washburn (1911–2000) (Wells et al. 2012; Washburn 1973, 1978, 1982; Washburn and McCown 1972). Another theory suggests that it is the result of limits in the metabolic burden the mother can take in favor of the fetus, and subsequently this puts a limit to how large and energetically expensive a fetus can be (metabolic crossover hypothesis) (Dunsworth et al. 2012). No matter what the cause is, the fact remains that the human newborn is extremely unprepared to survive by itself in nature and demands significant care and parental investment, thus pushing toward stable long-term mating relationships. This makes humans much more monogamous oriented than primates and other mammals.

Observations are consistent with the belief that humans are mildly polygamous by nature and this is a stable cross-cultural characteristic. Serial monogamy is a situation in between monogamy and polygamy (Barash and Lipton 2002; Platek and Shackelford 2007; Salmon and Shackelford 2008). Social norms do not permit departures from monogamy to manifest openly, especially for women. In spite of this, departures from monogamy are present for both sexes universally (Barash and Lipton 2002). This is also true for previously considered monogamous species, as DNA testing proved that 10–80% of offspring come from a father which is not the male social partner of the couple. This might also was the case for prehistoric humans as well, but in modern human societies, the rate is probably below 4% (Bellis et al. 2005). The globalization which started with the colonial era brought a gradual social homogenization, and while before, almost 90% of societies were polygynous, currently the vast majority are monogamous, and monogamy is also a feature, among others, which determines whether a society is modern or antiquated.

Polygyny was socially more dominant, and it is related to a number of differences between sexes. On average, men are physically larger and with a tendency toward competitive and often violent behavior. Females mature sexually earlier than men and often prefer men older than themselves. All these are also found in mammals where polygyny is the rule since through natural selection, males obtain characteristics which help them to compete with other males, with higher strength, status, and chances for success with advancing age, while females reproduce early and more frequently. These correspond to a pattern of "sexual dimorphism" and "sexual bimaturism." In monogamous species like gibbons, males and females are of the same size. In gorillas which live in unimale polygamy, males are 30% bigger (Foley and Lewin 2013; Lewin 2009).

Studies of old societies who accepted polygyny suggest that nearly all women were mated and reproductive. On the contrary, there was significant variability in men, with some men being nonreproductive bachelors, most being monogamous, and a few having a harem. This points to another fact that, although the physical tendency is toward polygamy, humans are clearly capable of monogamy, at least at the social level. Even their physical inclination toward polygamy seems to be less strong in comparison with most mammals. In evolutionary terms, as described

above, this could be explained by the fact that the human offspring is helpless at birth and takes several years to grow up, and this is more pronounced in comparison to the offspring of other mammals. Subsequently it needs more postnatal care and parental investment from both parents for several years until it grows up.

On the other hand, the tendency of females to seek multiple sexual partners is difficult to explain. It was also difficult to document until recently, because of the secretive way it was conducted in all species. This tendency occurs in spite of risking even violent behaviors from the side of the male and the high risk of abandonment. The probable explanation is that females try to improve the genetic quality of offspring while at the same time they keep the advantages of stable parenting through social monogamy.

The above are in accord with the presence of a lower threshold for sexual excitement in men which therefore are more susceptible to pornography, prostitution, and paraphilias. They are also more eager to engage in sexual activities with strangers, and they pay more emphasis on the physical attributes of the partner since these reflect fertility status. They pay less attention to intellectual attributes and are jealous and possessive. On the contrary, females seem to be more concern with male access to recourses. The mechanism for these choices is largely unconscious, at least concerning the deeper evolutionary goal.

Men are more inclined to physical aggression and violence than women, and much of their behavior is based on the show-off or physical strength. This is of course culturally enhanced, but it is based on inherent traits. There is no culture in which the sex images are the opposite and women are culturally expected to be more violent than men.

In nature physical aggression and violence is often linked with mating, even in the great apes. While in human society and culture, rape is linked to moral and political issues, in the animal kingdom, rape is probably the strategy followed by the otherwise socially and sexually unsuccessful individuals. In humans, the "domination hypothesis," introduced by Susan Brownmiller (1935–), suggests that rape is not sexually motivated, but instead, it is a conscious process of intimidation by which all men keep all women in a state of fear. This was a highly controversial theory in a clear feminist politico-ideological frame (Lalumiere et al. 2005), and one of the key arguments in favor was that no zoologist ever observed animals raping in their natural habitat. However this is far from true. At that time such evidence was available and in the following decades accumulated (Alcock 2001). Randy Thornhill (1944–) and Greg Palmer argued against this hypothesis and pointed out that the improved understanding of what motivates rape rather than ideological approaches likely helps prevent rape. They argued that sexuality is the motive behind rape since a disproportionate number of victims are very young women and suggested that rape is either an adaptation or a by-product of adaptive traits such as sexual desire and aggressiveness (Thornhill and Palmer 2000; Lalumiere et al. 2005; Figueredo et al. 2011). Furthermore, competition among males is probably more intensive in late adolescence and young adulthood, and this might explain the particularly high crime rates in these age groups (Rose 2001).

Parenting is a complex situation and task and demands a number of somatic but also intellectual abilities from the side of parents. Conflicts between parents but also among parents and offspring are frequent, and from an evolutionary perspective, this is also because their evolutionary goals and agendas are not identical. Parents share only half of their genetic material with each offspring which acts as a limiting factor in parental investment. The area of parent-offspring conflict is predictable and concerns mainly the tendency of the offspring to seeking and obtaining more investment than the parent has chosen to provide. In a reversal of situations, similar conflicts may occur when the offspring shows significantly less than expected inclination toward the parent and preference for other members of the family. The psychological dynamics within a family were the focus of psychological, sociological, and anthropological studies, and the conclusion is that they could be very intense as well as unconscious. Competition with same-sex parent and adjustment to opposite-sex parent can be considered under this view, as they can, even sophisticated psychoanalytic concepts like the "Oedipus concept."

A more complex social and psychological issue is stepparenting. Among animals, stepparenting is rare, and when it occurs, it might hide different aims from the side of the stepparent. When created experimentally, these families are very dysfunctional, and even murders happen. Infanticide and neglect of stepchildren are the rules rather than the exceptions (Power 1975; Hasegawa and Hiraiwa 1980; Barash 2003a).

While most human stepparents are clearly able to function and invest in their stepchildren, which is an important element especially in societies with high divorce rates, in evolutionary psychology, the term "Cinderella effect" (Daly and Wilson 2005b) refers to the alleged higher incidence of child abuse and mistreatment by stepparents in comparison with biological parents. Of course it refers to the famous Cinderella fairytale, and it is believed to be a direct effect of competition concerning mating and parental investment as described above. There is a wide belief that stepfamilies are emotionally conflicted more frequently in comparison to biological families. Non-biological parents have an inherent disinclination to invest in unrelated children. It is both interesting and disturbing that there are some data suggesting that even the accidental injury of children is higher when a stepparent exists but not in single-parent families when one of biological parents has left (Tooley et al. 2006).

One of the sensitive and delicate issues to deal with in a sociobiological perspective is religion and religiosity. Currently there is a controversy whether they are a consequence of evolved psychological adaptations or a by-product of other cognitive adaptations (Beit-Hallahmi 2012; D'Onofrio et al. 1999; Fountoulakis et al. 2008; Rossano 2006). It is to be noted however that primitive religious-like ceremonies have been observed in chimpanzees (Harrod 2014).

An issue which recently started to be the focus of interest and research is the fact that the more the culturally and technologically advanced a society is, the more it demands biologically determined secondary abilities, especially neurocognitive, from its members. This seems to be even more intensified and pronounced with the

informatics and electronics revolution of the last few decades (Geary 1995) and creates new challenges since human societies try to be simultaneously competitive but also inclusive and caring.

12.7 Darwinian (Evolutionary) Psychiatry

The Darwinian theory had a major influence on how health and disease are conceptualized and what might constitute the best treatment option. There is a newly emerged field, called "Darwinian medicine." It utilizes a different and novel approach to the consideration of symptoms and diseases and tries to provide with more rational and informed choices for treatment (Sims 2001; Rose 2001).

A number of medical conditions including obesity, anemias, autoimmune diseases, and hypertension were put in an evolutionary frame (Gluckman et al. 2009). A number of questions concerning "why we have this problem" might be answered in an evolutionary frame. For example, why modern humans manifest high rates of obesity? Is this a consequence of generations of humans living in an environment of limited resources and frequent famine which made important the accumulation of reserves? Is primary (essential) hypertension a consequence of adaption to low-salt diet which resulted in hyper-response to salt intake? Is maxillary sinusitis a problem of walking upright since the position of the duct for drainage is perfect for quadrupedal walking, but it is located too high when the head is erect as in bipedal walking? Are fever and diarrhea defense mechanisms to reduce the survival of pathogens inside the body and to eject them?

According to this approach, also mental health and disease could be understood as the end result of the interaction between the organism and the environment, with the addition that abnormal behaviors and symptoms could reflect either an extreme form of otherwise adaptive behaviors or the triggering of them in an out-of-frame or proportion way and under inappropriate conditions.

This is somehow different from the standard approach in clinical psychiatry and psychopathology where connections with recent events and reaction to recent problems in the frame of the individual patient's and core family are considered (proximate mechanisms). In contrast, evolutionary psychiatry stresses that variation (including variation in behavior) is not only normal but evolutionarily necessary and is concerned with the misfit of preexisting normal coping mechanisms which could cause maladjustment or disease if triggered in an inappropriate way or persist for longer than expected and especially in an environment and with social demands extremely different from those encountered by humans during the Pleistocene and the Stone Age (Fabrega 2002).

As psychiatry is part of medicine, so is Darwinian psychiatry a subset of Darwinian medicine. If this is so, it is important to see whether mental symptoms and disorders could be considered in the frame of evolutional adaptations.

The classic psychoanalytic theory of Sigmund Freud (1856–1939) is a very fruitful starting point. Especially his theory on the instincts of Eros (life and survival) vs. Thanatos (death and aggression) and the libidinal investing as well as the Oedipus complex have direct relevance to concepts and theories of evolutionary psychology as described above.

However, psychopathology is quite different from psychology of normal mental functioning. The big question is whether diseases and disorders like schizophrenia, manic depression (bipolar disorder), depression, and others can be analyzed and understood in an evolutionary frame.

The problem is perplexed by the problematic reliability of psychiatric diagnosis and the presence of a "gray zone" between normality and psychopathology. Although it is not standard approach, one could suggest that some psychiatric conditions could be considered to be clearly abnormal and psychotic symptoms are such an example. Experiences similar to psychosis are very rare in the general population, and the average person cannot "understand" how a psychotic person feels. On the other hand, some other conditions like anxiety disorders and depression seem to constitute an extreme version of normal experiences of grief and anxiety, at least in the way the patients experience them and the way the observer perceives. Thus, the inner experience of a depressed patient is quite understood by the average healthy person which in the past had experienced several periods of grief, mourning, and anxiety. A third group of conditions include behaviors and inner experiences which are frequently seen in the general population but in mental patients seem to exist in an unusually accumulated coexistence, and they manifest out of frame concerning the intensity and the environmental stimuli. These conditions include certain personality traits like antisocial behaviors, eccentric dressing and outlook, substance use, body modification, etc. For example, a large proportion of the population has used cannabis at least once, has been involved in minor stealing at least once especially during adolescence, dresses in an odd way occasionally, and has piercing and/or tattoo. When these characteristics accumulate in a single person and to an unusual degree, e.g., daily use of cannabis, habitual delinquency, whole-body cover of tattoos, and extreme piercing with health risks, then it is highly possible the person suffers from some kind of mental disorder.

If one views mental disorders with the above described way, then it is clear that it is highly unlikely to find an evolutionary explanation for the first category. This is reasonable since there is no apparent evolutionary advantage in hearing voices or seeing visions at any age and at any frequency. Such conditions are probably related to a deep primary disruption in the functioning of the brain and subsequently of the mental apparatus. Some delusional ideas, however, could be conceptualized as extreme forms of caution and efforts toward harm avoidance. The only way out could be to find some kind of fitness advantage in the healthy members of families of patients with psychotic disorders. Although there are assumptions that creativity and high intelligence run together with manic depression and schizophrenia in

families, this has never been proven. An impressive example of the coexistence of high intelligence and schizophrenia in a family is Albert Einstein (1879–1955) and his son Eduard (1910–1965; Fig. 12.10). Another example of the coexistence of greatness and multiple mental disorders and suicidality is the Hemingway family (Fig. 12.11).

Fig. 12.10 Eduard Einstein (1910–1965)

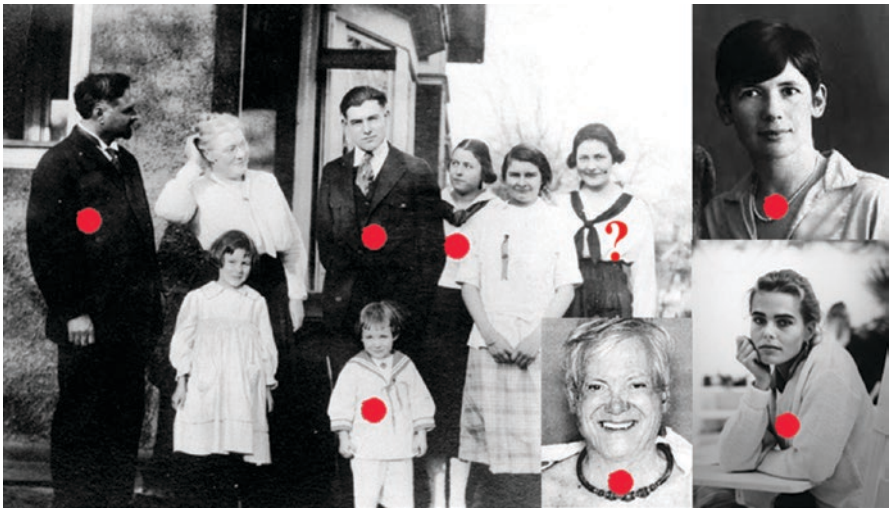

Fig. 12.11 Members of the Hemingway family c. 1917. Main photo: Clarence (father), Grace (mother), and offspring (Carol, Ernest, Leicester, Ursula, Madelaine "Sunny," and Marceline). Right top: Pauline Pfeiffer (wife). Right bottom: Gregory (son). Left bottom: Margaux (granddaughter). Red dots mark those who died by suicide. The question mark stands for a possible suicide for Marceline

For the other two categories, however, an evolutionary approach is highly possible. Since affect is an adaptation which serves both fast unconscious decisions and communication with peers, mood and anxiety disorders can be conceptualized as an extreme form of communication, a "cry for help." An alternative explanation could be that depressed individuals attempt to preserve their position within the social group but the same time avoid risky and costly behaviors by sending out signals to ask for help (Allen and Badcock 2003). Suicide could be conceptualized as the triggering of a behavior where the individual sees no fitness-enhancing opportunities and death is the only right action since it will conserve resources for kin and enhance inclusive fitness. Substance abuse on the other hand as well as behavioral addictions (e.g., gambling) could be considered to be a by-product of the evolution of the "behavioral and habits formation systems," which permit the individual to acquire new and adaptive behaviors and habits. However the interaction of these systems with the presence of supernormal stimuli (drugs, carbohydrates, games etc.), which have a higher than expected effect both on the attentional grab and also at the biochemical level, leads to the formation of addictions. This is neither an adaptation nor an exaptations (spandrels), but rather a mismatch, that is, a mechanism which had been developed to function in a different environment, is dysfunctional today at least in vulnerable individuals.

On the contrary, the case of antisocial behavior and body modification as well as extreme cases of provocative and bizarre way of dressing probably constitute exaptations (sprandels) since they are based on behaviors which had developed in order to promote fitness but currently are expressed for a different reason. Usually this reason is overt or hidden aggression which takes the form of physical aggression or provocative show-off of a violation of social norms. In most cases there is no gain in terms of better adaptation or fitness; on the contrary the individual could be highly dysfunctional.

There are two significant problems when one tries to put the above in a comprehensive frame for clinical psychiatry. First, in order to have behaviors and experiences "out of proportion" and "out of frame," regardless of their initial evolutionary relevance, there should be some kind of dysfunction of controlling mechanisms. Again the concept of a brain dysfunction at the core of mental disorders seems to be essential even for the evolutionary approach, which, never the less, can explain the source of individual symptoms.

The second problem is political/ideological again, but it is at the root of the whole establishment, and the problem is strengthened by the approach itself. If there is an evolutionary explanation behind many antisocial behaviors, then these constitute essentially normal nonpsychiatric variations rather than abnormal conditions. On the contrary, a more conservative approach would argue that if supernormal stimuli are, at least partially, responsible for many mental problems, then these stimuli are "unnatural" and should be eradicated from human societies (wide suppression policies).

The detailed answer to both these issues is beyond the scope of the present chapter. However, one should have in mind that persons with antisocial behaviors are fully responsible for their acts in front of the law; therefore everybody accepts their "civil right" in the choosing of these behaviors but also in the accepting of their consequences. There is a huge debate whether self-destructive behaviors (including suicide) should be considered as "civil rights" or mental disorders, but the prevailing attitude is in favor of the second.

Concerning supernatural stimuli, an approach in favor of a wide eradication of this kind of stimuli from human societies does not take into consideration the fact that essentially modern societies are based on the presence of supernatural stimuli and demands. This is often the cause of mismatch conditions, where new "health problems" arise, and behaviors are triggered under inappropriate situations while focusing on the wrong target. Such examples are the demands of living in megacities with very complex social roles and dynamics, the cognitive load and demands the modern education and especially modern educational methods including multimedia and the Internet pose on the human mind, and the need for accuracy and precision in occupational tasks. Another interesting feature of modern life is that a significant number of stressors and threats are not visible and material, as they used to be in the past, but, on the contrary, are abstracted, theoretical, complex, and difficult for the average individual to understand in full. For example, during the Pleistocene, the danger was predator animals, while today it is the distant risk of having a disease which will give symptoms sometime in the future, the danger for economic problems, etc. The fact is that while biological evolution is slow (and Darwinian), cultural and societal evolution (which is Lamarckian) is very fast.

12.8 Criticism

While ethology is based on observation, a major problem in evolutionary psychology and sociobiology is that they depend too much on reasoning and less on the analysis of data. Very few theories can be experimentally tested or prospectively studied. Of course they follow the rules of science, but it is doubtful that many of the theories which have been developed could fulfill the falsificationism criterion proposed by Karl Popper (1902–1994) (Popper 1959). Probably while isolated statements do not fulfill the criterion, the whole theoretical framework does, but it is rather underdeveloped and conclusions are difficult.

Apart from the epistemological, there is a number of ideological-political issues which make the application of evolutionary principles to human behavior controversial (Confer et al. 2010). The first is the widespread objection to the Darwinian theory of evolution in general. Then there is the bitter controversy on the importance of nature vs. nurture in the shaping of human behavior. Inevitably these lead to important politico-ideological conflicts, and the evolutionary approach to human behavior has been accused of developing and spreading malevolent political or moral ideas, of justifying existing social hierarchies and "reactionary policies," and of giving support to racist and sexist attitudes.

The obvious problem with this kind of criticism is the well-known "naturalistic fallacy." This biased way of thinking identifies "natural" with "good" (Moore 2004). This is behind lay beliefs that "natural remedies" are good and medications are toxic and that a natural way of life in nature is better for human health. Of course these are in sharp contrast with the improvement of life and the impressive increase in life expectancy as a result of "unnatural" and technological advances during the last few decades. Still, it is a very popular way of viewing things not only among lay people

but also among many health and social sciences professionals and philosophers. Darwinism has been a particular problem for this way of viewing things, because it is directly destroying the romantic viewing of nature and the anthropocentric consideration of the universe.

An essential characteristic of politico-ideological criticism is that it mixes epistemology and the results of science with morality and ethics. Is the wolf in the *Little Red Riding Hood* a "bad" and "unmoral" being? Of course the tale is a metaphor; however it reflects our tendency to utilize an anthropomorphic and anthropocentric way when viewing nature. There is nothing moral, good, or bad in the natural relationship between wolves and sheep, the first being the predators and the second being the prey. The description of similar structures and phenomena in human society and related underlying psychological phenomena in the individual human being is neither good nor bad, as long as there is proof that this is the scientific case.

The human society and the human culture were both developed in order to control these behaviors and create a more friendly environment for human beings to live, and both society and culture fight constantly with the most primitive and aggressive aspects of human nature.

As discussed before, there is a long anti-societal and anti-civilization ideology, with deep roots in irrationalism, which however differs as a concept from anti-rationalism and non-rationalism, and in simple words, it interprets the world through wishful thinking (intuition) but simultaneously keeping in touch with reality, e.g., as in the writings of Friedrich Wilhelm Nietzsche (1844–1900). An example of anti-rationalism is the teachings of Saint Augustine of Hippo (354–430). Often irrationalism, non-rationalism, and anti-rationalism coexist in most ideological and philosophical thoughts, since their major concern is not scientific theories and scientific explanation and understanding of the world but the effect such progress might have on various aspects of humanism and especially in the rejection of the perceived special top position humans have in the hierarchical pyramid of the universe.

Last but not least, one should always have in mind that the topics discussed in this chapter are sensitive in terms of humanity and politics and have been used both ways by completely opposing sociopolitical groups. This sensitivity and dangerousness is impressively shown in the life and works of the Nobel Laureate Konrad Lorenz. Lorenz joined the Nazi Party in 1938, and he was also a university chair at the University of Königsberg under the Nazi regime. At the same time, he published articles in accord with Nazi ideology, especially "racial hygiene" couched in pseudoscientific metaphors and with anti-Semitic content. This led to accusations that his scientific work had been contaminated by Nazi sympathies. During the WWII, he served as a military psychologist, conducting racial studies in occupied Poznań under Rudolf Hippius, on the biological characteristics of "German-Polish half-breeds" in order to determine whether they were psychologically and physically fit to be allowed to reproduce humans. His real contribution to this project is unknown, and this 2-year period is not mentioned in his memoirs. Because of the above, in 2015, the University of Salzburg posthumously rescinded an honorary doctorate

awarded to him in 1983 and also accused him of using his work to spread "basic elements of the racist ideology of National Socialism" (Burkhardt 2005; Föger and Taschwer 2001; Kalikow 1983; Nisbett 1976). In sharp contrast, Karl von Frisch lost his academic position in 1933 when the Nazi regime passed the Civil Service Law, and he was proved to have 1/8th Jewish ancestry. He had also attracted negative attention for employing Jewish assistants and for practicing "Jewish science." He also worked actively to help Polish scientists who arrested by the Gestapo (Deichmann 1992).

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