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THINK OR BE DAMNED: THE PROBLEMATIC CASE OF HIGHER COGNITION IN ANIMALS AND LEGISLATION FOR ANIMAL WELFARE

By
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Recent discoveries of higher cognitive abilities in some species of birds and mammals are bringing about radical changes in our attitudes towards animals and will lead to changes in legislation for the protection of animals. We fully support these developments, but at the same time we recognize that the scientific study of higher cognition in animals has touched on only a small number of vertebrate species. Accordingly, we warn that calls to extend rights, or to at least better welfare protection, for the handful of species that have revealed their intelligence to us may be counterproductive. While this would improve the treatment of the selected few, be they birds or mammals, a vast majority of species, even closely related ones, will be left out. This may not be a particular problem if being left out is only a temporary state that can be changed as new information becomes available. But, in practice, those protected and not protected are separated by a barrier that can be more difficult to remove than it was to erect in the first place. We

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summarize the recent research on higher cognition from the position of active researchers in animal behavior and neuroscience.

I. INTRODUCTION: STATING THE CASE

The recent expansion of research on the higher cognitive abilities of animals has brought many surprises to scientists trained in the tradition of setting humans well apart from other creatures and following the strict rule of avoiding anthropomorphism.[1] Likewise, many of the new findings have so alerted legislators and the general public to a changing view on animals that we find ourselves on new ground when we consider how society treats animals and how we can protect them from cruelty that we would find intolerable and unacceptable if applied to ourselves.[2]

This article is a response, from the point of view of practicing scientists in the field of higher cognition in animals, to debates on how new findings on animal cognition are to be reflected in the law. Our response to the challenges posed by recent discoveries is several fold. First, we give an overview of what has been achieved in scientific research and what is known about cognitive abilities in animals. Second,

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[1] *See* Lesley J. Rogers, *Minds of Their Own: Thinking and Awareness in Animals* 6–7 (Westview Press 1998) (stating that anthropomorphism has been traditionally frowned upon by scientists); John A. Fisher, *The Myth of Anthropomorphism,* in *Readings in Animal Cognition* 3, 3–16 (Marc Bekoff & Dale Jamieson eds., MIT Press 1999) (discussing one view of anthropomorphism). Trained in ethology (animal behavior) in the 1960s, one of the authors, Lesley J. Rogers, was taught to strictly avoid any hint of anthropomorphism in interpreting results. For example, animals could be said to have mental representations but not ideas and to decide according to pre-set rules but not by thinking.

[2] Steven M. Wise, *Animal Rights: One Step at a Time*, in *Animal Rights: Current Debates and New Directions* 19, 19–50 (Cass R. Sunstein & Martha C. Nussbaum eds., Oxford U. Press 2004); James Rachels, *Drawing Lines*, in *Animal Rights: Current Debates and New Directions* 162, 162–74 (Cass R. Sunstein & Martha C. Nussbaum eds., Oxford U. Press 2004).

we state the limitations of that knowledge. Third, we argue how we see the pitfalls unfolding at the applied and legislative levels if current research findings are misconstrued.

This paper consists of several interlocking theses, some of them seemingly contradictory. The first one states that current avant-guard research in the fields of perception and higher cognition in animals is important and shows that asking new questions, not surprisingly, results in answers that demand changes in attitudes. In addition, our discussion will show that science is not value free and biology not apolitical.[3] The second thesis of this paper confirms that it is important for policy makers and lawmakers to take into consideration the new scientific findings. The third thesis of this paper seemingly contradicts the second by arguing that the conclusions some policy and lawmakers are beginning to draw from research on animal cognition are either flawed or problematic (in terms of the current scientific knowledge). Some of the proposed changes (such as including some species, but not others, into new legislative frameworks for protection) promise to make life even worse for those species not included. We argue that a scale of "value" along some older *Scala Naturae* could become a disaster in terms of protection of animals and animal welfare in general.[4] The fourth thesis is that much more research will be needed, because the animals so far studied for higher cognitive ability represent only a small fraction of vertebrate species.[5] Hence, we are very much in the infancy of this field, even though the theoretical and conceptual shifts have already been overwhelmingly large (as will be described in this paper). The final thesis of the paper states that the search for criteria for better legislation to protect animals must not only include cognitive abilities, often comparable to those of humans, but also recognize that animals may have some capabilities that are more highly developed than in humans and that these capabilities need to find reflection in legislation as *species appropriate legislation.*

II. THE BACKGROUND

The discoveries of higher cognitive abilities in animals in the last two to three decades have been most exciting and groundbreaking.[6] They have occurred because many researchers have chosen to drop the

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[3] *See generally* Gisela Kaplan & Lesley J. Rogers, *Gene Worship: Moving Beyond the Nature/Nurture Debate over Genes, Brain and Gender* 3–45 (Other Press 2003) (developing the argument of the role of biology in politics and the malleability of science within certain belief systems).

[4] *See e.g.* Steven M. Wise, *Drawing the Line: Science and the Case for Animal Rights* 43–45 (Perseus Books 2002) (proposing a scale that assigns a cognitive ability score to each species and then drawing a line to divide those who deserve basic liberty rights from those who do not).

[5] *E.g.* Lesley J. Rogers & Gisela Kaplan, *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* (Kluwer Academic/Plenum Publg. 2004).

[6] The revival of interest in research in this field was stimulated by Donald Griffin's book, *Animal Thinking*. Rogers, *supra* n. 1, at 8.

tacit and implicit assumption that humans are better in everything and that animals, as first described by Descartes, merely exist by responding unconsciously to stimuli in the environment or according to some preset genetic program.[7] The discoveries have shown, starting perhaps with the discovery of echolocation in bats,[8] that humans cannot necessarily hear what animals can hear, see what they can see, smell what they can smell, or feel as they feel.[9]

Over the last twenty years or so, increasingly, a very different and seemingly even more important point has been made: namely, that some animals can actually do what we can do, feel what we can feel, and even plan for the future as humans do. In other words, the horizons are expanding vastly, now admitting that there are aspects to other living organisms that can be described as having *more* capabilities than we have and, even more startling to many people, that higher cognitive abilities in animals, in some aspects or specific tasks, may be *equal* to those of humans.[10] Our own research is centered in this (latter) avant-guard field and this paper will, naturally, report favorably on current advances in our knowledge of sensory perception and higher cognitive abilities of animals.

Once we needed only to take into consideration that animals, or many of them, can feel pain. And, although it was not a simple matter to develop effective legislation to protect animals on the basis of sentience, it could be done, albeit with a few, still debated, grey areas. One such area is a debate about at what stage of development an embryo or fetus can feel pain and another is about whether invertebrates can feel pain.[11] Many countries with laws to protect vertebrate species are considering whether or not at least some invertebrates (e.g. octopuses and

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[7] Rene Descartes, *Animals Are Machines*, in *Animal Rights and Human Obligations* 13, 17 (Tom Regan & Peter Singer eds., 2d ed., Prentice Hall 1989) (arguing that animals are simply automata, acting purely mechanistically without perception of pain or awareness); *e.g.* John Dupré, *The Mental Lives of Nonhuman Animals*, in *Readings in Animal Cognition* 227–33 (Marc Bekoff & Dale Jamieson eds., MIT Press 1999) (suggesting mental consciousness in animals).

[8] Donald R. Griffin, *Listening in the Dark: The Acoustic Orientation of Bats and Men* 57–80 (Yale U. Press 1958); *see also* Lesley J. Rogers & Gisela Kaplan, *Songs, Roars, and Rituals: Communication in Birds, Mammals, and Other Animals* 107–09 (Harvard U. Press 2000) (discussing echolocation in bats).

[9] *See e.g.* Rogers & Kaplan, *supra* n. 8, at 26–47 (comparing sensory perception in humans and nonhuman animals); William C. Stebbins, *The Acoustic Sense of Animals* 1–3 (Harvard U. Press 1983) (comparing the functions and mechanisms of hearing in various species).

[10] Juan D. Delius, *Sapient Sauropsids and Hollering Hominids*, in *Geneses of Language* 1, 2–25 (Walter A. Koch ed., Universitätsverlag Dr. Norbert Brockmeyer 1990) (discussing a task on which pigeons perform better than humans).

[11] Melissa Sowry, *Lawmakers Continue to Promote Fetal-Pain Bills*, http://abcnews.go.com/Health/story?id=1594819&page=1 (Mar. 19, 2006); *e.g.* Richard C. Brusca & Gary J. Brusca, *The Invertebrates* (2d ed., Sinauer Assoc. 2003) (considering whether invertebrates feel pain); *see* David J. Mellor et al., *The Importance of 'Awareness for Understanding Fetal Pain*, 49 Brain Research 455 (2005) (for a recent article on fetal pain).

lobsters) should be included in the rubric enacted to protect vertebrates.[12] Law enactments and law enforcements are, of course, very different things. And all too often cruelties to animals, even at a basic level of care, remain unpunished or even tolerated or condoned,[13] indicating that the "grey areas" do not just extend to our understanding of pain and stress in animals but how we actually put that understanding into practice. At any point in time, if one cared to look, there are likely to be tens of thousands of animals suffering pain and stress that are not being attended to despite legislative frameworks that may have been adopted.[14] To include octopuses and lobsters into legislative frameworks may seem almost extravagant at a time when cattle, pigs, sheep, and poultry, to name a few, still often live and die under appalling conditions.[15] At least we are beginning to gain scientific insight and one would hope that, gradually, such insights will be translated into practice—whatever the species.

But recently the grey areas of existing legislation have become larger because, it seems, quite unexpected species have been found to possess higher cognitive abilities.[16] First came the research on higher cognition in apes. The demonstration that apes could count,[17] make

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[12] *See e.g.* Ministry Research, Sci. & Tech., *Biotech Regulatory Wayfinder: An Interactive Guide to New Zealand's Biotechnology Legislation, Animal Welfare*, "How is Animal Welfare Regulated?" http://www.morst.govt.nz/wayfinder/regulations/welfare.asp (accessed Mar. 19, 2006) (The New Zealand and Australian Animal Research and Animal Welfare Acts include protection of octopuses, lobsters, and some other invertebrates.); The United Kingdom Parliament, *Animal Welfare Bill*, http://www.publications.parliament.uk/pa/cm200506/cmstand/a/st060117/am/60117s02.htm (Mar. 19, 2006) (for more on the debate in the U.K. parliament regarding whether to protect some invertebrates under laws similar to those protecting vertebrates).

[13] This is particularly true of livestock for consumption. *See e.g.* David J. Wolfson, *Beyond the Law: Agribusiness and the Systematic Abuse of Animals Raised for Food or Food Production* 10 (Farm Sanctuary, Inc. 1999) (explaining the inadequacies of protection of animals raised for food).

[14] *Id.*; *see also* Jim Mason & Mary Finelli, *Brave New Farm?* in *In Defense of Animals: The Second Wave* 104, 120–22 (Peter Singer ed., Blackwell 2006) (explaining the lack of legal protection for farm animals in the U.S.); Stephanie Edwards, *Class B Dog and Cat Dealers Are No Friends to the Animals*, http://www.hsus.org/animals_in_research/animals_in_research_news/Class_B_Dealers.html (Feb. 15, 2006) (explaining that although Class B dealers are regulated by the Animal Welfare Act, they often subject animals to inhumane conditions).

[15] Mason & Finelli, *supra* n. 14, at 120–22; *see also* Jeffrey Moussaieff Masson, *The Pig Who Sang to the Moon: The Emotional World of Farm Animals* (Ballantine Books 2003) (for a sensitive exploration of the way humans treat pigs and other animals); Matthew Scully, *Dominion: The Power of Man, the Suffering of Animals, and the Call to Mercy* (St. Martin's Press 2002) (describing animal suffering caused by humans).

[16] *See e.g.* Rogers & Kaplan, *supra* n. 5 (for many chapters with examples of higher cognition in vertebrate species).

[17] Sarah T. Boysen & Gary G. Bernston, *Numerical Competence in a Chimpanzee (*Pan troglodytes*)*, 103 J. Comp. Psychol. 23, 23 (1989); Sarah T. Boysen, *Counting in Chimpanzees: Nonhuman Principles and Emergent Properties of Number*, in *The Development of Numerical Competence: Animal and Human Models* 39, 39–59 (Sarah T. Boysen & E. John Capaldi eds., Lawrence Erlbaum Assocs. 1993).

and use tools,[18] learn sign language,[19] and even express desires and emotions has impressed society and stirred some to call for an extension of human rights to encompass our nearest relatives.[20] Many of the arguments in support of inclusion of the great apes in the same genus as currently reserved for humans alone (i.e. *Homo*)[21] have a sound scientific basis and growing support from research.[22] Such a change in the status of apes would be instrumental in changing both attitudes and legislation to treat them as our equals. In fact, to include apes along with us in the same genus should not be an enormous shift in thinking from the biologist's point of view since they are our closest relatives on the evolutionary tree and, over recent years, molecular geneticists have provided evidence that their genetic coding (DNA) differs from ours by no more than 1.2%.[23] On the other hand, in terms of broad social thinking, social practice, and the law, to extend rights to apes and include them in the same genus as humans would be an enormous step, since we would have to dismantle the colossal wall that we have erected between ourselves (humans) and all other species (animals).

Fatefully perhaps, just as we were chipping away at this wall, startling new research has shown that several avian species can perform the higher cognitive abilities that so impressed us about apes. Some species of birds can: manufacture and use tools;[24] "follow the direction of eye gaze,"[25] which shows they may be aware of the thoughts

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[18] Gavin R. Hunt, *Manufacture and Use of Hook-Tools by New Caledonian Crows*, 379 Nature 249, 249–51 (1996).

[19] Roger S. Fouts et al., *Teaching Sign Language to Chimpanzees* 306 (R. Allen Gardner et al. eds., St. U. N.Y. Press 1989); *see also* R. Allen Gardner & Beatrix T. Gardner, *Teaching Sign Language to a Chimpanzee*, 165 *Science* 664, 664–72 (1969) (summarizing sign language studies of chimpanzees).

[20] *See generally The Great Ape Project*: *Equality beyond Humanity* (Paola Cavalieri & Peter Singer eds., St. Martin's Press 1993) (a collection of thirty-one essays to support the call for the immediate extension of our human rights to the great apes).

[21] U. of Mich. Museum of Zoology, *Animal Diversity Web, Homo Sapiens (Human)*, http://animaldiversity.ummz.umich.edu/site/accounts/classification (accessed Mar. 19, 2006).

[22] *See supra* nn. 17–19 and accompanying text (for examples of research demonstrating the high cognitive abilities of apes); *see generally "Language" and Intelligence in Monkeys and Apes*: *Comparative Development Perspectives* (Sue Taylor Parker & Kathleen Rita Gibson eds., Cambridge U. Press 1990) (The book focuses on such areas as the nature of culture, intelligence, language, and imitation; the differences among species in mental abilities and developmental patterns; and the evolution of life histories and of mental abilities and their neurological bases.).

[23] Robin Orwant, *What Makes Us Human*, vol. 181, issue 2435 New Scientist 36, 38 (Feb. 21, 2004).

[24] Hunt, *supra* n. 18, at 249–51.

[25] Thomas Bugnyar et al., *Ravens*, Corvus corax, *Follow Gaze Direction of Humans around Obstacles*, 271 *Procs. Royal Socy. London B* 1331, 1331–36 (2004); *see also* Thomas Bugnyar & Bernd Heinrich, *Ravens*, Corvus Corax, *Differentiate between Knowledgeable and Ignorant Competitors*, 272 *Proc. Royal Socy. B* 1641, 1641–45 (2005) (testing whether ravens behave differently when caching and retrieving food if being observed by other ravens).

of another; express numerosity;[26] form abstract concepts;[27] and communicate using referential signals.[28] These new findings lead us to ask whether we should now start to talk about rights for birds, or at least for some avian species. And this debate opens an even more difficult question about all of the species on the evolutionary trajectory between birds and apes. Some researchers think the ape-equivalent cognitive abilities are limited to corvids (*Corvidae*: crows and ravens) and parrots (*Psittacinae*: generally referred to as parrots, but also including cockatoos).[29]

Although we recognize that corvids and parrots may possess special abilities in higher cognition,[30] we are also keenly aware that drawing this conclusion may be merely a reflection of the avian species that have been tested for their cognitive abilities so far. This is not an insignificant point to make, because, if society were to accept that corvids and parrots are a special case among birds, it would need to broaden the protective umbrella just a little more to include these orders of birds along with the apes. On the other hand, society might use what it knows about corvids and parrots as a pointer to finding out more about the cognitive abilities of other avian species, and this could lead to opening the protective umbrella much more widely.

In other words, a range of issues relating to legislation to protect animals would arise if other avian species, so far not tested, show higher cognitive ability. Added to this, scientists may discover that other species of yet another phylogenetic Class show such abilities. For example, we recently watched a monitor lizard (*Varanus varius*) solve a complex problem.[31] It had found a large dog bone that it could not

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[26] Jacky Emmerton & Juan D. Delius, *Beyond Sensation: Visual Cognition in Pigeons*, in *Vision, Brain, and Behavior in Birds* 377, 377–79 (H. Philip Zeigler & Hans-Joachim Bischof eds., MIT Press 1993).

[27] *See* Delius, *supra* n. 10, at 2–25 (discussing the cognitive ability of pigeons and other birds).

[28] Christopher S. Evans, *Referential Signals*, in *Perspectives in Ethology* 99, 99–100 (Owings et al. eds., Plenum Press 1997); Lesley J. Rogers & Gisela Kaplan, *Bird Brain? It May be a Compliment!* 7 Cerebrum 37, 43–44 (2005) [hereinafter Rogers & Kaplan, *Bird Brain*]; Lesley J. Rogers & Gisela Kaplan, *An Eye for a Predator: Lateralization in Birds, with Particular Reference to the Australian Magpie, Behavioral and Morphological Asymmetries in Vertebrates*, http://www.eurekah.com/abstract.php?chapid=2715&bookid=196&catid=20 (last updated Sept. 2005) [hereinafter Rogers & Kaplan, *An Eye for a Predator*].

[29] *E.g.* Nathan J. Emery, *Cognitive Ornithology: The Evolution of Avian Intelligence*, 361 Phil. Transactions Royal Socy. 23, 23 (Dec. 7, 2005) (available at http://www.princeton.edu/~asifg/braindiversity/Emery%20-%20Cognitive%20Ornithology.pdf).

[30] Gareth Huw Davies, *Bird Brains*, http://www.pbs.org/lifeofbirds/brain/ (accessed Mar. 19, 2006).

[31] Thirty degrees latitude, in the subtropical rainforest of east coast Australia (hinterland of Coffs Harbour, Mid-north Coast in the state of New South Wales). Lace monitors roam freely in summer in that area, and the authors have a property in these parts maintaining it in its pristine form. It affords observation of wildlife now rarely seen elsewhere. For Genus and species information, see Biocrawler.com, *Monitor Lizard*, "Classification: Genus Varanus," http://www.biocrawler.com/encyclopedia/varanidae (last modified June 11, 2005).

swallow unless it aligned it at a certain angle to its throat.[32] It tried several postures when the bone was on the ground but did not succeed in getting it right.[33] The lizard then picked up the bone and transported it to a tree stump, which it used as an anvil to strike the bone against until it was at the correct alignment.[34] This small anecdotal observation suggests several parameters of higher cognitive ability: problem solving, tool use by using the trunk of the tree to manipulate the food, and even intentionality, because the monitor lizard carried the bone purposefully to the tree trunk. There was no trial and error, no hesitation, and no mistake.[35] Presumably, such findings would throw us into a legislative conundrum that would require us to test the cognitive abilities of every species needing protection from human cruelty.

The demand for proof of cognitive ability in animals has a few pitfalls. Let us presume that scientists would actually be willing to test most avian species based solely on the hypothesis that more avian species than just corvids and parrots, let alone animals of another Class such as reptiles (e.g. crocodiles or monitor lizards),[36] might possess higher cognitive ability. If scientists do set about testing the cognitive abilities of a broad range of avian species, they will be faced with the difficulty of choosing what tests to apply. This is not as easy as it may sound, as may be mistakenly assumed by those not familiar with the scientific study of animal and human behavior. The "fair" view might seem to be to apply the same kind of baseline test to all species. Not only a matter of fairness, there is an implied view in this approach that "intelligence" (or better—higher cognitive ability) involves absolute and fixed criteria and, moreover, that these criteria have something to do with intelligence as we understand it (and which we, as humans, claim to possess). However, one of the distinct assets of the natural world is not only diversity, but also diversity in skills for different ecological niches that a species might occupy. Not all birds have color vision,[37] not all have a sense of smell,[38] not all can fly,[39] not all sing,[40] and some of their extraordinary skills and abilities might get lost in tests that are simply inappropriate for the species.[41]

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[32] *Supra* n. 31.

[33] *Supra* n. 31.

[34] *Supra* n. 31

[35] *Supra* n. 31.

[36] Biocrawler.com, *Reptile*, http://www.biocrawler.com/encyclopedia/Reptile (last modified June 22, 2005).

[37] Gisela Kaplan & Lesley J. Rogers, *Birds: Their Habits and Skills* 112–14 (Allen & Unwin 2001).

[38] *Id.* at 124–29.

[39] *Id.* at 30–34.

[40] *Id.*

[41] Nathan J. Emery & Nicola S. Clayton, *Comparing the Complex Cognition of Birds and Primates*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* 3, 3–55 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic/Plenum Publg. 2003).

Such a demand for proof of cognitive ability creates, we believe, an insoluble dilemma. Scientists would need to take into account species' differences before deciding whether a species fails to meet the criteria set for higher cognitive abilities. Scientists would have to adapt tests to reflect ecologically acceptable criteria for the species, and would then be faced with the difficulty of comparing results between very different tests. Moreover, some species have survived life on this planet for millions of years by being well adapted to their ecological niche.[42] They might, therefore, have very specific cognitive adaptations and, thus, superior cognitive abilities of a very specific type. Even if scientists fix the criteria for a test, this raises the question of how many aspects of higher cognition a species would need to possess before we would consider moving it into a legally protected category.

Finally, let us put humans into this testing arena as well. For instance, when testing the simple spatial ability to discriminate between several figures with one facing a different way than the rest (referred to as "odd-man-out" tests and used widely in human intelligence tests),[43] the birds tested, in this case pigeons, performed substantially better and faster than humans.[44] There are so many tests that could be devised in which humans would be low on the scale of performance, and, to make this quite unambiguous and clear, humans or human infants would often be considerably *poorer* in their performance than birds, including pigeons and chickens.[45] Such simple tests could examine memory, vision, hearing, spatial mapping, and navigation; and many other tests could be applied that would be equally valid to administer, each as a "criterion" fixed test for establishing relative higher cognitive ability. However, we are unable to say at what level of performance on these tests, say on a scale of one to ten, we would decide that a species is worthy of legal protection and additional welfare legislation.

Changes in cognitive ability during development are an added complication since species vary in the rate at which they pass through the various stages of development.[46] Scientists are still debating at

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[42] For example, turtles (Class *Reptilia*, Order *Testudines*) have changed very little from the Triassic on, and crocodiles (Class *Reptilia*, Order *Crocodilia*) have changed little from the early Mesozoic on (about 200 million years). *Integrated Principles of Zoology*, 540, 552 (Cleveland P. Hickman et al. eds., 12th ed., McGraw-Hill 2003).

[43] Pritika Sanghi & David L. Dowe, *A Computer Program Capable of Passing I.Q. Tests*, www.csse.monash.edu.au/~sanghi/CSE3301/Paper.doc (accessed Mar. 19, 2006).

[44] Delius, *supra* n. 10, at 7–8.

[45] *See id.* at 6–18 (comparing the cognitive ability of pigeons to humans); Rogers, *supra* n. 1, at 68–69, 76–77 (comparing the cognitive ability of humans to chickens and pigeons).

[46] *See e.g.* Peter Marler, *Differences in Behavioural Development in Closely Related Species: Birdsong*, in *The Development and Integration of Behaviour* 41, 41–70 (Patrick Bateson ed., Cambridge U. Press 1991) (reviews of the bird species differences in mechanisms of behavioral development); Andrew N. Iwaniuk & John E. Nelson, *Developmental Differences Are Correlated with Relative Brain Size in Birds: A Comparative Analysis*, 81 Canadian J. of Zoology 1913, 1913–28 (2003).

which stage of development an embryo is able to feel pain,[47] and this has enormous importance to research since embryos prior to that stage could be used without concern for their welfare. The ability to feel pain emerges at some, usually early, stage of development, and higher cognitive abilities will emerge at later stages of development (of the central nervous system), but it remains unclear when exactly they do emerge in species other than humans.[48]

One potential solution to the problem of what to do about specific cognitive specializations versus broader cognitive ability is to consider behavioral flexibility (i.e. cognitive ability across different tasks), also seen as a measure of higher cognition in humans.[49] However, measuring is not simple and encompasses all of the problems that we have mentioned above.

One of the issues referred to above depends largely on arguments and knowledge about evolution, and the other issue depends on knowledge of development. Both ultimately address the question of whether society can, or should, draw a line between those species that can "think" and those that are damned because they cannot do so (at least along the parameters that scientists might have set for them). Furthermore, for a species chosen for protection because of its higher cognitive abilities, there is the question concerning during what stage of development those abilities are manifested. Individual differences within species and experience might also be a consideration.

III. EVALUATING RECENT STUDIES

To further discussion on this topic, we need to summarize the new findings on the cognitive abilities of birds. These are new and important findings in themselves, but they have the added value, for the sake of the debate here, that birds are not our direct predecessors, as are apes, and thus belong to an entirely different Class.[50] A discussion of birds therefore frees us from the implied assumption that the primate line (with humans as an imagined pinnacle) is special and cognitively superior to the rest of the animal kingdom.

A. *Neocortex and Higher Cognition*

One of the lynch pins of the formerly held opinion that birds have inferior cognitive abilities has always been the fact that they lack a

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[47] Parliamentary Off. of Sci. & Tech., *Fetal Awareness*, 94 POSTnote 1 (Feb. 1997).

[48] *See generally Behavioral Development* (Klaus Immelmann et al. eds., Cambridge U. Press 1981) (providing an overview of cognitive development in all species); *see also* Michael Tomasello & Josep Call, *Primate Cognition* 401–16 (Oxford U. Press 1997) (providing an overview of cognitive development in humans).

[49] Alexander Easton, *Behavioural Flexibility, Social Learning, and the Frontal Cortex*, in *The Cognitive Neuroscience of Social Behaviour* 59, 59–79 (Alexander Easton & Nathan J. Emery eds., Psychol. Press 2005).

[50] Birds belong to Class Aves, and apes, along with all other primates and mammals, to Class Mammalia. Lord Rothschild, *A Classification of Living Animals* 41–44 (John Wiley & Sons Inc. 1961).

neocortex,[51] that part of the brain known in mammals to be used for higher cognitive function.[52] In humans, the neocortex, recently referred to as the isocortex, is the convoluted part of the brain, which can be seen clearly as two cerebral hemispheres.[53] Humans use the neocortex for most higher cognitive processes, including abstract thinking, problem solving, forming memories, and carrying out complex communication.[54]

Part of the cortex, the frontal cortex, is thought to be responsible for flexibility in human behavior.[55] The neocortex also plays a role in the expression of emotions and personality.[56]

All mammals have a neocortex,[57] although not as large or convoluted as ours,[58] and we know that one of its functions in animals is to process and store information responsible for changing behavior as a result of experience (i.e. learning).[59] Not surprisingly, scientists have tended to view the evolution of the neocortex (its becoming larger in comparison to the rest of the brain) as a pre-cursor to the higher cognitive abilities of primates, and the human neocortex, proportionately the largest of them all, as evolution's pinnacle in cognitive function.[60]

Non-mammalian brains, including the brains of birds, were thought to be simpler and of a more ancient form.[61] The neocortex of mammals has a layered structure (six layers of nerve cells), whereas the forebrain of the bird is mainly made of collections of nerve cells

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[51] Emery, *supra* n. 29, at 24.

[52] Shirley A. Bayer & Joseph Altman, *Neocortical Development* ix (Raven Press 1991); John C. Eccles, *Evolution of Consciousness*, 89 Proc. Natl. Acad. Sci. 7320, 7321 (1992).

[53] Rogers, *supra* n. 1, at 153–54; Lesley J. Rogers, *Increasing the Brain's Capacity: Neocortex, New Neurons, and Hemispheric Specialization*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-primates?* 289, 296–98 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic & Plenum Publishers 2004) [hereinafter Rogers, *Increasing the Brain's Capacity*].

[54] Stuart J. Dimond, *Hemisphere Function in the Human Brain: An Introduction*, in *Hemisphere Function in the Human Brain* 1, 1 (Stuart J. Dimond & J. Graham Beaumont eds., Halsted Press 1974).

[55] Easton, *supra* n. 49, at 66.

[56] Mark Solms & Oliver Turnbull, *The Brain and the Inner World* 107–08 (Other Press 2002); Wendy Heller et. al., *Regional Brain Activity in Anxiety and Depression, Cognition/Emotion Interaction, and Emotion Regulation*, in *The Asymmetrical Brain* 532, 534–35 (Kenneth Hugdahl & Richard J. Davidson eds., MIT Press 2003).

[57] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 107; *see* Bayer & Altman, *supra* n. 52, at ix (stating that "[t]he neocortex is the crown of the mammalian central nervous system").

[58] John K. Rilling & Thomas R. Insel, *The Primate Neocortex in Comparative Perspective Using Magnetic Resonance Imaging*, 37 J. Human Evolution 191, 220 (1999).

[59] *See* Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 38 (explaining that the neocortex is used for higher cognitive processes such as problem solving and abstract thinking).

[60] Bayer & Altman, *supra* n. 52, at ix.

[61] Avian Brain Nomenclature Consortium, *Avian Brains and a New Understanding of Vertebrate Brain Evolution*, 6 Nat. Rev. Neuroscience 151, 151–52 (2005).

(neurons) gathered together into discrete structures called nuclei.[62] These differences in the brain's structure are not too "surprising, because more than two hundred million years ago birds branched from the line of evolution that led to mammals and on to humans via primates."[63] Both the avian forebrain and the mammalian neocortex are derived from the same structure, known as the pallium.[64] Brains following the two separate evolutionary trajectories became quite different in organization and connection, but apparently adapted to achieve many similar functions.[65]

Neuroscientific study of the avian brain has advanced enormously over recent years. Views on its complexity relative to the mammalian brain have changed so greatly that all parts of the forebrain of the bird have been renamed recently to match parts of the mammalian brain.[66] These new names have replaced the older ones and have equated regions of the avian brain to regions of the mammalian brain.[67]

Parallel with this change in opinion on the anatomy of the avian brain, a growing number of studies have shown that birds can perform complex cognitive tasks.[68] These discoveries show that there must be more than one way that a very clever, if not intelligent, brain can be constructed. Moreover, the relatively small size of bird brains, most likely to assist them in their ability to fly, is no longer seen as a mark of an inferior brain. As an analogy, modern, well-designed, smaller computers can perform more functions more rapidly than many older, larger computers.[69] Research has shown us very clearly that, contrary to earlier beliefs, size of the brain is not a reliable indicator of cognitive capacity despite the fact that some anthropologists still make much of brain size with respect to human evolution.[70]

Of course, we recognize that brain size alone is not the main measure to be considered, and it is now common practice to adjust it according to body size because an allowance must be made for the fact that much of the brain is devoted to moving and controlling body musculature.[71] Those species with a higher ratio of brain weight to body

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[62] *Id.* at 154.

[63] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 38.

[64] Avian Brain Nomenclature Consortium, *supra* n. 61, at 151.

[65] Kaplan & Rogers, *supra* n. 37, at 27–28.

[66] Avian Brain Nomenclature Consortium, *supra* n. 61, at 155.

[67] *Id.*

[68] Emery, *supra* n. 29, at 27–29; Giorgio Vallortigara, *Visual Cognition and Representation in Birds and Primates*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* 57–94 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic & Plenum Publishers 2004).

[69] Steven E. Schoenherr, *The Evolution of the Computer*, http://history.acusd.edu/gen/recording/computer1.html (last updated June 1, 2004).

[70] *E.g.* William Noble & Iain Davidson, *Human Evolution, Language and Mind: A Psychological and Archaeological Inquiry* 154–59 (Cambridge U. Press 1996) (These authors build their theory of the evolution of language on the increasing size of the human brain.).

[71] Rogers, *Increasing the Brain's Capacity*, supra n. 53, at 289–96.

weight, known as the encephalization quotient (EQ), are considered to have more cognitive capacity.[72]

Avian species fare quite well on such a ratio, but one has to take into account the fact that the bones of birds that fly have special adaptations to make them light: namely, they have an interior lattice of bony supports with many air pockets.[73] This means that their bones are strong but also light. This fact alone influences (increases) the ratio of brain to body weight and makes comparisons between birds and species that do not have this adaptation for flight, such as mammals and reptiles, untenable. Although the brain to body weight ratio may be used to make useful comparisons between avian species,[74] it is invalid to make comparisons of birds with non-birds.[75]

Recognition of the weak association between brain size, as a whole, and cognitive capacity does not, however, mean that the relative sizes of subregions of the brain may not indicate specific cognitive specializations of the species. At this level of size measurement, many believe, relationships between size and function may exist, at least as they vary within a taxonomic order.[76] Some avian species and some mammals, for instance, need to store food (referred to as caching), and there is a corresponding area in the brain, the hippocampus, which is important for storing spatial memory used to carry out this task.[77]

Several researchers have presented evidence that the hippocampus is larger in species that cache their food, and thus need to use spatial memory in order to find it at a later date. Avian species (e.g. nuthatches[78] and marsh tits[79]) and mammalian species (e.g. squirrels and polygynous vole species[80]) that cache have a larger hippocampus volume than their close relatives that do not cache. Although one comprehensive study of the evidence for larger hippocampal size in caching species threw the original claims into doubt, because no such

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[72] *See* Harry J. Jerison, *Evolution of the Brain and Intelligence* 61–62 (Academic Press 1973); Harry J. Jerison, *Brain, Body, and Encephalization in Early Primates*, 8 J. Human Evolution 615, 615–35 (1979).

[73] George Ruppel, *Bird Flight* 30 (Van Nostrand Reinhold 1977).

[74] Rogers, *supra* n. 1, at 93–94.

[75] Rogers, *supra* n. 53, at 289–323.

[76] Willem de Winter & Charles E. Oxnard, *Evolutionary Radiations and Convergences in the Structural Organization of Mammalian Brains*, 409 Nature 710, 713–14 (2001).

[77] Jennifer A. Basil et al., *Differences in Hippocampal Volume among Food Storing Corvids*, 47 Brain, Behaviour & Evolution 156, 156 (1996).

[78] David F. Sherry et al., *The Hippocampal Complex of Food-Storing Birds*, 34 Brain, Behaviour & Evolution 308, 308 (1989).

[79] John R. Krebs et al., *Hippocampal Specialization of Food-Storing Birds,* 86 Proc. Natl. Acad. Sci. 1388, 1388–92 (1989).

[80] Rogers, *supra* n. 1, at 115 ("Mammals that store food (e.g. squirrels) . . . have an enlarged hipppocampal region of the brain."); Basil, *supra* n. 77, at 162 (summarizing a study that found that in polygynous vole species, the males had hippocampi that were of a greater volume than the females).

relationship was found,[81] a later research group found that the relationship did indeed hold, provided one looked at North American and Eurasian species separately.[82] This function-related size of the hippocampus, however, might be little reflected in overall brain size, or in the overall size of the cerebral hemispheres or forebrain, since other regions of the brain might not co-vary, or they may even show the opposite association.

B. Communicating Intentionally

The ability to communicate meaningfully and intentionally is unquestionably a mark of higher cognition. Until just a few decades ago, it was believed that only humans have this capacity, but then Cheney and Seyfarth showed that wild vervet monkeys use different vocalizations to warn conspecifics of different types of approaching predators.[83] These monkeys have a specific call for an eagle, another for a leopard, and yet a third for a snake.[84] When other vervet monkeys hear one of these particular calls, they interpret the meaning of the message and take appropriate evasive action.[85] Since these initial findings, similar abilities have been demonstrated by other primates, including Diana monkeys,[86] other mammals,[87] and two avian species.[88]

Birds use a varied and complex array of vocalizations to communicate a wide variety of messages in specific situations. To name but a few, they use song to advertise their territories or to attract a mate, other vocalizations, such as food calls, either to ask to be fed or to signal to other birds in their flock that they have found food, and alarm calls to warn others of predators.[89]

"Until recently the virtually universal view has been that animal vocalizations are involuntary and that they are dominated by emotion."[90] This would mean that, although other birds might obtain

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[81] Anders Brodin & Ken Linborg, *Is Hippocampal Volume Affected by Specialization for Food Hoarding in Birds?* 270 Procs. Royal Socy. B, London 1555, 1555 (2003).

[82] Jeffrey R. Lucas et al., *Does Hippocampal Size Correlate with the Degree of Caching Specialization?* 271 Procs. Royal Socy. B, London 2423 (2004).

[83] Dorothy L. Cheney & Robert M. Seyfarth, *How Monkeys See the World: Inside the Mind of Another Species* 102 (U. Chi. Press 1990).

[84] *Id.*

[85] *Id.* at 102–03.

[86] Klaus Zuberbühler, *Referential Labeling in Diana Monkeys*, 59 Animal Behaviour 917, 922–23 (2000).

[87] *E.g.* Daniel T. Blumstein & Kenneth B. Armitage, *Alarm Calling in Yellow-Bellied Marmots: I. The Meaning of Situationally Variable Alarm Calls*, 53 Animal Behaviour 143, 166 (1997) (discussing marmots); Marta B. Manser, *The Acoustic Structure of Suricates' Alarm Calls Varies Depending on Predator Type and the Level of Urgency*, 268 Procs. Royal Socy. B, London 2315, 2318–21 (2001) (discussing meerkats).

[88] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 44.

[89] *Id.* at 63; Rogers & Kaplan, *supra* n. 8, at 70–99.

[90] Peter Marler & Christopher Evans, *Bird calls: Just Emotional Displays or Something More?* 138 Ibis 26, 26 (1996); *see* Rogers & Kaplan, *supra* n. 8, at 48 (discussing the view of some that animals, unlike humans, only make unintentional vocalizations).

meaning from the communication, the bird calling might have no ability to decide what call it makes and when it might be better to remain silent instead of attracting attention to itself.[91] As an example of the latter, it is pointless for a bird to issue an alarm call if it is alone, since it would merely attract the attention of the predator. Further, the bird, hearing and responding to an alarm call, might make the appropriate response without being aware of why it does so.[92]

Experimental evidence, however, indicates that this is not the case.[93] Detailed research on alarm calls in domestic chickens has demonstrated that chickens make entirely different alarm calls to signal the approach of a predator overhead versus the approach of a predator on the ground.[94]

> When recordings of [such] calls are played to a bird in the laboratory, [the bird] takes the appropriate evasive action (crouching if it hears the aerial alarm call, and [in an attempt to drive off or deter the predator] standing straight up and vocalizing loudly if it hears the ground-predator alarm call . . .).[95]

The important discovery showing that the chicken makes alarm calls with the intention of warning other members of its species, rather than doing so simply automatically when it sees the predator, came from experiments which compared the responses given by the chicken on seeing a predator when it was tested alone compared to when another chicken was caged alongside it.[96] The chicken, seeing the aerial predator, emitted "alarm calls only when the other chicken was present."[97] In contrast, "[w]hen [tested] alone, [the chicken] suppress[ed] its alarm call [so as to] avoid drawing attention to itself. In other words, the bird [does not simply call automatically; it] calls only when there is another bird to protect."[98]

Our own research on the Australian magpie (*Gymnorhina tibicen*) looks at referential communication in birds tested in their natural habitat.[99] Magpies vocalize a number of different alarm calls: some

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[91] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 43.

[92] *Id.* at 43–44.

[93] *Id.* at 44.

[94] *Id.*

[95] *Id.*; *see* Christopher S. Evans et al., *On the Meaning of Alarm Calls: Functional Reference in an Avian Vocal System*, 46 Animal Behaviour 23, 23–28 (1993) (referring to observations involving male chickens that suggest that ground alarm calls are evoked by animals moving on the substrate, while aerial alarm calls are produced in response to objectives moving overhead); Evans, *supra* n. 28, at 107 (discussing laboratory experiments using video-recorded and computer-generated images of predators to confirm the relationship between predator type and the type of alarm call elicited, where responses evoked were those that would facilitate detection of ground predators and aerial predators); Kaplan & Rogers, *supra* n. 37, at 146–47 (summarizing the aforementioned laboratory experiments).

[96] Evans, *supra* n. 28, at 116; Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 44.

[97] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 44.

[98] *Id.*

[99] *Id.*

signal alarm in a general sense, while others signal in the presence of a specific predator.[100] For example, magpies produce a very distinct call when they see an eagle circling overhead.[101] These calls were recorded and then played back to groups of magpies.[102] By scoring the magpies' behavior before, during, and after the playback we are able to determine whether the birds interpret the meaning of the calls.[103] When the recording of the "eagle" alarm call is played, the magpies look overhead to scan the sky for a flying predator.[104] This is a specific response that occurs very rarely when the general alarm calls are played back.[105] In fact, the response elicited by the eagle alarm call is even more specific than this. Magpies show a preference to look overhead with their left eye,[106] which means that they are using the right hemisphere to process the information.[107] Input from the left eye mostly goes to the right hemisphere, and previous research in our laboratory has shown that this hemisphere is specialized for detecting predators.[108]

The Australian magpie is a corvid, but the chicken (*Gallus gallus*) is not, although we know that both species use referential alarm calls.[109] In fact, the ancestral stock of the domestic chick ranks amongst the earliest evolved species,[110] and this species is not considered to have the well-developed forebrain typical of corvids and parrots.[111] However, despite these less evolved features and the assumed lesser intelligence of chickens, they communicate referentially and intentionally.[112]

This shows that, on these grounds alone, chickens must be included amongst those avian species that we now consider to exhibit higher cognition. The recent paper by Emery leaves chickens and related species, including quail, out of the category of species showing higher cognition[113] and fails to cite the work of Evans et al. which

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[100] *Id.*

[101] *Id.*

[102] *Id.*

[103] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 44.

[104] *Id.*

[105] *Id.*

[106] Rogers & Kaplan, *An Eye for a Predator*, *supra* n. 28, at http://www.eurekah.com/abstract.php?chapid=2715&bookid=196&catid=20.

[107] *See* Giuseppe Lippolis et al., *Lateralization of Predator Avoidance Responses in Three Species of Toads*, 7 Laterality 163, 179 (2002) (discussing this in the context of toads responding to a predator stimulus).

[108] *Id.*; Giuseppe Lippolis et al., *Lateralization of Escape Responses in the Striped-Faced Dunnart,* Sminthopsis macroura *(Dasyuridae Marsupalia)*, 10 Laterality 457, 457–58 (2005) (demonstrating that "[f]light . . . responses are controlled to a greater extent by the right hemisphere than the left hemisphere").

[109] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 10.

[110] Kaplan & Rogers, *supra* n. 37, at 185–86.

[111] Emery, *supra* n. 29, at 26.

[112] Evans et al., *supra* n. 95, at 34–35.

[113] Emery, *supra* n. 29, at 23.

demonstrates these species' impressive abilities to communicate referentially and intentionally.[114]

Although it remains to be tested empirically, we suggest that the ability to use alarm calls referentially and intentionally may be widespread across avian species. Recent evidence shows that a species of songbird, the black-capped chickadee, produces different calls to signal the presence of different predators, and the referential nature of these calls was tested by presenting audio playbacks and recording the responses of the bird receiving the calls.[115] The black-capped chickadee signals the size and potential threat of an approaching predator by adding syllables to the end of its alarm call.[116] The birds were tested with thirteen different species of raptors and two mammalian species of predator, and their calls were both recorded and later played back to them.[117] The smaller predators elicited more calls and more "D" syllables at the end of the calls than the larger ones, and the relationship between these two variables was systematic (i.e. in a straight-line relationship).[118]

Smaller raptors are a greater threat to chickadees than larger ones since they are more skillful than larger predators in changing flight direction on attack.[119] Size was not the only information in the signal, however, since the birds did not vocalize when they saw a small, harmless non-predator, such as a quail.[120] Playback of the calls elicited by the smaller, more threatening raptors, in turn, elicited more mobbing calls from the chickadees than did playback of calls elicited by larger raptors,[121] which indicated that the birds interpret the meaning of these calls. As the researchers said, this behavior represents an "unsuspected level of complexity and sophistication in avian alarm calls."[122] A vocalization that seemed to be a simple call has turned out to be remarkably complex, conveying much information.

C. *Learning of Vocal Communication*

Most study of communication in birds has been on their songs. Scientists know much about the complexity of song in many species and that some species learn their songs from bird tutors.[123] Some species have an enormous capability to form memories of the songs that they have heard during a sensitive period when they are young. For example, marsh wrens (*Acrocephalus palustri*) learn a great many of

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[114] Evans et al., *supra* n. 95, at 23–38.

[115] Christopher N. Templeton et al., *Allometry of Alarm Calls: Black-Capped Chickadees Encode Information about Predator Size*, 308 Science 1934, 1935 (2005).

[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] *Id.* at 1937.

[120] *Id.* at 1935, 1935 fig. 2, 1936 fig. 3.

[121] Templeton et al., *supra* n. 115, at 1936.

[122] *Id.* at 1934.

[123] Rogers & Kaplan, *supra* n. 8, at 128–40.

the songs that they hear other members of their species singing during a sensitive period from days twenty-five to fifty-five of life.[124] They have excellent memories, which is an aspect of higher cognition but does not in itself show that they are aware of forming or recalling these memories.

One of the critical abilities of humans is to be able to learn language.[125] The neocortex was once thought to be an indispensable precondition for language and vocal learning.[126] As we know today, humans are not the only ones capable of learning sounds, an attribute that has certainly contributed to notions of higher cognitive ability.[127] The capacity to learn, to remember, and to reproduce certain sequences of vocalizations requires a specific set of nuclei in the brain.[128]

While humans can no longer claim to be the only species with this ability, so far as we know today, this ability to learn vocalizations is limited to only a rather select group of species and phylogenetic orders of birds, cetaceans, and bats.[129] Complex vocal learning has been shown in parrots,[130] Anna's (*Calypte anna*) and Amazilia (*Amazilia amazilia*) hummingbirds,[131] and all songbirds.[132] In addition, songbirds, parrots, and hummingbirds are not closely related taxonomically.[133] According to Gahr, this suggests that vocal learning may have evolved independently at least three times among birds, whereas

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[124] Peter J. B. Slater & Alexandra E. Jones, *Lessons in Bird Song*, 44 Biologist 301, 301–03 (1997); *see also* Rogers & Kaplan, *supra* n. 8, at 134 fig. 6.1 (graphing song learning in marsh wrens).

[125] *See e.g.* Noble & Iain, *supra* n. 70, at 215–27 (The author suggests that humans formed language and gestures to gain an advantage in information exchange and planning, particularly in getting food.).

[126] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 45.

[127] Peter J.B. Slater & Robert F. Lachlan, *Is Innovation in Bird Song Adaptive?* in *Animal Innovation* 117, 117–35 (Simon M. Reader & Kevin N. Laland eds., Oxford U. Press 2003); Manfred Gahr, *Neural Song Control System of Hummingbirds: Comparison to Swifts, Vocal Learning (Songbirds) and Nonlearning (Suboscines) Passerines, and Vocal Learning (Budgerigars) and Nonlearning (Dove, Owl, Gull, Quail, Chicken) Nonpasserines*, 426 J. Comp. Neurology 182, 182–83 (2000).

[128] Fernando Nottebohm, *From Bird Songs to Neurogenesis*, 260 Sci. Am. 74, 74–77 (1989); Rogers, *supra* n. 1, at 98.

[129] Avian Brain Nomenclature Consortium, *supra* n. 61, at 156; Erich D. Jarvis, *Learned Birdsong and the Neuro Biology of Human Language*, 1016 Annals New York Acad. Sci. 749, 751 (2004).

[130] Susan M. Farabaugh et al., *Vocal Plasticity in Budgerigars (*Melopsittacus undulatus*): Evidence for Social Factors in the Learning of Contact Calls*, 108 J. Comp. Psychol. 81, 81 (1994); Anthony F. Gramza, *Vocal Mimicry in Captive Budgerigars (*Melopsittacus undulatus*)*, 72 Zeitschrift für Tierpsychologie 971, 971 (1970); Irene M. Pepperberg, *Functional Vocalizations by an African Grey Parrot*, 55 Zeitschrift für Tierpsychologie 139, 139–60 (1981).

[131] Luis F. Baptista & Karl L. Schuchmann, *Song Learning in the Anna Hummingbird (*Calypte anna*)*, 84 Ethology 15, 15 (1990) (demonstrating the Anna hummingbird's ability to "learn[ ] syllable types, frequency, rhythm and syntax"); *see* Gahr, *supra* n. 127, at 182–83.

[132] Kaplan & Rogers, *supra* n. 37, at 164–69.

[133] Gahr, *supra* n. 127, at 183.

among mammals it is a trait present in only a few, including humans.[134]

Scientists have used many aspects and methods to investigate how, when, and to what extent song is learned. Marler's classical study of teaching white-crowned sparrow juveniles (*Zenotrichia leucophrys*) to sing from listening to playback of tape-recorded song established the concept of a sensitive period in song learning, inspiring other researchers into further research on the importance of the sensitive period and on plasticity of learning at different age groups.[135] Other studies have emphasized the quality and extent of social facilitation in song learning. As Bennett Galef has stressed, social learning refers to acquisition of information from conspecifics, and this facilitates development of adaptive patterns of behavior.[136] As has been shown in barn owls, learning ability can be altered by the richness of the social environment.[137] Songbirds are able to transcend simple auditory learning, an ability to recognize specific sounds common among animals.[138] Songbirds also engage in vocal learning or vocal imitation: the sounds they produce match the ones they have heard (within limits imposed by anatomical and other constraints of the vocal apparatus).[139]

More importantly, transmission of such vocal imitation can occur by cultural transmission,[140] as has been observed in some cetaceans.[141] Birds may not be as vocally prolific as humans, but the range of vocalizations expressed by an avian species may extend to

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[134] *Id.*

[135] Peter Marler, *Birdsong and Speech Development: Could There Be Parallels?* 58 Am. Sci. 669, 671 (1970).

[136] Bennett G. Galef, Jr., *Recent Progress in Studies of Imitation and Social Learning in Animals*, in *Advances in Psychological Science: Biological and Cognitive Aspects* vol. 2, 275, 275–99 (Michel Sabourin et al. eds., Psychol. Press Ltd. 1998).

[137] Michael S. Brainard & Eric I. Knudsen, *Sensitive Periods for Visual Calibration of the Auditory Space Map in the Barn Owl Optic Tectum*, 18 J. Neuroscience 3929, 3939 (1998).

[138] E. Curio, *Cultural Transmission of Enemy Recognition by Birds*, in *Social Learning: Psychological and Biological Perspectives* 75, 75 (Thomas R. Zentall & Bennett G. Galef, Jr. eds., Lawrence Erlbaum Assocs. 1988); Slater & Jones, *supra* n. 124, at 302.

[139] Slater & Jones, *supra* n. 124, at 302.

[140] Curio, *supra* n. 138, at 75–76, 87–88; Francoise Dowsett-Lemaire, *The Imitative Range of the Song of the Marsh Warbler* Acrocephalus Palustris, *with Special Reference to Imitations of African Birds*, 121 Ibis 453, 465 (1979); *see also* Galef, *supra* n. 136, at 284–85 (detailing studies which demonstrate social learning of song in birds).

[141] Luke Rendell & Hal Whitehead, *Culture in Whales and Dolphins*, 24 Behavioral & Brain Sci. 309, 309 (2001); *see also* Luke Rendell & Hal Whitehead, *Cetacean Culture: Still Afloat After the First Naval Engagement of the Culture Wars*, 24 Behavioral & Brain Sci. 360 (2001) (a candid response to criticism and support of their article entitled *Culture in Whales and Dolphins*); Andrew Whiten, *Imitation and Cultural Transmission in Apes and Cetaceans*, 24 Behavioral & Brain Sci. 359 (2001) (a response to the Rendell & Whitehead article entitled *Culture in Whales and Dolphins* supporting the findings asserted there).

thousands of sounds, as may be the case for starlings, certain corvids, some smaller passerines, and parrots.[142]

In other words, the processes of learning vocalizations in birds can be very complex. The ability to learn demonstrates brain plasticity. For at least some species, such as the canary and the Australian magpie, it has been tested and confirmed that such plasticity is maintained well into and even throughout adulthood.[143] Also, parrots are capable of learning human language sounds well into advanced age.[144] Moreover, Pepperberg has shown that learning of human speech by Grey parrots may not be merely "parroting," but may involve comprehension of the meaning of the words, permitting the parrot to answer questions and express desires.[145]

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[142] *See* Donald E. Kroodsma & Linda D. Parker, *Vocal Virtuosity in the Brown Thrasher*, 94 Auk 783, 783–85 (1977) (on repertoire size in small passerines); *see also* S.A. Ince & P.J.B. Slater, *Versitility and Continuity in the Songs of Thrushes* Turdus *ssp.*, 127 Ibis 355, 355 (1985) (showing the large song capacity of various thrushes); C.K. Catchpole & P.J.B. Slater, *Bird Song: Biological Themes and Variations* §§ 8.2, 8.3, 8.7 (Cambridge U. Press 1995) (The authors provide a good general introduction to repertoire size and possible functions.). Note, however, that repertoire size and higher cognition may not necessarily be related. Repertoire size can have ecological functions such as territorial defense and sexual selection without involving "meaning" in the sense of semantic designation of sounds. In some species, however, such as many corvids like ravens, jays, Australian magpies, European magpies, and parrots, sounds can be more than embellishment and vocal learning. Gisela Kaplan, *The Australian Magpie: Biology and Behaviour of an Unusual Songbird* ch. 8, 99–101 (CSIRO Publg. 2004). In songbirds sounds can become a sign of plasticity and advanced abilities. *Id.* at 93 (for Australian magpies; F.M. Campbell et al., *Stimulus Learning and Response Learning by Observation in the European Starling, in a Two-Object/Two Action Test*, 58 Animal Behaviour 151, 151–58 (1999) (for starlings); Irene Maxine Pepperberg, *The Alex Studies: Cognitive and Communicative Abilities of Grey Parrots*, 152, 158, 166–67 (Harvard U. Press 2000) (demonstrating parrots' ability to understand relativity from vocal stimuli).

[143] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 46; *see also* Kaplan, supra n. 142, at 99–101 (explaining the magpie's ability to learn songs into adulthood).

[144] This is supported by our unpublished observations. We trained a galah, a native cockatoo of Australia, to say a new word. The bird was an abused bird that had been held in captivity for most of its life. Ill-treated galahs become difficult to handle. The bird suffered from mental distress expressed in stereotyped movements, unsolicited screaming, feather pulling, self-mutilation, extreme fearfulness of humans, and signs of hyperventilation often leading to death. On arrival, the bird was, in fact, close to death. Because of its history, however, the age was known. It was seventy-five years of age on arrival (human years) and it took more than two years of medical and behavior modification treatment to restore the bird's health. At the age of seventy-seven, we taught the bird a nonsense word, "cocka-chook," which we could be rather certain that it had not heard before. The bird acquired the word within a week. Hence, this one learning experiment alone shows remarkable plasticity into old age (galahs in captivity are said to have a life-span of about seventy to eighty years). Parrot Haven Aviary, *Galah Cockatoo*, "Life Span," http:www.parrot-haven-aviary.com.au/galah.htm (accessed Mar. 19, 2006). In the case of this bird, it was even more remarkable because, as we know from humans, severe and prolonged abuse has an impact on learning capacity. This took place in Armidale, N.S.W., Australia, in about 2000.

[145] Pepperberg, *supra* n. 142, at 208.

D. Avian Cognition Compared to That of Humans

Birds not only display an astounding array of communicative abilities, on some tasks their cognitive abilities surpass those of humans. For example, newly hatched chicks can recognize an object as a whole even when it is partly hidden behind another object (a cognitive process called amodal completion), whereas human babies are unable to do this until they are four to seven months old.[146] At first the human baby recognizes the partly hidden object only if the visible parts of the object move in a coordinated way (e.g. a dog with its head moving and tail wagging), and then later the object is recognized when it is stationary.[147] Chicks can recognize stationary objects that are partly occluded very soon after they hatch.[148] This difference between chicks and humans is probably due to the precocial nature of young chicks.[149] For example, very soon after hatching, chicks must be able to recognize and follow the hen, even when she moves behind objects; in contrast, newborn humans do not walk or move around their environment independently.[150]

Another study has demonstrated that a bird can perform better than a human on a task requiring matching of rotated objects or symbols. Juan Delius tested pigeons on a task based on a question selected from the Eysenck IQ test for humans.[151] Pigeons were trained to look at three keys in a row.[152] An asymmetrical symbol was projected onto the center key and the same symbol was projected onto one of the side keys.[153] On the other side key was projected a mirror-image reversal of the symbol.[154] The pigeon had to peck the side key matching the one in the center in order to obtain a food reward.[155] Once the pigeon was performing the task accurately, the symbols were rotated at different angles compared to the one on the center key.[156] Humans find this task more and more difficult as the rotation angles increase, just as we have difficulty in recognizing a familiar face when we see it upside down; but pigeons have no difficulties in performing this task regardless of the angle of rotation.[157] This ability to recognize objects at different angles would serve the flying pigeon well since it would need to

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[146] Lucia Regolin & Giorgio Vallortigara, *Perception of Partly Occluded Objects in Young Chicks*, 57 Perception & Psychophysics 971, 974–75 (1995); Vallortigara, *supra* n. 68, at 61–62 (summarizing the preceding study, *Perception of Partly Occluded Objects in Young Chicks*).

[147] Rogers, *supra* n. 1, at 81.

[148] Regolin & Vallortigara, *supra* n. 146, at 972.

[149] Vallortigara, *supra* n. 68, at 62.

[150] *Id.*

[151] Delius, *supra* n. 10, at 6–8.

[152] *Id.* at 8.

[153] *Id.*

[154] *Id.*

[155] *Id.*

[156] *Id.*

[157] Delius, *supra* n. 10, at 8.

recognize objects at different angles, whereas we ground walkers have less cause to do this.

E. Illusions and Biological Motion

Another recently discovered ability of birds similar to that of humans is their ability to see optical illusions and moving images from an array of moving dots.[158] The latter ability is referred to as biological motion.[159] Humans can recognize a moving human by merely seeing a set of moving dots generated by placing the dots on parts of the human body, such as the feet, knees, hand, elbows, shoulder, head, etc.[160] Chicks are able to recognize a hen represented by synchronously moving dots in a similar way.[161]

In one set of experiments, newly hatched chicks were exposed to a computer-generated pattern of moving dots representing a hen so that they became imprinted on this particular pattern, and, when tested later with this pattern and a pattern of dots moving in random (nonbiological motion), female chicks approached the one representing the hen.[162] Although it might appear that a computer-like, pre-programmed brain would be able to do this, the ability to recognize biological motion is considered to be an example of higher cognition in humans. It relies on complex processing in the brain.[163]

Another set of experiments has shown that young chicks can see optical illusions, which is an ability said to depend on higher cognition and once thought to be unique to humans, who use the neocortex to do it.[164] The researchers imprinted chicks on a three-dimensional object (a cone or a cylinder) and then tested them with two-dimensional

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[158] Lucia Regolin et al., *Visual Perception of Biological Motion in Newly Hatched Chicks as Revealed by an Imprinting Procedure*, 3 Animal Cognition 53, 53 (2000).

[159] *Id.*

[160] Gunnar Johansson, *Visual Perception of Biological Motion and a Model for its Analysis*, 14 Perception & Psychophysics 201, 201 (1973).

[161] Regolin, *supra* n. 158, at 53, 58.

[162] *Id.* at 56–58.

[163] D.I. Perret et al., *Retrieval of Structure from Biological Motion: An Analysis of the Visual Responses of Neurones in the Macaque Temporal Cortex*, in *AI and the Eye* 181, 193 (Andrew Blake & Tom Troscianko, eds., Wiley & Sons 1990).

[164] *See* E. Clara et al., *Domestic Chicks Perceive Stereokinetic Illusions* 2–3 (submitted for publication in Perception in 2006) (copy on file with *Animal L.*) (mentioning the human ability to see optical illusions and concluding that young chicks can do so as well); Rogers, *supra* n. 1, at 55–56, 124 (linking cognition to "the ability to form mental representations of objects" and citing Eccles's view that "consciousness is unique to humans and is a product of our highly developed neocortex"); Paul M. Churchland, *Perceptual Plasticity and Theoretical Neutrality: A Reply to Jerry Fodor*, 55 Phil. Sci. 167, 171–178 (1988) (discussing the author's conclusion that "the great many illusions and visual effects whose character shows that our visual modules are indeed penetrable by higher cognitive assumptions); *but see* Athanassios Raftopoulos, *Is Perception Informationally Encapsulated? The Issue of the Theory-Ladenness of Perception*, 25 Cognitive Sci. 423, 423–51 (2001) (This author believes that nearly all cases of visual illusions reported by Churchland as evidence for the cognitive penetrability of perception can be explained by other means.).

images that can be seen by humans as optical illusions of a cone and cylinder.[165] The illusion of a three-dimensional cone emerges when we look at a flat disc onto which off-center concentric circles have been drawn and this disc is rotated slowly.[166] The cylinder emerges from two flat discs, overlapping but slightly off-center and rotating together as one piece.[167] We call the ability to see these optical illusions stereokinesis.[168] The chicks imprinted on a cone and tested with a choice of these two illusions (at opposite ends of a runway) approached the illusion of the cone, and those imprinted on the cylinder approached the illusion of the cylinder.[169] The chicks could see the optical illusions.[170] Recent research has shown primates, the Rhesus macaque and the common marmoset, can also see these optical illusions.[171]

F. *Thinking of Objects Out of Sight*

If an object or an animal moves out of sight, we can still think about it and remember where it disappeared, and this is yet another aspect of higher cognition that we used to think of as being unique to humans. The problem has been investigated traditionally within the Piagetian conceptualization of "object permanence."[172]

Very young children do not recognize objects that have disappeared from their sight, but as they grow older, their ability to recognize such objects increases.[173] Experiments with chicks have also shown that birds possess this ability, and likely other species too. Regolin imprinted chicks on small red balls.[174] By being exposed to the balls after hatching, the chicks followed them as they would their mother.[175] The chicks were then tested in an arena with two screens placed a little way apart.[176] The chick had to stand in a small cage with transparent walls and watch the red ball as it was moved behind

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[165] E. Clara et al., *supra* n. 164, at 2.

[166] *Id.* at 9–10, 17–18.

[167] *Id.* at 1–7.

[168] *Id.* at 1; *see also* R.B. Mefferd Jr., *Perception of Depth in Rotating Objects: Phenomenal Motion in Stereokinesis*, 27 Perceptual & Motor Skills 903, 903–26 (1968).

[169] E. Clara et al., *supra* n. 164, at 20–22.

[170] *Id.*.

[171] E. Clara et al., *Perception of the Stereokinetic Illusion by the Common Marmoset (*Callithrix Jacchus*)* 2 (submitted for publication in the J. Animal Cognition 2006) (copy on file with *Animal L.*) (showing that "the common marmosets behaved as if they could perceive stereokinetic illusions"); R.M. Siegel & R.A. Andersen, *Perception of Three-Dimensional Structure from Motion in Monkey and Man*, Nature 259, 259 (January 21, 1988) (showing "that the Rhesus monkey can detect 3-D structure from motion in the same way as human subjects").

[172] *See generally* Vallortigara, *supra* n. 68, at 54 (The psychologist Piaget developed a model for development of the human child, one step of which involves the ability to know that an object still exists even when it has disappeared from view.).

[173] Rogers, *supra* n. 1, at 81.

[174] Vallortigara, *supra* n. 68, at 76.

[175] *Id.*

[176] *Id.*

one of the screens.[177] About two or three minutes after the ball had disappeared, the chick was released and the experimenter watched which screen the chick approached.[178] The chick chose the screen behind which the ball had disappeared, indicating that it could hold a memory of the location of the ball even though it had disappeared from sight.[179] This shows that the bird does not simply respond to only those objects and other stimuli that it can see at any one time, but it can hold and use memories of things past.[180] Even though the time that passed was very short for these young chicks, adult birds are likely to be able to do this over a much longer time span. No one has yet tested adult chickens on such a task.

Other researchers have shown that object permanence is an ability shown by the Grey parrot, as well as some other parrots,[181] and ring doves.[182] As yet, no other species have been tested for this ability, but given the broad evolutionary sweep of the species tested, one assumes this ability is widespread among avian species.

G. *Hiding Food and Knowing about Being Watched*

Some birds hide, or cache, their food at times of plenty and retrieve it later, sometimes after only a few days.[183] Other times, in species living in harsh climates, birds cache their food and retrieve it after months and at a time when it is scarce. The Clarke's nutcracker (*Nucifraga columbiana*) is a case of the latter, and it has an extraordinary capacity for remembering the locations of thousands of seeds that it cached in the season of plenty.[184] It does so using cognitive spatial maps; that is, using geometry rather than simply the details or landmarks surrounding the spot where each seed was cached.[185] Use of the latter strategy would be useless after snow has fallen.

The study of birds caching their food in the laboratory and retrieving it after short delays allows close observation of their strategies. Western scrub-jays (*Aphelocoma californica*) remember not only *where* they have cached the food items, but also *what* food items they have cached.[186] Researchers gave the birds two types of food, one relatively

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[177] *Id.*

[178] *Id.*

[179] *Id.*

[180] Vallortigara, *supra* n. 68, at 76–77.

[181] Irene M. Pepperberg & Mildred S. Funk, *Object Permanence in Four Species of Psittacine Birds: An African Grey Parrot (*Psittacus erithacus*), an Illiger Mini Macaw (*Ara maracana*), a Parakeet (*Melopsittacus undulatus*), and a Cockatiel (*Nymphicus hollandicus*)*, 18 Animal Learning & Behavior 97, 97 (1990).

[182] Claude Dumas & Donald M. Wilkie, *Object Permanence in Ring Doves (*Streptopelia risoria*)*, 109 J. Comp. Psychol. 142, 142 (1995).

[183] Emery & Clayton, *supra* n. 41, at 17; Kaplan & Rogers, *supra* n. 37, at 173.

[184] Kaplan & Rogers, *supra* n. 37, at 173.

[185] Sara J. Shettleworth, *Spatial Memory in Food-Storing Birds*, 329 Phil. Transactions Royal Socy., London B 143, 143–45 (1990).

[186] Emery & Clayton, *supra* n. 41, at 32, 36.

imperishable and the other perishable.[187] The birds cached both types in plastic, sand-filled ice-cube trays attached to a wooden board, surrounded by a Lego Duplo structure.[188] Then the birds were taken to another location for some time before they were again released into the room where they had made the caches.[189] They retrieved the perishable food items first and then the imperishable ones.[190] In humans, scientists give this kind of memory the special name of episodic memory, and we believe that it is typical of higher order cognitive ability.[191]

Because scrub-jays, like ravens, pilfer cached food from each other, one would expect the bird engaged in caching food to avoid being seen by another bird.[192] In fact, a bird that has been observed by another when it cached food items later, when alone, retrieves the food items and caches them again in a new location.[193] In another experiment, researchers allowed the bird to cache in two trays, only one of which the observing bird could see.[194] When the bird that had carried out the caching returned to its caches, this time alone, it retrieved and re-cached more food items from the tray that the observer had been able to see than from the tray that it had been unable to see.[195] These results suggest that birds are not only aware of being watched at the time they make a cache, but also that they have some concept of what the observer's intention may be. Of a human, we would say that he or she knows what is on the observer's mind. Primatologists refer to the primate equivalent of the caching bird as having a theory of mind, which they see as evidence of a very high level of cognition.[196]

H. *Following the Direction of Gaze*

Another behavior suggesting that one individual knows something about what another is thinking is following the direction of gaze. If someone looks in a certain direction, a second person might think that the first sees something interesting and may be thinking about something different than he or she is. In response, the second person would look in the same direction as the first. These cognitive steps that would lead the second person to follow the direction of the first's eyes may take place so rapidly that the second would be barely aware of them, but we consider such action to involve higher cognition.

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[187] Nicola S. Clayton, et al., *Elements of Episodic-Like Memory in Animals*, 356 Phil. Transactions Royal Socy., London B, 1483, 1485 (2001).

[188] *Id.*

[189] *Id.*

[190] *Id.* at 1485–86.

[191] *Id.* at 1483–84.

[192] Emery & Clayton, *supra* n. 41, at 18–20.

[193] *Id.* at 18.

[194] *Id.* at 18–20.

[195] *Id.*

[196] Daniel J. Povinelli & Todd M. Preuss, *Theory of Mind: Evolutionary History of a Cognitive Specialization*, 18 Trends in Neurosciences 418, 418–24 (1995).

Sometimes, when a human's view is obstructed, or if one cannot see anything of interest when one follows another person's direction of gaze, she may ask, "What are you looking at?" This suggests that following the direction of gaze is an aspect of higher cognition, and one that scientists might be able to see in animals, if it occurs. Some recent studies have shown that chimpanzees will follow a human's gaze direction.[197] While this might be a measure of their intelligence, we would not be particularly convinced if it were the only one we had. The animal could be responding to straight-forward behavioral cues to orient its direction of gaze, rather than being capable of understanding that the human can see something that it cannot see. Nevertheless, it is indisputable that gaze following is valuable to social life. For example, it might be a guide to the location of predators, food, and many other resources important for survival.

No one thought that a bird might be able to follow the direction of a human gaze, especially those species with eyes on the sides of their head and no clear pupil or white of the eye that would make it easy to tell in what direction they are looking.[198] When hand-raised ravens (*Corvus corax*) were tested to see whether they could follow the direction of a human's eye gaze,

> not only did the ravens look up when a human looked up, but when the human was looking at something hidden from the raven's immediate view . . . the raven would . . . come over to the barrier and peer around it. If the raven was responding only to simple . . . cues and not using higher cognition, [one would expect the bird to merely] stay where it is, look at the barrier, find it uninteresting, and go on with whatever it was doing before. Instead, the raven behaved as if it were aware that something interesting was located behind the barrier.[199]

Of course, when it comes to one bird following the direction of gaze of another, the bird might follow the direction in which the other's head, particularly the beak, is pointing. But it is not quite that simple because many birds have two regions (fovea) of the retina specialized for detailed vision—one looking in front and one to the side.[200] Therefore, the beak may be pointing in one direction, but the bird may be looking sideways in another direction, or to both places at once. But it seems that birds do know when animals with two eyes placed frontally, facing forward, are looking at them.[201] They might have evolved

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[197] Joseph Call, *The Use of Social Information in Chimpanzees and Dogs*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* 263, 272 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic/Plenum Publishers 2004). Some experiments show that dogs can follow human gaze direction when looking for food. *Id.* at 272–73.

[198] Kaplan & Rogers, supra n. 37, 99–101.

[199] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 43.

[200] Onur Güntürkün et al., *Neural Asymmetries and Visual Behaviour in Birds*, in *Biological Signal Processing* 122, 131 (Hans Christoph Lüttgau & Reinhold Necker eds., VCH 1989).

[201] Rogers & Kaplan, *Bird Brain*, *supra* n. 28, at 43.

this ability because many of their predators have frontal eyes (e.g. birds of prey—owls, and other raptors—as well as predatory mammals),[202] and this ability can be generalized to apply to humans. Ravens also cache food items and might use the ability to recognize direction of gaze to decide when they are being observed as they cache food.[203] These clever behaviors of ravens and other corvid species, as well as their abilities to solve complex problems and to use tools, discussed *infra* part I, indicate that they have complex cognitive abilities related to social behavior and finding food.

I. Making and Using Tools

Making tools and using them has long been considered the hallmark of human superiority over other species, but we now know that some animals do this too.[204] Chimpanzees select twigs and break them to lengths suitable for inserting into termite nests to fish out the insects.[205] This finding, as well as other examples of tool using in apes,[206] was surprising until an even more surprising discovery was made. New Caledonian crows make and use tools to probe insects from holes in trees.[207] To manufacture one type of jagged-edged tool, the crow uses its beak to cut pieces from the leaves of pandanus palms.[208] Others they fashion from twigs.[209] Moreover, the crows have been seen to store their tools in notch holes in trees and retrieve them to use at a later time.[210]

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[202] *Id.*; Kaplan & Rogers, *supra* n. 37, at 100–01.

[203] Thomas Bugnyar & Kurt Kotrschal, *Leading a Conspecific Away from Food in Ravens (*Corvus corax*)?* 7 Animal Cognition 69, 69–76 (2004).

[204] Sue Taylor Parker & Kathleen R. Gibson, *Object Manipulation, Tool Use and Sensorimotor Intelligence as Feeding Adaptations in Cebus Monkeys and Great Apes*, 6 J. Human Evolution 623, 623 (1977); Louis Lefebvre et al., *Tools and Brains in Birds*, 139 Behaviour 939, 939 (2002).

[205] Hilary O. Box & Anne E. Russon, *Socially Mediated Learning among Monkeys and Apes: Some Comparative Perspectives*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* 97, 122 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic 2004); *see* W.C. McGrew, *Culture in Nonhuman Primates?* 27 Annual Revs. in Anthropology 301, 315 (1998) (discussing chimpanzee tool use).

[206] Other examples of tool use in apes include cracking open nuts by placing them on an anvil stone or tree root and hitting them with a hammer stone. W.C. McGrew, *The Material of Culture*, in *Chimpanzee Cultures* 25, 25–39 (Richard W. Wrangham et al. eds., Harvard U. Press 1994).

[207] Hunt, *supra* n. 18, at 249.

[208] Gavin R. Hunt & Russell D. Gray, *Direct Observations of Pandanus-Tool Manufacture and Use by New Caledonian Crow (*Corvus moneduloides*)*, 7 Animal Cognition 114, 116–18 (Nov. 28, 2003).

[209] Hunt, *supra* n. 18, at 250; *see also* Alex A.S. Weir et al., *Shaping of Hooks in New Caledonian Crows*, 297 Sci. 981, 981 (2002) (for a study on New Caledonian crows' ability to shape hooks from wire).

[210] Gavin Raymond Hunt, *Human-Like, Population-Level Specialization in the Manufacture of Pandanus Tools by New Caledonian Crows* Corvus moneduloides, 267 Procs. Royal Socy. B 403, 404 (2000); Gavin R. Hunt & Russell D. Gray, *Diversification and Cumulative Evolution in New Caledonian Crow Tool Manufacture*, 270 Procs. Royal Socy. B 867 (2003).

This research suggests that the crows have some notion of what the function of tools is and that they can plan ahead for a future event. Such foresight is considered to be one of the mainstays of higher cognition.[211] Not only can birds plan ahead by caching food, as discussed above, but they are also able to plan the means by which they will obtain food in the future.[212]

There are many other examples of avian species using tools, but not ones that they themselves have manufactured. A comprehensive analysis of tool use in birds by Lefebvre et al. concludes that tool use is more common in corvids and passerines than in other avian orders, but that this trait may have evolved several times over rather than being passed on from a common ancestor.[213] Additionally, this study demonstrated that using tools correlates with having a larger brain,[214] but see *infra* notes 260 to 268 and accompanying text for more discussion of this.

J. Forming Abstract Concepts

To form abstract concepts requires highly complex cognition, and at least one study on pigeons tested in controlled laboratory conditions has shown that they can form abstract concepts.[215] Testing pigeons pecking at keys onto which photographs had been projected showed that they could form abstract concepts of "oddity" (pecking the odd picture out of a group) and "sphericity" (pecking the image of any rounded shape).[216] They even formed the abstract concept of "water" and would peck at any image with water in it, regardless of whether the water was in a glass, a lake, or a droplet on a leaf.[217] Moreover, pigeons can learn to discriminate between photographs containing and not containing a human, or humans.[218]

The ability to discriminate between objects that are the same or different has also been shown by pigeons using operant techniques,[219] and by the Grey parrot, Alex, using his ability to communicate using human speech.[220] It is not known, however, whether these two very different species use the same cognitive processes to make these deci-

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[211] McGrew, *supra* n. 206, at 25–39.

[212] Hunt & Gray, *supra* n. 208, at 116–18.

[213] Lefebvre et al., *supra* n. 204, at 939–73.

[214] *Id.*

[215] Delius, *supra* n. 10, at 1–29.

[216] *Id.*

[217] *Id.*

[218] R. J. Herrnstein & D. H. Loveland, *Complex Visual Concept in the Pigeon*, 146 Sci. 549, 549 (1964).

[219] Delius, *supra* n. 10, at 7–8; Shigeru Watanabe, *Van Gogh, Chagall and Pigeons: Picture Discrimination in Pigeons and Humans*, 4 Animal Cognition 147, 148–49 (2001).

[220] Irene M. Pepperberg, *Acquisition of the Same/Different Concept by an African Grey Parrot (*Psittacus erithacus*): Learning with Respect to Categories of Color, Shape, and Material*, 15 Animal Learning & Behavior 423, 423 (1987).

sions.[221] Yet, the contention that pigeons use higher cognition to do so has been strongly questioned.[222]

Even young chicks have some abilities to form abstract concepts, as Giorgio Vallortigara has found.[223] The chick can learn to find food buried exactly at the center of arenas of different geometrical shapes (squares, triangles, circles).[224] They do not simply measure the distance from the walls, as shown by testing them in arenas of different sizes as well as shapes, but find the center using geometrical cues.[225] This ability in a bird, and a young one at that, is quite unexpected and takes us well away from the traditional view of birds being out on an evolutionary limb with small and not very complex brains.[226]

K. A Concept of Self

The abilities to abstract and to think of past and future events are considered to be highly complex forms of cognition.[227] But to some scientists the idea of self-awareness is even more indicative of higher cognition.[228] We can conduct verbal tests on humans to establish whether an individual is capable of perceiving himself or herself as a separate entity in the world.[229] Non-verbal tests of self-awareness may involve the use of a mirror.[230] In a mirror humans can recognize themselves, make poses, and thus consciously alter the image in the mirror.[231] Chimpanzees also adopt postures like us when they look at their image in a mirror.[232] Monkeys, as far as we know, commonly do not recognize themselves in a mirror.[233]

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[221] More detailed testing would be needed to find out exactly what cognitive steps the two species make in arriving at such decisions.

[222] Euan M. Macphail, *Brain and Intelligence in Vertebrates* 168–237 (Clarendon Press 1982).

[223] Vallortigara, *supra* n. 68, at 81.

[224] L. Tommasi et al., *Young Chickens Learn to Localize the Centre of a Spatial Environment*, 180 J. Comp. Physiology A 567, 567–69 (1997) (Chicks trained to find food in center of square subsequently searched near centers of circles, triangles, and rectangles.).

[225] Luca Tommasi & Giorgio Vallortigara, *Searching for the Center: Spatial Cognition in the Domestic Chick (*Gallus gallus*)*, 26 J. Experimental Psychol.: Animal Behavior Processes 477, 480–81 (2000).

[226] Rogers, *supra* n. 1, at 58, 72.

[227] *See id.* at 61–81 (discussing research on animal insight, concept formation, memory, and mental representations).

[228] *See id.* at 15 ("Awareness of self is a central aspect of consciousness.").

[229] *See* Povinelli & Preuss, *supra* n. 196, at 422 (noting that evidence of self-awareness in children includes comments made by the children about their plans and mental states).

[230] *Id.*

[231] *See id.* at 421 fig. 3, 422 (noting the behavior in chimpanzees and likening it to that of humans).

[232] *Id.*

[233] Gordon G. Gallup, Jr., *Chimpanzees: Self-Recognition*, 167 Sci. 86, 86–87 (1970); Rogers, *supra* n. 1, at 27.

According to studies by Gordon G. Gallup, Jr., chimpanzees are able to recognize their mirror images.[234] Here, researchers placed a red dot on the foreheads of anaesthetized chimpanzees, and, after the chimpanzees regained consciousness, they were presented with a mirror.[235] If a chimpanzee were to merely point at the dot in the mirror, it would indicate that the chimpanzee did not recognize itself in the image.[236] However, in this test, the chimpanzees (and orangutans in a subsequent test) started wiping their own foreheads, suggesting that they were able to recognize the images in the mirrors as their own.[237] These tests have been criticized by some,[238] and there are many complications to these experiments and ways in which they must be controlled.[239] In general, though, the tests show that an ape is aware that its image in a mirror is itself. The results of these tests led to a perception that such cognitive ability is unique to the most highly advanced primates, great apes and humans, and therefore is linked to the increased size of the neocortex. However, a recent experiment has radically changed this view.

Prior and fellow researchers tested whether or not a bird could recognize itself in the mirror.[240] They chose hand-raised European magpies (*Pica pica*)[241] and exposed them to a series of tests.[242] The crucial test involved placing a red dot on the bird's throat in a spot where the bird could not see it directly, then watching the bird's behavior when facing a mirror.[243] They found convincing evidence that the bird directed its attention to its own body and attempted to reach the spot where the red paint had been placed, rather than pecking at the reflection of the red dot in the mirror.[244] So far, this is the only test of its kind showing self recognition in mirrors, but the rigorous research protocol would suggest that, at least in this one avian species, something akin to self-awareness is present. Other tests with birds

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[234] Gallup, Jr., *supra* n. 233, at 86–87.

[235] *Id.*

[236] Rogers, *supra* n. 1, at 24–26.

[237] *Id.* at 26–27.

[238] *See* C. M. Heyes, *Self-Recognition in Primates: Further Reflections Create a Hall of Mirrors*, 50 Animal Behaviour 1533 (1995) (criticizing the Gallup experiment's design, noting unreliable effects, flawed analysis and reliance on circumstantial evidence); C. M. Heyes, *Theory of Mind in Nonhuman Primates*, 21 Behavioral & Brain Scis. 101, 104 (1998) (arguing that the evidence of self-recognition is not reliable).

[239] *See* Rogers, *supra* n. 1, at 26–28 (describing the methods and controls used in Gallup's mirror tests and the need for more rigorously controlled experiments).

[240] H. Prior et al., *Sich Selbst Vis-à-vis: Was Elstern Wahrnehmen*, 2 Rubin 26, 26–30 (2000).

[241] *Id.* at 26–30; Biocrawler.com, *European Magpie*, http://www.biocrawler.com/encyclopedia/Pica_pica (last modified May 5, 2005).

[242] Prior et al., *supra* n. 240, at 28–30.

[243] *Id.* at 28–29.

[244] *Id.* at 29–30.

and mirrors have failed to show that the birds recognize their image as self.[245]

IV. CONCLUSION

A. *The Theses Summarized—A Road Map for the Future?*

The above is not intended to be an exhaustive account of the cognitive abilities of birds, but it is intended to point out that the latest research presents society with a need to change our traditional thinking on birds. We believe, therefore, that this research opens up debate on legislation to protect birds. Moreover, our first thesis argued that biology is not value free.[246]

Here, this point has been demonstrated in just two specific theoretical developments: the overturning of the Cartesian model and the supremacist, simplistic evolutionary views. Decades of research into the abilities of great apes, while valuable and conducted under strict scientific conditions, have generally maintained what Emery and Clayton rightly describe as "primocentrism."[247] Primocentrism focuses on the primate line, because it is allegedly the only branch in the animal kingdom in which it is worthwhile to search for higher cognitive abilities.[248] We have shown here that primocentrism is an ideology rather than scientific fact. Findings of higher cognitive abilities in birds overturn old assumptions that higher cognition followed a steady and superior evolution along just one evolutionary trajectory. In addition, challenges to these old assumptions have come from new discoveries about the complex cognition of octopuses and fish.[249] Hence, the research on avian species has been extremely important in breaking the nexus between cognitive ability and the primate line. It has also undermined assumptions about the importance of the neocortex as a precondition for any cognitive development.

Research outside the primate line has thus caused a conceptual shift away from dearly held assumptions about evolution. Many scientists have known for a long time that evolution can work in homolo-

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[245] Emery & Clayton, *supra* n. 41, at 41–44 (discussing the variety of mirror guided self-recognition tests conducted on crows, parakeets, western scrub-jays, and parrots). Note, however, that Grey parrots possess significant object permanence ability. Prior et al., *supra* n. 240, at 27.

[246] *See e.g.* R.C. Lewontin et al., *Not in Our Genes: Biology, Ideology, and Human Nature* (Pantheon Books 1985) (arguing that certain interpretations of biology are guided by political, social, and religious beliefs and, in extreme cases, by ideology). The book offers a very useful introduction to the susceptibility of biology to being distorted by political arguments and general belief systems. *Id.* at 5–36.

[247] Emery & Clayton, *supra* n. 41, at 4–5.

[248] *Id.*

[249] *See* Yfke van Bergen et al., *Social Learning, Innovation, and Intelligence in Fish*, in *Comparative Vertebrate Cognition: Are Primates Superior to Non-Primates?* 141–68 (Lesley J. Rogers & Gisela Kaplan eds., Kluwer Academic/Plenum Publishers 2004) (for discussion of complex cognition in fish).

gous and analogous ways.[250] Traits can emerge, disappear, and reemerge in one species, one order, and across orders with no direct links between them.[251] Clearly, in support of our second thesis, it is of considerable importance that policy and lawmakers are beginning to understand these conceptual shifts and to distinguish fact (science) from ideology (dressed as science).

Our third thesis, that the conclusions some policy and law makers are beginning to draw from research on animal cognition are either flawed or problematic, has been discussed in several ways. First, the inclusion of great apes in legislation designed for humans (giving apes modified additional rights) may not only *not* free society from primocentrism, but may have serious implications for other species not included.

The international primatology community debated such issues at length at its 2004 meeting in Turin.[252] A core group of attendees wished to proceed with lobbying politicians and the legal profession for including great apes in new rights legislation. We were present at that meeting and noticed the reservations by a significant number of primatologists, especially by those working with lesser apes (gibbons) and monkeys. Supporters of the motion based their arguments largely on cognitive ability and the view that a start had to be made. Supporters felt that the great apes were just pioneers in a long road of new legislative measures that could follow for improved protection of other animals. However, since such action retains primocentrist positions, it is equally conceivable that great apes could become the exception among animals and that no further legislative changes would follow.

Second, still pertaining to our third thesis, there are conceptual and scientific problems to consider if new legislation were to be based on a blanket set of criteria that the *animals*, not we as legislators or scientists, must fulfill. The philosopher Regan grappled with species differences in cognitive ability and suggested that rights be extended to those with desires, a sense of the future, feelings of pleasure and pain, and other aspects of higher cognition.[253] However, as Bateson pointed out so clearly, the problem confronting those of us who study the behavior of animals is how to identify those species that have these abilities.[254] We have addressed this problem before and found it

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[250] *See e.g.* Stephen Jay Gould, *The Structure of Evolutionary Theory* (Harvard U. Press 2002) (discussing analogy in evolution); Ernst Mayr, *What Evolution Is* 25–27 (Basic/Perseus Books 2001) (for discussion on homology in evolution).

[251] *See* Gould, *supra* n. 250 (discussing analogy in evolution); Mayr, *supra* n. 250, at 25–27 (for discussion on homology in evolution).

[252] Both authors have served as members of the scientific committee of the International Primatological Society (IPS), Turin, Italy, 2004, and have written extensively on orangutans. *See IPS 2004 - Torino*, http://www.ips2004.unito.it/index.html (for information about the meeting); *see also* Gisela Kaplan & Lesley J. Rogers, *The Orangutans* (Perseus Publg. 2000) (for a book on orangutans by the authors).

[253] Tom Regan, *The Case for Animal Rights* (U. of Cal. Press 1983).

[254] Patrick Bateson, *Ethics and Behavioral Biology*, 35 Advs. Study Behavior 211, 211–33 (2005).

largely insoluble on the basis of current knowledge of animal behavior.[255] We have also cautioned against creating a new *Scala Naturae* based on cognitive ability.[256] Similarly, Emery and Clayton have pointed out the perils of re-erecting a *Scala Naturae*.[257]

As we hope the above discussion shows, cognitive ability is not a simple linear continuum from the lower, "less intelligent," to the higher, "more intelligent," species. The evolution of higher cognitive abilities may be influenced by many selective forces, including those of habitat and social system, the latter being a rather generally held view among primatologists and, more recently, ornithologists.[258] As shown here, whatever the reason for one species displaying "more intelligent" behavior than another, there is no simple formula for testing relative cognitive ability. Indeed, the failure of any one species to meet the criteria scientists have set on any given task may merely reflect the limits of our own human intelligence. In other words, species vary in their cognitive abilities and, were humans creative and knowledgeable enough about the species, we might be able to design a task on which that species would excel, such as pigeons performing better than humans on the rotation matching-to-sample task.[259] Clearly, performance on a single task would be insufficient evidence on which to base ethical and legal decisions.

Moreover, society tends to rate more highly those species that behave more similarly to ourselves by using cognitive processing that equates to ours. At one level this view is a form of "speciesism" because it fails to recognize equality in species' differences in cognitive type. To species known to use tools, an ability we humans value greatly, we afford the rank of the highest intelligence.[260] This is the case for primates, the highest rank being originally reserved for apes, chimpanzees in particular, but recently extended to capuchin monkeys, since the discovery that they use tools in the wild.[261] A reflection of the same attitude is manifested when the intelligence of avian species is discussed, the tool-using species being ranked at the top.[262] However, tool use to obtain food is a useful behavior in only some habitats and is irrelevant in others: there is no value in using a tool when a beak, mouth, or hand will do. In fact, a study of the Galapagos woodpecker

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[255] Lesley J. Rogers & Gisela Kaplan, *All Animals Are* Not *Equal: The Interface between Scientific Knowledge and Legislation for Animal Rights*, in *Animal Rights: Current Debates and New Directions* 175, 175–202 (Cass R. Sunstein & Martha C. Nussbaum eds., Oxford U. Press 2004).

[256] *Id.*

[257] Emery & Clayton, *supra* n. 41, at 3.

[258] Emery, *supra* n. 29, at 30.

[259] Delius, *supra* n. 10, at 6–18.

[260] Rogers, *supra* n. 1, at 81–89.

[261] Dorothy Fragaszy et al., *Wild Capuchin Monkeys (*Cebus libidinosus*) Use Anvils and Stone Pounding Tools*, 64 Am. J. Primatology 359, 361 (2004).

[262] Hunt & Gray, *supra* n. 210, at 873–74; S. Tebbich & R. Bshary, *Cognitive Abilities Related to Tool Use in the Woodpecker Finch*, Cactospiza pallida, 67 Animal Behaviour 689, 689–90 (2004).

finch (*Cactospiza pallida*) found that use of cactus spines to probe insects from holes occurs seasonally and only in those birds living in dry habitats, where other food is less abundant.[263]

We might rank this species highly on our scale of "intelligence," but this would leave out the species' close relatives living in habitats where food is more abundant, or those specialized to eat different types of food. Some have argued that higher cognitive abilities emerge only when the habitat demands it,[264] and in a general sense they could be correct. However, we are not of the opinion that science could back such distinctions between closely related species.

We do not disagree with the concept that tool using requires higher cognitive abilities, and special ones as well since it involves making causal connections between objects external to the animal's own body.[265] But society should not assume that a species ranks lower down the scale merely because it has not been observed to use tools. A broader filter such as species variations in innovative behavior, as used by Lefebvre et al., would be preferable.[266] Such an approach would encompass tool using, but not exclusively.[267] In fact, there is some evidence that innovation in one area may be traded off against innovation in another, since Lefebvre and Bolhuis found a negative association between tool using and food caching.[268] Different regions of the brain appear to be involved in each case, since food caching correlates with the size of the hippocampus[269] and tool using with the size of an adjacent region of the forebrain, the nidopallium.[270] A tradeoff between these two regions of the forebrain could mean that overall size of the forebrain remains stable.

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[263] Sabine Tebbich et al., *The Ecology of Tool-Use in the Woodpecker Finch (*Cactospiza pallida*)*, 5 Ecology Ltrs. 656, 656 (2002).

[264] *See e.g.* Reuven Dukas, *Evolutionary Ecology of Learning*, in *Cognitive Ecology: The Evolutionary Ecology of Information Processing and Decision Making* 129, 135 (Reuven Dukas ed., U. Chi. Press 1998) (stating that "[a]ll types of phenotypic plasticity, including learning, can be seen as adaptations to some pattern of environmental variation"); Phyllis C. Lee, *Innovation as a Behavioural Response to Environmental Challenges: A Cost and Benefit Approach*, in *Animal Innovation* 262, 262, 272 (Simon M. Reader & Kevin N. Laland eds., Oxford U. Press 2003) (discussing innovation in nonhuman primates due to environmental changes and concluding that such innovation occurs when the benefits outweigh the costs of changing old behaviors); Simon M. Reader & Kevin N. Laland, *Animal Innovation: An Introduction*, in *Animal Innovation* 3, 25–26 (Simon M. Reader & Kevin N. Laland eds., Oxford U. Press 2003) (discussing studies that indicate that animal innovation may be a product of its environment).

[265] Parker & Gibson, *supra* n. 204, at 623–41.

[266] Louis Lefebvre et al., *Brains, Innovations and Evolution in Birds and Primates*, 63 Brain, Behavior & Evolution 233, 233–46 (2004).

[267] *Id.*

[268] Louis Lefebvre & Johan J. Bolhuis, *Positive and Negative Correlates of Feeding Innovations in Birds: Evidence for Limited Modularity*, in *Animal Innovation* 39, 55 (Simon M. Reader & Kevin N. Laland eds., Oxford U. Press 2003).

[269] *See supra* nn. 77–82 and accompanying text (discussing the relationship between size of the hippocampus and species that cache their food).

[270] Lefebvre et al., *supra* n. 204, at 939–73.

Without laboring these points further, we stress the difficulty in ranking animals according to any scale that might translate with ease into legal or ethical guidelines. However, society needs to make changes to the current animal welfare guidelines and legislation.

Legislation in the United Kingdom gives special protection to those species that we keep commonly as pets (cats and dogs) and use for special sports (horses).[271] On scientific grounds, protecting these species and not primates is clearly unacceptable. Society can now see that the widespread disregard of any protection for birds is based on false attitudes. Although society may be faced with a daunting task of deciding which species to protect, the point stands that some species deserve to be protected because they can "think," regardless of the problem that others fall outside this category at present. Following the new discoveries of higher cognition in some avian species, the grey area of where we could draw a line between those species deserving special protection and those that do not has broadened. While some have argued that understanding our evolutionary origins should help us to decide whom to protect, and how to deal with moral questions surrounding the use of animals in research,[272] new discoveries about birds have rather muddied the waters since similar cognitive horizons might be reached by analogous, rather than homologous, routes.

The final thesis of this paper has implied that *species specificity* would require *species-appropriate* legislation, and that runs very much counter to a simple rule that all animals be afforded the *same* rights to be seen as equal before the law. Species-appropriate legislation, taking into account not only needs and perceptual capabilities but cognitive ones as well, strongly implies degrees of *differences* in legislative protection. We are not lawmakers and admit that this may be a difficult task, but lawyers assure us that differences among humans (in terms of class, status, power, sex, religion, ethnicity, etc.) have largely been addressed by blanket rules of equal rights of procedure and representation before the law.[273] Of course, we might simply afford all vertebrate species equal basic protection regardless of their cognitive abilities, which is essentially the present situation in several countries.[274] But these legislative protections often do not go far enough to

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[271] *See e.g. Animals (Scientific Procedures) Act 1986*, § 5(6), http://www.archive.official-documents.co.uk/document/hoc/321/321-xa.htm (May 15, 2000) (only allowing special licenses for use of "cats, dogs, primates or equidæ" where "no other species are suitable for the purposes of the programme . . . or . . . it is not practicable to obtain animals of any other species that are suitable for those purposes").

[272] *See e.g.* Lewis Petrinovitch, *Darwinian Dominion: Animal Welfare and Human Interests* (MIT Press 1999) (taking an evolutionary basis for deciding on animal welfare).

[273] *E.g. A Universal Declaration of Human Rights*, U.N. Gen.Assembly Res. 217 A (III) (Dec. 10, 1948) (available at http://www.un.org/Overview/rights.html) (setting out the basic human rights of all humans); Kaplan & Rogers, *supra* n. 3, at 96–99.

[274] *See e.g. Code of Practice for the Housing of Animals in Designated Breeding and Supplying Establishments* §§ 3.19(6), 3.21, 3.28, 3.37 (U.K. 1995) (available at http://scienceandresearch.homeoffice.gov.uk/animal-research/publications/publications/code-

encompass special perceptual needs. To give just two examples: computer or other electronic equipment emits sounds in the ultrasound range that rodents, particularly rats, can hear as noise.[275] This noise

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of-practice/housing-of-animals-breeding/hadcb31.pdf?view=Binary) (mentioning species appropriate protections and those based on "biological" or "physiological and behavioural needs of the animals" but not varying protections based on cognitive ability); *European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes*, pt. I, art. 1, §§ 1, 2a (Mar. 18, 1986), http://conventions.coe.int/Treaty/en/Treaties/Html/123.htm (applying to "any animal used or intended for use in any experimental or other scientific procedure where that procedure may cause pain, suffering, distress or lasting harm," defining "animal" as "any live non-human vertebrate," and not varying protections based on cognitive ability of species); Animal Welfare Advisory Comm. (N.Z.), *Code of Recommendations and Minimum Standards for the Care and Use of Animals for Scientific Purposes*, http://www.biosecurity.govt.nz/animal-welfare/codes/scientific-purposes/index.htm (Aug. 1995) (website no longer available) (copy on file with *Animal L.*) (The code covers "all live non-human vertebrates" and contains many species-specific considerations. *Id.* at §§ 4(e), 4(p), 6.1, 6.2, 6.3.1, 6.3.2, 6.3.5, 6.3.10, 7.1, 7.3, 7.5, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.5.5, app. I(5)(d)(iv), app. I(6)(b)(iii), app. III(4)(c). But while generally ignoring cognitive ability as a factor for protection, the code uses "cognitive development" as a factor for choosing the appropriate species for projects. *Id.* at § 6.2.); Natl. Health & Med. Research Council Austrl. et al., *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* (7th ed., Australian Govt. 2004) (available at http://www.nhmrc.gov.au/publications/_files/ea16.pdf) (While providing protections to "all non-human vertebrates," the code contains many species-specific considerations. *Id.* at 1, §§ 1.15, 1.16, 3.1.8, 3.1.10, 3.2.1(iii), 3.3.1, 3.3.3, 3.3.7, 3.3.16, 3.3.25, 3.3.28, 3.3.74, 4.1.4, 4.1.5, 4.4.3, 4.4.4, 4.4.14, 4.4.19, 4.4.20(vii), 4.4.20(viii), 4.4.21, 4.4.22, 4.4.25, 4.4.26, 4.5.3, 5.1.1, 5.2.1(iii), 5.2.3, 5.3.1, 5.4.2, 5.4.6, 5.5.2(iii), 5.5.2(iv), 5.7.1(v), 5.9.1, 5.9.4, apps. 2, 3, 4. Additionally, this code is not void of consideration of cognitive capacity. The code uses "cognitive development" as a factor in choosing animals for studies. *Id.* at § 3.2.2. Also, the code provides for special considerations for "use of non-human primates." *Id.* at § 3.3.79. The policy for these considerations listed in appendix three of the code makes clear that the considerations are due to non-human primates' special cognitive abilities. *Id.* at § 3.3.79, app. 3, 57; Animal Welfare Comm., Natl. Health & Med. Research Council, Austrl., *Policy on the Care and Use of Non-Human Primates for Scientific Purposes*, "Introduction," http://www.nhmrc.gov.au/ethics/animal/issues/nonhuman.htm (June 6, 2003).); Ministry Research, Sci. & Tech., *supra* n. 12, at "What is regulated?" http://www.morst.govt.nz/wayfinder/regulations/welfare.asp#what (stating that New Zealand's Animal Welfare Act of 1999 regulates all animals with backbones as well as other selected species); *Animals (Scientific Procedures) Act 1986*, *supra* n. 271, at §1(1), http://www.archive.official-documents.co.uk/document/hoc/321/321-xa.htm (defining "protected animal" as any living vertebrate other than man and any species of octopus).

[275] The typical most sensitive range of hearing in rats lies exclusively in the ultrasonic range (20-40 kHz). G. Clough, *Environmental Effects on Animals Used in Biomedical Research*, 57 Biological Rev. 487, 487–523 (1982). Rats use the ultrasonic range to convey information about potential threats to other conspecies. S.M. Brudzynski & D. Ociepa, *Ultrasonic Vocalization of Laboratory Rats in Response to Handling and Touch,* 52 Physiology & Behavior 655, 655–60 (1992). In facilities with many singly housed rats, the din could be substantial (at 22-32 kHz) but is inaudible to the human ear. S. R. Milligan et al., *Sound Levels in Rooms Housing Laboratory Animals: An Uncontrolled Daily Variable*, 53 Physiology & Behavior 1067, 1067–76 (1993). The fact that human ears cannot detect these sounds easily leads to neglect of this welfare concern. *Id.* The U.S. *Animal Welfare Act*, 7 U.S.C. § 2131 et seq. (2000) (as amended), does not mention protections for these types of sounds. Additionally, neither the United Kingdom nor New Zealand seem to offer such protections. Alan Bates, *Detailed Discussion of*

happens to fall into the same frequency range as rat pup distress calls.[276] Hence, adult rats being exposed to such ultrasound range (that humans cannot hear) suffer ongoing and serious stress.[277] Another example might be the use of strong cleaning fluids in the immediate environment of animals, such as dogs, with a sense of smell at least a hundred fold better than that of humans.[278]

Alternatively, it might be possible to think of special legislative protections concerning mental suffering. To our knowledge, no such clause exists in any welfare legislation. Once society has acknowledged that an animal is aware, it must accept that the animal can suffer mentally. For example, it is common practice to do adverse things to animals in the presence of conspecifics (dogs on operating tables watched by other dogs, or animals being slaughtered in abattoirs and elsewhere in the presence of other animals).[279] Mental suffering can also be experienced by animals that are deprived of a rich and stimulating environment.[280] It is of course well known that barren housing and poor social environments lead to substantial deterioration in wellbeing, and the literature on this topic runs into tens of thousands of papers covering most animals held in research facilities.[281] Current legislative frameworks tend not to address this directly but by implication. The Animal Welfare Act (U.S.) provides an example of the typical language of animal welfare legislation. It states that the policy of the

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the Offences of Cruelty to Domestic and Captive Animals, http://animallaw.info/nonus/articles/ddukukocdca.htm (Animal Legal & Historical Center 2002) (Although New Zealand's *Protection of Animals Act of 1911* prohibits causing an animal "unnecessary suffering;" suffering is not deemed unnecessary if a legitimate purpose for the activity exists. Seemingly, use of computer or electronic devices would qualify as having a legitimate purpose.); Ministry Research, Sci. & Tech., *supra* n. 12, at http://www.morst.govt.nz/wayfinder/regulations/welfare.asp (specifically including mice within its protective scope, but failing to address exposure to noise levels).

[276] M. Dimitrijevic et al., *Neonatal Sound Stress and Development of Experimental Allergic Encephalomyelitis in Lewis and Da Rats*, 78 Intl. J. Neuroscience 135, 135–43 (1994).

[277] A paper on rodent hearing and on the complex and severe physiological harm (of noise) has attracted a large body of research and resulted in many research papers. C. Fernandes & S. E. File, *Beware the Builders: Construction Noise Changes, [14C]GABA Release and Uptake from Amygdaloid and Hippocampal Slices in the Rat*, 32 Neuropharmacology 1333, 1333–36 (1993); Dimitrijevic et al., *supra* n. 276, at 135–43.

[278] Cf. Lesley J. Rogers & Gisela Kaplan, *Spirit of the Wild Dog: The World of Wolves, Coyotes, Foxes, Jackals and Dingoes* 49–54 (Allen & Unwin Sydney 2003) (especially Chapter 3 (Sensory abilities), on the sense of smell). Again, as with the rodents mentioned above, animal welfare legislation in at least three countries seems void of such protections. 7 U.S.C. § 2131 et seq.; Alan Bates, *supra* n. 275, at http://animallaw.info/nonus/articles/ddukukocdca.htm; Ministry Research, Sci. & Tech., *supra* n. 12, at "What is regulated?" http://www.morst.govt.nz/wayfinder/regulations/welfare.asp (only regulating chemical exposure "which is unusual or abnormal when compared with normal management or practice").

[279] Karen S. Strange, et al., *Psychosocial Stressors and Mammary Tumor Growth: An Animal Model*, 22 Neurotoxicology & Teratology 89, 89–102 (2000).

[280] Bennet G. Galef, *Environmental Enrichment for Laboratory Rodents: Animal Welfare and the Methods of Science*, 2 J. Applied Animal Welfare Sci. 267, 267–80 (1999).

[281] *Id.*

Act is, "to insure that animals intended for use in research facilities or for exhibition purposes or for use as pets are provided humane care and treatment."[282] The Act directs the Secretary of Agriculture to promulgate standards for "the humane handling, care, treatment, and transportation of animals by dealers, research facilities, and exhibitors."[283] These standards must include "minimum requirements . . . for handling, housing, feeding, watering, sanitation, ventilation, shelter from extremes of weather and temperatures, adequate veterinary care, and separation by species where the Secretary finds necessary for humane handling, care, or treatment of animals."[284]

"Humane handling and treatment" only appears to be all-encompassing, but welfare practice is, in fact, still largely confined to physical wellbeing. Animal welfare legislation is chiefly concerned with preventing the suffering of animals, and that is centered mainly on physical pain.[285] Housing conditions for animals are taken into consideration, and increasingly so, but mostly in terms of providing basic needs for survival and preventing physical pain.[286]

It is not commonly acknowledged that animals have something like a "psyche."[287] Those in favor of legislation for animal rights, by contrast, tend to take note of the perceived cognitive abilities of animals. In fact, the latter has been one of the main arguments for extending rights to the great apes.

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[282] 7 U.S.C. § 2131(1).

[283] *Id.* at § 2143(a)(1).

[284] *Id.* at § 2143(a)(2)–(2)(A).

[285] *See e.g. id.* at §§ 2143(a)(2)–2143(a)(2)(A) (The Secretary of Agriculture must promulgate standards for the physical well-being of the covered animals but not the emotional well-being.); Stephan K. Otto, *State Animal Protection Laws-The Next Generation*, 11 Animal L. 131, 131–64 (discussing criminal laws of various states which focus almost exclusively on culpability for inflicting physical pain on covered animals); Animal Legal & Historical Center, *Statutes/Laws, Portugal, Protection of Animals Law, Statute in Full*, "Chapter I General Principles of Protection, Article 1st General measures of protection," http://www.animallaw.info/nonus/statutes/stpt92_95_en.htm (accessed Mar. 23, 2006) (forbidding all unjustified violence against animals which includes acts of unnecessarily inflicting death, cruel and prolonged suffering, or severe lesions); *Republic Act No. 8485,* Republic of Philippines, The Animal Welfare Act of 1998, § 2, http://www.internationalwildlifelaw.org/phil_animal_act.html (accessed Mar. 23, 2006) (not specifying psychological protection, although one might argue this falls within protections from "pain and/or suffering").

[286] *See e.g.* Animals (Scientific Procedures) Act, 1986, § 10(6B)(a) (Eng.) (available at http://www.archive.official-documents.co.uk/document/hoc/321/321-xa.htm) (stating that to get a certificate, a person must show "that the environment, housing, freedom of movement, food, water and care provided for each such animal are appropriate for the animal's health and well-being"); *but see Animal Welfare Institute Policy on the Use of Vertebrate Animals for Experimentation and Testing*, https://labanimalissues.org/usepolicy.htm (accessed Mar. 19, 2006) ("Enclosures or cages must be sufficiently large and well constructed to permit burrowing, climbing, perching, swinging, walking, stretching, rolling, or other normal actions ordinarily seen in the species when not confined.").

[287] *See* Jeffrey Moussaieff Masson & Susan McCarthy, *When Elephants Weep: The Emotional Lives of Animals* xiii (Delacorte Press 1995) (explaining that most scientists do not acknowledge that animals are capable of feeling).

B. *Realities in Animal Welfare*

Debate on the issues that we have discussed will continue, but meanwhile attitudes and legislation must change in ways that will allow flexibility for future change as science provides new knowledge. Positive strides have been made to protect animals used in research, and to a lesser extent in agriculture. But strategies to avoid change are common. Many scientists have retreated behind closed doors, where they continue to conduct the same procedures on animals—but further away from public scrutiny. Animal houses at universities and research institutions now lock their doors, and species that need sunlight and mental stimulation have been moved to basement areas where they are held in confined housing and impoverished in many ways.[288] In some countries, pharmaceutical laboratories are looking to relocate to countries lacking legislative protection for animals, like Singapore.[289]

Moreover, in practice, some vertebrate species receive better protection than others.[290] Within many western countries, welfare provisions for animals in the agricultural sectors tend to be undercontrolled (varying according to state and country).[291] The rules allow, either by lack of appropriate legal provisions or too little will in enforcement of existing legislation, unspeakable and ongoing cruelties to animals to occur and to continue unchecked and uncriticized. Indeed, there are often no real mechanisms to check and investigate allegations of cruelty.[292] Very basic welfare measures are not always applied

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[288] Personal observations by authors on recent visits to laboratories in United States universities.

[289] Bateson, *supra* n. 254, at 211–33.

[290] *See e.g. Farmed Animal Watch*, http://www.farmedanimal.net/faw/faw5-35.htm (Sept. 14, 2005) ("Data from the [U.S.] National Animal and Health Monitoring Service show that the mortality of calves on feedlots has increased from 1.4% in 1997 to 1.8% in 2003 . . . (based on rounded numbers). According to Dan Thompson with Kansas State University's College of Veterinary Medicine, 'I think a lot of producers would be amazed to know 5-10% of the cattle they ship wind up dead before leaving the feedlot.' Reasons for the increase in mortality are unclear, but Thompson cites respiratory disease, lower weights when coming to the feedlot, and a lack of qualified animal handlers as key suspects. The distance calves are transported is also a major factor; according to Thompson, while an 8-hour trip used to be considered a long haul, 'now it's 20 hours.' . . . 'It's always bothered me that the death of a calf in our industry is often viewed as a statistic on a piece of paper or as an economic driver of how we buy cattle. We assume we're going to have a high percentage of sickness and death loss and price them accordingly. . . That's an economic and animal welfare tragedy.'" In other words, a certain percentage of loss of livestock is an accepted industry risk and prices are adjusted accordingly.)

[291] For further discussion, see e.g. Gail Eisnitz, *Slaughterhouse: The Shocking Story of Greed, Neglect, and Inhumane Treatment Inside the U.S. Meat Industry* (Prometheus 1997); Paige M. Tomaselli, *International Comparative Animal Cruelty Laws*, http://www.animallaw.info/articles/ddusicacl.htm# (2003).

[292] *See* Jennifer H. Rackstraw, *Reaching for Justice: An Analysis of Self-Help Prosecution for Animal Crimes*, 9 Animal L. 243 (discussing the insufficient enforcement of animal cruelty laws in the United States due to prosecutorial discretion, elaborating on already present self-help mechanisms, most of which are likely provide little relief or

in practice and across all species. For instance, in contrast to the treatment of companion animals,[293] conditions in intensive farming are often appalling and animals suffer neglect, injuries, and serious basic deprivations.[294] Their pain and suffering in those instances tends not to find appropriate treatment or duty of care—tens of thousands of animals die daily as a result.[295] In those instances, even the lowest level of "welfare" for animals is not observed.[296]

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are not available in most jurisdictions, and suggesting model self-help legislation in an attempt to remedy the problem); *see e.g.* Arizonans for Humane Farms Coalition, http://www.yesforhumanefarms.org/ (last updated Mar. 18, 2006) (for information on a campaign to ban cruel farming practices in Arizona); East Bay Animal Advocates, *Fostering Cruelty in Chicken Production*, http://www.fosterfacts.net (accessed Mar. 19, 2006) (for information on the cruel treatment of chickens by one company).

[293] James Serpell, *In the Company of Animals: A Study of Human-Animal Relationships* (Cambridge U. Press 1996).

[294] Cf. Miyun Park, *Opening Cages, Opening Eyes: An Investigation and Open Rescue at an Egg Factory Farm, In Defense of Animals: The Second Wave* 174–80 (Peter Singer ed., Blackwell Publg. 2006) (describing the horrors that occur in egg producing facilities); Temple Grandin, *Euthanasia and Slaughter of Livestock*, 204 J. Am. Veterinary Med. Assn. 1354, 1354–60 (1994) (describing the horrible conditions that exist for animals processed by the slaughther industry); Stan Cox, *Fowl Play in the Slaughterhouse*, http://www.alternet.org/story/30348/ (accessed Mar. 19, 2006) (on chickens).

[295] *See* Dr. Jacky Turner et. al, *The Welfare of Broiler Chickens in the European Union* (Compassion in World Farming Trust 2005) (for an analysis of the European Union's Scientific Committee on Animal Health and Animal Welfare's Report of March 2000) (available at http://www.ciwf.org/publications/reports/Welfare_of_Broiler_Chickens_in_the_EU_2005.pdf).

[296] Farm Sanctuary Campaigns, Cruelty Investigations & Actions, http://www.farmsanctuary.org/adopt/index_cruelty.htm (accessed Mar. 16, 2006); Sean Poulter, *Birds' Factory-Farming Plight*, Daily Mail (Apr. 9, 2003) (available at http://www.dailymail.co.uk/pages/live/articles/news/news.html?in_article_id=175912&in_page_id=1770) (Poulter details information on a legal challenge by Compassion in World Farming (CIWF) against using fast-growing chickens in the U.K. The organization "is basing its case on the EU's 1998 General Farm Animal Directive that states that: 'No animal shall be kept for farming purposes unless it can be reasonably expected, on the basis of its genotype . . . that it can be kept without detrimental effect on its health and welfare.'" *Id.* CIWF says modern, broiler chicken breeds grow up to four times as fast as traditional ones, now reaching adult weight in a third to a quarter of the time it takes the "traditional chicken breed." *Id.* Of the eight hundred million chickens raised in the U.K. each year, "birds frequently develop painful leg deformities, together with heart and lung problems." *Id.* CIWF also notes that the birds used for breeding purposes are kept on restricted rations, causing them great hunger. *Id.* The action "follows repeat warnings about the cruelty involved from the Government's own advisers on the Farm Animal Welfare Council . . . ." *Id.* The British Poultry Council says CIWF's charges are "unfounded." *Id.* It contends the incidence of leg problems is "very low," and that it is not a case of starving but controlling the feed of breeding flocks. *Id.* The agency named in the case, the Department for Environment, Food & Rural Affairs, "said that farms were subject to regular veterinary inspection and it was possible to [prosecute] farmers if chickens are found to be suffering." *Id.*). Similar conflicts are occurring in other countries, including Australia. Animals Austrl., *Meat Poultry*, http://www.animalsaustralia.org/default2.asp?idL1=1273&idL2=1293 (accessed Apr. 5, 2006) (Australia); Farm Sanctuary, *Birds Exploited for Meat*, http://www.poultry.org/suffering.htm (accessed Apr. 5, 2006) (United States).

In light of this, and the substantial work that remains to be done in changing popular attitudes and in legislative activity and law enforcement, our observations and scientific details of cognitive abilities and debates as to their validity must appear academic. However, research is often substantially ahead of legislative responses to new knowledge.[297] Moreover, it takes a good while for the new knowledge to be understood as having a bearing on existing ethical frameworks and even longer to see such new knowledge incorporated into animal welfare frameworks and to reach the level of enactment and enforcement.[298] Against these negative reactions, we have seen a widespread improvement in the welfare of animals used at least in research in many western countries, even though progress seems frustratingly slow.[299] It is important, however, to extend debates so that welfare legislation to protect animals in research as well as in industries will eventually be improved and strengthened.

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[297] David J. Wolfson & Marriann Sullivan, *Foxes in the Hen House*, in *Animal Rights: Current Debates and New Directions* 205, 205–33 (Cass R. Sunstein & Martha C. Nusssbaum eds., Oxford U. Press 2004).

[298] Richard Posner, *Animal Rights: Legal, Philosophical, and Pragmatic Perspectives*, in *Animal Rights: Current Debates and New Directions* 51–77 (Cass R. Sunstein & Martha C. Nusssbaum, eds, Oxford U. Press 2004); *see* Wise, *supra* n. 2, at 19–41(pointing out the obstacles to legal rights for non-human animals).

[299] *Cf.* Paolo Cavalieri, *The Animal Debate*: *A Reexamination*, in *In Defense of Animals*: *The Second Wave* 54–68 (Peter Singer ed., Blackwell Publg. 2006).