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Ranking Forces of Nature by their Capacity to Generate Branching Patterns and its Relevance to the Sciences

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Abstract

I seek to investigate and show that it is possible to rank forces of nature by their capacity to generate branching patterns, and I seek to show the relevance of ranking forces of nature for the biological sciences, the physical sciences, and also computer science.

Keywords: ***Forces of physics; Branching patterns; Cloning; Evolutionary computing***

Introduction

Natural selection and the forces of evolution

In contrast with genetic mutation, gene duplication, recombination, and sexual reproduction (natural forces that increase the number and differentiation of characteristics across individuals in species), natural selection, in any generation, tends to decrease the number and differentiation of characteristics across individuals in species. Darwin and Wallace established the theory of evolution by natural selection, i.e., that given constant slight variations in the characteristics of individual organisms within species, less favorable variations for survival and reproduction will be eliminated, and more favorable variations will be selected and retained. As Darwin recognized natural selection is a conservative force that explains the gradual nature of evolution ("Natura non facit saltum"), and explains the conservation or retention of adaptive structures; thus, genetic mutation, gene duplication, sexual reproduction, and recombination are forces that tend to increase the number and differentiation of characteristics across individual organisms in any given generation in contrast with natural selection, and they tend to increase the rate of evolution in contrast with natural selection. However, natural selection may "increase" the rate of evolution over generations by conserving or retaining adaptive structures that facilitate an increase in the rate of evolution and species diversification, like the differentiation of forelimbs from hind limbs, the retention of vertebrata, the retention of bilateral symmetry, the retention of sexual reproduction, the retention of pollinating flowers, the retention of mammary glands, or the retention of organisms with larger and more complex brains. The emergence of such adaptive structures are not generated by natural selection per se, but may be generated by forces such as genetic mutation, gene duplication, sexual reproduction, and recombination, in conjunction with natural selection

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(or in conjunction with natural selection and assortative mating). What, then, shapes and organizes biological variation?

Natural selection is constantly shaping and organizing branching patterns of characteristics across individual organisms in species across generational time; however, assortative mating may generate larger branching patterns or branching geometries of characteristics across individual organisms in species than natural selection on its own: Angiosperm plants that participate in interspecific assortative mating with bee species, insect species, and bird species have greater branching geometries of characteristics than ancestral species of plants that do not participate in interspecific assortative mating with insect species, bee species, and bird species; Species in the genus Homo that participate in intraspecific assortative mating, including the human species, have greater branching geometries of characteristics, including behavioral characteristics and the expression of intelligences and personality characteristics, than primate species. (Intraspecific assortative mating is less in primate species since assortative mating within a shared language is absent in primates, and assortative mating across cultural characteristics is absent or far less compared to humans or even primordial species in the genus *Homo*). Branching patterns are fundamental to science, and many phenomena are considered or classified as branching patterns, including the tree of life, cellular differentiation of organisms, branching patterns of characteristics across individual organisms, branching patterns of characteristics and adaptive structures across species, languages and linguistic groups, religions and religious sects, and also families, organizations, and human societies.

It may be possible to rank forces of nature by the capacity to generate branching patterns

Given genetic variability and inheritance, natural selection shapes and organizes branching patterns of characteristics across individual organisms in species in generational time; however; assortative mating may generate larger branching patterns or branching geometries of characteristics than natural selection on its own. It also may be possible to assimilate the influential work of Susumu Ohno to this approach: Susumu Ohno suggests that gene duplication is more important for the emergence of new gene functions than point mutations and mutations at the level of genes and alleles [1-3]. Gene duplication is analogous to cloning, and it is possible to re-state Ohno's conjecture in a new way [4-6]. Ohno's view is in effect that the differentiation of gene functions by gene duplication and genome duplication is greater than by genetic mutation per se (i.e., point mutations or mutations affecting the expression the individual genes and alleles).

From this standpoint, gene duplication produces branching patterns in the evolution of species, i.e., the differentiation of gene functions by gene duplication and genome duplication generates branching patterns of (new) adaptive structures in the evolution of species (in conjunction with natural selection, or in conjunction with natural selection and assortative mating, as discussed earlier). Gene duplication and whole genome duplication events are viewed as being responsible for the emergence various adaptive structures in the evolution of species, including vertebrata in the evolution of vertebrates, the eye, and the emergence of structures available for pollination in angiosperm plants. Ohno's work may be re-formulated: the differentiation of gene functions by gene duplication and genome duplication is greater than by genetic mutation on its own, and the emergence of branching patterns of adaptive structures in the evolution of species are greater by gene duplication and genome duplication than by genetic mutation on its own. Thus, to incorporate Susumu Ohno's work to this perspective, gene duplication and whole genome duplication events have a greater capacity to generate branching patterns than genetic mutation on its own (which also may be restated: gene duplication and whole genome duplications events have a greater capacity to generate branching patterns of characteristics in the evolution of species than genetic mutation and natural selection on their own). Similarly, sexual reproduction and recombination have a greater capacity to generate branching patterns of characteristics across individual organisms in species, and in the evolution of species, than asexual reproduction of organisms.

Cloning? It is an interesting question of how to assess the capacity of cloning to produce branching patterns. Sexual reproduction and recombination have a greater capacity to produce branching patterns of characteristics across individual organisms in species in generational time than the asexual reproduction of organisms, and sexual reproduction and the alternation of generations have a greater capacity to generate branching patterns of characteristics across individual organisms in species, and in the evolution of species, than asexual reproduction. However, cloning produces branching patterns when there are multiple lines of clones that may be differentiated across functions, as in multiple cell lines that differentiate into the different cell types, tissues, organs, and adaptive structures of complex organisms; more limited cases compared to cellular differentiation of complex organisms are the multiple kinds of cloned individuals and castes of some eusocial insects that fulfill different functions across the eusocial organism. (Major transitions of evolution have included new cell lines and new cell types that have emerged as new adaptive structures in the evolution of species, and also new castes of individual members in the emergence of eusocial species).

Cloning is complementary to natural selection

Cloning is complementary to natural selection in ways not always explicitly recognized: In a population of pure clones, opportunities for natural selection are absent. Darwin and Wallace recognized that natural selection required constant or near constant slight variations across individual organisms in species: Darwin and Wallace sought to establish that there are constant or near constant slight variations across species, that the variations are heritable, and that more favorable variations are conserved and retained. Consequently, as suggested, in a population of pure clones, opportunities for natural selection are reduced or are absent. (Note that in lines of clones, natural selection is more limited though natural selection may function to conserve and retain more favorable lines of clones than less favorable lines of clones, and this may be facilitated when lines of clones experience genetic mutation or gene duplication; moreover, in cases of individuals taken or selected from natural populations to produce populations of clones, it should be recognized that there is a set of exceptions or limiting cases to the prediction that the distribution of characteristics of any natural population would collapse or reduce in any population of clones taken, derived, or modeled from the natural population: Exceptions would be if the natural population or natural populations were themselves populations of clones, as in asexual colonies of ferns or other asexual colonies of plants, or asexual bacteria; a population of pure clones would still reduce the characteristics of asexual species and asexual colonies since asexual species and asexual colonies will have limited genetic differentiation across lines of clones as a result of genetic mutation and also potential gene duplications).

Even though clones reduce or eliminate opportunities for natural selection across units in biological systems, the emergence of clones contributes to the evolution of biological systems and biological species, particularly more complex biological systems, more complex cellular life, and the evolution of biological species with more and different sets of adaptive structures. For example, mitochondria are organelles in cells that are asexual clones, and it has been recognized that their status as asexual clones reduces potential competition between mitochondria within cells in organisms: “Competition between the mitochondria in a single cell, and the consequent evolution of selfish mitochondria, is largely suppressed because all of the mitochondria in a single individual [organism] are genetically identical.” That is, the status of mitochondria as asexual clones reduces or eliminates opportunities for natural selection between mitochondrial clones within organisms [7,8]. The emergence of clones moves the unit of natural selection to a higher level of organization, as in cell lines and cell types that are clones in organisms, symbionts that have become cloned or near cloned organelles in cells and experience their own asexual cell division in cells (as in mitochondria in eukaryotic cells, or chloroplasts in algae or plants), or clone castes in eusocial insects. Natural selection then acts at the level of the organism in relation to other organisms, or the eusocial colony versus other colonies or species. This also suggests a rule in biological systems: In biological systems clones reduce or eliminate opportunities for natural selection in the line of clones or generations of clones; however, the presence of clones, as in cell types and cell lines in multicellular organisms or castes of individuals in eusocial insects, thereby moves the unit of natural selection to a higher level of organization. This may be the individual organism in a species of individual organisms with variations across its members, the eukaryotic cell that incorporates symbionts as organelles to be cloned in reproduction (as in mitochondria or chloroplasts), or eusocial colonies or eusocial species.

Comparisons of clones to natural populations and ranking forces of nature by their capacity to generate branching patterns

Cloning organisms is also a technical achievement that has been introduced in 20th and 21st century biology. It is thus possible to consider comparisons of populations of clones to natural populations from which the clones are derived or modeled: In the case of an individual organism taken at random from a natural population of a species to produce a population of clones (such as 1,000 or a 1,000,000 or more), it is possible to predict that the distribution of characteristics of the natural population will collapse or reduce in the population of clones.

(It is interesting to consider if there are any exceptions to this prediction across the natural populations of species: a possible exception or set of exceptions is if the individual organism selected to be cloned is not an individual organism at random; instead, a possible exception or set of exceptions is if the individual organism is a kind of super individual or superorganism that has a number of latent capacities or characteristics that approached or possibly exceeded the capacities, talents, or adaptive characteristics in the distribution of characteristics including behavioral characteristics in the case of the human species of the natural population from which the clone was taken or derived).

In the human species, if an individual taken at random was cloned to produce a population of clones, it is possible to predict that the distribution of characteristics of the natural population of the species would collapse or reduce in the population of clones: that is, the number and differentiation of faces and facial characteristics, body types (i.e., ectomorphs, mesomorphs, and endomorphs) and physical characteristics, and intelligences, personality characteristics, and talents would collapse in the generation of clones. From the standpoint of evolution, it is possible to recognize that human evolution itself involves increasing the quantities that are collapsed or reduced in the population of clones: faces and facial characteristics, body types and physical characteristics, behavioral characteristics including the expression of intelligences, talents, and personality characteristics, and also the degree of assortative mating across individuals (i.e., there is more assortative mating, mating across categories of similar characteristics and dissimilar characteristics, "like with like" or "opposites attract," than in a population of clones). Thus, it is also interesting to recognize that assortative mating is identified as a variable, and that assortative mating has been increasing in the evolution of the genus Homo; by contrast, natural selection as a force of evolution is commonly treated as a constant across primates, or primordial human species, or the human species. Since assortative mating has been identified as a variable, it is possible to suggest a functional analogy across biological systems: It is possible to jump from intraspecific assortative mating in the genus Homo to interspecific assortative mating: Interspecific assortative mating may increase the size of the branching patterns or branching geometries of characteristics in the co-evolution of angiosperm species or flowering plants with bee species, insect species, and bird species; by contrast, interspecific assortative mating is absent or far more limited between non-flowering plants and bees, insects, birds or other organisms; natural selection as a force of evolution is commonly treated as a constant across angiosperm plants and ancestral varieties of plants and non-flowering plants.

Thus, it is possible to recognize that interspecific assortative mating has been increasing in the co-evolution of angiosperms or flowering plant species, and bees, insects, and birds, and that the number of insect species and bird species that co-evolve with flowering plants has been increasing in the evolution and diversification of angiosperm species. (Wilson estimates that angiosperm species make up approximately one-sixth of all species that have been described, and it is estimated that 80%-90% of all plant species are angiosperm species; insect species consist of approximately two-thirds of all species described; not all insects are pollinators, though pollinators are taken from orders Hymenoptera, Diptera, Lepidoptera, Coleoptera, and also a small though substantial number of pollinating bird species). Moreover, it is possible to recognize that assortative mating may increase the rate of evolution more than natural selection on its own, since angiosperm species have faster rates of evolution than ancestral species of plants (e.g., ferns) or non-flowering plants; interspecific assortative mating also may play a role in increasing speciation and biological diversity more than natural selection on its own, given the large diversity of bee species, insect species, and bird species that have co-evolved as pollinators to different flowering plants [9-10]. (This paper does not focus on the nature of speciation and its large literature; however, it should be recognized that conventional models of speciation emphasize allopatric speciation, or speciation by physical or geographic barriers and genetic drift: “Since most species originate as geographical isolates, one should expect that a certain percentage of such isolated populations are on the borderline between subspecies and species”. “Allopatric models of speciation emphasize the role of geographical separation in achieving reproductive isolation between populations, and are currently considered to be the best candidates for understanding most speciation events”; however, rainforests have the greatest species diversity and the greatest number of species per unit area, which implies that speciation is more frequent generations compared to generations in the physical proximity of high resource available environments of rainforests compared to speciation that occurs as a result of physical and geographic barriers; in addition to simple resource and nutrient availability, assortative mating may play a role in increasing the capacity for speciation across terrestrial and marine environments more than natural selection on its own) [11-13]. In contrast with natural selection, a theory of assortative mating predicts that the size of the branching patterns or branching geometries of characteristics across angiosperm species that co-evolve with and participate in assortative mating with bee species, insect species, and bird species are larger than the branching patterns of characteristics of ancestral species of plants or non-flowering plants (that do not participate in such interspecific assortative mating). Similarly, a theory of intraspecific assortative mating predicts that the size of the branching patterns or branching geometries of characteristics across individual members of a species are greater in species with more intraspecific assortative mating than in species with less, i.e., humans compared to primates; thus, in contrast with the theory of natural selection, a theory of intraspecific assortative mating predicts that the size of the branching patterns of characteristics across individual organisms in the human species will be larger than the distribution of characteristics across individual organisms in primate species; as suggested, natural selection is commonly treated as a constant across primate species, proto-human species in the genus *Homo*, and *Homo Sapiens*.

Evolutionary transitions in natural selection

On evolutionary transitions in the nature of natural selection, and its relationship to biological evolution: It is also interesting to consider a natural population of pure clones: If an individual organism was taken at random from a natural population of clones to produce a population of clones, the population of clones would not reduce or collapse any distribution of quantities of the natural population since the natural population was itself a population of pure clones or identical (**TABLE. 1**). As suggested, it is interesting to recognize that in a population of pure clones, the pattern of constant or near constant slight variations across individual members of species established by Alfred Russel Wallace and Charles Darwin collapses, and opportunities for natural selection are absent [14]. Thus, it may be recognized that in species of cloned organisms, such as asexual plants or asexual bacteria, the intensity or severity of natural selection is less than in species with sexual reproduction and recombination. In asexual species, genetic variability is more limited (consisting of mutation and polyploidy) compared to species with sexual reproduction and genetic recombination, or sexual reproduction, recombination, and the alternation of generations. Thus, it may be said that in the evolutionary transition from asexual reproduction in species to sexual reproduction, the intensity and severity of natural selection increases; however, by this standard, it also may be recognized that in the evolution of species the intensity and severity of natural selection may decline somewhat (even if it is still clearly present and an important force in evolution), as in the decrease in the number of offspring and the increase in the physical and parental investment in offspring by mammalian species (such as longer internal gestation, mammary glands, and parental investment), and also bird species and marsupial species compared to, say, the common though not universal technique of spawning of most fish species, amphibians, or echinoderm species. Natural selection is commonly treated as a constant or near constant as an explanatory force across species in sociobiology and related subjects. However, natural selection may be recognized as a variable that increases or declines in its severity or intensity with evolutionary transitions in modes of sexual reproduction and degree of physical and parental investment (in addition to or independent of attempts to assess a complex set of selection pressures in a given habitat or environment, and the severity or intensity of each).

TABLE 1. **Evolutionary transitions in natural selection.**

Asexual Reproduction in Species Sexual Reproduction	**Transition to Sexual Reproduction, Alternation of Generations (Increases capacity for number of offspring with differential characteristics)**	**Analytic result (widely acknowledged): Increase in Intensity of Natural Selection**
Sexual Reproduction by High Number of Offspring & Low Physical and Parental Investment (Echinoderms, Fish, Amphibians)	Transition to Sexual Reproduction with Low Number of Offspring and High Physical and Parental Investment (Birds, Marsupials, Mammals)	Analytic result (not usually acknowledged): Relative decrease in intensity of natural selection

Natural selection, assortative mating, the nature of scientific explanation, and branching patterns

More generally, as suggested, it is possible to predict that, selecting an individual organism from any species, and cloning them to produce a population two or more (or a 1,000 or a 1,000,000 or more), will collapse or reduce the distribution of characteristics of the natural population of any species from which the population of clones are taken, derived, or modeled. In many cases that distribution of characteristics is a branching pattern, as in the distribution of characteristics across individual organisms in biological species. Thus, cloning to produce a population of clones collapses the branching pattern or branching geometry of characteristics of the natural population from which the population of clones are derived, taken, or modeled. In physics, other branches of science, or philosophy, there is a large literature of scientists and philosophers commenting on the strategy and nature of explanation of physics or other sciences, such as scientific achievements that seek to use general principles to predict patterns in phenomena, or scientific achievements that seek to explain important findings or discoveries by a style of explanation called “explanation by concept” [15-20]. However, it is logically possible that the distribution of characteristics or quantities of a natural population may be other shapes or fundamental patterns instead of branching patterns per se; as suggested, selecting an individual unit from a natural population and cloning them collapses the distribution of characteristics of the natural population. Since cloning collapses or reduces the shape or shapes of the distribution of characteristics of the natural population, then it may be possible to conceive of how to increase the quantities and forces involved in maintaining, growing, or developing the shape or shapes of the distribution of characteristics or quantities of the natural population (i.e., if it is in principle possible to reduce a set of characteristics or quantities, then it may be possible to increase the characteristics or quantities or identify how to increase them). An example is selecting an individual organism from the natural population of human beings, and cloning them to produce a population of clones: In the population of clones, the number and differentiation of characteristics across individual organisms reduces or collapses (facial characteristics, physical characteristics, behavioral characteristics including intelligences, talents, and personality characteristics; the capacity for assortative mating also reduces); that is, the distribution of characteristics of the natural population collapses or reduces, and thus also the shape or shapes of the distribution of characteristics of the natural population collapses or reduces, which is a branching pattern or branching geometry of characteristics across individual organisms of the human species. The logic of the comparison of clones to the natural population of the human species may be reversed: Human evolution itself involves increasing the number and differentiation of faces and facial characteristics, physical characteristics and body types, behavioral characteristics, including intelligences, talents, and personality characteristics, and also assortative mating; that is, human evolution itself involves increasing the geometrical area of characteristics of the human species that are reduced or collapsed in a population of clones. What are the processes or factors involved in increasing the number and differentiation of characteristics across individual organisms in the human species? That is, what are the processes or factors involved in increasing the geometry of characteristics of the branching pattern or branching patterns of characteristics across individual organisms in the evolution of the human species? Is the only force involved Darwinism or natural selection? A new explanation is assortative mating: Intraspecific assortative mating in the evolution of the human species may generate larger branching patterns of characteristics across individual organisms in the human species than natural selection on its own. What increases assortative mating in the human species? Culture. Culture increases the number of qualities across individuals in human societies: Human societies have vastly more culture than primate societies; that is, human societies may have secular culture and religious culture, God, gods, goddesses, dance, music, science, philosophy, literature, fashion, cuisine, viticulture, horticulture, the arts, theatre, film, or other cultural phenomena; human societies have a differentiation of roles in the division of labor (or divisions of labor) that have the capacity to increase and diversify with increases in culture and material culture or technology, such as in hunting, horticulture, agriculture, warfare, or industry, or in families, groups, organizations, or the larger economy; human societies have an increasing differentiation of roles, experts, and specializations as material culture or technology diversifies and increases across organizations and society [21-25].

Conclusion

Thus, culture in human societies increases the capacity for assortative mating across categories of similar characteristics ('like with like') and categories of dissimilar characteristics ('opposites attract' or mating across complementary characteristics) more than in primate societies. It has not escaped the notice of the present author that, since Darwinism or natural selection has been used as a design model or "design process" in robotics and computer science to generate patterns, artificial intelligence, and the retention of machine learning, in principle, assortative mating may be used as an alternative model or design process in robotics and computer science for the generation of patterns, artificial intelligence, the performance of simulations, and the generation of different types of machine learning; moreover, the framework discussed in this paper, of ranking forces by their capacity to generate branching patterns, or the development of techniques or standards for ranking different branching patterns themselves, also may generate new models for generating patterns, artificial intelligence, and machine learning in computer science and robotics. An additional potential consequence of this strategy is ranking computer science programs, applications, and algorithms in robotics and artificial intelligence by their capacity to generate branching patterns of capacities and intelligences (instead of strategies that attempt to simulate

Darwinism or natural selection in artificial intelligence and robotics, or focus only on a single intelligence or capacity instead of multiple intelligences and capacities.

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