

Some useful Evolutionary Psychiatry and related evolutionary terms



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Acheulean: is an archaeological industry of stone tool manufacture characterized by distinctive oval and pear-shaped "hand-axes" associated with early humans. Acheulean tools were produced during the Lower Palaeolithic era across Africa and much of West Asia, South Asia, and Europe, and are typically found with *Homo erectus* remains. It is thought that Acheulean technologies first developed in Africa out of the more primitive Oldowan technology as long ago as 1.76 million years ago, by *Homo habilis*. Acheulean tools were the dominant technology for the vast majority of human history. Acheulean tools were not made by fully modern humans – that is, *Homo sapiens* – although the early or non-modern (transitional) *Homo sapiens* did use Late Acheulean tools, as did the proto-Neanderthal species. Most notably, however, it is *Homo ergaster* (sometimes called early *Homo erectus*), whose assemblages are almost exclusively Acheulean, who used the technique. Later, the related species *Homo heidelbergensis* (the common ancestor of both Neanderthals and *Homo sapiens*) used it extensively

Acquired trait: A phenotypic characteristic, acquired during growth and development that is not genetically based and therefore cannot be passed on to the next generation (for example, the large muscles of a weightlifter).

Adaptations: Heritable characteristics that improve the ability to survive and reproduce in a given environment, used to describe the process of genetic change within a population, as influenced by natural selection.

Adaptationism is the view that many physical and psychological traits of organisms are evolved adaptations. Adaptationists perform research to try to distinguish adaptations (e.g., the umbilical cord) from by-products (e.g., the belly button) or random variation (e.g., convex or concave shape of the belly button). George Williams' *Adaptation and Natural Selection* (1966) was highly influential in its development, defining some of the heuristics, such as complex functional design, species universality, and reliability used to identify adaptations. Adaptationism is an approach to studying the evolution of form and function that attempts to frame the existence and persistence of traits on the scenario that each of them arose independently due to how that trait improved the reproductive success of the organism's ancestors. If and only if a trait fulfils the following criteria will evolutionary biologists in general declare the trait an adaptation:

1. The trait is a variation of an earlier form.
2. The trait is heritable through the transmission of genes.
3. The trait enhances reproductive success.
- 4.

Adaptive lag: Also called phenotypic lag, it describes cases where the rate at which humans adapts to their environment is slower than the rate of environmental change, leading to a mismatch. Evolutionary Psychology hypothesises that human psychological mechanisms are largely evolved solutions to adaptive problems in the EEA.

Adaptationist program: An approach to understanding evolution that assumes that traits are adaptations.

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Adaptive radiation: The diversification, over evolutionary time, of a species or group of species into several different species or subspecies that are typically adapted to different ecological niches (for example, Darwin's finches). The term can also be applied to larger groups of organisms, as in "the adaptive radiation of mammals."

Adaptive strategies: A mode of coping with competition or environmental conditions on an evolutionary time scale. Species adapt when succeeding generations emphasize beneficial characteristics.

Allele: One of the alternative forms of a gene. For example, if a gene determines the seed colour of peas, one allele of that gene may produce green seeds and another allele produce yellow seeds. In a diploid cell there are usually two alleles of any one gene (one from each parent). Within a population there may be many different alleles of a gene; each has a unique nucleotide sequence.

Allele frequency, or gene frequency, is the relative frequency of an allele (variant of a gene) at a particular locus in a population, expressed as a fraction or percentage. Specifically, it is the fraction of all chromosomes in the population that carry that allele.

Given the following:

- 1) a particular locus on a chromosome and a given allele at that locus
- 2) a population of N individuals with ploidy n , i.e. an individual carries n copies of each chromosome in their somatic cells (e.g. two chromosomes in the cells of diploid species)
- 3) the allele exists in i chromosomes in the population

The allele frequency is the fraction of all the occurrences i of that allele and the total number of chromosome copies across the population, $i/(nN)$. The allele frequency is distinct from the genotype frequency, although they are related, and allele frequencies can be calculated from genotype frequencies.

Allometry: The relation between the size of an organism and the size of any of its parts. For example, an allometric relation exists between brain size and body size, such that (in this case) animals with bigger bodies tend to have bigger brains. Allometric relations can be studied during the growth of a single organism, between different organisms within a species, or between organisms in different species.

Allopatric speciation: Speciation that occurs when two or more populations of a species are geographically isolated from one another sufficiently that they do not interbreed.

Allopatric: Living in separate places. Compare with sympatry.

Altruism in biological organisms can be defined as an individual performing an action which is at a cost to themselves (e.g., pleasure and quality of life, time, probability of survival or reproduction), but benefits, either directly or indirectly, another third-party individual, without the expectation of reciprocity or compensation for that action. One definition for altruism in the clinical setting is:- "intentional and voluntary actions that aim to enhance the welfare of another person in the absence of any quid pro quo external rewards".

Anatomically modern human (AMH): A member of the human lineage that is recognized by anthropologists as having essentially the same anatomy as present-day *Homo sapiens*. Anatomically modern *Homo sapiens* refers in paleoanthropology to individual members of the species *Homo sapiens* with an appearance consistent with the range of phenotypes in modern humans. Anatomically modern humans evolved from archaic humans in the Middle Palaeolithic, about

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200,000 years ago. The emergence of anatomically modern humans marks the dawn of the subspecies *Homo sapiens sapiens*. The subspecies of *Homo sapiens* includes all modern humans. The oldest fossil remains of anatomically modern humans are the Omo remains found in modern-day East Africa, which date to 195,000 ($\pm 5,000$) years ago and include two partial skulls as well as arm, leg, foot and pelvis bones.

Ancestral characteristic: A trait found in both an organism being studied and the common ancestor of a group, to which the study organism belongs.

Antagonistic pleiotropy: An effect whereby genes that change in respect of their fitness advantages, over time. This concept is part of evolutionary theory for aging. (Williams 1957).

Anthropology is the study of humanity, its main subdivisions being social anthropology and cultural anthropology, which describes the workings of societies around the world, and linguistic anthropology, which investigates the influence of language in social life. Biological or physical anthropology concerns long-term development of the human beings as organisms.

Archaeology: studies past human cultures through investigation of physical evidence. The archaeological record consists of artefacts, architecture, biofacts or ecofacts, and cultural landscapes. Archaeology can be considered both a social science and a branch of the humanities. Archaeologists study human prehistory and history, from the development of the first stone tools in Africa, 3.3 million years ago up until recent decades. Archaeology as a field is distinct from the discipline of palaeontology, the study of fossil remains. Archaeology is particularly important for learning about prehistoric societies, for whom there may be no written records to study. Prehistory includes over 99% of the human past, from the Palaeolithic until the advent of literacy in societies across the world. Archaeology has various goals, which range from understanding cultural history to reconstructing past lifestyles to documenting and explaining changes in human societies through time.

Artificial selection: The process by which humans breed animals and cultivate crops to ensure that future generations have specific desirable characteristics. In artificial selection, breeders select the most desirable variants in a plant or animal population and selectively breed them with other desirable individuals. The forms of most domesticated and agricultural species have been produced by artificial selection; it is also an important experimental technique for studying evolution.

Assortative mating: The tendency of like to mate with like. Mating can be assortative for a certain genotype (e.g., individuals with genotype AA tend to mate with other individuals of genotype AA) or phenotype (e.g., tall individuals mate with other tall individuals).

Atavism is the tendency to revert to an ancestral type. An atavism is an evolutionary trajectory reversal so that traits reappear which had disappeared generations before. Atavisms can occur when genes for previously existing phenotypical features remain preserved in DNA, and these become expressed through a mutation that either knock out the overriding genes for the new traits or make the old traits override the new one.

Australopithecus: informal australopithecine, is an extinct genus of hominins. From paleontological and archaeological evidence, the *Australopithecus* genus apparently evolved in eastern Africa around 4 million years ago before spreading throughout the continent and eventually becoming extinct somewhat after two million years ago. During that time, a number of australopithecine species emerged.

Balanced polymorphism: A stable polymorphism, which is maintained by balancing selection.

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Balancing selection: Selection that maintains polymorphism. Balancing selection refers to a number of selective processes by which multiple alleles (different versions of a gene) are actively maintained in the gene pool of a population at frequencies longer than for expected from genetic drift alone.

Behavioural ecology is the study of the evolutionary basis for animal behavior due to ecological pressures. Behavioural ecology emerged from ethology after Niko Tinbergen outlined four questions to address when studying animal behavior which are the proximate causes, ontogeny, survival value, and phylogeny of behaviour. If an organism has a trait which provides them with a selective advantage (i.e. has an adaptive significance) in a new environment natural selection will likely favour it. This was originally proposed as the theory of natural selection by Charles Darwin. Adaptive significance therefore refers to the beneficial qualities, in terms of increased survival and reproduction, a trait conveys. Genetic differences in individuals lead to behavioural differences that in turn drive differences in adaptation, reproductive success, and ultimately evolution. Individuals are always in competition with others for limited resources, including food, territories, and mates. Conflict will occur between predators and prey, between rivals for mates, between siblings, mates, and even between parents and their offspring.

Candidate gene: A gene that is thought likely to influence the trait of interest, usually because major mutations at the gene affect the trait.

Clade: A set of species descended from a common ancestral species. Synonym of a monophyletic group.

Cladism: Phylogenetic classification. The members of a group in a cladistic classification share a more recent common ancestor with one another than with the members of any other group. A group at any level in the classificatory hierarchy, such as a family, is formed by combining a subgroup at the next lowest level (the genus, in this case) with the subgroup or subgroups with which it shares its most recent common ancestor.

Cladists: Evolutionary biologists who seek to classify Earth's life forms according to their evolutionary relationships, not just overall similarity.

Cladogram: A branching diagram that illustrates hypotheses about the evolutionary relationships among groups of organisms. Cladograms can be considered as a special type of phylogenetic tree that concentrates on the order in which different groups branched off from their common ancestors. A cladogram branches like a family tree, with the most closely related species on adjacent branches.

Class: A category of taxonomic classification between order and phylum, a class comprises members of similar orders. See taxon.

Conspecific - an organism belonging to the same species as another organism.

Cranial capacity From early primates to hominids and finally to Homo sapiens, the human brain has continued to grow. The volume of the human brain has increased as humans have evolved (see Homininae), starting from about 600 cm³ in Homo habilis up to 1600 cm³ in Homo neanderthalensis, which was the hominid with the biggest brain size. The increase in brain size stopped with Neanderthals. Since then, the average brain size has been shrinking over the past 28,000 years. The cranial capacity has decreased from around 1,550 cm³ to around 1,440 cm³ in males while the female cranial capacity has shrunk from around 1,500 cm³ to around 1,300 cm³.

Culture is that complex whole group behaviour which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society. Culture is also used as a description of the way of life, especially the general customs and beliefs, of a

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particular group of people at a particular time. Culture can be seen as a series of activities and worldviews that provide humans with the feeling of being individuals of value in a world meaning; raising themselves above the merely physical aspects of existence, in order to deny any animal insignificance and death that Homo Sapiens became aware of when they acquired a larger brain.

In psychiatry culture is often used in such a way as to infer what it means to be and experience being human. Culture is a central concept in anthropology, encompassing the range of phenomena that are transmitted through social learning in human societies. The word is used in a general sense as the evolved ability to categorize and represent experiences with symbols and to act imaginatively and creatively. The ability to have culture in humans arose with the evolution of behavioural modernity around 50,000 years ago. This capacity is often thought to be unique to humans, although some other species have demonstrated similar, though much less complex abilities for social learning. It is also used to denote the complex networks of practices and accumulated knowledge and ideas that is transmitted through social interaction and exist in specific human groups, or cultures, using the plural form. Some aspects of human behaviour, such as language, social practices such as kinship, gender and marriage, expressive forms such as art, music, dance, ritual, religion, and technologies such as cooking, shelter, and clothing are said to be cultural universals, found in all human societies.

Darwinian fitness: (DF) is a term from population genetics that refers to the relative number of copies of a particular gene that an individual contributes to future generations. It can be defined either with respect to a genotype or to a phenotype in a given environment.

Darwinian Psychiatry: The Darwinian concept of mental disorder builds on two basic ideas:

(1) the capacity to achieve biological goals is the best single attribute that characterizes mental health; and (2), the assessment of functional capacities cannot be properly made without consideration of the environment in which the individual lives.

Derived characteristic: A trait that is found in an organism that was not present in the common ancestor of a group of organisms being studied.

Descent with modification: Darwin's term for evolution.

Domestication is to convert animals or plants to domestic uses. It is done by initially taming an animal, especially by generations of breeding, to live in close association with human beings as a pet or work animal and usually creating a dependency so that the animal loses its ability to live in the wild. .

Dual inheritance theory: (DIT), also known as gene–culture coevolution or biocultural evolution was developed to explain how human behaviour is a product of two different and interacting evolutionary processes: genetic evolution and cultural evolution. In DIT, culture is defined as information and behaviour acquired through social learning. One of the theory's central claims is that culture evolves partly through a Darwinian selection process, which dual inheritance theorists often describe by analogy to genetic evolution. 'Culture', in this context is defined as 'socially learned behavior', and 'social learning' is defined as copying behaviours observed in others or acquiring behaviours through being taught by others. Most of the modelling done in the field relies on the first dynamic (copying) though it can be extended to teaching. Social learning at its simplest involves blind copying of behaviours from a model (someone observed behaving), though it is also understood to have many potential biases, including success bias (copying from those who are perceived to be better off), status bias (copying from those with higher status), homo-phily (copying from those most like ourselves), conformist bias (disproportionately picking up

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behaviours that more people are performing), etc.. Understanding social learning is a system of pattern replication, and understanding that there are different rates of survival for different socially learned cultural variants, this sets up, by definition, an evolutionary structure: Cultural Evolution. Because genetic evolution is relatively well understood, most of DIT examines cultural evolution and the interactions between cultural evolution and genetic evolution.

EEA: (Environment of Evolutionary Adaptedness): A statistical conglomeration of past environments, including environmental pressures, in which currently observed adaptations were shaped. Also called the Ancestral Environment, it refers to the environment in which human cognitive structures evolved; generally, the Pleistocene (from two million years ago to historical times), in small bands of hunter-gatherers (Bowlby 1988). Evolutionary Psychology hypothesises that human psychological mechanisms are largely evolved solutions to adaptive problems in the EEA.

Encephalization is defined as the amount of brain mass related to an animal's total body mass. Quantifying an animal's encephalization has been argued to be directly related to that animal's level of intelligence.

Epistasis is a phenomenon that consists of the effect of one gene being dependent on the presence of one or more 'modifier genes' (genetic background). Similarly, epistatic mutations have different effects in combination than individually. It was originally a concept from genetics but is now used in biochemistry, population genetics, computational biology and evolutionary biology. It arises due to interactions, either between genes, or within them leading to non-additive effects. Epistasis has a large influence on the shape of evolutionary landscapes which leads to profound consequences for evolution and evolvability of traits.

Essentialism is the view that, for any specific entity (such as an animal, a group of people, a physical object, a concept), there is a set of attributes which are necessary to its identity and function.

Eugenics: discredited enterprise of "Improvement" of the human gene pool through selective breeding.

Eusociality: is the highest level of organization of animal sociality, is defined by the following characteristics: cooperative brood care (including brood care of offspring from other individuals), overlapping generations within a colony of adults, and a division of labour into reproductive and non-reproductive groups. The division of labour creates specialized behavioural groups within an animal society which are sometimes called castes. Eusociality is distinguished from all other social systems because individuals of at least one caste usually lose the ability to perform at least one behaviour characteristic of individuals in another caste. Eusociality exists in certain insects, crustaceans and mammals.

Evolution: Darwin defined this term as "descent with modification." It is the change in a lineage of populations between generations. In genetic terms, evolution can be defined as any change in the frequency of alleles in populations of organisms from generation to generation.

Evolutionary biology: The branch of biology that deals with the changes in populations of organisms, especially taxonomy, palaeontology, ethology, population genetics, and ecology.

Evolutionary constraints are restrictions, limitations, or biases on the course or outcome of adaptive evolution. The term usually describes factors that limit or channel the action of natural selection.

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Evolutionary developmental biology: aka. Evo-devo is a field that compares the developmental processes of different organisms to examine the ancestral relationship between them, and to discover how developmental processes evolved. It considers the origin and evolution of embryonic development such as how modifications of developmental processes lead to the production of novel features, such as the evolution of feathers; the role of developmental plasticity in evolution; and how ecology impacts development and evolutionary change. The contemporary field of evo-devo has gained impetus from the discovery of genes regulating embryonic development in model organisms.

Evolutionary psychiatry or Darwinian psychiatry is the application of modern evolutionary theory to understanding mental health and disease. The goal of evolutionary psychiatry is to understand why people get sick, not simply how they get sick. Modern medical research and practice has focused on the molecular, psychological and physiological mechanisms underlying health and disease, while evolutionary psychiatry focuses on the question of why evolution has shaped these mechanisms in ways that may leave us susceptible to disease.

Evolutionarily stable strategy (ESS): A strategy that cannot be displaced by any alternative. Individuals that play the ESS must be at least as fit as any feasible alternative when the rest of the population is playing the ESS.

Exaptation is a term used in evolutionary biology to describe a trait that has been co-opted for a use other than the one for which natural selection has built it. It was introduced by Gould in 1982 to make the point that a trait's current use does not necessarily explain its historical origin. He proposed exaptation as a counterpart to the concept of adaptation.

Extended phenotype: The phenotype of all the individuals that are affected by a gene. The main idea is that phenotype should not be limited to biological processes such as protein biosynthesis or tissue growth, but extended to include all effects that a gene has on its environment, inside or outside the body of the individual organism.

Fitness: is a central idea in evolutionary and sexual selection theories. Fitness can be defined either with respect to a genotype or to a phenotype in a given environment. In either case, fitness describes individual reproductive success and is equal to the average contribution to the gene pool of the next generation that is made by an average individual of the specified genotype or phenotype.

The term "Darwinian fitness" can be used to make clear the distinction with physical fitness. Where fitness is affected by differences between various alleles of a given gene, the relative frequency of those alleles will change across generations by natural selection and alleles with greater positive effect on individual fitness will become more common over time; this process is known as natural selection.

Fitness component: Traits, such as survival, mating success, and reproduction, that combine to determine fitness.

Game theory is "the study of mathematical models of conflict and cooperation between intelligent rational decision-makers." Game theory is mainly used in evolutionary psychology, economics, political science, and psychiatry as well as biology. Originally, it addressed zero-sum games, in which one person's gains result in losses for the other participants. Today, game theory applies to a wide range of behavioural relations, and is now an umbrella term for the science of logical decision making in humans, animals, and computers.

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Gene-centred view of evolution: The gene-centred view of evolution, gene's eye view, gene selection theory, or selfish gene theory holds that adaptive evolution occurs through the differential survival of competing genes, increasing the allele frequency of those alleles whose phenotypic trait effects successfully promote their own propagation, with gene defined as "not just one single physical bit of DNA [but] all replicas of a particular bit of DNA distributed throughout the world". The proponents of this viewpoint argue that, since heritable information is passed from generation to generation almost exclusively by DNA, natural selection and evolution are best considered from the perspective of genes. Proponents of the gene-centred viewpoint argue that it permits understanding of diverse phenomena such as altruism and intra-genomic conflict that are otherwise difficult to explain.

Genetic drift is the change in the frequency of a gene variant (allele) in a population due to random sampling of organisms. The alleles in the offspring are a sample of those in the parents, and chance has a role in determining whether a given individual survives and reproduces. A population's allele frequency is the fraction of the copies of one gene that share a particular form. Genetic drift may cause gene variants to disappear completely and thereby reduce genetic variation.

Group selection: The selection operating between groups of individuals rather than between individuals. It would produce attributes beneficial to a group in competition with other groups rather than attributes beneficial to individuals.

Hamilton's rule: An allele that increases the fitness of its neighbours by B but reduces the fitness of its carrier by C will increase if $rB > C$, where r is a measure of the genetic similarity of neighbours to the focal individual.

Handicap principle: The idea that expensive adaptations such as a peacock's tail have evolved precisely because they constitute a handicap to survival: they are costly signals that only the fit individuals can afford, and thus function as a signal that cannot be faked. This is also called reproduction at the expense of health. (Zahav1975).

Heredity: The process by which characteristics are passed from one generation to the next.

Heritability: Broadly, the proportion of variation (more strictly, variance) in a phenotypic character in a population that is due to individual differences in genotypes. Narrowly, it is defined as the proportion of variation (more strictly, variance) in a phenotypic character in a population that is due to individual genetic differences that will be inherited in the offspring.

Heritable: Partly or wholly determined by genes; capable of being passed from an individual to its offspring.

Heterozygosity: (for most purposes), The proportion of individuals in a population that are heterozygotes.

Heterozygote: An individual having two different alleles at a genetic locus. Compare with homozygote.

Heterozygous: Having two different alleles for a particular trait. See also heterozygote.

Heterozygote advantage: A condition in which the fitness of a heterozygote is higher than the fitness of either homozygote. (Buss2005).

Hominid: Member of the great apes (family Hominidae), which now include human, gorilla, orang-utan, and chimpanzee.

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Hominidae whose members are known as great apes or hominids, are a taxonomic family of primates that includes seven extant species in four genera: Pongo, the Bornean and Sumatran orang-utan; Gorilla, the eastern and western gorilla; Pan, the common chimpanzee and the bonobo; and Homo, the human.

Hominin: All taxa closer to humans than to chimpanzee. Apart from us, all these taxa are now extinct.

Homeotic mutation: A mutation causing one structure of an organism to grow in the place appropriate to another. For example, in the mutation called "antennapedia" in the fruit fly, a foot grows in the antennal socket.

Homo erectus: meaning "upright man" is an extinct species of hominid that lived throughout most of the Pleistocene geological epoch. The earliest fossil evidence of Homo erectus dates to 1.9 million years ago and the most recent to 70,000 years ago. It is generally thought that H. erectus originated in Africa and spread from there, migrating throughout Eurasia as far as Georgia, India, Sri Lanka, China and Indonesia.

Homo habilis (meaning "handy man" or "able man") is a species of the tribe Hominini, during the Pleistocene period, which lived between roughly 2.8 and 1.5 million years ago.

Homozygote: An individual having two copies of the same allele at a genetic locus. Also sometimes applied to larger genetic entities, such as a whole chromosome; a homozygote is then an individual having two copies of the same chromosome.

Hypothesis: A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation. Scientific hypotheses must be posed in a form that allows them to be rejected.

Inclusive fitness: The inclusive fitness of an organism is judged by the number of offspring it has, how they support them, and how their offspring could support others. Inclusive fitness theory maintains that an organism may improve its overall genetic success by altruistic social behaviour. (Hamilton 1964)

Intra-genomic conflict: The selfish gene theory postulates that natural selection will increase the frequency of those genes whose phenotypic effects ensure their successful replication. Generally, a gene achieves this goal by building, in cooperation with other genes, an organism capable of transmitting the gene to descendants. Intra-genomic conflict arises when genes inside a genome are not transmitted by the same rules, or when a gene causes its own transmission to the detriment of the rest of the genome (this last kind of gene is usually called a selfish genetic element, ultra-selfish gene, or parasitic DNA).

Just-so stories: Circular, tautological and untestable explanations for traits, particularly purported adaptations.

Kin selection: An evolutionary strategy that favours the reproductive success of an organism's relatives, even at a cost to the organism's own survival and reproduction. It is an instance of inclusive fitness which combines the number of offspring produced with the number an individual can produce by supporting others, such as siblings (Hamilton 1964 Dawkins 1979).

Life history theory:-Life history theory considers whether events in a person's lifetime may be reactively shaped by natural selection to produce the largest possible number of surviving offspring.

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These include childhood development, age of sexual maturation, first reproduction, and number of offspring and level of parental investment, senescence and death (Stearns 1977).

Life-history trait: Traits, such as mortality rate, fertility, or age of reproduction, that are closely associated with fitness.

Macroevolution: A vague term generally used to refer to evolution on a grand scale, or over long periods of time. There is no precise scientific definition for this term, but it is often used to refer to the emergence or modification of taxa at or above the genus level. The origin or adaptive radiation of a higher taxon, such as vertebrates, could be called a macro-evolutionary event.

Maladaptive trait: A trait, character or behaviour which results in an organism pos-sessing or performing it to have lower genetic fitness than one which does not, resulting in premature death or the failure to reproduce.

Mendelian inheritance: The mode of inheritance of all diploid species, and therefore of nearly all multicellular organisms. Inheritance is controlled by genes, which are passed on to the offspring in the same form as they were inherited from the previous generation. At each locus an individual has two genes, one inherited from its father and the other from its mother. The two genes are represented in equal proportions in its gametes.

Mismatch: A theory that organisms possess traits (including behavioural, emotional, and biological) that have been passed down through generations, preserved by natural selection because of their adaptive function in a given environment. However, the given environment of the evolutionary period can be quite unlike the current environment. It is also called "Genome lag". Therefore, traits that were at one time adaptive in a certain environment are now maladaptive "mismatched" to the environment that the trait is currently present in. (Nesse and Dawkins 2010)

Mitochondrial Eve is the matrilineal most recent common ancestor (MRCA) of all currently living humans. This is the most recent woman, from whom all living humans today descend, in an unbroken line, on their mother's side, and through the mothers of those mothers, and so on; back until all lines converge on one woman, who is estimated to have lived approximately 100,000–200,000 years ago. Because all mitochondrial DNA (mtDNA) generally is passed from mother to offspring without recombination, all mtDNA in every living person is directly descended from hers by definition, differing only by the mutations that over generations have occurred in the germ cell mtDNA since the conception of the original "Mitochondrial Eve". Unlike her biblical namesake, she was not the only living human female of her time. However, her female contemporaries, excluding her mother, failed to produce a direct unbroken female line to any living person in the present day.

Modularity of mind: The concept that minds may, at least in part, be composed of innate neural structures or modules which have distinct evolutionarily selected and developed functions. Somewhat different definitions of "module" have been proposed by different authorities (Fodor1983).

MRCA In biology, the **most recent common ancestor** (MRCA) of any set of organisms is the most recent individual from which all organisms in a group, for example a haplogroup, are directly descended. The term is often applied to human genealogy.

Mousterian is a name given by archaeologists to a style of predominantly flint tools (or industry) associated primarily with Neanderthals (*Homo neanderthalensis*) and dating to the Middle

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Palaeolithic, the middle part of the European Old Stone Age. Mousterian tools that have been found in Europe were made by Neanderthals and date from between 600,000 BP and 40,000 BP

Mutation: A change of the nucleotide sequence of the genome of an organism, (sometimes an extra-chromosomal genetic element), a change in genetic material that results from an error in replication of DNA. Mutations can be beneficial, harmful, or neutral depending to some extent on their environment.

Multilevel selection: A type of group selection. Once pre-adaptations such as group formation, nest building, high cost of dispersal and morphological variation are present, between-group competition has been cited as a quintessential force in the transition to advanced eusociality. Because the hallmarks of eusociality will produce an extremely altruistic society, such groups will out-reproduce their less cooperative competitors, eventually eliminating all non-eusocial groups from a species. Multilevel selection has been heavily criticized by some for its conflict with the kin selection theory.

Natural selection: Darwin's theory of the process by which evolutionary change occurs. Based on the principles of variation, inheritance and adaptation, the process of natural selection produces adaptations. It is demonstrated by the differential survival and reproduction of classes of organisms that differ from one another in one or more usually heritable characteristics. Through this process, the forms of organisms in a population that is best adapted to their local environment increase in frequency relative to less well-adapted forms over a number of generations. It contrasts with artificial selection or selective breeding.

Neanderthals were a species or subspecies of human in the genus *Homo* which became extinct between 40,000 - 28,000 years ago. They were closely related to modern humans, having DNA over 99.5% the same. Remains left by Neanderthals include bone and stone tools, which are found in Eurasia, from Western Europe to Central, Northern, and Western Asia. Neanderthals are generally classified by palaeontologists as the species *Homo neanderthalensis*, having separated from the *Homo sapiens* lineage 600,000 years ago, or alternatively a subspecies of *Homo sapiens* (*Homo sapiens neanderthalensis*)

Neo-Darwinism: (1) Darwin's theory of natural selection plus Mendelian inheritance. (2) The larger body of evolutionary thought that was inspired by the unification of natural selection and Mendelism. It may be used as a synonym for "The modern evolutionary synthesis".

Niche construction theory: A theory which states that, organisms also interact with environments, take energy and resources from environments, make micro- and macro-habitat choices with respect to environments, and construct artefacts, . By doing so they modify the natural selection pressures present in their own, and in each other's, local environments. This is termed "niche construction" (Odling-Smee 2003)

Oldowan,: is the archaeological term used to refer to the earliest stone tool archaeological industry in prehistory. Oldowan tools were used during the Lower Palaeolithic period, 2.6 million years ago up until 1.7 million years ago, by ancient hominins across much of Africa, South Asia, the Middle East and Europe. This technological industry was followed by the more sophisticated Acheulean industry.

Ontogeny The origin and development of an individual organism from embryo to adult. It is also called ontogenesis. It is the entire sequence of events involved in the development of an individual organism. Compare **phylogeny**.

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Out of Africa, OOA: In paleoanthropology, the recent African origin of modern humans, also called the "Out of Africa" theory (OOA), the "recent single-origin hypothesis" (RSOH), "replacement hypothesis", or "recent African origin model" (RAO), is the most widely accepted model of the geographic origin and early migration of anatomically modern humans. The theory argues for the African origins of modern humans, who left Africa in a single wave of migration which populated the world, replacing older human species. A first dispersal took place between 130,000-115,000 years ago via northern Africa, but died out or retreated, though Chinese researchers question this extinction and claim the presence of modern humans in China at least 80,000 years ago. A second dispersal took place via the so-called Southern Route, which followed the southern coastline of Asia, and colonized Australia by around 50,000 years ago. Europe was populated by an early offshoot which settled the Near East and Europe (post-Toba hypothesis).

Out-of-Africa model: The hypothesis that modern humans evolved recently in Africa and spread from there, replacing archaic hominins. It contrasts with the multiregional model.

The Palaeolithic Age, Era or Period is a prehistoric period of human history distinguished by the development of the most primitive stone tools discovered and covers roughly 95% of human technological prehistory. It extends from the earliest known use of stone tools, probably by *Homo habilis* initially, 2.6 million years ago, to the end of the Pleistocene around 10,000 BP.

Palaeontology: is the scientific study of life existent prior to, and sometimes including, the start of the Holocene Epoch roughly 11,700 years before present. It includes the study of fossils to determine organisms' evolution and interactions with each other and their environments.

Parental investment: The investment that parents make in an offspring which increases that offspring's chances of surviving. By definition, such investment imposes a cost to the parents as measured by their ability to invest in other offspring, current and future. Components of fitness include the wellbeing of existing offspring, parents' future reproduction, and inclusive fitness through aid to kin (Hamilton 1964, Trivers 1972).

Parent-offspring conflict: (POC). The idea that conflicts can occur even before birth. Adaptive mechanisms benefit the foetus at the expense of the mother. It is used to signify the evolutionary conflict arising from differences in optimal parental investment (PI) to an offspring from the standpoint of the parent and the offspring. (Trivers 1972).

Phenotypic plasticity is the ability of an organism to change its phenotype in response to changes in the environment. It is fundamental to the way in which organisms cope with environmental variation. Phenotypic plasticity encompasses all types of environmentally induced changes (e.g. morphological, physiological and behavioural) that may or may not be permanent throughout an individual's lifespan. It is now more broadly used to describe all phenotypic responses to environmental change including through learning.

Phylogeny: The study of ancestral relations among species, often illustrated with a "tree of life" branching diagram, which is also known as a phylogenetic tree. Phylogeny is the study of the evolutionary history and relationships among individuals or groups of organisms (e.g. species, or populations). These relationships are discovered through phylogenetic inference methods that evaluate observed heritable traits, such as DNA sequences or morphology under a model of evolution of these traits. The result of these analyses is a phylogeny (also known as a phylogenetic tree).

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Phylum is a major taxonomic division of living organisms that contain one or more classes. Humans are classified as Kingdom: Animalia, *Phylum*: Chordata, *Class*: Mammalia, *Order*: Primates, Family: Hominidae, Genus: *Homo*, Species: *H. sapiens*

Pleistocene is the geological epoch which lasted from about 2,588,000 to 11,700 years ago, spanning the world's recent period of repeated glaciations.

Polymorphism: A condition in which a population possesses more than one allele at a locus. Sometimes it is defined as the condition of having more than one allele with a frequency of more than five percent in the population.

Population: group of members of the same species that are in close enough proximity to allow them to interbreed.

Population bottleneck: A brief reduction in population size, which causes a burst of random genetic drift. It may be caused by a founder effect. It is an important concept regarding the frequencies of genetic diseases in some isolated populations.

Primates are a mammal of the order Primates who arose from ancestors that lived in the trees of tropical forests; many primate characteristics represent adaptations to life in this challenging three-dimensional environment. Most primate species remain at least partly arboreal. An early close primate relative known from abundant remains is the Late Palaeocene 55–58 million years old. Molecular clock studies suggest that the primate branch may be even older, originating around 63–74 mya. The order Primates was traditionally divided into two main groupings: prosimians and anthropoids (simians). Simians includes monkeys, apes and hominins.

Quantitative genetics: The study of the inheritance of genetically complex traits.

Quantitative trait: Some characteristic that may be influenced by multiple genes and that is studied by the methods of quantitative genetics.

Reproductive value: A measure of the average contribution to subsequent generations of individuals at any given age, relative to the contribution of the average individual (Fisher 1930).

Runaway selection: The idea, first proposed by Fisher, that once certain traits become associated with mate value, sexual selection for these traits can go into runaway mode. Runaway selection or Fisher's runaway is a model of inter-sexual selection that helps to explain traits that do not obviously increase survival. This model is based upon a positive feedback "runaway" mechanism. It was first proposed by British evolutionary biologist (Fisher 1915).

Segregation distortion: In principle, the two parental alleles have equal probabilities of being present in the mature gamete. However, there are several mechanisms that lead to an unequal transmission of parental alleles from parents to offspring. One example is a gene, called a segregation distorter that "cheats" during meiosis or gametogenesis and thus is present in more than half of the functional gametes. Possible examples have also been reported in humans.

"Identification of Two Maternal Transmission Ratio Distortion Loci in Pedigrees of the Framingham Heart Study"

Selection:

Any natural or artificial process that results in differential reproduction among the population, so that the inheritable traits of only certain individuals are passed on in greater proportion, to succeeding generations. (Darwin 1859).

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Self-domestication refers to a theory of the process of adaptation of wild animals to humans, without direct human selective breeding of the animals. The term is also used to refer to biological processes in the evolution of humans and human culture. Self-domestication is a process which mirrors our domestication of animals. We have transformed ourselves through a similar process of self-selection our transformation has been primarily cultural, but also has biological component.

Sexual selection: Is one mode of natural selection in which some individuals out reproduces others of a population because they are better at securing mates. (Darwin1859). It is a type of social selection where traits are selected by a mate. The sexual selection concept arises from the observation that many animals evolve features whose function is not to help individuals survive, but help them to maximize their reproductive success. This can be realized in two different ways: by making themselves attractive to the opposite sex (intersexual selection, between the sexes); or by intimidating, deterring or defeating same-sex rivals (intrasexual selection, within a given sex). These traits therefore increase an individual's likelihood of reproducing, rather than surviving.

Social brain hypothesis : This hypothesis considers that the evolution of our large brain and human intelligence ,rather than being driven by ecological problem solving, evolved as a means of surviving and reproducing in large and complex social groups. Thus the dynamic social world, in which individuals are constantly making and breaking alliances, drove human evolution. (Dunbar 1998).

Social learning or Observational learning is learning that occurs through observing the behaviour of others. It is a form of social learning which takes various forms, based on various processes. In humans, this form of learning seems to not need reinforcement to occur, but instead, requires a social model such as a parent, sibling, friend, or teacher. Particularly in childhood, a model is someone of authority or higher status. In animals, observational learning is often based on classical conditioning, in which an instinctive behaviour is elicited by observing the behaviour of another, but other processes may be involved as well.

Spandrels: Triangular spaces formed where two arches intersect. Used by Gould and Lewontin to refer to structures that are necessary by-products of traits that arose for reasons quite unrelated to any present function.

Species is one of the basic units of biological classification and a taxonomic rank. A species is simplistically defined as the largest group of organisms in which two individuals are capable of reproducing and that the offspring are fertile.

Stabilizing selection: A type of selection that favours intermediate trait values. Stabilizing selection is a type of natural selection in which genetic diversity decreases and the population mean stabilizes on a particular trait value. This is thought to be the most common mechanism of action for natural selection because most traits do not appear to change drastically over time. Stabilizing selection commonly uses negative selection (a.k.a. purifying selection) to select against extreme values of the character. Stabilizing selection is the opposite of disruptive selection. Instead of favouring individuals with extreme phenotypes, it favours the intermediate variants. It reduces phenotypic variation and maintains the status quo. Natural selection tends to remove the more severe phenotypes, resulting in the reproductive success of the norm or average phenotypes.

Stone Age: was a broad prehistoric period during which stone was widely used to make implements with a sharp edge, a point, or a percussion surface. The period lasted roughly 3.4 million years, and ended between 6000 BCE and 2000 BCE with the advent of metalworking. Stone Age artefacts include tools used by modern humans and by their predecessor species in the genus Homo, and

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possibly by the earlier partly contemporaneous genera *Australopithecus* and *Paranthropus*. Bone tools were used during this period as well but are rarely preserved in the archaeological record. The Stone Age is further subdivided by the types of stone tools in use. The Stone Age is the first of the three-age system of archaeology, which divides human technological prehistory into three periods: The Stone Age; The Bronze Age; The Iron Age

Survival of the fittest: A term that refers to the survival of only those organisms best able (fittest) to obtain and utilize resources, resulting in the evolution of organisms that are best adapted to the environment. Darwin used metaphorically to describe "natural selection." The phrase was invented by the 19th century philosopher Herbert Spencer. It has been misapplied through history to explain and justify social and economic inequities in human populations ("social Darwinism") or as a method for improving the human condition through selective breeding (eugenics). Survival alone is insufficient for evolution, it is reproduction, or passing on of genes that really counts. Most modern biologists no longer use this term when describing or discussing natural selection.

Sympatry: originating in or occupying the same geographical area.

Theory: A plausible or scientifically acceptable, well-substantiated explanation of some aspect of the natural world; an organized system of accepted knowledge that applies in a variety of circumstances to explain a specific set of phenomena and predict the characteristics of as yet unobserved phenomena.

Trade-off: A situation where one trait cannot be increased without decreasing another. The term is used to describe constraints in optimization arguments.

Trait: A physical or behavioural characteristic or feature of an organism.

Unconscious selection may be defined as non-intentional human selection. The term was introduced by Darwin and its modern concept was developed by C .D. Darlington. Unconscious selection, or automatic selection as it is sometimes called, could have been responsible for most of the differences that distinguish domesticated species from their wild progenitors. Some differences, such as those in seed or fruit colours, may have developed from conscious selection at an early time. For unconscious selection to operate in the development of domesticated plants there would have to have been a deliberate planting of seeds by people.