PART II

CHAPTER 4
ANIMALS AND HUMAN EVOLUTION

The souls of non-human animals have been a subject in the history of philosophy and theology.[1] Some see Descartes' separation of humans and animals as contrary to Scholasticism; that animals were self-moving machines living without a soul.[2] It is thought perhaps Descartes rejected the scholastic notion of sensitive souls in animals and vegetative souls in plants because this judgment endangers the immateriality and uniqueness of human souls; consequently Descartes feared any attempts to prove that animals can think.

Traditionally philosophers have discussed animals when thinking about the human soul.[3] As evolved beings, humans especially as embodied in space-time are part of the animal kingdom. It is widely agreed that contemporary thinking about the soul ought to acknowledge this. For some, a complete grasp of the human cortex is only possible through a comprehensive grasp of the brains of animals.[4] Others see a multidisciplinary understanding as desirable.[5]

This chapter ponders matters related to animals and evolutionary thinking, starting with animal-human comparisons and the associated question about the uniqueness of human beings. Special attention is given to the evolved human brain. This is further explored in relation to language and speech. Having considered evolution and the brain, we also investigate evolution and the mind as portrayed in evolutionary

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[1] Rod Preece, *Brute Souls, Happy Beasts and Evolution: The Historical Status of Animals* (Vancouver: UBC Press, 2005), pp.24-173; Joshua M.Moritz, "Animals and the Image of God in the Bible and Beyond," *Dialog: A Journal of Theology* Vol.48 No.2 (Summer 2009), pp.134-146

[2] Michael Miller, "Descartes' Distinction Between Animals and Humans: Challenging the Language and Action Tests" *American Catholic Philosophical Quarterly* Vol.LXXII No.3 (Summer 1998), pp.339-370

[3] Peter Harrison, "Animal Souls, Metempsychosis, and Theodicy in Seventeenth-Century English Thought," *Journal of the History of Philosophy* Vol.31 No.4 (October 1993), pp.519-544;

[4] Marcello G.P.Rosa and Rowan Tweedale, "Brain maps, great and small: lessons from comparative studies of primate visual cortical organization," *Philosophical Transactions of the Royal Society B* Vol.360 No.1456 (29 April 2005), pp.665-691 (p.665)

[5] Jaak Panksepp, *Affective Neuroscience: The Foundations of Human and Animal Emotions (Series in Affective Science)* (New York: Oxford University Press, 2004), pp.5-6.

psychology. For convenience we use the conventional understanding of 'animal' to mean non-human animal.

Animal Comparisons and Human Uniqueness

Human uniqueness was traditionally a question for metaphysics and religion rather than natural science. Yet, unique human features have been part of scientific studies, e.g. in the sequencing of nonhuman primates' genomes and the human genome.[6] Insights into the nature of human biengs can be gained from comparative studies.[7] Comparative study of animal cognition is a growing interdisciplinary endeavour which includes humans and nonhuman animal comparisons.[8]

It is widely accepted that humans are related to the African great apes: *Homo sapiens* have a common ancestor with *Pan troglodytes* (the chimpanzee) and *Pan paniscus* (the bonobo) approximately 5 to 6 million years ago (Mya), with *Gorilla gorilla* (the gorilla) around 7 to 8 Mya, and with *Pongo pygmaeus* (the orangutan) about 12–13 Mya. However, some thinkers like Creationists do not accept evolution and are sceptical of Darwinian ideas.[9]

Humans and great apes, collectively understood as the 'hominoids', share similarities in life history, biology and behaviour but differences too. Traditionally, human origins were investigated using fossils and morphological comparisons between living species; now genetics and molecular biology are used.[10] Human brain evolution includes study of molecular evolution, protein sequence evolution, gene

[6] Samuel J.Sholtis and James P.Noonan, "Gene regulation and the origins of human biological uniqueness ," *Trends in Genetics* Vol.26 No.3 (March 2010), pp.110-118
[7] Paul G.Middlebrooks and Marc A.Sommer, "Neuronal Correlates of Metacognition in Primate Frontal Cortex," *Neuron* Vol.75 No.3 (9 August 2012), pp.517-530
[8] Sara J.Shettleworth, "The evolution of comparative cognition: Is the snark still a boojum?," *Behavioural Processes* Vol.80 No.3 (March 2009), pp.210-217
[9] Pascal Gagneux and Ajit Varki, "Genetic Differences between Humans and Great Apes," *Molecular Phylogenetics and Evolution* Vol.18 No.1 (January 2001), pp.2-13; see also Michael J.Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution*, 10th Anniversary Edition (New York: Free Press, 2006), as contrasted to John S.Wilkins, "Are creationists rational?," *Synthese* Vol.178 No.2 (January 2011), pp.207-218.
[10] Wolfgang Enard, "Functional primate genomics - leveraging the medical potential," *Journal of Molecular Medicine* Vol.90 No.5 (May 2012), pp.471-480; Tomas Marques-Bonet, Oliver A.Ryder, and Evan E.Eichler, "Sequencing Primate Genomes: What Have We Learned?," *Annual Review of Genomics and Human Genetics* Vol.10 (2009), pp.355-386; David R.Begun "Fossil record of Miocene hominoids," in Winfried Henke and Ian Tattersall (eds.), *Handbook of Palaeoanthropology, Volume 2: Primate Evolution and Human Origins* (Berlin: Springer, 2007), pp.921-977; Leah Krubitzer, "In Search of a Unifying Theory of Complex Brain Evolution," *Annals of the New York Academy of Sciences* Vol.1156 No.1 (March 2009), pp.44-67

expression evolution, and their adaptations. The functional characteristics that distinguish the human brain from its ancestors and other primates have a molecular basis: changes in DNA sequences that occurred in the human linage after separation from the common human-chimpanzee ancestor some 5 to 7 million years ago.[11]

Some believe that to understand why human brains have their features, one needs to know what they contributed to early primate behaviour, and to know that, we need comparative research in brain, cognition and behaviour in various mammals, and also in the animals closely related to humans e.g. rodents, tree shrews, and rabbits. Such comparative science does not exist today.[12]

If the continuities and homologues of evolution (likeness between features stemming from a common ancestry) are accepted, particularly in subcortical areas of the brain, then animal models could assist to uncover the principles governing genetic and neural substrates of emotionality in mammals. But there are limits in learning from animal minds and brains.[13]

For example, neurobehavioural and neuropsychiatric disorders in humans may not be simply mapped onto operations at the nonhuman level, e.g. developmental disabilities, mood disorders and psychosis, require verbal reports and expressive use of speech and language. These cannot be replicated in nonhuman organisms. However, in other cases, animal models can be insighful, e.g. transgenic and knockout mouse models have advanced the understanding of neurobiology in human disorders.[14]

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[11] Hilliary Creely and Philipp Khaitovich, "Human brain evolution," *Progress in Brain Research* Volume 158 (2006), pp.295-309 (p.297 & p.300).
[12] T.M.Preuss, "Primate Brain Evolution," in Jon H.Kaas (ed.), *Evolutionary Neuroscience* (Oxford and San Diego: Academic Press, 2009), pp.783-825 (p.819). Integration of observations and theory across species is recognised in brain-body medicine, in neuroimaging etc.. Richard D.Lane and Tor D.Wager, "The new field of Brain-Body Medicine: What have we learned and where are we headed?," *NeuroImage* Vol.47 No.3 (September 2009), pp.1135-1140
[13] Elisabeth A. Murray and Steven P.Wise, "What, if anything, can monkeys tell us about human amnesia when they can't say anything at all?," *Neuropsychologia* Vol.48 No.8 (July 2010), pp.2385-2405; see too Martien J.H.Kas et.al., "Interspecies comparisons of functional genetic variations and their implications in neuropsychiatry," *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics* Vol.150B No.3 (5 April 2009), pp.309-317
[14] Gene S.Fisch, "Animal Models and Human Neuropsychiatric Disorders," *Behavior Genetics* Vol.37 No.1 (January 2007), pp.1-10 (p.8

It is noted that neural studies of cognition in monkeys have been undertaken for over 70 years, mainly using macaque monkeys, and sometimes marmosets, and at times squirrel monkeys and cebus monkeys.[15] Humans have also been compared to great apes including chimpanzees.[16] Chimpanzees are the nearest evolutionary relative to humans with almost 99% identity of numerous homologous proteins sequences.[17]

Novel behaviours and/or environmental aspects of hominid ancestors are proposed to explain human uniqueness such as cooperative hunting, spoken language, use of tools and weapons, bipedalism, rapid climate changes, greater sociality, fire use and cooking of food,[18] languages, music and religion. It is generally accepted that modern humans have common genetic features with the 'great apes'.[19] The term 'great apes': chimpanzees, bonobos, gorillas, and orang-utans, is used now in the colloquial sense, because phylogenetic analysis of genomic information no longer supports the traditional species grouping. In the present classification, these species are now grouped together with humans in the family Hominidae.[20]

The Human Brain

Distinctive characteristics of human actions can be related to evolved brain structures. The striking differences could be due to dramatic modifications in brains. More specifically, the approximately threefold increase in brain size since the last common ancestor (LCA) shared by hominins (the lineage incorporating modern humans and fossil close relatives and ancestors), and panins (the lineage incorporates bonobos, common chimpanzees, and their fossil close relatives and ancestors).[21]

Accordingly, *Homo sapiens* demonstrates remarkable differences in language expression and cognition, compared to these and other living apes. The recent

[15] Richard Passingham, "How good is the macaque monkey model of the human brain?," *Current Opinion in Neurobiology* Vol.19 No.1 (February 2009), pp.6-11
[16] Nissi Varki et.al., "Heart disease is common in humans and chimpanzees, but is caused by different pathological processes," *Evolutionary Applications* Vol.2 No.1 (February 2009), pp.101-112.
[17] Ajit Varki and David L.Nelson, "Genomic Comparisons of Humans and Chimpanzees," *Annual Review of Anthropology* Vol.36 (2007), pp.191-209 (p.193)
[18] See for instance, Rachel N.Carmody and Richard W.Wrangham, "The energetic significance of cooking," *Journal of Human Evolution* Vol.57 No.4 (October 2009), pp.379-391.
[19] Chet C.Sherwood, Francys Subiaul and Tadeusz W.Zawidzki, "A natural history of the human mind: tracing evolutionary changes in brain and cognition," *Journal of Anatomy* Vol.212 No.4 (April 2008), pp.426-454.
[20] Varki & Nelson, *Genomic Comparisons,* p.192
[21] Sherwood, Subiaul & Zawidzki, *A natural history of the human mind,* p.427

expansion of the prefrontal cortex (PFC) in humans is matched by a dramatic rise in pyramidal cell complexity. Since cognition is frequently linked with PFC, differences in the structure of PFC in animal species will probably influence their cognitive styles.[22]

It is asked, 'What's human about the human brain?'[23] Scientists answer that it is not as a super ape brain but contains significant quantitative and qualitative modifications. There is a pattern of brain morphology uniquely human amongst the apes, not identified with one area or cortical feature, but involves numerous parts of the brain. Some patterns of neural morphology uniquely differentiate humans from an ape species, while others are consistently different between all nonhuman apes and humans. This demonstrates that human brain evolution has not been restricted to just scaling of ape brain morphologies in particular regions or overall. Rather, there have been substantial alterations in morphology with unique changes in each region.[24]

Since large brain size and the increased extent of the neocortex are distinctive in modern humans, many ideas about human cognitive evolution focus solely on this anatomical variable.[25] *Encephalisation* is a measure of "the extent to which the brain has increased in size to a degree greater than expected when taking body size into account…. encephalisation is conceptualized as the overlay of phylogenetically more recent nervous tissue upon ancestral forms."[26]

Neural tissue has high energy demands, therefore enlarged brain sizes could only occur if matched by considerable benefits in fitness: the human brain is an

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[22] Guy N.Elston, "Cortex, Cognition and the Cell: New Insights into the Pyramidal Neuron and Prefrontal Function," *Cerebral Cortex* Vo.13 No.1 (November 2003), pp. 1124-1138.
[23] Todd M.Preuss, "What's human about the human brain?" in Michael S.Gazzaniga, (ed.), *The New Cognitive Neurosciences*, Second Edition (Cambridge, MA & London: The MIT Press, 2000), pp.1219-1234. Or as asked in the title of the book by Richard Passingham, *What is special about the human brain?* Oxford Psychology Series 46 (Oxford and New York: Oxford University Press, 2008).
[24] Kristina Aldridge, "Patterns of differences in brain morphology in humans as compared to extant apes," *Journal of Human Evolution* Vol.60 No.1 (January 2011), pp.94-105 (pp. 101-102);
[25] Manuel F.Casanova and Christopher R.Tillquist, "Encephalization, Emergent Properties, and Psychiatry: A Minicolumnar Perspective," *The Neuroscientist* Vol.14 No.1 (February 2008), pp.101-118. (p.101)
[26] Casanova & Tillquist, *Encephalization,* p.102

'expensive brain.'[27] The benefits of larger brains are supported by conditions whereby positive selection pressures can produce actual increases in brain size. An energetically costly rise in brain size has to be balanced either by a rise in the species' total energy budget or by offsetting changes of energy allocation to other maintenance functions. [28]

Neural organisation is a factor: gene expression, the relative extent of neocortical areas, etc. Questions arise, like "Does it even make sense to ask how many 'extra' grams of neocortical tissue are necessary for the development of recursive syntax, pair-bondedness, or 'theory of mind'?" [29]

But researchers see qualitative differences about some human faculties. D.C.Penn, K.J.Holyoak and D.J.Povinelli argue that Darwin was mistaken: the profound biological continuity between human and nonhuman animals hides an equally profound functional discontinuity. Between human and nonhuman minds, discontinuity is evident in nearly every domain of cognition, from reasoning about spatial relations to the deceiving of conspecifics. It runs much deeper than "even the spectacular scaffolding provided by language or culture alone can explain…one of the most important challenges confronting cognitive scientists of all stripes, in our view, is to explain how the manifest functional discontinuity between extant human and nonhuman minds could have evolved in a biologically plausible manner." [30]

The most significant functional discontinuities between nonhuman and human minds are humans' unique mental, linguistic, cultural, logical, and causal reasoning abilities. This stems partly from the differences in how nonhuman and human cognitive architectures can approximate the systematic, relational, higher-order capabilities of a physical symbol system.[31] These authors conclude that progress in symbolic-connectionist models of cognition offer a possible account of how the human species' unique ability to approximate the higher-order relational abilities of a

[27] Karin Isler and Carel P.van Schaik, 'The Expensive Brain: A framework for explaining evolutionary changes in brain size," *Journal of Human Evolution* Vol.57 No.4 (October 2009), pp.392-400.
[28] Isler & van Schaik, *The Expensive Brain,* p.393 and p.399
[29] Sherwood, Subiaul & Zawidzki, *A natural history of the human mind,* p.427
[30] Derek C.Penn, Keith J.Holyoak and Daniel J.Povinelli, "Darwin's mistake: Explaining the discontinuity between human and nonhuman minds," *Behavioral and Brain Sciences* Vol.31 No.2 (April 2008), pp.109-130 (p.110)
[31] Penn, Holyoak & Povinelli, *Darwin's mistake,* p.111

physical symbol system may have been incorporated into the proto-symbolic cognitive architecture which was inherited from nonhuman ancestors. This goes some way to explaining the basis of language and speech.

Language and Speech

Many linguists and psycho-linguists see a primary discontinuity between nonhumans and human communication, yet the movement in comparative studies is towards interpreting the uniquely human part in narrower terms. For example, adding to the general idea that languages with grammar are uniquely human, the notion that the sole aspect of the human language faculty that is truly unique to humans is the computational mechanism of recursion. Others contend that participating in cultural activities with shared goals and intentions is uniquely human, but think that the cognitive abilities of a human child born on a desert island, miraculously surviving to adulthood, would not differ much compared to the cognitive abilities of other great apes.[32]

A homologue of Broca's area, the area in the brain that is involved in language comprehension and production, has been identified in animals. The cortical region which includes part of the inferior frontal lobe and Brodmann's areas 44 and 45 has been recognised in some species of Old World monkeys and all species of great apes, but comparative studies of neuroanatomy are few.[33] Studying the structure and function of this cortical area in chimpanzees offers comparisons for ascertaining which characteristics of Broca's area in humans are inherited from the common ancestry with great apes, and which are more recent evolved specialisations. In general, Broca's area in the human left hemisphere grew in relative size compared the chimpanzee homologue possibly as an adaptation for the human language capabilities.[34]

[32] Penn, Holyoak & Povinelli, *Darwin's mistake*, p.110
[33] Natalie M. Schenker et.al., "Broca's Area Homologue in Chimpanzees (Pan troglodytes): Probabilistic Mapping, Asymmetry, and Comparison to Humans," *Cerebral Cortex* Vo.20 No.3 (March 2010), pp.730-742 (p.731)
[34] Schenker et.al., *Broca's Area Homologue,* p.738

Ideas about the origins of human language vary.[35] Linguistics searches for a genetically determined capability to acquire the code of human language, an innate mechanism or significant genes such as FOXP2,[36] ASPM and HAR1F.[37] Psychology and biology favours environmental factors. It is wondered, 'How could a brain conferring reason on humans have arisen?' One explanation is genetic, where a series of genetic changes leads to a type of 'explosion' or a series of mutations, by some changes in the properties of the nervous system which has evolutionary adaptive value. A second explanation is the epigenetic one, where some alterations in adaptability, or brain plasticity, led to changes in the evolutionary niche and exploiting of new potentials.[38] That is, the brain acquired capabilities of using recursive rules, mental representations, and the ability to count: conditions for human thought and language.

Now if language is a 'sapiens-specific capacity', then language evolution needs a human central nervous system (CNS) capable of differentiating speech and auditory inputs from thoughts. A compromised CNS could impair these functions and result in symptoms like auditory hallucinations. There is an argument that schizophrenia is a disease unique to humans based on data from CNS gene expression studies. If schizophrenia is a specifically human disease, concentrating on human-specific CNS capacities could aid in better understanding of this disorder.[39]

Against the views of linguist N.Chomsky, there are those who hold that language evolved through natural selection, and so to investigate language's primate origins is reasonable, and language did not materialise suddenly in hominin evolution.[40]

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[35] Olivier Joly et.al., "Processing of vocalizations in humans and monkeys: A comparative fMRI study," *NeuroImage* Vol.62 No.3 (September 2012), pp.1376-1389; T.V.Chernigovskaya, "From Communication Signals to Human Language and Thought: Evolution or Revolution?," *Neuroscience and Behavioral Physiology* Vol.39 No.8 (October 2009), pp.785-792

[36] See e.g. Genevieve Konopka et.al., "Human-specific transcriptional regulation of CNS development genes by FOXP2," *Nature* Vol.462 No.7270 (12 November 2009), pp. 213-217. Konopka et al. acknowledge, "human tissue was obtained from the NICHD Brain and Tissue Bank for Developmental Disorders at the University of Maryland." (p.217). It is uncertain about the sources of the human tissue.

[37] See e.g. Artemy Beniaminov, Eric Westhof and Alain Krol, "Distinctive structures between chimpanzee and humanin a brain noncoding RNA," *RNA* Vol.14 No.7 (July 2008), pp.1270-1275

[38] Chernigovskaya, *From Communication Signals*, pp.785-786

[39] Brian Dean, "Is schizophrenia the price of human central nervous system complexity?," *Australian and New Zealand Journal of Psychiatry* Vol.43 No.1 (2009), pp.13-24.

[40] See e.g. Michael C.Corballis, "The Evolution of Language," *Annals of the New York Academy of Sciences* Vol.1156 No.1 (2009), pp.19-43; also William H.Calvin and Derek Bickerton, *Lingua ex Machina: Reconciling Darwin and Chomsky with the Human Brain* (Cambridge, Massachusetts &

Nevertheless, others think that language through appearance of syntax was a catastrophic event, occurring in early generations of *Homo sapiens*. The idea that grammatical language evolved progressively is consistent with 'grammaticalization' whereby grammar emerges incrementally, than with Chomsky's 1975 view that all humans are endowed with an innate universal grammar.

Spoken language or speech communication is arguably "the most important activity that distinguishes humans from non-human species…while many animal species communicate and exchange information using sound, humans are unique in the complexity of the information that can be conveyed using speech, and in the range of ideas, thoughts and emotions that can be expressed." [41] The functional neuroanatomy of the brain of mammals has largely come from studies of the cat auditory cortex.[42] The location the auditory cortex in the cat, on the lateral surface of the brain, enables electrophysiological recordings to occur simply.

In the primate brain, the primary auditory cortex is found on the supratemporal plane, which makes electrode placements much harder. Later researchers have overcome such technical problems. The findings show structural dimensions of primate auditory cortex that are different from non-primate data, and have interesting implications for human speech perception. The early phases of sound processing depend on neural systems that are conserved through primate evolution.[43] The location of language in the left cerebral hemisphere leads to a right-handedness for manipulation but also manual gestures e.g. hand movements during speech and pointing gestures by infants during language learning. Their antecedents could be found in the way chimpanzees use their right hand to communicate with each other.[44]

London, England: The MIT Press, 2000), p.196; Marc D.Hauser, Noam Chomsky, W.Tecumseh Fitch, "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?" *Science* Vol. 298 No.5598 (22 November 2002), pp.1569-1579

[41] Brian C.J.Moore, Lorraine K.Tyler and William Marslen-Wilson, "Introduction. The perception of speech: from sound to meaning," *Philosophical Transactions of the Royal Society B* Vol.363 No.1493 (12 March 2008), pp.917-921 (p.917)

[42] Sophie K.Scott and Richard J.S.Wise, "The functional neuroanatomy of prelexical processing in speech perception," *Cognition* Vol.92 Nos.1-2 (May-June 2004), pp.13-45

[43] They are probably common, applicable to all sounds used in communication apart from speech. Roy D.Patterson and Ingrid S.Johnsrude, "Functional imaging of the auditory processing applied to speech sounds," *Philosophical Transactions of the Royal Society B* Vol.363 No.1493 (12 March 2008), pp.1023-1035

[44] Adrien Meguerditchian, Jacques Vauclair and William D.Hopkins, "Captive chimpanzees use their right hand to communicate with each other: Implications for the origin of the cerebral substrate for language," *Cortex* Vol.46 No.1 (January 2010), pp.40-48

Animal studies using speech and studies on infants using stimuli across domains suggest that features of infant speech perception are domain general, initially at least; and available to non-human species though phonetic learning is unique to humans.[45] Nevertheless, the intricateness of human communication demonstrates that it utilises added neural structures.[46]

The question naturally arises, can apes talk?[47] One reply is no, or that it is nearly impossible to teach them. Chimpanzee tongues, vocal tracts, neural centres, etc. differ to those in humans. However some apes communicate with sign language, language prostheses e.g. plastic symbols, and other means, and some researchers have used computer generated sounds and big movements of arms to reach marine mammals. Animal language researchers are keen to find out just what animals can learn about human-designed language, rather than whether animals can learn the language they are in.[48]

Ape communication can take the form of non-vocal acoustic signals like hand clapping, and context-specific vocalisations in novel settings. The question arises, whether chimpanzees *(Pan troglodytes)* selectively generate particular vocalisations to attract human attention. In one study, chimpanzees were more likely to generate two particular calls, the raspberry and the extended grunt ('attention-getting sounds'), when a human was present with a preferred food item than they were when either stimulus (human, food) was presented singly. Further, chimpanzees were more likely to generate traditionally defined 'food' vocalisations in the presence of food alone compared to when food was presented with a human, or when a human was

[45] Patricia K.Kuhl, et.al,. "Phonetic learning as a pathway to language: new data and native language magnet theory expanded (NLM-e)," *Philosophical Transactions of the Royal Society B* Vol.363 No.1493 (12 March 2008), pp.979-1000 (p.982).
[46] The primary parts of the auditory cortical system in humans has yet to be completely grasped. Cf. Josef P.Rauschecker and Sophie K.Scott, "Maps and streams in the auditory cortex: nonhuman primates illuminate human speech processing," *Nature Neuroscience* Vol.12 No 6 (June 2009), pp.718-724
[47] William A.Hillix and Duane M.Rumbaugh, *Animal Bodies, Human Minds: Ape, Dolphin, and Parrot Language Skills* (New York: Kluwer Academic/Plenum Publishers, 2004), pp.9-24; 269-280
[48] That they cannot communicate via the vocal channel like grey parrots with a double larynx. Hillix & Rumbaugh, *Animal Bodies Human Minds,* p.24

alone. The results suggest that chimpanzees use context-specific vocalisations and they may intentionally generate such sounds.[49]

It has been argued that the best chance for apes to learn human language is to be in a language-rich setting and reared as human children. The methods used to teach animals in this situation are applicable to assisting humans with handicaps to communicate better. Virtually every special training device or method that has been used with apes has shown effectiveness with human children: plastic symbols, lexigrams, and sign language. Deaf children learn sign language of course, but its potential for helping language-handicapped hearing children has been mostly unrecognised.[50]

The research progresses with neuroscientific technologies. Imaging technology is used to study brain functioning of nonhuman animals, identical to the methods for studying humans. New insights have arisen about the association between the processing of communication signals by brain structures in humans, apes, and monkeys.[51]

All things considered, while many in Christian anthropology look to the spiritual soul as a distinguishing feature of human nature, the above scholarship shows uniqueness in the human physical make-up over time as derived from our animal nature. There is overt scientific thinking that language is an extraordinary achievement, and is virtually for certain that it is a uniquely human one. "Arguably, it is language that makes us human. Yet such a complex ability cannot have evolved entirely de novo in our species... we can be fairly sure of one thing. Language is not, after all, for the birds."[52]

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[49] William D.Hopkins, Jared P.Taglialatela and David A.Leavens, "Chimpanzees differentially produce novel vocalizations to capture the attention of a human," *Animal Behaviour* Vol.73 No. 2 (February 2007), pp.281-286

[50] Hillix & Rumbaugh, *Animal Bodies, Human Minds*, p.270

[51] Christopher I.Petkov and Benjamin Wilson, "Communication and the primate brain: insights from neuroimaging studies in humans, chimpanzees and Macaques," *Human Biology* Vol.83 No.2 (April 2011), pp.175-189 (p.185); Jared P.Taglialatela et.al., "Visualizing Vocal Perception in the Chimpanzee Brain," *Cerebral Cortex* Vol.19 No.5 (May 2009), pp.1151-1157. Taglialatela et.al used positron emission tomography to explore the neural mechanisms involved in the perception of conspecific vocalisations in chimpanzees.

[52] Michael C.Corballis, *From Hand to Mouth: The Origins of Language* (Princeton, New Jersey: Princeton University Press, 2002), p.20

The forces of evolution and time have shaped the physical brain and its role, particularly in humans and their animal ancestors. Consequently, evolution has also influenced the mind which has descended through natural selection, adaptation and survival. We now turn to one understanding of the evolved mind, evolutionary psychology.

Evolutionary Psychology

Evolutionary psychology in the narrow sense is the scientific project of mapping human evolved psychological mechanisms; in the broad sense, it includes reformulating and expanding the social sciences and medical sciences in light of the progressive mapping of human evolved architecture.[53] Evolutionary psychologists also aim to explain cognitive phenomena by inferring what kind of problems human hunter-gatherer ancestors in the Pleistocene epoch may have solved so as to survive and reproduce. Then to determine how natural selection works out in the population, leading to the mental structures that characterise modern humanity.[54]A related concept is evolutionary developmental psychobiology (evo-devo psychobiology).[55]

Sometimes evolutionary psychology is linked to the sociobiology of E.O.Wilson in the 1970s, R.Dawkins' ideas on the selfish gene, and classical ethology. Human nature was regarded as an epiphenomenon of natural selection in evolution wherein genes reproduced and continued in time but human individuals exist finitely. It also diverges with sociobiology. Evolutionary psychology proposes that natural selection generates a particular set of adaptations to the environment, whereas sociobiology thought that humans generally try to maximise their fitness. A second divergence is that evolutionary psychology focusses on the evolution of psychological modules, whereas sociobiology was mainly concerned with the evolution of behaviours.[56]

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[53] John Tooby and Leda Cosmides, "Conceptual Foundations ," in David M.Buss (ed.), *The Handbook of Evolutionary Psychology* (Hoboken, New Jersey: Wiley, 2005), pp.5-67 (p.6)
[54] David S.Moore, "Individuals and populations: How biology's theory and data have interfered with the integration of development and evolution," *New Ideas in Psychology* Vol.26 No.3 (December 2008), pp.370-386
[55] Jason Scott Robert, "Taking old ideas seriously: Evolution, development, and human behavior," *New Ideas in Psychology* Vol.26 No.3 (December 2008), pp.387-404. See also the conceptual discussion in George F.Michel and Celia L.Moore, *Developmental Psychobiology: An Interdisciplinary Science* (Cambridge, Massachusetts and London: The MIT Press, 1995), pp.1-125.
[56] Viren Swami, "Evolutionary Psychology: 'New Science of the Mind' or 'Darwinian Fundamentalism'?" *Historical Materialism* Vol.15 No.4 (2007), pp.105-136..

Evolutionary psychology studies the adaptive function of behaviours and traits in modern *Homo sapiens*.[57] Natural selection and evolutionary psychology are invoked to account for numerous behaviours that are regarded as crimes in modern society, like assault, murder, rape and theft.[58] The evolutionary understanding of rape has been controversial since the 1980s in academic and popular arenas. The chief assertion is that rape is part of a reproductive strategy occurring in evolution, where rape of women by men is found across culture and throughout history.[59]

Evolutionary psychology has many uses,[60] and has been applied to social conventions. For instance, teachers' subconscious feelings toward gifted children has an evolutionary psychology interpretation.[61] Other areas of research include socio-economics,[62] and intelligence.[63] The controversial nature of some evolutionary psychology is acknowledged.[64]

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[57] For example, Paul W.Eastwick, "Beyond the Pleistocene: Using Phylogeny and Constraint to Inform the Evolutionary Psychology of Human Mating," *Psychological Bulletin* Vol.135 No.5 (September 2009), pp.794-821

[58] Tony Ward and Russil Durrant, "Evolutionary psychology and the rehabilitation of offenders: Constraints and consequences," *Aggression and Violent Behavior* Vol.16 No.5 (September-October 2011), pp.444-452

[59] Suzanne Zeedyk, "The science of rape: (mis)constructions of women's trauma in evolutionary theory," *Feminist Review* Vo.86 No.1 (July 2007), pp.67-88; William F.McKibbin et.al., "Why Do Men Rape? An Evolutionary Psychological Perspective," *Review of General Psychology* Vol.12 No.1 (March 2008), pp.86-97.

[60] See for example, Graham Sewell, "Yabba-Dabba-Doo! Evolutionary Psychology and the Rise of Flintstone Psychological Thinking in Organization and Management Studies," *Human Relations* Vol. 57 No.8 (1 August 2004), pp.923-955 and the response, Lívia Markóczy and Jeffrey Goldberg "Yabba-Dabba-Doo! A Response to Unfair Accusations," *Human Relations* Vol.57 No.8 (1 August 2004), pp.1037-1046..

[61] For example, John G.Geake and Miraca U.M.Gross, "Teachers' Negative Affect Toward Academically Gifted Students: An Evolutionary Psychological Study," *Gifted Child Quarterly* Vol.52 No.3 (Summer 2008), pp.217-231

[62] Aaron Ahuvia, "If money doesn't make us happy, why do we act as if it does?" *Journal of Economic Psychology* Vol.29 No.4 (August 2008), pp.491-507

[63] Satoshi Kanazawa and Kaja Perina, "Why night owls are more intelligent," *Personality and Individual Differences* Vol. 47 No.7 (November 2009), pp.685-690. Kanazawa and Perina's hypothesis is, "more intelligent individuals are more likely to acquire and espouse evolutionarily novel values than less intelligent individuals, whereas general intelligence does not affect the acquisition and espousal of evolutionarily familiar values." Kanazawa & Perina, *Why night owls,* p.685.

[64] Jaime C.Confer et.al., "Evolutionary Psychology: Controversies, Questions, Prospects, and Limitations," *American Psychologist* Vol.65 No.2 (February-March 2010), pp.110-126;. See also Jaak Panksepp and Jules B.Panksepp, "The Seven Sins of Evolutionary Psychology," *Evolution and Cognition* Vol.6 No.2 (2000), pp.108-131; David M.Buss, "The Great Struggles of Life: Darwin and the Emergence of Evolutionary Psychology," *American Psychologist* Vol.64 No.2 (February/March 2009), pp.140–148; and James R.Liddle and Todd K.Shackelford, "Teaching the Evolution of the Mind Current Findings, Trends, and Controversies in Evolutionary Psychology," *Teaching of Psychology* Vol.38 No.2 (April 2011), pp.128-132

Evolutionary Psychology: Brain and Mind

On the modern brain and mind, evolutionary psychology looks back in evolutionary time to adaptive problems experienced by hunter–gatherer ancestors. They solved problems of living and survival, resulting in adaptive specialisations: systems provided with design characteristics organised to enable ancestral issues to be addressed resourcefully.[65]

Evolutionary psychologists explain that cognitive neuroscience can be used to reverse-engineer the brain, dissecting the computational architecture into functionally separate information-processing units. Then it analyses how these units operate. Some functionally specialised computational adaptations include those designed for social inference, sexual motivation, judgment in doubts and conditioning, plus content-filled systems for acquiring knowledge and for visual recognition.[66] Mind can be understood as "the set of information processing devices, embodied in neural tissue, that is responsible for all conscious and nonconscious mental activity, that generates all behavior, and that regulates the body."[67]

Looking at human nature, evolutionary psychology sees some faulty ideas where human psychological architecture is assumed to consist mainly of learning and reasoning mechanisms that are general-purpose and content-independent. Such architecture of mind is like a blank-slate *(tabula rasa)*, lacking specialised circuits from natural selection. Like a blank paper with no causal input to determine what is written on it, the blank-slate concept of the mind justifies the notion that the organisation of the evolved mind plays a limited causal role in production the content of social and mental life in humans. Here, the mind learns and absorbs content nearly wholly from the exterior sources.

Thus evolutionary psychology is critical of what has been called the Standard Social Science Model (SSSM). The social sciences study cultural-social phenomena in independent ways unrelated to the psychological mechanisms evolved in human beings.[68] But for evolutionary psychologists, this mistaken blank-slate view

[65] Bradley Duchaine, Leda Cosmides and John Tooby, "Evolutionary psychology and the brain," *Current Opinion in Neurobiology* Vol.11 No.2 (1 April 2001), pp.225-230
[66] Duchaine, Cosmides & Tooby, *Evolutionary psychology and the brain,* p. 225
[67] Tooby & Cosmides, *Conceptual Foundations,* p.16
[68] Tooby & Cosmides, *Conceptual Foundations,* p 6

eliminates evolved psychological mechanisms as the chief causal organisers of social phenomena. Thereby causing the social sciences to be helpless in comprehending the logic of the social world. Evolutionary psychology provokes opposition because the stakes for many social scientists, behavioral scientists, and humanists are high. If evolutionary psychology eventuates to being be solidly-founded, there are supposed implications for the existing structure of the social and behavioral sciences (SSSM) which they say will have to be disassembled. For nearly a century, the lament is that SSSM has been dominant in the scholarly world, protecting important parts of its thinking from criticism and reform.[69]

Instead for evolutionary psychology, human ancestors faced problems like avoiding predators and finding shelter, not solved by a general cognitive mechanism. The mind was arranged into modules; problems of adaptation were selected for their specific problem-solving mechanisms. This became the 'massive modularity thesis' using the metaphor of the Swiss Army knife: different tools for diverse operations.[70]

Enquiries into what the mental modules were that underlie observed behaviour, instead of the behaviour itself, means researchers can exclude any interfering effects of the environment. It is anticipated that real 'human nature' is discoverable. Species-typical and species-specific architecture of adaptations are found in all living humans: a universal 'architecture' of the mind. Any differences between e.g. individuals and cultures, are products of different environments 'triggering' different aspects of the same innate programmes. [71]

Others look to a middle ground between wholly innate modularity of mind and a blank-slate mind of no-innateness. The mind is not a 'Swiss Army knife' containing different tools for diverse operations, because at least some cognitive systems are the emergent products of modularisation, not hard-wired mental modules. It is hence very unlikely that the brain is fully modular as evolutionary psychologists have proposed.[72]

[69] Tooby & Cosmides, *Conceptual Foundations*, p 6-7
[70] Swami, *Evolutionary Psychology*, p.115
[71] Swami, *Evolutionary Psychology*, p.115
[72] Swami, *Evolutionary Psychology*, p.123

Critical Comment

Evolutionary psychology which seeks to reform other subjects, itself attracts criticism. The ancestral environment of human beings does not seem to provide a consistent explanation. For example, bipedalism (animal movement using two hind limbs or two legs) is a human characteristic; so too is the casing for a large brain. Both occur through evolution but are significantly diverse. It is pointed out that bipedalism is not a particular human adaptation, as ancient hominids also walked on two legs. It would be an error to account for bipedalism as an adaptation to the human ancestral environment. A large brain case is particularly human, typical of the human genus.[73]

There is doubt about the kind of evidence needed is to show that something was the result of natural selection. This would require evidence about variations in ancestral populations, evidence about their heritability, and for a complete account there would a need for evidence for the advantage they offered to human ancestors. Moreover, an explanation of what caused the differences to occur needs evidence expressly backing the evolutionary claims made. Some regard evolutionary psychology as "speculation disguised as results."[74]

Similarly, the human brain, consuming 18 percent of the bodily energy intake while being 2 percent of body mass, is more expensive to run compared to an internal combustion engine.[75] Humans evolved this organ only if it played an adaptive role. The required evidence shifts from brain features to particular adaptive mechanisms. Critics of evolutionary psychology note that the evidence needed to confirm adaptation accounts in the human lineage over millions of years is scarce. Such evidence, if it existed, is lost, probably forever. "It may be a cold, hard fact that there are many things about evolution of the human mind that we will never know and about which we can only idly speculate."[76]

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[73] Robert C.Richardson, *Evolutionary Psychology as Maladapted Psychology* (Cambridge, Massachusetts & London, England: The MIT Press, 2007), p.11.
[74] Richardson, *Evolutionary Psychology,* p.12
[75] David J.Buller, "Four Fallacies of Pop Evolutionary Psychology," *Scientific American* Vol.300 No.1 (January 2009), pp.60-67. The 'expensive brain' was noted above in the context of selection and brain size.
[76] Buller, *Four Fallacies,* p.67

Critics also claim evolutionary psychology is disjointed in concepts and unjustified empirically.[77] The implied understanding of the brain supporting modular ideas about mind is that mental function is fixed and should be reflected in neurological structures. But neuroscience challenges evolutionary psychologists: knowledge about the brain implies that the brain it is not structured in the way that would be needed to sustain the massively modular view of mind.[78]

Evolutionary psychology retains ideas about massive modularity apparently contrary to the evidence, it is claimed. A module adapted to the Pleistocene savannah can hardly well map neatly onto today's urban environment. This 'misfit hypothesis' between brain architecture and modern reality enables evolutionary psychology to explain problems in society. The misfit hypothesis poses a question once expressed in Cartesian terms, but now in ne-Darwinian terms: how to correlate a biological view of persons as self-interested individuals with ordinary moral categories of values, norms and obligations. Evolutionary psychology's critics find it wanting as "a positivist social science in the grand tradition which seeks to mechanize morality in order to facilitate social engineering. It does so on the basis of the assumption that a causal chain exists between our evolved modules and certain undesirable behaviors." [79]

Another shortcoming s the tendency to use circular explanations for particular human behaviours.[80] Evolutionary psychology could weaken its stance by arguing that human capacities like morality and powers of reasoning are what they are only because they have been 'selected for'. Consequently, if the evolutionary hypothesis itself relies on reason, and if reason is the product of natural selection, then the hypothesis undermines itself.[81] We further investigate one particular application of evolutionary psychology, namely, this subject of morality.

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[77] Richard Hamilton, "The Darwinian Cage: Evolutionary Psychology as Moral Science," *Theory, Culture and Society* Vol.25 No.2 (March 2008), pp.105-125

[78] Data from normal and brain-injured patients shows the association between brain structure and mental function is very flexible, perhaps such flexibility is a unique human adaptation. Hamilton, *The Darwinian Cage,* p.107

[79] Hamilton, *The Darwinian Cage,* p.107. This assumption is challenged to temper evolutionary psychology's claims to social explanation.

[80] Svend Brinkmann, "Can We Save Darwin from Evolutionary Psychology?" *Nordic Psychology* Vol.63 No.3 (October 2011), pp.50-67. Brinkmann's other criticism is that EP accounts involve rather dramatic reductions of psychological phenomena like beauty, aggression and love, to something else.

[81] Brinkmann, *Can We Save Darwin,* p.61

Evolutionary Psychology and Morality

Evolutionary thinkers hold that natural selection has formed human-specific phenomena, including morality.[82] Previously this claim would have been criticised by science and religion, since morality, understood as a biological adaptation, seems to lose much of its normative weight. Yet it is claimed that evolutionary psychology can be used to support a biologically-based morality that can be consistent with morality's ontological status.[83]

By contrast the social sciences see morality as a human cultural capability that shields most behaviour from adaptively-specialised brain circuits. Such an evolved culture-absorbing brain entailed elimination of specialised circuitry. Thus the human mind became a blank slate, a tape recorder, designed to receive environmental signals without its own new content.[84] The cultural determinist or blank-slate perspective predicts impartial uptake of the surrounding culture, with no participation by evolved functional specialisations in directing culturally-relevant behaviours. However, evolutionary perspectives predict that human universal architecture enables a cultural baseline and that people will depart from the baseline given by surrounding culture.

Others find that moral phenomena are ideal issues for evolutionary psychology to consider, since morality in the social sciences is a kind of cultural realm, without 'biological' regulation: various behaviours e.g. altruism, sexuality, infidelity, kinship relations etc., are areas where evolutionary biology has explicitly developed its explanations.[85] In the case of opposition to incest, for example, there are hypotheses concerning the existence and functional architecture of the human kin-recognition system. The evolutionary predicted inter-individual variations in moral attitude cannot be explained easily by cultural determinist theories which hold that moral attitudes in individuals are perfectly conceived from surrounding ambient cultural attitudes via a general learning capacity. These social science theories that claim that

[82] Debra Lieberman, John Tooby and Leda Cosmides, "Does morality have a biological basis? An empirical test of the factors governing moral sentiments relating to incest," *Proceedings of the Royal Society B* Vol.270 No. 1517 (22 April 2003), pp.819-826
[83] Joseph Bankard, "Moral Instincts and the Problem with Reductionism: A Critical Look at the Work of Marc Hauser," *Theology and Science* Vol.9 No.4 (2011), pp.411-426 (p.411)
[84] Lieberman, Tooby & Cosmides, *Does morality have a biological basis?,* p.819
[85] Lieberman, Tooby & Cosmides, *Does morality have a biological basis?,* p.826

morality is free of biological regulation thus require revision, according to their critics.[86]

When evolutionary psychology accounts for ethical norms, one trend is optimistic: a nature-provided, universal sense of right and wrong in all cultures at all times.[87] The other trend is more pessimistic about the truth of moral propositions: sceptical about feelings and instincts evolved over millions of years from blind forces linking human beings with an abstract world of morality. Some propose a middle path which holds that evolutionary psychology is the best available account of moral intuition.[88] A credible evolutionary psychology account of moral phenomena is thought possible. There is also a middle path between no common biological foundations for moral reasoning versus genetic determinism that all intuitive moral responses are written into the genes.[89]

Critical Analysis

The scientific world of evolution, animals, brain and mind seem somewhat distant from the traditional Catholic theological understanding of the person as body-soul unity. The human person is recognised as an embodied soul, and his/her body can be acknowledged as an evolved entity from other animals, as detailed above for the brain in particular. Yet in the scientific forum, there is, as previously noted, a tension with the magisterium's teaching about special creation of the soul. More positively, theories of evolution and of the origin of the universe stimulate theological interests because they make contact with the teachings about creation *ex nihilo* and the creation of human beings in the image of God.[90]

Diverging views both from scientists and other Christian thinkers can be perceived as a threat to traditional Catholic teachings. One corollary is that consonance is hard to find and perhaps genuine dialogue is unlikely at this stage, at least on these foundational teachings. Certainly for humans, the importance of other animals, evolution, and time, all provide a deep organic definition to human nature, as

[86] Lieberman, Tooby & Cosmides, *Does morality have a biological basis?,* p.826
[87] Steven D.Hales, "Moral relativism and evolutionary psychology," *Synthese* Vol.166 No. 2 (January, 2009), pp.431-447
[88] Hales, *Moral relativism,* p.432
[89] Hales, *Moral relativism,* pp.433-434
[90] ITC, *Communion and Stewardship,* no.64, p.244

exemplified in the evolution of the body, brain and mind. In fact, the Catholic Church teaches that "through his very bodily condition he sums up in himself the elements of the material world. Through him they are thus brought to their highest perfection and can raise their voice in praise freely given to the Creator." [91]

Moreover, in the Catholic understanding it is because of the spiritual soul that the body *made of matter* becomes a living, human body.[92] Now this assigns a level of causality which science does not recognise. In addition, what may also be difficult to interpret empirically is the teaching that "every spiritual soul is created immediately by God - it is not "produced" by the parents."[93] Tommaso and later Thomism supports the magisterial view of divine, supernatural origin of soul which animates the body to be the unity that is the human person. The state of these teachings may highlight Barbour's types of science-religion relationship as conflict, and independence, but surely not dialogue at this stage.

On the bodily dimensions of human beings, however, Tommaso also writes how in accord with the nutritive soul we are living beings, with the sensitive soul, animals; and in accord with the intellective soul, people. Therefore the predications that 'man is an animal' or 'an animal is a living being', could be accidental. But Tommaso replies, this predication is essential, since man as man, is an animal; and an animal is a living thing. Hence, humans are one, animal and living.[94] So, although evolution was a discovery centuries after the middle ages and Tommaso's views can be considered antiquated, in its own terms his thinking nonetheless recognised the continuity and rising complexities of life from plants, animals and then rational animals or humans, that is, the nutritive, the sensitive and the intellectual.

More generally, it is helpful to recall that it took over a thousand years for naturalism to become the method to studying nature which does not appeal to God for explanation of nature at work.[95] R.L.Numbers, writing prior to the rise of the 'new atheism' of R.Dawkins, D.Dennett, and C.Hitchens, observed that notwithstanding

[91] *Catechism of the Catholic Church,* no.364; p.93
[92] *Catechism of the Catholic Church,* no.365; p.93
[93] *Catechism of the Catholic Church,* no.366; p.93
[94] Aquinas, *SCG,* Book 2, Ch.58, [1-3] p.173
[95] Ronald L. Numbers, "Science without God: Natural Laws and Christian Beliefs," David C.Lindberg and Ronald L.Numbers (eds.), *When Science and Christianity Meet* (Chicago: University of Chicago Press, 2003), pp.265-285

the efforts of unbelievers to use scientific naturalism to build a world without God, Christian support has remained firm. Christian scientists believed that God typically achieved his ends through natural means.[96]

There are, as well, limits to scientific and natural explanations;[97] in fact, there are explanatory constraints not only in science, but also in philosophy and religion.[98] J.F.Haught argues that an adequate explanation requires many levels and is unendingly deep so that not even all the sciences together can never comprehend the rich totality of causes beneath each cosmic event. Each branch of science presumes that it does not have to fully explain everything.[99] Theological explanations are the deepest explanations; however, they omit less and thus are less clear. And as we have seen, invoking divine purpose or creativity can annoy naturalists.[100]

On the other hand, it is hard to accept naturalism's account of a lifeless and mindless universe as the historical context for mind. If the ultimate cause of mind is mindlessness, Haught thinks we would still need reasons to trust our minds now, as Darwin himself seemed to realise.[101] Furthermore, in a mindless, lifeless and often valueless universe,[102] there is nothing hugely significant in death and the expiration of mind, if mind is held to be ethereal in modernity. In this apparently mindless account offered by naturalism, some see no immortal souls.[103] Yet for many, there is a belief in a survival beyond death even in a scientific age.

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[96] Numbers, *Science without God,* p.284
[97] John F.Haught, "Theology, evolution, and the human mind: How much can biology explain?," *Zygon* Vol.44 No.4 (December 2009), pp.921–931; John F. Haught, "Evolutionary Naturalism and the Future of Theology," *ITEST Bulletin* Vol.40 No.1 (Winter 2009), pp.3-11
[98] Peter Hampson, "Credible Belief in Fides et Ratio: I Explanatory constraints in philosophy, science and religion," *New Blackfriars* Vol.87 No.1011 (September 2006), pp.482-504; Peter Hampson, "Credible Belief in Fides et Ratio: II The theology-psychology dialogue," *New Blackfriars* Vol.87 No.1012 (November 2006), pp.631–650
[99] John F.Haught, *Is Nature Enough? Meaning and Truth in the Age of Science* (Cambridge and New York: Cambridge University Press, 2006), p.18; also John F.Haught, "Is Nature All There Is?," in Theresa Wong Yai-Chow, Wen Hsiang Chen, W and Frank Budenholzer (eds.), *The Cosmos in Becoming: Perspectives of Christianity and Chinese Religions,* Fu Jen Series on Religions, Science and Culture, Number 3 (Adelaide: ATF Press, 2008), pp.3-20. For a contrasting view see Jerome A.Stone, "Is Nature Enough? Yes," *Zygon* Vol.38 No.4 (December 2003), pp.783–800. Stone says, "nature is not enough. But it's all we have, and it will have to do." (p.783)
[100] Haught, *Science, Naturalism and Resurrection,* p.49
[101] Haught, *Is Nature Enough?,* p.53
[102] Haught, *Is Nature Enough?,* p.196. By expelling such critical intelligence from "the universe that gave rise to it, modern naturalism has led not only to a diminished view of human life, but to a trivialization of death as well." (p.197)
[103] So thinks Owen Flanagan, Haught, *Is Nature Enough?,* p.198

Naturalism points to humans as material beings. While morality and the mental might be viewed as signs of a spiritual nature, Haught does not consider these phenomena as evidence for immortality, spirits or souls.[104] He sees theology's traditional notion of 'immortality of the soul' as problematic for understanding Christianity within the context of ecology and evolution. It may be more helpful to speak of bodily resurrection, as it suggests that the cosmos and each event in its evolution shares in human destiny somehow.

Haught proposes comparisons with an atomic particle removed from its surrounding energy field, and a living cell taken from its place in a complex multicelluar organism. As in these situations, if a person was torn from their natural and social environments, their identity would change. "Ecologically speaking, each human person is a deeply relational center tied dynamically into an evolutionary environment. And so, inevitably, changes to that environment somehow reconfigure the identity of the personal centers connected to it."[105]

Using K.Rahner's ideas, Haught explains how God has taken on the materiality of the world, specifically human flesh. Thus death can be viewed as a deeper relationship with the universe as a movement toward deeper intimacy with an eternally embodied deity. In this way, death is a moment of liberation which recalling the Greek idea of the immortality of the soul as a release from prison. Suggestions like this are important as ecology invites theology to think of death and beyond in ways which enable the whole world of nature to have some share in human destiny.[106]

As discussed in chapter 1 of Part I, the International Theological Commission (ITC) also uses the data from evolution and genetics. It sees disagreement over the pace and mechanisms in evolution, but notes support for some theory to account for the development and diversity of life. The ITC comments that molecular biology and physical anthropology both make a credible case for the origin of the human species in Africa about 150,000 years ago in a humanoid population of common genetic

[104] Haught, *Is Nature Enough?,* pp.191-208
[105] John F.Haught, *God After Darwin: A Theology of Evolution* (Boulder, Colorado and Oxford: Westview Press, 2000), p.161.
[106] Haught, *God After Darwin,* p.162 & p.163

lineage. It identifies the decisive factor in human origins is a continually increasing brain size, culminating in *homo sapiens.* This concurs with the thinking detailed in this chapter on animals and human evolution. As the human brain developed, "the nature and rate of evolution were permanently altered: with the introduction of the uniquely human factors of consciousness, intentionality, freedom and creativity, biological evolution was recast as social and cultural evolution."[107]

Nevertheless, the ITC quotes John Paul II on the limitations of materialistic theories of human origins. It insists that an adequate understanding is needed of the 'ontological leap' to "the human which cannot be explained in purely scientific terms"[108] The world must be open to non-disruptive divine action. The emergence of the first members of the human species, as individuals or in populations, represents an event not inclined to pure natural explanations. It can, however, be attributed fittingly to divine intervention. Acting indirectly through causal chains, God prepared the way for 'an ontological leap...the moment of transition to the spiritual'."[109] Science can examine these causal chains, according to the ITC. But it is theology which locates special creation of the human soul within the plan of the triune God. As previously noted, this would be in conflict with physicalist sciences that claim to find a complete materialist explanation for human origins.

Conclusions

The evolutionary descent of humans, molecular biology, comparative studies and animal neuroscience,[110] are several substantial ways to study human persons. Evolutionary psychology and its internal debates within has influenced contemporary social-cultural thought as it develops physicalist portraits of minds, morality and human nature. It helps situate the mind and brain in time and evolution. For Christians, scientific research into animals and evolution contributes to contemporary thinking about the soul by providing the neurological precursors to becoming human beings, reinforcing the animal and earthly nature of the body in body/soul unity. The

[107] ITC, *Communion and Stewardship,* no.63, p.244
[108] ITC, *Communion and Stewardship,* no.64, p.244. Such thinking is worth further consideration.
[109] ITC, *Communion and Stewardship,* no.70, p.245
[110] Oronzo Capozzi et.al., "Evolutionary descent of a human chromosome 6 neocentromere: A jump back to 17 million years ago," *Genome Research* Vol.19 No.5 (May 2009), pp.778–784. See also Sara J.Shettleworth and Jennifer E.Sutton, "Do animals know what they know?," in Susan Hurley and Matthew Nudds (eds.) *Rational Animals?* (Oxford: Oxford University Press, 2006), pp.235-246; Justin N.Wood and Marc D.Hauser, "Action comprehension in non-human primates: motor simulation or inferential reasoning?," *Trends in Cognitive Sciences* Vol.12 No.12 (December 2008), pp.461-465

person so situated in the world is contrary to any concept of "angelism"[111] which places spirit in opposition to matter.

Without any thought of souls, the sciences as outlined in this chapter reveal the uniqueness of humans in areas such as differences in brain, language, culture and so forth. Uniqueness nevertheless is also accompanied by human *continuity* with animals. Uniqueness is founded on continuity. Take the amygdala, a brain structure which links higher order sensory information from the neocortex with subcortical and brainstem structures. It enables adaptive motor and physiological responses to be generated. In mammals, the amygdala is associated with emotional responses e.g. fear, and in nonhuman and human primates, the amygdala has been linked with social behaviours. It has been found that the human amygdala is not merely an evolutionarily 'scaled-up' version of an ape amygdala. The human amygdala contained considerably and proportionately more neurons in the lateral nucleus than the ape amygdala.[112] The human version has an ape pedigree.

The added Catholic vision of human nature is the soul which, as officially taught, is a leap in the unfolding of evolution. The uniqueness factor is also found in the spiritual nature of human beings. Without accepting this, the empirical sciences find human uniqueness in the physical realms, and in a number f ways. Humans are strikingly not apes because it is humans who walk, talk, cook, cry, and "building, dressing, sweating, marrying, cleaning, cutting our hair, pulling our wisdom teeth, struggling through childbirth, and threatening one another by brandishing our lawyers rather than our canine teeth. We have diverged from other apes."[113] To say humans are apes is to contradict Darwin's intent to study the origin of species, to reduce humans to their descent.[114] Furthermore, most animals have no innate interest in liberty since animals are not like humans who have the capability to structure, review and pursue

[111] J.F.Donceel, S.J., *Philosophical Anthropology* (New York: Sheed and Ward, 1967), p.453
[112] Nicole Barger et.al., "Neuronal populations in the basolateral nuclei of the amygdala are differentially increased in humans compared with apes: A stereological study," *The Journal of Comparative Neurology* Vol.520 No.13 (1 September 2012), pp.3035–3054
[113] Jonathan Marks, "Darwin's ventriloquists," *Anthropology Now* Vol.1 No.3 (December 2009), pp.1-11 (p.1)
[114] Marks, *Darwin's ventriloquists,* p.2

their own ideas of the good.[115] Clearly the scientific study of animals and evolution can enlighten our understanding of the nature of human beings.[116]

Animal-human comparisons, discoveries about human uniqueness, and how the mind evolved, are scientifically stated, frequently debated yet not ultimately resolved. Indeed, a fully-agreed, complete account of human nature not been reached, yet. This provides an opening for those questioning the natural limits of physicalism and for offering another portrait of human nature that is different, compelling, and which makes room for the human being's spiritual nature and transcendence. We now turn to an alternative, counter-balancing outlook on body-soul: as human beings who live their lives, across spans of time.

[115] Alasdair Cochrane, "Do Animals Have an Interest in Liberty?," *Political Studies* Vol.57 No. 3 (October 2009), pp.660-679

[116] As philosopher Alasdair MacIntyre argues that human identity is "primarily, even if not only, bodily and therefore animal identity and it is by reference to that identity that the continuities of our relationships to others are partly defined." Alasdair MacIntyre, *Dependent Rational Animals, Why Human Beings Need the Virtues*, The Paul Carus Lectures 20 (Chicago and La Salle, Illinois: Open Court, 1999), p.8