



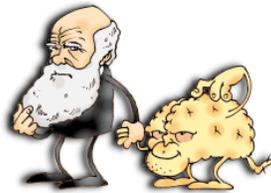
PHIL 474/673 -NATURAL RATIONALITY – WEEK 7 – FEBRUARY 13

Benoit Hardy-Vallée, Department of Philosophy  
University of Waterloo  
<http://phi673uw.wordpress.com>

---

## EVOLUTIONARY PSYCHOLOGY AND RATIONALITY

---



*Nothing is easier than to admit in words the truth of the universal struggle for life, or more difficult—at least, I have found it so—than constantly to bear this conclusion in mind. Yet unless it be thoroughly engrained in the mind, the whole **economy of nature**, with every fact on distribution, rarity, abundance, extinction, and variation, will be dimly seen or quite misunderstood. We behold the face of nature bright with gladness, we often see superabundance of food; we do not see, or we forget, that the birds which are idly singing round us mostly live on insects or seeds, and are thus constantly destroying life; or we forget how largely these songsters, or their eggs, or their nestlings, are destroyed by birds and beasts of prey; we do not always bear in mind, that, though food may be now superabundant, it is not so at all seasons of each recurring year.*

(Darwin, 1859)

*[E] very work of science great enough to be well remembered for a few generations affords some exemplification of the defective state of the art of reasoning of the time when it was written; and each chief step in science has been a lesson in logic.*

(Peirce, 1877)

### 1 Evolution and natural selection

- Evolution: changes in gene frequency across generations
- Mechanism: natural selection
- 3 elements:
  - Variation
  - Heritability
  - Selection
- Other mechanisms of evolution: mutation, recombination genetic drift, migration, speciation, extinction, cooperation, sexual selection, kin selection, adaptation
- **Fitness**: measure of effectiveness in survival and reproduction, reproductive success

- **Inclusive fitness:** “an individual's own reproductive success plus the effects the individual's actions have on the reproductive success of their genetic relatives.” (Wikipedia)
- **Adaptation:** anatomical structure, physiological process or behavioral trait of an organism that has evolved over a period of time by the process of natural selection such that it increases the expected long-term reproductive success of the organism. (Wikipedia)
- **Trait:** a feature of an organism (organisms are collection of traits)
- See (Hull & Ruse, 1998, 2007; Mayr, 1988; Ruse, 1998; Sober, 2000; Sterelny & Griffiths, 1999) for discussions in philosophy of biology

## 2 Conceptual revolution

- Provides a general **mechanism** that explains the diversity and adaptivity of living beings (natural selection)
- **Principle** to organize the mass of fact about them, (tree of life).

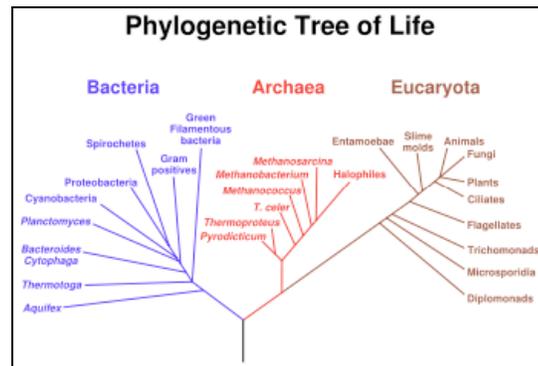


Figure 1 Tree of Life (Wikipedia)

- Replacement of “population thinking” by “typological thinking.”(Mayr, 1959).
- “Nothing makes sense in biology except in the light of evolution” (Dobzhansky, 1973)

### 2.1 More than biology: a new logic.

- (see Dennett, 1995; Gayon, 2003; Thagard, 1992, chapter 6)
- Explanatory: *“The Darwinian controversy is, in large part, a question of logic. Mr. Darwin proposed to apply the statistical method to biology.”* (Peirce, 1877)
- *“The conceptions that had reigned in the philosophy of nature and knowledge for two thousand years, the conceptions that had become the familiar furniture of the mind, rested on the assumption of the superiority of the fixed and final; they rested upon treating change and origin as signs of defect and unreality. In laying hands upon the sacred ark of absolute permanency, in treating the forms that had been regarded as types of fixity and perfection as originating and passing away, the "Origin of Species " introduced a mode of thinking that in the end was bound to transform the logic of knowledge, and hence the treatment of morals, politics, and religion.”*(Dewey, 1910, pp. 1-2)

### 3 Important contributions to evolutionary biology

- **Modern evolutionary synthesis:** Darwin + Mendel (Dobzhansky, 1937)
- **Sex-ratio** (Fisher, 1930): the male/female ratio is a dynamical equilibrium
- **Inclusive fitness** (Hamilton, 1964a, 1964b): sum of an individual's own reproductive success plus the effects the individual's actions have on the reproductive success of their genetic relatives.
- Hamilton's rule:  $C < R \times B$ .
- Cost should be inferior to the product of genetic **Relatedness** between the actor and the recipient and **B** is the benefit to the recipient.
- **Cladistics** (Hennig, 1966): classification by evolutionary origin
- **Reciprocal altruism** (Trivers, 1971) (tit-for-tat)
- **Gene-centered view of evolution**, 'Selfish Gene' (Dawkins, 1976): natural selection act upon genes. Distinction between the vehicle (organisms) and replicators (genes): genes create organisms as a means of acquiring resources and copying themselves
- **'Spandrels' and 'exaptation'** (Gould & Lewontin, 1979): evolutionary products may not be adaptive: they may be development constraints or vestige
- **Evolutionary game theory** (Maynard Smith, 1982): genes are 'agents' in evolutionary games.

### 4 Biology and Economics

- **Darwin** : analogy between political economy (the social science) and "economy of nature" (also *oeconomy* of nature).
- Malthus + Adam Smith + Lyell + Darwin = Natural Selection
- Division of labor, competition ("struggle" in Darwin's words), trading, cost, the accumulation of innovations, the emergence of complex order from unintentional individual actions, the scarcity of resources and the geometric growth of populations are ideas borrowed from economics
- Darwin's main contributions are its transforming biology into a *historical* science (like geology) and an *economic* science
- But: biology and economics had to attain a certain degree of maturity before establishing an fruitful dialogue (Hammerstein, 1998, p. 3)
- The 'logisitic turn' drove economics toward 'social physics', not toward a biology of decision-making
- Exception: (Veblen, 1898, 1899): Economics should be an evolutionary (dynamic) science
- Relevance for social sciences: Marx

*Darwin has interested us in the history of Nature's Technology, i.e., in the formation of the organs of plants and animals, which organs serve as instruments of production for sustaining life. Does not the history of the productive organs of man, of organs that are the material basis of all social organisation, deserve equal attention? And would not such a*

*history be easier to compile, since, as Vico says, human history differs from natural history in this, that we have made the former, but not the latter? (Marx, 1867/1981, p. 493, fn 4)*

- Ecology : *Oecology* is the “body of knowledge concerning the economy of nature (...) the study of all those complex interrelationships referred to by Darwin as the condition of the struggle for existence” From “Morphology of Organisms” (1866); see (Stauffer, 1960). The contemporary ecology textbooks commonly use this quote to define ecology (Dodson, 1998, p. 2).
- Sociobiology (Wilson, 1975)
- Bioeconomics (Hodgson, 2001; Landa & Ghiselin, 1999)
- Evolutionary economics (Hammerstein & Hagen, 2005)
- Evolutionary game theory
  - *Biological* evolutionary game theory
  - *Economic* evolutionary game theory
- Behavioral ecology (Krebs & Davies, 1997)
- Optimal foraging
- Game theory (Dugatkin & Reeve, 1998)
- Biological markets (Noë *et al.*, 2001)
- Evolutionary psychology

## 5 Biology and psychology

*In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation.*

*-(Darwin, 1859)*

### 5.1 Evolutionary psychology

- William James (James, [1890]1950)
- (Humphrey, 1976): The social function of the intellect
- Modern revival : (Barkow *et al.*, 1992; Pinker, 1997; Tooby & Cosmides, 2005)
- **Evolutionary Psychology** (paradigm) vs. **evolutionary psychology** (biological approach to cognition) (Buller, 2005)

## 5.2 The core of Evolutionary Psychology

- Guiding principles<sup>1</sup>:
- **Principle 1.** The brain is a physical system. It functions as a computer. Its circuits are designed to generate behavior that is appropriate to your environmental circumstances.
- **Principle 2.** Our neural circuits were designed by natural selection to solve problems that our ancestors faced during our species' evolutionary history.
- **Principle 3.** Consciousness is just the tip of the iceberg; most of what goes on in your mind is hidden from you. As a result, your conscious experience can mislead you into thinking that our circuitry is simpler than it really is. Most problems that you experience as easy to solve are very difficult to solve -- they require very complicated neural circuitry
- **Principle 4.** Different neural circuits are specialized for solving different adaptive problems.
- **Principle 5.** Our modern skulls house a stone age mind.
- **Modularity:** encapsulated, fast and automatic computational devices. Ex: face recognition, theory of mind, kin recognition, etc.
- **Machiavellian Intelligence** (Byrne & Whiten, 1988): the social nature of Homo Sapiens was a selective pressure in its evolutionary history.
- EP as darwinian, computational, massively modular cognitive psychology

## 5.3 EP and its rivals

- EP vs traditional cognitive science e.g. (Fodor, 1983): *all* the mind is modular, cognitive science should be understood as a branch of biology, cognitive mechanisms have adaptive function.
- EP vs sociobiology: organisms are adaptation executors, not fitness maximizers (Tooby & Cosmides, 2005, p. 14).
- EP vs SSSM (Standard Social Science Model): minds are not tabula rasa, cultural variability is limited, genetics is important
- EP vs ABC (Associationist, Behaviorist, Connectionist) psychology: learning cannot start from zero, computation must be modularized, minds domain-specific adaptation, many 'mental organs' are innate.
- EP vs logic/probability: 'darwinian algorithms' are more effective than rational algorithms
- EP vs 'Heuristics and Biases': so-called errors are adaptation, effective and efficient in natural, ecological environments

---

<sup>1</sup> Evolutionary Psychology: A Primer, Leda Cosmides & John Tooby, online at: <http://www.psych.ucsb.edu/research/cep/primer.html>

## 5.4 Explanatory practices

- Biological version of Marr 3 levels model (implementation, computation, function) (Marr, 1982)

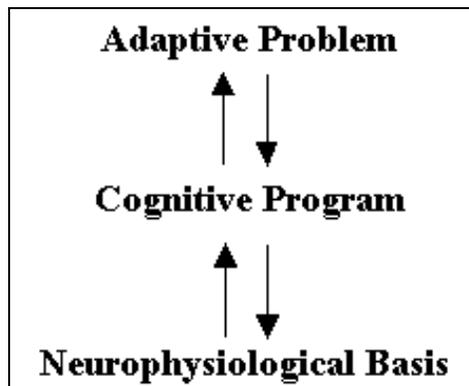


Figure 2 Three complementary levels of explanation in evolutionary psychology

- Cheater-detection module: performance in Wason selection task is higher in social context (application of modus tollens). Tooby and Cosmides argued that this (and other biological considerations) support the idea of a CDM.

Here are four cards. Each of them has a letter on one side and a number on the other side. Two of these cards are shown with the letter side up, and two with the number side up.

**E**      **C**      **5**      **4**

Indicate which of these cards you have to turn over in order to determine whether the following claim is true:

**If a card has a vowel on one side, then it has an odd number on the other side.**

In its crackdown against drunk drivers, Massachusetts law enforcement officials are revoking liquor licenses left and right. You are a bouncer in a Boston bar, and you'll lose your job unless you enforce the following law:

**"If a person is drinking beer, then he must be over 20 years old."**

The cards below have information about four people sitting at a table in your bar. Each card represents one person. One side of a card tells what a person is drinking and the other side of the card tells that person's age. Indicate only those card(s) you definitely need to turn over to see if any of these people are breaking the law.

**drinking beer**      **drinking coke**      **25 years old**      **16 years old**

Figure 3 Wason selection task (From Samuels & Stich, 2004)

- EP an other disciplines:
- Philosophy (Papineau, 2003; Skyrms, 2000) Psychology (Goetz & Shackelford, 2006) Politics (Reiners, 2001) Religion (Atran, 2002), Language (Pinker, 1997), Anthropology (Sperber, 1996)
- criticisms: (Buller, 2005; Fodor & Pylyshyn, 1988; Griffiths, 2002, 2006; Griffiths & Gray, 2001; Over, 2003)
- 

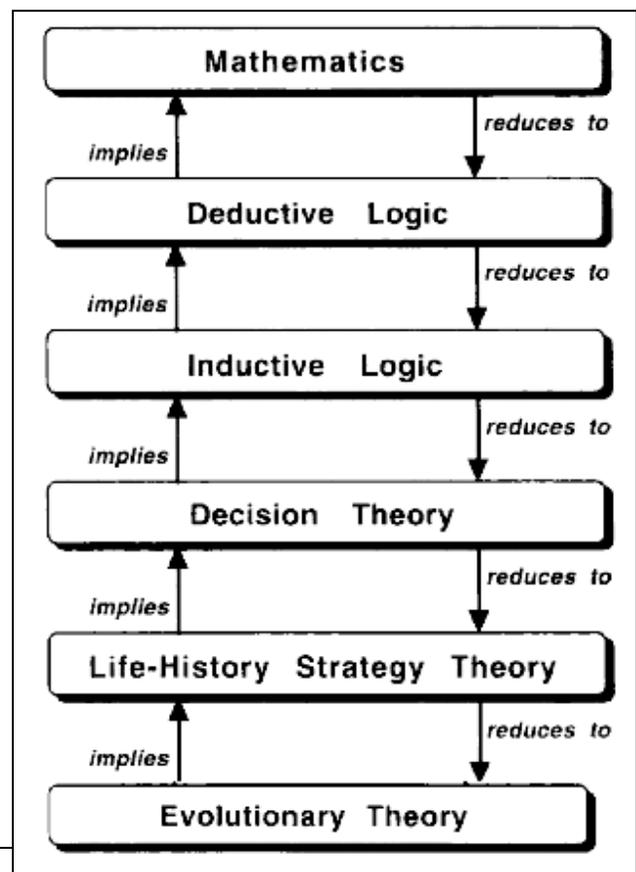
## 6 Evolution and Rationality

### 6.1 Evolutionary rationalism (Danielson, 1998): evolution make humans rational

- “If people's innate spacing of qualities is a gene-linked trait, then the spacing that has made for the most successful inductions will have tended to predominate through natural selection. Creatures inveterately wrong in their inductions have a pathetic but praiseworthy tendency to die out before reproducing their kind” (Quine, 1969, p. 126)
- *"Natural selection guarantees that most of an organism's beliefs will be true, most of its strategies rational"* (Dennett, 1987, p. 96)
- *"Darwinian selection guarantees that organisms either know the elements of logic or become posthumous"* (1981: 121)(Fodor, 1981)
- “An immensely complex conspiracy of pressures, some cognitive, some genetic, some that work through social and other environmental selection, drive systems that perpetuate themselves through control and feedback mechanisms to statistically converge towards rationality, in the sense captured by microeconomics.” (Ross & LaCasse, 1995, p. 488)
- Cooper: (Cooper, 2001): ladder of reducibility
- Criticisms: (Stich, 1990): “better safe than sorry” and (Kitcher, 1992)
- Related criticisms: Panglossian paradigm (Gould & Lewontin, 1979)

### 6.2 EP and rationality

- Evolution make us ‘ecologically rational’
- Cooperation and altruism should not be construed as ‘anomalies’
- We have evolved mechanisms for fast and frugal decision-making



- Our environment can make us irrational

## References

- Atran, S. (2002). *In gods we trust : The evolutionary landscape of religion*. Oxford ; New York: Oxford University Press.
- Barkow, J. H., Cosmides, L., & Tooby, J. (1992). *The adapted mind : Evolutionary psychology and the generation of culture*. New York: Oxford University Press.
- Buller, D. J. (2005). *Adapting minds : Evolutionary psychology and the persistent quest for human nature*. Cambridge, Mass.: MIT Press.
- Byrne, R. W., & Whiten, A. (Eds.). (1988). *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes and humans*. Oxford: Blackwell.
- Cooper, W. S. (2001). *The evolution of reason : Logic as a branch of biology*. Cambridge, UK ; New York: Cambridge University Press.
- Danielson, P. (1998). *Modeling rationality, morality, and evolution*. New York: Oxford University Press.
- Darwin, C. (1859). *On the origin of species by means of natural selection*. London,: J. Murray.
- Dawkins, R. (1976). *The selfish gene*. New York: Oxford University Press.
- Dennett, D. C. (1987). *The intentional stance*. Cambridge, Mass.: MIT Press.
- Dennett, D. C. (1995). *Darwin's dangerous idea : Evolution and the meanings of life*. New York: Simon & Schuster.
- Dewey, J. (1910). *The influence of darwin on philosophy, and other essays in contemporary thought*. New York,: H. Holt and company.
- Dobzhansky, T. (1973). Nothing makes sense in biology except in the light of evolution. *American Biology Teacher*, 35, 125-129.
- Dobzhansky, T. G. (1937). *Genetics and the origin of species*. New York: Columbia University Press.
- Dodson, S. I. (1998). *Ecology*. New York: Oxford University Press.
- Dugatkin, L. A., & Reeve, H. K. (1998). *Game theory & animal behavior*. New York ; Oxford: Oxford University Press.
- Fisher, R. A. (1930). *The genetical theory of natural selection*. Oxford,: The Clarendon press.
- Fodor, J., & Pylyshyn, Z. (1988). Connectionism and cognitive architecture. *Cognition*, 28, 3-71.
- Fodor, J. A. (1981). *Representations : Philosophical essays on the foundations of cognitive science* (1st MIT Press ed.). Cambridge, Mass.: MIT Press.
- Fodor, J. A. (1983). *The modularity of mind : An essay on faculty psychology*. Cambridge, Mass.: MIT Press.
- Gayon, J. (2003). From darwin to today in evolutionary biology. In J. Hodge & G. Radick (Eds.), *The cambridge companion to darwin* (pp. 240-264). Cambridge: Cambridge University Press.
- Goetz, A. T., & Shackelford, T. K. (2006). Modern application of evolutionary theory to psychology: Key concepts and clarifications. *Am J Psychol*, 119(4), 567-584.
- Gould, S. J., & Lewontin, R. C. (1979). The spandrels of san marco and the panglossian paradigm: A critique of the adaptationist programme. *Proc R Soc Lond B Biol Sci.*, 205(1161), 581-598.
- Griffiths, P. E. (2002). What is innateness? *The Monist*, 85(1), 70-86.
- Griffiths, P. E. (2006). Ethology, sociobiology, and evolutionary psychology.
- Griffiths, P. E., & Gray, R. D. (2001). Darwinism and developmental systems. *Cycles of Contingency: Developmental Systems and Evolution*, 195–218.
- Hamilton, W. D. (1964a). The genetical evolution of social behaviour. I. *J Theor Biol*, 7(1), 1-16.
- Hamilton, W. D. (1964b). The genetical evolution of social behaviour. II. *J Theor Biol*, 7(1), 17-52.
- Hammerstein, P. (1998). What is evolutionary game theory. In L. A. Dugatkin (Ed.), *Game theory and animal behavior* (pp. 3-15). Oxford Oxford UP.
- Hammerstein, P., & Hagen, E. H. (2005). The second wave of evolutionary economics in biology. *Trends in Ecology & Evolution*, 20(11), 604.
- Hennig, W. (1966). *Phylogenetic systematics*. Urbana, IL: University of Illinois Press.
- Hodgson, G. M. (2001). Bioeconomics. In P. A. O'Hara (Ed.), *Encyclopedia of political economy* (pp. 37-41). London ; New York: Routledge/Taylor & Francis Group.
- Hull, D. L., & Ruse, M. (1998). *The philosophy of biology*. Oxford ; New York: Oxford University Press.
- Hull, D. L., & Ruse, M. (2007). *The cambridge companion to the philosophy of biology*. Cambridge ; New York: Cambridge University Press.

- Humphrey, N. K. (1976). The social function of intellect. In P. P. G. Bateson & R. A. Hinde (Eds.), *Growing points in ethology* (pp. 303-317). Cambridge: Cambridge University Press.
- James, W. ([1890]1950). *The principles of psychology* (Authorized ed.). New York: Dover Publications.
- Kitcher, P. (1992). The naturalists return. *The Philosophical Review*, 101(1), 53-114.
- Krebs, J. R., & Davies, N. B. (1997). *Behavioural ecology : An evolutionary approach* (4th ed.). Oxford, England ; Malden, MA: Blackwell Science.
- Landa, J. T., & Ghiselin, M. T. (1999). The emerging discipline of bioeconomics: Aims and scope of the journal of bioeconomics. *Journal of Bioeconomics*, VI(1), 5-12.
- Marr, D. (1982). *Vision : A computational investigation into the human representation and processing of visual information*. San Francisco: W.H. Freeman.
- Marx, K. (1867/1981). *Capital : A critique of political economy* (Fowkes, B., & Fernbach, D. ed.). London ; New York, N.Y.: Penguin Books.
- Maynard Smith, J. (1982). *Evolution and the theory of games*. Cambridge ; New York: Cambridge University Press.
- Mayr, E. (1959). Darwin and the evolutionary theory in biology. In *Evolution and anthropology: A centennial appraisal* (pp. 409-412). Washington, D.C.: Anthropological Society of Washington.
- Mayr, E. (1988). *Toward a new philosophy of biology : Observations of an evolutionist*. Cambridge, Mass.: Belknap Press of Harvard University Press.
- Noë, R., Hooff, J. A. R. A. M. v., & Hammerstein, P. (2001). *Economics in nature : Social dilemmas, mate choice, and biological markets*. Cambridge, UK: New York, NY Cambridge University Press.
- Over, D. E. (2003). *Evolution and the psychology of thinking : The debate*. Hove ; New York: Psychology Press.
- Papineau, D. (2003). *The roots of reason : Philosophical essays on rationality, evolution, and probability*. Oxford: Oxford University Press.
- Peirce, C. S. (1877). The fixation of belief. *Popular Science Monthly*, 12, 1-15.
- Pinker, S. (1997). *How the mind works*. New York: Norton.
- Quine, W. V. O. (1969). *Ontological relativity, and other essays*. New York,: Columbia University Press.
- Reiners, D. (2001). Stuck in the pleistocene: Rationality and evolved social roles. *Politics Life Sciences*, 20(2), 139-154.
- Rose, M. R., & Lauder, G. V. (1996). *Adaptation*. San Diego: Academic Press.
- Ross, D., & LaCasse, C. (1995). Toward a new philosophy of positive economics. *Dialogue*, 34, 467-493.
- Ruse, M. (1998). *Philosophy of biology*. Amherst, N.Y.: Prometheus Books.
- Skyrms, B. (2000). Game theory, rationality and evolution of the social contract. In L. D. Katz (Ed.), *Evolutionary origins of morality*. Thorverton: Imprint Academic.
- Sober, E. (2000). *Philosophy of biology* (2nd ed.). Boulder, Colo.: Westview Press.
- Sperber, D. (1996). *Explaining culture : A naturalistic approach*. Oxford, UK ; Cambridge, Mass.: Blackwell.
- Stauffer, R. C. (1960). Ecology in the long manuscript version of darwin's " Origin of species" And linnaeus' " Oeconomy of nature". *Proceedings of the American Philosophical Society*, 104(2), 235-241.
- Sterelny, K., & Griffiths, P. E. (1999). *Sex and death : An introduction to philosophy of biology*. Chicago, Ill.: University of Chicago Press.
- Stich, S. (1990). *The fragmentation of reason : Preface to a pragmatic theory of cognitive evaluation*. Cambridge, Mass.: MIT Press.
- Thagard, P. (1992). *Conceptual revolutions*. Princeton, N.J.: Princeton University Press.
- Tooby, J., & Cosmides, L. (2005). Conceptual foundations of evolutionary psychology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 5-67). Hoboken, NJ: Wiley.
- Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46(1), 35.
- Veblen, T. (1898). Why is economics not an evolutionary science? *The Quarterly Journal of Economics*, 12(4), 373-397.
- Veblen, T. (1899). The preconceptions of economic science. *The Quarterly Journal of Economics*, 13(2), 121-150.
- Wilson, E. O. (1975). *Sociobiology : The new synthesis*. Cambridge, Mass.: Belknap Press of Harvard University Press.