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KAGAN, CONNIE B-H

RATIONALITY OF ANIMALS

The University of Oklahoma PH.D. 1979

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS iii

ILLUSTRATION vi

Chapter

I. INTRODUCTION. 1

Significance of Rationality in Traditional Historical Positions Regarding the Moral Status of Animals

Significance of Rationality for Deontological and Utilitarian Systems
Deontological
Utilitarian

Review of Representative Contemporary Positions
McCloskey
Singer
Regan

Prospectus

II. NEUROPHYSIOLOGY 45

Use of the Neurophysiological Similarity Notion in Philosophy and Zoology
Philosophy
Zoology

Empirical Evidence for Correlation between Neurophysiological Complexity and the Capacity for Inductive Reasoning
Evolutionary Development of the Bilateral Brain
Anatomical Asymmetry
Other Anatomical Comparisons
Functional Asymmetry

Significance of the Empirical Evidence

III. LANGUAGE. 74

Theories of Language

Skinner's Empiricist Theory
Chomsky's Rationalist Theory

Evidence for Linguistic Behavior
Use of Symbols
Rule-following
Summary

Use of the Criteria

SUMMARY. 121

NOTES. 123

BIBLIOGRAPHY 138

ILLUSTRATION

Figure Page

1. Lateral Aspect of Left Hemisphere 58

RATIONALITY OF ANIMALS

CHAPTER I

INTRODUCTION

Significance of Rationality in Traditional Historical Positions Regarding the Moral Status of Animals

From the fifth century BC until the nineteenth century, the Chain of Being paradigm provided the principles--plenitude, gradation, and continuity--which were used in determining the moral status of animals. These were metaphysical principles from which moral principles were derived [1].

The plenitude principle, formulated by Plato, proposes that everything that could be is. In Plato's metaphorical language, the Good, an immaterial unity which is self-sufficient total reality, is also the logical ground and dynamic source of the existence of all things including the natural world [2].

The gradation and continuity principles were formulated by Aristotle [3]. According to the gradation principle, the natural world is a natural order since the structure of the universe is a serial order of forms of being. In Aristotle's formulation this order is an ontological scale based on the development from potentiality (matter) to actuality (form), and parallelled by a scale of value in which good increases in direct proportion to form.

The continuity principle, which presupposes the gradation principle, proposes a qualitative continuum inherent in nature such that overlappings occur between some forms on a graduated scale. The gradation principle emphasizes distinctive characteristics used for ranking forms of beings while the continuity principle emphasizes shared characteristics.

Aristotle illustrates the use of these principles in considering the moral status of animals [4]. Animals, like man, have "nutritive and sensitive soul" (continuity), but only man has "rational soul" (gradation). Nutrition and sensation are physical functions whose presence is inferred from observing the behavior of animals. Animals can perceive particulars (aisthésis), but only man can think conceptually (noēsis) since only man has the necessary immaterial rational soul. This appears circular (only man is rational because only man has rational soul), but Aristotle argues that man's distinctive capacity for thought is related to his capacity for propositional speech. Logos is used in the sense of reason and also in the sense of discourse or language. Aristotle takes man's unique capacity for propositional speech as evidence for his distinctive capacity for conceptual thought. Then, given the value scale that parallels the ontological scale, man's ontological and moral superiority is established. Aristotle concludes that the natural and moral function of animals is to serve man through use as food, sacrificial offerings, and laborers [5].

The basic pattern of this argument was repeated for centuries with novelties only as variations on the theme.

Aquinas, for example, provided religious variations. In Summa Contra Gentiles, his argument that the worth of animals is instrumental is based on their lack of intellect [6]. I will not recount the entire argument, but several points will illustrate his approach. (1) Only rational creatures are free agents. Those that are not free agents are instruments for free agents. (2) God is the last end of the universe. Since animals are unable to attain this end by knowing and loving God, their proper end is to serve those who can attain knowledge of God. (3) Since intellectual natures are more like God, he provides all non-intellectual natures for the sake of the intellectual ones.

In Summa Theologica, Aquinas considers the question, "Whether it is lawful to kill any living thing" [7]. He argues that "the order of things is such that the imperfect are for the perfect" so that it is natural and moral for each form of life to be used by those forms superior to it. Furthermore, even though murder is a sin because it deprives a man of life, it would be a mistake to think that killing animals is a sin because it deprives them of life. It would be a mistake because animals "are devoid of the life of reason", and we should not be fooled into thinking they have reason by the fact that they move since their movement is due merely to natural impulse.

Aquinas' last point provides a bridge to the familiar Cartesian position that animals are machines that lack reason and therefore cannot experience pain and pleasure. Descartes' position is more subtle, though probably no less odd, than many presentations of it

suggest, and I will discuss it in more detail further on. But the expected motifs are there. Animals differ qualitatively from humans in that they are not rational, as evidenced by their lack of propositional speech. Unlike animals, humans have an immaterial, immortal soul. Descartes himself makes the moral inference. "My opinion is not so much cruel to animals as indulgent to men ... since it absolves them from the suspicion of crime when they eat or kill animals" [8].

And so it went until the nineteenth century, when the Chain of Being paradigm began to be displaced by the Evolution paradigm. This conceptual transition greatly altered the principles that had guided thinking about the moral status of animals. Discarding the plenitude principle had the consequences that (a) explanation of lower forms of life by higher ones was replaced by the explanation of higher forms by lower ones, and (b) the emphasis on mind-body dualism was replaced by a monistic explanation of the common origin of all life. The notion of fixed essences, central to the gradation principle, was replaced by a notion of dynamic organic forms influenced by their environment. The static, atemporal continuity principle in the Chain of Being paradigm was temporalized.

Some effects of these transitions on discussions about the moral status of animals are seen clearly in the work of the nineteenth-century classical utilitarians. Bentham rejected rationality as an appropriate criterion for membership in the moral community. He argued that such membership ought to be based on

having interests, that sentience is the natural feature that entails having interests, that animals are sentient and therefore ought to be included in the moral community. As he put it in a well-known statement, "The question is not, Can they reason?, Can they talk?, but, Can they suffer?"[9].

J.S. Mill defended utilitarianism, specifically including Bentham's inclusion of animals in the moral community, against Whewell, arguing that its seeming "unnatural" to Whewell is not sufficient grounds for its rejection [10].

With this brief review to provide historical context, I want now to consider the ahistorical, but categorical significance of rationality in major types of ethical systems.

Significance of Rationality for Deontological and Utilitarian Systems

Deontological

In deontological systems, rationality is claimed to be the criterion for membership in the moral community. This admits all humans and excludes all animals. Behavioral criteria are irrelevant since even individual humans who seem irrational (insane) or non-rational (infants) are included. Their inclusion is based on species-membership, i.e., the norm for the species is rationality and although they are abnormal, they are included since they share another feature, species-membership, with the normal ones.

In some cases it is said that, although they are not rational, they are potentially rational and therefore qualify. It is not always clear what "potentiality" means in this context. In the case of infants, it seems to mean a developmental disposition. In the case of insane people who had once been sane, it may mean, optimistically, a disposition to return to a previous state. Or, in the case of the insane as well as that of congenital or severely brain-damaged idiots, it may simply express a counter-factual. So potentiality does not serve well to shore up rationality as a firm criterion. The basic criterion is not rationality, potential or actual, but species-membership.

It might be argued that rationality is a necessary condition for membership in a deontological moral community because the fundamental conception of moral duty is a rational concept and rationality is required to grasp it. It does seem to be a necessary condition that some members of the moral community be rational, but not that every member must be. Non-rational members benefit without reciprocation.

It might be interesting to consider the proportion of rational agents to non-reciprocating beneficiaries. When the moral community is limited to humans, the number of agents far exceeds the number of non-reciprocating beneficiaries. If animals are not rational, then their admission to the moral community (on some other basis) would swing the balance in the other direction. The moral community would be composed of a small percentage of rational agents and a large percentage of non-reciprocating

beneficiaries. This situation raises basic questions about the purpose of the moral enterprise. One intuitive response is that any such arrangement would be unfair to the agents, but that response overlooks the notion of duty in deontological systems. Given that notion, the agents would be the fortunate few who are able to express their nature as moral beings.

If rationality were in fact the criterion for membership, the moral community might include some humans (sane adults) and some animals (e.g., bright primates) and exclude some humans (infants, idiots, insane) and some animals. Furthermore, there would be a need to determine what is meant by rationality since it would no longer be a code word for "member of the human species".

Even without regard to these difficulties, given, say, the Kantian system, there are problems about rationality [11]. In this system, one has no duties directly to animals, though one may have duties directly to other humans that regard animals. So one ought not mutilate his neighbor's cow because one could certainly not will the principle of that action (destroying or defacing another's property) to be a universal law. One may also have indirect duties to humans that regard animals. These either constrain or encourage various actions. One ought not be unjustifiably cruel to animals because being unjustifiably cruel to animals encourages cruelty to humans. (In a historical instance, doctors and butchers were excluded from jury duty in England on the grounds that their hearts were hardened.)

Nozick argues against the view that cruelty to animals encourages cruelty to humans by asking if butchers commit more murders [12]. I do not think Nozick's point succeeds as a reply against the argument in Kant's form because it overlooks the qualification of justifiability. The argument is not that being cruel to animals encourages cruelty to humans, but rather that being unjustifiably cruel to animals encourages cruelty to humans. The critical point is what is justifiable or, rather, the criteria for justifiability.

Kant, assuming the instrumental function of animals (means, not ends in themselves), justifies vivisection, but he says that such cruelty for sport cannot be justified. Vivisection, unlike sport, has a "praiseworthy aim". But the notion of a praiseworthy aim as a criterion is still problematic. One must decide what is the aim of various actions, e.g., vivisection and sport. Then one must decide whether or not such an aim is praiseworthy. If this is not circular, neither is it very helpful. We began by seeking a criterion for justifiability and now must seek one for praiseworthiness. Kant's own examples suggest some ordering of activities that serve various human purposes, but no principle for such ordering is given.

Kant's treatment of the converse argument is interesting. One ought to be kind to animals inasmuch as they manifest human qualities (acts, motivations, or nature) since this encourages the fulfillment of duties to humans. This is closely related to the basic principle that one should always treat humanity in one-

self or others as an end in itself, never as a means. Animals have a dual status. As non-humans, they are means to human ends, but the "human" qualities that they have must be respected. But "human" qualities in animals are not actually human qualities, but animal qualities that are analogous to human ones. Kant gives the example of an old dog who had provided years of service and deserves to be cared for, with the notion of "service" as the analogous one. The critical question, which is not dealt with, is what justifies the analogy.

Utilitarian

In most contemporary literature, as well as in the late nineteenth-century utilitarian literature, the criterion for membership in the moral community appears to be sentience. Sentience is taken to be the ability to feel pleasure or pain. I say that sentience appears to be the criterion because to say so is to use a kind of shorthand.

Within a utilitarian system, the interests of all members of the moral community are to be taken into account. A necessary and sufficient condition for membership in the moral community is having interests. But whom does this include? Or, more formally, what natural capacity is the condition for having interests? Many utilitarians hold that the natural capacity of sentience is such a condition. Sentient beings have interests.

Sentience is inferred on the basis of physiological structure (organization and complexity of nervous system) or on the basis of behavior. All humans and many animals are considered to

be sentient and, therefore, to have interests that are to be given equal consideration in making moral decisions.

The egalitarian principle requires that all members must be treated alike unless relevant differences justify differential treatment. In any specific case, given the egalitarian principle, two further considerations must obtain. One is to determine whether there is a relevant difference in some members of the moral community that would justify treating them differently in this case. The other is to determine whether the net result of the action would increase pleasure (or decrease pain) for the moral community as a whole. The second determines whether or not any action should be taken. The first determines who will be treated differently.

Although rationality is not a criterion for membership in the moral community, it is often a critical factor at these two steps. Non-rationality may be proposed as a relevant difference in various situations in order to justify treating animals less well than humans. Of course, this is not a successful strategy since the same arguments also justify lesser treatment of some humans (infants, etc.).

Rationality is also critical when one weighs the advantages and disadvantages of any action. So it may be argued that, because they are not rational, animals do not anticipate pain and do not suffer mental anguish although humans may do both. This introduces a qualitative distinction.

These are the most common uses of the notion of rationality within a utilitarian structure. However, it also enters in in a more basic way through the claim that rationality is a necessary condition for having interests, which is the qualifying criterion for membership in the moral community. On this view, sentience is not a sufficient condition for having interests even if it is allowed as necessary.

Review of Representative Contemporary Positions

These typical views are exemplified in recent journal articles. The ones that I want to review are "Rights" by H. J. McCloskey [13], "All Animals are Equal" by Peter Singer [14], and "The Moral Basis of Vegetarianism" by Tom Regan [15]. I have selected these because they are fairly well known and because they attempt to present sustained arguments relevant to the major issues about the moral status of animals.

McCloskey

McCloskey's article is a conceptual analysis of the notion of rights. He considers what a right is and who or what logically may possess rights. He presents an entitlement theory of rights (entitlement to "do, have, enjoy, or have done") as opposed to a claim against someone; and he rejects the principles of reciprocity and correlativity as necessary conditions for rights [16].

His interest for us is in his consideration of who or what may possess rights, since he specifically considers animals. In reviewing some other positions regarding animal rights, he approvingly

presents Ritchie's argument that the attribution of animal rights leads to absurd conclusions: (1) If animals have rights, they invade each other's rights (e.g., "the cat invades the right of the mouse"); (2) If animals have rights, perhaps humans should have to "allow parasites to continue to inhabit us if they do not have seriously deleterious effects on our health" [17]. McCloskey rejects Plamenatz's solution to the first one, that rights are rights against rational beings, because of his own view that rights are primarily not claims, but entitlements.

McCloskey does not specify what sort of entitlement might be meant in either of the two so-called absurd conclusions, whether it is the right to life, to freedom of movement, etc. But even in the general sense presented, it is not clear that the conclusions from attributing rights are adequate bases for not attributing them. I do not want to say that the conclusions are not absurd, only that they are no more absurd when considering animals than when considering humans.

The argument that supports the first conclusion seems to be this: (1) Most members of some species of animals behave in aggressive ways towards some members of other species of animals. (2) This behavior is natural. (3) If we attribute rights to animals, then it will follow that some animals are naturally violating the rights of other animals. / Therefore, we should not attribute rights to animals. If this argument means that rights should not be attributed when they may be violated, or stronger, when they will be violated, then we cannot make sense of human rights. Those

who talk about rights think it makes sense to talk about the rights of blacks in South Africa or Jews in the Soviet Union, i.e., that possessing rights is not conditional on assurances of non-violation. But one might insist that the argument means that rights should not be attributed when (a) they may/will be violated, and (b) such violation is a natural phenomenon. So we have to ask what "natural" means here. It seems to have the sense of species-specific, genetically determined, survival-oriented behavior. But in that case, there is no reason to exempt humans. To use another of McCloskey's (Ritchie's) examples, a tiger may violate the rights of a human as well as the rights of a cow. If the possible natural violation of the cow's rights is a good reason for not attributing rights to cows, then it is also a good reason for not attributing rights to humans.

The first McCloskey/Ritchie conclusion has to do with whether or not animals should be allowed moral status. The second is concerned with consequences of decisions within the moral community. If parasites are members of the moral community, and if their inhabiting us does not have seriously deleterious effects on our health, then should we allow them to do so? The sort of parasite he has in mind is a flea, which suggests that the criterion for membership in the moral community under consideration may be animation, rather than sentience. But, be that as it may, it is hard to see why this is a forceful objection to animal rights. The proposed question is exactly the sort of question that has to be considered when membership is limited to humans. It is, in

fact, almost identical to the abortion question. To argue that one should not attribute rights when doing so will result in having to confront situations where rights seem to conflict trivializes the notion of rights. The way the situation is presented--the flea's habitation does not have seriously deleterious effects on the human--suggests that the outcome of deliberation will be that the parasite ought to remain, since the human's suffering is outweighed by the parasite's requirement for survival. It is not obvious that this would be the result of careful deliberation, but let us suppose it to be so. Surely, the human's suffering does not provide a good reason for rejecting the attribution of rights to the parasite. Since one of the features of moral principles is objectivity, rights are not attributed to others on the basis of predetermined benefits to oneself or withheld from others on the basis of predetermined disadvantages to oneself.

In both cases, the conclusions to which the attribution of animal rights leads provide no better reasons for rejecting animal rights than human rights. If the conclusions are absurd, they are absurd in the case of humans as well. McCloskey has apparently overlooked this and sees absurdity only in the case of animals. What he says is that Ritchie's conclusions "suggest that animals cannot be possessors of rights, but it does not establish that this is so" [18].

McCloskey then mentions what he takes to be some relevant considerations that have been overlooked by advocates of animal rights. (1) Does the claim that animals have rights include all

animals? (2) Why are rights generally claimed only for (some or all) sentient beings rather than animate ones or inanimate things? He then argues that although free moral agents (i.e., rational humans) may possess rights, freedom or rationality is not the test for possessing rights since it seems reasonable to claim that lunatics and infants are entitled to decent treatment, even though they themselves are unable to demand their entitlements.

McCloskey then states that the situation of animals is different from that of lunatics and infants. With regard to legal rights, he says that although legal claims may be made on behalf of animals, the law confers duties on humans, not rights in the animals. His argument here is purely linguistic. Since most people (he acknowledges exceptions) are reluctant, disinclined, and uneasy in talking about legal rights of animals, then it is inaccurate and misleading to do so. What he is claiming is that the fact that most people do not talk as though animals have legal rights demonstrates that they do not. The "fact", in this case, is a generalization of his own intuition. But suppose it were the case. The argument is invalid since the conclusion does not follow from the premise. Suppose that most people do not talk as though animals exist; the lack of such talk does not demonstrate that animals do not exist.

But then he says that, with regard to both legal and moral rights, such talk is a consequence of the fact that animals do not have rights, and that fact is based on the inappropriateness of applying our concept of "interests" in the case of animals "because

the concept of interests has this evaluative-prescriptive overtone" [19]. Having rights is conditional on having interests and animals fail to meet this criterion because of the "evaluative-prescriptive overtone" of the concept of interests. Unfortunately, McCloskey does not tell us what he means by the "evaluative-prescriptive overtone". He says, "The concept of interests which is so important here is an obscure and elusive one" [20]. But since it is the concept on which his argument rests, his failure to explain it makes it difficult to assess his argument.

He then proposes a second criterion for having rights, viz., the ability to possess property, and he argues that since animals do not have this ability, they do not have rights. There are two things wrong with this argument. First, to be able to possess property does not seem to be a reasonable criterion for possessing rights. It seems to be a sort of category mistake that confuses commodities and conditions. Secondly, even if it were a reasonable criterion, it is not obvious that all animals would fail to meet it. He asks a rhetorical question: "Can a horse possess anything, e.g., its stable, its rug, in a literal sense of 'possess'?"[21]. I do not know about horses, but I do know that anyone who has spent much time with dogs can recall instances when a dog hid an object, ran off with it if approached, or resisted attempts to take it out of its mouth or otherwise remove it, all examples of literal possession. Furthermore, animals can have legal possession of objects, e.g., as beneficiaries of bequests.

McCloskey thinks that his criteria for having rights--having interests and ability to possess--are adequate and that animals do not meet them and therefore do not have rights. He notes, however, that congenital idiots "whose level of existence falls far short of that of the highest animals" do not meet the criteria [22]. He offers a pragmatic solution. He says that "animals, or at least the higher animals, may usefully be said to have rights by analogy", although he acknowledges that rights by analogy have different implications from rights. He also says that it may be "a useful lie" to attribute rights to humans who do not meet the criteria since to deny them "opens the way to a dangerous slide" [23].

It might help us to understand McCloskey's denial of rights to animals on the interests criterion if he explained on what basis rights by analogy were to be attributed, but he provides no explanation. It is difficult to surmise what he thinks the usefulness of "rights by analogy" for animals and rights by pretense for humans might be.

Singer

Singer's main concern is to show why animals ought to be included in the moral community. His position is that the appropriate criterion for membership in the moral community is having interests and that sentience is a necessary and sufficient condition for having interests. Sentience is taken to mean the "capacity to suffer or experience enjoyment or happiness". The egalitarian principle ought to be extended to other species on the basis of sentience and not to do so is arbitrary and immoral discrimination

that Singer calls "speciesism".

What we are interested in now, of course, is how the notion of rationality fits into Singer's arguments. The most obvious fact is that although the notion appears a number of times, it is not treated thematically and indeed, there seems to be some ambiguity in Singer's position.

I do not intend to recount Singer's entire argument, but rather, to look closely at those points where Singer does discuss rationality. I will also look at those points where he discusses intelligence or thinking, since Singer does not make fine distinctions between these cognates. What he does is to lump thinking, intelligence, and rationality together and refer to them as "abilities". These cognitive abilities are opposed to sentience, which is referred to as a "capacity".

It is important to remember that Singer's comments about rationality are of two sorts, which we can call "formal" and "substantial". When he talks about rationality in a formal way, he is discussing <u>how</u> the notion fits into a moral scheme. When he talks about it in a substantive way, he tells us <u>who</u> he thinks is, is not, or may be rational.

Singer rejects rationality as a criterion for membership in the moral community. His position is that sentience is the necessary and sufficient condition for having interests, which is, in turn, the necessary and sufficient condition for membership in the moral community. He points out that there are factual inequalities in capacities and abilities among individuals or groups and

that these may even be genetically determined. But these inequalities do not justify exclusion of the inferiors from the moral community. Imagine, he suggests, a hierarchical society based on IQ, such that the interests of all those with IQs above 100 would be preferred to those whose IQs were below 100. In this example, the unequal consideration of interests is based on factual differences in intellectual abilities. What is wrong with this arrangement, Singer thinks, is that equality is not an assertion of fact, but a moral ideal. "The claim to equality does not depend on intelligence, moral capacity, physical strength, or similar matters of fact" [24]. The egalitarian principle is a prescriptive principle that requires equal consideration of interests.

Since having interests depends on sentience, sentience provides the boundary of moral concern. Whatever can suffer is interested in not suffering and whatever can experience pleasure is interested in doing so. To use intelligence or rationality as a criterion for membership in the moral community is arbitrary and irrelevant. "Our concern for others ought not to depend on ... what abilities they possess" [25].

Singer then asks a rhetorical question which is relevant to the formal role of rationality as a criterion for membership in the moral community, but the question makes use of a substantive assumption about who is intelligent. He asks, "If possessing a higher degree of intelligence does not entitle one human to use another for his own ends, how can it entitle humans to exploit nonhumans?" [26]. Singer obviously thinks, given his previous

arguments, that it cannot. That is, it cannot if one is talking about the boundary of membership in the moral community.

But notice the assumption that humans are more intelligent than non-humans. This becomes extremely important once we have moved beyond the question of membership in the moral community and begin to consider specific actions. Assume that some animals are included in the moral community on Singer's terms, i.e., cognitive abilities are irrelevant considerations. These abilities, which were considered irrelevant with regard to membership, become relevant as soon as specific decisions about behavior must be made. Singer himself puts it quite clearly: "It is an implication of this principle of equality that our concern for others ought not to depend on what they are like, or what abilities they possess--although precisely what this concern requires us to do may vary according to the characteristics of those affected by what we do" [27]. The first part of this sentence, which declares abilities to be irrelevant, is about the criterion for membership in the moral community; the second part of this sentence, which declares characteristics to be relevant, is about behavior within the moral community.

There is nothing eccentric about this. Singer is following the usual utilitarian pattern. First, one decides who qualifies for membership in the moral community; then one decides what action is justified in a specific case and which differences among members are relevant to justify differential treatment in that case. We have seen that Singer thinks cognitive abilities are irrelevant with regard to membership, but he clearly thinks they are generally

relevant when making decisions within the moral community.

He says, "There are important differences between humans and other animals, and these differences must give rise to some differences in the rights that each have" [28]. He equates "capable of making rational decisions" with "capable of understanding the significance of voting" and says that since dogs are incapable of the latter, they cannot have the right to vote. He also says that since a pig cannot vote, it is meaningless to talk of its right to vote.

He emphasizes that equal consideration of interests does not require identical treatment. "The extension of the basic principle of equality from one group to another does not imply that we must treat both groups in exactly the same way, or grant exactly the same rights to both groups. Whether we should do so will depend on the nature of the members of the two groups" [29].

It is in considering behavior within the moral community that rationality is a relevant, and often critical, feature. In discussing vivisection, Singer says that it is simple discrimination not to use orphaned human infants since "adult apes, cats, mice, and other mammals are more aware of what is happening to them, more self-directing, and so far as we can tell, at least as sensitive to pain, as any human infant" [30]. In discussing vegetarianism, he says that what is primarily wrong with eating animals is the related suffering, not the killing. He says that killing humans is the greatest wrong one can do to a human because humans are "conscious of their existence over time, and have desires and

purposes that extend into the future" [31]. His assertion that suffering, not killing, is the primary wrong in eating animals is obviously based on an assumption that animals and humans differ in this regard. But then he acknowledges possible exceptions. "If one took this view one would have to hold ... that killing a human infant or mental defective is not in itself wrong, and is less serious than killing certain higher mammals that probably do have a sense of their own existence over time" [32]. This is obviously both vague (which mammals is not specified) and cautious ("probably do", etc.). The major point, though, is formal, i.e., for whoever has these abilities for future projection, to be killed is a greater wrong than to be made to suffer.

I do not think Singer argues this point persuasively. In order to contrast killing and suffering, let us take killing to mean immediate, painless death. To say that X is the greatest wrong one can do to a subject implies that X is the alternative least preferred by that subject.

We can immediately think of counter-examples to Singer's view--a request for mercy killing, a suicide or suicide attempt, spies who carry cyanide tablets. In each of these cases, the subject's assumption is that being killed is preferable to suffering. And it will not do to claim that any of these is irrational behavior, for that merely begs the question whether or not a rational subject prefers suffering to being killed.

Singer's argument is that subjects prefer suffering because they are rational (in the sense of self-consciousness over time

and having future projects). But the examples above can easily be specified such that to be killed is preferred precisely because the subject is rational [33]. The form of the subject's argument could be, "I have lived a long, full life; the future seems intolerably grim, so it is best to die now."

If one's religious beliefs include a pleasant after-life, then being killed would be not merely a termination to this life, but a necessary transition to one which is better.

But suppose one's beliefs do not include notions of an after-life. Dying might be one of the future projects that the rational subject has. There is a body of recent literature in psychology stressing the psychological importance of perceiving one's own death as one's own project. Included in this is the notion that, to the greatest extent possible, one ought to be in control of his own dying; that to plan for and participate in one's own dying is not irrational, but is much more rational than treating death as the ultimate horror over which one has no control. That does not suggest that one will necessarily prefer death to suffering, but it does suggest that doing so can be rational.

Since we can think of cases where a subject would prefer death to suffering and that preference would be a rational choice, then Singer's claim that the greatest wrong one can do to rational subjects is to kill them seems too strong. And when the claim is properly qualified, then it will not provide a distinct contrast with the greatest wrong one can do to non-rational subjects. That is, in both cases, the greatest wrong may be to cause the subjects to suffer.

There is a point of similarity between Singer's argument regarding rational subjects--it is better to live miserably than not to continue to live--and one often used to justify mistreatment of animals--it is better to have lived miserably than never to have lived at all. The shared point is that life is preferable to not living. But beyond that, the arguments and their implications are quite different.

In the second one, the proposition that living is preferable to never having lived is taken to be self-evident. If that is accepted, then the moral questions that are raised are about the responsibility of those who are already living to "those" who are not. For example, it might seem that contraception and abortion are prohibited and that constant copulation is a moral ideal.

In Singer's argument, the proposition that continuing to live is preferable to not doing so is based on one's sense of his existence over time and his interest in his own future projects. The moral questions that are raised are about circumstances that would override the prima facie prohibition against killing (e.g., war, capital punishment, euthanasia) and about the distinction between killing someone and letting them die (e.g., malnutrition, maintenance of chemical or mechanical life-support devices, suicide-prevention programs).

What we have considered so far is the case in which a rational being A determines what is in his or her own interest, makes those interests known, and prefers to be killed to suffering.

There is another kind of case that also serves as a counter-example to Singer's claim--the case in which another person B, assuming the non-rationality of A, determines what is in A's interests. B assumes that A is sentient, desiring to increase pleasure and diminish pain. Let us suppose that A needs painful surgery, though the surgery provides only the opportunity for, not the assurance of recovery. Consequently, B does not know if A's endurance of the painful surgery will result in A's greater happiness in the long run since the surgery may or may not be successful. B has been advised that if A does not have the surgery, the condition may or may not be naturally arrested and the conjectured probabilities are about 50-50. In either case, A will suffer pain that will be prolonged if the condition is not naturally arrested.

This is a case where it seems reasonable to hold that killing A would be a greater harm to him than causing him (or allowing him) to suffer. If A is an animal, then this is a case where it is assumed that suffering is preferable to being killed. This kind of case circumscribes Singer's claim that in the case of animals, suffering is worse than being killed.

Near the end of his article, Singer criticizes the work of several social philosophers who exclude animals from the moral community with what Singer considers to be devious arguments. One of these is William Frankena who proposes equal treatment of humans simply because they are human. What makes them human, according to Frankena, is that "they have emotions and desires and are able to think, and hence are capable of enjoying a good life

in a sense in which other animals are not." Frankena adds that by the "good life" he means "not so much the morally good life as the happy or satisfactory life" [34].

Singer points out that including thinking as a characteristic of humans excludes some people. He is not sure how it applies to animals. He says, "We may doubt that they [other animals] can think--although the behavior of some apes, dolphins and even dogs suggests that some of them can--but what is the relevance of thinking?" [35]. Indeed, his concern is not with whether or not animals can think, but to show that thinking is irrelevant to a happy or satisfying life. But this is a very hard position to support given common human experience. Most people recognize qualitative differences as well as quantitative ones in happiness or satisfactions, and these are generally related to cognitive abilities.

Singer is actually somewhat inconsistent. He first says that thought is irrelevant to enjoying a good life and then he says it is unnecessary. The latter is easier to defend, but Singer does not seem to make the distinction between relevance and necessity here that would make for a consistent argument. He argues that "every sentient being is capable of leading a life that is happier or less miserable than some alternative life". His point seems to be that sentience, not thinking, is the necessary condition for enjoying a good life. So far, so good. But then he adds that "in this respect, the distinction between humans and nonhumans is not a sharp division, but rather a continuum along which we move

gradually, and with overlaps between the species, from simple capacities for enjoyment and satisfaction, or pain and suffering, to more complex ones" [36]. If this continuum were simply degrees of sentience, Singer would be reiterating the claim that sentience is the necessary condition for enjoying a good life. But I think he intends that the more complex capacities for enjoyment and satisfaction involve thought since just before this he has said that "only some people are capable of leading intellectually satisfying lives, or morally good lives". And this, of course, is an assertion that thought is relevant to enjoying a good life; indeed, thought is a necessary condition at that pole of the continuum that represents the most complex enjoyment and satisfaction. So thought is not irrelevant to enjoying a good life and indeed is necessary for the highest possible enjoyment.

What Singer ought to have done here is to make the same sort of distinction that he had previously made in arguing that thought is irrelevant as a criterion for membership in the moral community, but relevant within the community. I am not suggesting that that is an indefeasible position, but that it would be internally consistent and also consistent with the rest of his argument.

Throughout, Singer's comments about the cognitive abilities of various species seem rather off-hand. At no point does he recognize a need for trying to determine more definitely what cognitive abilities animals might have, even though, as we have seen, this becomes crucial in making decisions within the moral community.

Regan

Regan's argument for vegetarianism is based on two major ethical precepts: (a) that it is wrong to cause undeserved suffering and (b) the right to life--plus arguments to show that there is no justification for excluding animals from the moral community. Although it is obvious that Regan's self-assigned task is both lengthy and complex, it seems to me that he glides over a few troublesome points that warrant closer attention. It is those points, rather than the entire argument, that I want to consider here since they are not unrelated to the matter of rationality.

Given the similarities between other animals and humans in physiology and pain behavior, Regan thinks it reasonable to adopt the "naive" position that animals do feel pain until a compelling counterargument is presented. Regan rejects the Cartesian position, and although I agree with his conclusion, I think his argument for it is faulty.

He presents the Cartesian claim as follows: that animals cannot use language implies that they do not think, which implies that they have no minds, which implies that they have no consciousness, which implies that they do not experience pain. He points out that this argument can be challenged either by disputing the fact that animals cannot use language or by disputing the assertion that language use is a necessary condition for experiencing pain, and he chooses the latter tack.

He uses infants and paralyzed adults as counter-examples, pointing out that we do not deny their experiencing pain simply because they cannot use language. He adds that we do not think an infant's potential for language is correlated with a potential for feeling, but rather that he feels, say, pain now although he cannot say so. Our belief that non-language-using humans or animals are in pain is based on behavioral evidence other than linguistic behavior.

It seems quite right that language use is not a necessary condition for experiencing pain, and it is also true that Descartes claimed that animals are incapable of language and that they do not experience pain. But Descartes' point is more subtle than Regan's presentation suggests. To say that language use is a necessary condition that is the first in a chain of entailments is a bit misleading.

Descartes distinguishes between (a) the ability to use language, which is bound up with thought, and (b) the use of language, specifically speech, which is "the only certain sign" of the ability to use language. Linguistic ability and thought are bound together since, for Descartes, thought involves a proposition and a propositional attitude, and this necessarily requires language [37].

Descartes assumes that animals do not have the ability to use language because the certain sign, speech, is absent in their case. In a letter to More, he says that it is possible that animals think, and that we cannot prove it is not so. But since the sign (speech) is absent, it seems likely that they do not [38].

Given this assumption, Descartes allows that animals can experience some mechanical physiological sensations, but not pain, since the formulation of the proposition "I am in pain" requires language.

For Descartes, the animal case and Regan's human case (infants and paralyzed adults) would not be analogous. As in the animal case, the sign (speech) of linguistic ability is absent, but in the human case, the absence of the sign is not counted as evidence for the inability to use language. It is true that this may reflect anthropocentric bias, motivated in Descartes' case by theological beliefs. But there are other reasons for his failure to treat the same phenomenon (absence of speech) as relevant evidence in the animal case but not in the human case. Given the doctrine of innate ideas, thought is a universal characteristic of humans. The infant's potentiality for speech is assumed because it is assumed that he already has the ability to use language. And since he has the ability, it is possible that he is thinking "I am in pain" though he is not saying that, but merely screaming.

Since Regan's argument glides over the distinction between not using language and not being able to use language, he misses some important problems in the Cartesian position. (1) He rejects a relationship between the experience of pain and speech. The more basic point is the relationship between experience and linguistic ability. Descartes' position, that the reality of much of our experience depends on formulating propositions about it, seems very odd given common human experience. (2) Furthermore, a serious critical analysis of Descartes' position must consider whether or

not his formulation of the doctrine of innate ideas is sound. (3) Also, one needs to consider the role of negative evidence in Descartes' denial of linguistic ability to animals.

Regan mentions, as indicated above, that Descartes' position, as Regan presents it, could be challenged by disputing the fact that animals do not use language. Regan rejects this tack because of the difficulties involved in the concept of language. Although such difficulties abound, Descartes makes the argument easier in his case by clearly stating what is necessary and sufficient, i.e., the ability to formulate propositions. Overlooking the difficulties listed above, if one accepts Descartes' position, it seems plausible to argue that some primates (e.g., Washoe, Lucy, Lana, Koko) have demonstrated the required linguistic ability. And that would require reconsideration of the role of negative evidence and the role of innate ideas. But I think this would be merely an academic exercise, since it depends on accepting Descartes' questionable notion of the relationship between linguistic ability and experience.

Regan's argument that it is wrong to cause animals undeserved suffering is structured to show: (1) that undeserved suffering is wrong in the case of humans, and (2) that humans and animals share the relevant features required for membership in the moral community, so that what is wrong in the case of humans is also wrong in the case of animals.

The criterion for membership in the moral community is having interests and needs; sentience (capability of experiencing pleasure

and pain) is the natural feature that entails having interests. Regan combines the value judgments that pain is intrinsic evil and pleasure is intrinsic good with the principle of non-injury (that injuring a sentient being is prima facie wrong), so that aggression requires justification.

Regan then considers distributions of pleasure and undeserved pain in four situations:

(a) pain to animals more than pleasure to humans

(b) pain to animals equal to pleasure to humans

(c) pain to animals slightly less than pleasure to humans

(d) pain to animals greatly less than pleasure to humans.

He presents (a) as the sort of case presented by the nineteenth-century utilitarians. For Regan, given the prima facie obligation not to cause pain and the assumption that the animals do not deserve the pain, then it follows that the practice is immoral.

He specifies (b) and (c) such that severely mentally retarded humans are substituted for animals in factory farm situations. He suggests that the practices would be considered morally objectionable. He does not argue for this, but apparently assumes an intuitive response.

Regan then presents a series of arguments to show that if the animal pain and human pain are comparable, then there is no justification for differential treatment of humans and animals in these cases. The theme of his arguments is that the most plausible argument for differential treatment, i.e., that humans are and animals are not the sorts of beings who can have rights, is an

untenable argument. I do not want to consider all his arguments, but rather, the assumption that is critical to all of them, i.e., that the pain animals suffer in either case (b) or (c) is comparable to the pain humans suffer in either case. Although comparability is essential to Regan's position, he provides only a partial analysis of it.

His judgment that pain is an intrinsic evil provides for comparability in a formal sense. Since the evil is intrinsic, pain's evilness does not depend on where it occurs, but on what it is. It is just as evil when it occurs in animals as it is when it occurs in humans.

What Regan omits is an analysis of comparability of pain in a material sense. Given (a) his judgments that pain is evil and that pleasure is good, and (b) his belief that moral behavior should decrease pain and increase pleasure, material distinctions are required. Moral alternatives generally do not include eliminating pain, but, rather, various means for minimizing it or, perhaps, merely redistributing it.

The problems are not unfamiliar. (1) What criterion (amount, intensity, duration, etc.) is appropriate and adequate for quantifying pain? (2) How reconcile the use of an objective criterion for quantification with subjective individual variations in experience? (3) How take into account relevant qualitative features? For example, it is sometimes claimed that since humans are rational and animals are not, human suffering is qualitatively different since it involves mental anguish. Alternatively, it is sometimes claimed

that because of their rationality and mental preoccupations, humans are less sensitive than animals to pain. These alternatives arise because of the peculiar nature of pain. Regan's failure to consider material comparability weakens his series of arguments that depend on the assumption of comparability.

Regan then considers case (d), in which the amount of pain is greatly exceeded by the amount of pleasure a practice produces. Given all possible arrangements (pleasure to humans much greater than pain to animals, pleasure to some animals much greater than pain to other animals, pleasure to some humans much greater than pain to other humans, pleasure to animals much greater than pain to humans), Regan suggests that the practice might be justified if the pain is trivial, but he thinks it would not be if the pain is non-trivial.

Here Regan comes closer to a problem which he has skirted before, i.e., the structural problem of justice within a utilitarian framework. To this point, his suggestions about which practices would or would not be considered morally objectionable have depended on an intuitive sense of justice to temper the unadulterated application of the utility principle. He now formulates a principle of justice (though he refers to it only as "a moral principle"): "No practice which causes undeserved, non-trivial pain can be justified solely on the grounds of the amount of pleasure it brings about for others, no matter how 'high' the quality of the pleasure might be supposed to be" [39]. His suggested "test" for this principle is again an appeal to an intuitive sense of justice.

He uses this principle to answer the supposed objection that since pleasures differ qualitatively, not just quantitatively, and since only humans are naturally endowed to experience higher-quality pleasures, then humans have a greater claim than animals to be spared undeserved pain.

Regan's formulation of a principle of justice acknowledges the need for a reconciliation of the utility principle and a justice principle, but it does not adequately effect such a reconciliation. And while it would be unreasonable to expect him to deal thoroughly with the structural problems of utilitarianism while he is using it to analyze a specific moral problem, it is also unreasonable to embrace his conclusions without a more careful consideration of the theory from which they come.

The supposed objection to which he is responding also raises again the other structural problem that Regan does not adequately handle, i.e., the problem of comparability within utilitarianism. What he says here is, "Even if we assume, what is debatable, that pleasures can differ qualitatively one from another, this objection must offend a moral principle to which we would all subscribe", i.e., his principle of justice.[40].

His position here, I think, can be understood only in light of his understanding of the comparability of pain in a formal, not material, sense. What he is saying is that material comparability of pleasures, if there is such a thing, does not matter since pain is pain (the formal sense) and ought to be avoided. This also suggests, of course, a notion of the primary goal of utilitarianism as decreasing pain, rather than increasing pleasure.

This actually introduces another dimension of the comparability problem. In the discussion above, I pointed out the difficulties in Regan's position pertinent to comparing pain to pain. Here, the difficulty includes comparing pain to pleasure and pleasure to pleasure.

I said above that it is reasonable to be charitable about Regan's failure to pursue the problem of reconciling principles of utility and justice. I think it is also reasonable to be somewhat less charitable about his inadequate treatment of the comparability problem because of the critical role of his notion of comparability in his arguments. Even the principle of justice that he presents depends on his notion of pain as comparable in a formal sense without regard to material comparability. But as I have shown, to treat comparability of pain in a purely formal sense is not sufficient.

The second major section of Regan's paper has to do with right-to-life arguments, since he recognizes that the pain arguments, even if successful, are insufficient to support vegetarianism.

In discussing the possibility of animal rights, Regan considers a common type of objection to ascribing rights to animals, i.e., that it leads to the absurdity that a wolf who eats a lamb should be said to violate the lamb's rights. Regan's argument is that it would not be correct to say that the wolf violates the lamb's rights since the lamb can have rights only against those who can be morally responsible for their actions (i.e., are

capable of considering relevant features and making moral decisions). Regan thinks that a wolf cannot do this, is not morally responsible, and is not the kind of being against whom the lamb has rights. He compares the wolf's situation to that of severely retarded humans and claims that they cannot be expected to recognize our rights and cannot be said to violate them regardless of their actions.

It seems to me that this is not an adequate reply to the objection since it introduces instability into the notion of rights. Regan's position has these consequences: If one non-rational human, X, is killing another human, Y, X is not violating Y's rights, since Y has no rights against X in that situation. Would rational human Z be morally obligated to interfere? Let us suppose that in addition to the right not to suffer and the right to life, Y has the right to have those rights enforced against those who cannot recognize them, in this case, against X. On Regan's view, the enforcement right is meaningless since X is not violating Y's rights, indeed, cannot do so since he cannot recognize them. This seems more absurd than the alleged absurdity it is intended to counter.

It seems more reasonable to say that Y has specified rights that are non-circumstantial, i.e., they are rights against anyone who is physically capable of violating them. In that case, we would say that X is violating Y's rights, though he (X) is not morally culpable, and Z has a prima facie obligation to interfere.

To return to Regan's animal example, we would say that the wolf is violating the lamb's rights by eating it, though he is not morally culpable. A rational adult has a prima facie obligation to interfere, though he might make a moral decision that the lamb's rights ought to be overridden, given the particular circumstances.

Regan's major argument in this section is that the most plausible argument for human right to life also supports animal right to life. The right-to-life argument is as follows: Individuals have positive interests ("desires, goals, hopes, preferences, and the like"), the satisfaction of which brings intrinsic value to their lives./ The intrinsic value of any one life is "as good judged in itself" as that of any other./ Therefore, each individual has a right to pursue his interests (so long as he does not violate another's rights)./ Life is a necessary condition for pursuing interests./ Therefore, all individuals who possess interests have a right to life.

Regan says that he is not sure that this argument will withstand scrutiny, but that its strength is the notion of having interests as a condition for the right to life. Regan here argues that animals' having interests is demonstrated by behavior that shows preferential choice and goal-directed action. Later, he says that the assumption of animals' having interests is "an empirical question, to be answered on the basis of reasoning by analogy--that, roughly speaking, beings who are very similar to us, both in terms of physiology and in terms of non-verbal behavior,

are, like us, beings who have interests. The difficulty lies in knowing how far this analogy can be pushed" [41].

The notion of interests that Regan seems to have in mind here--"desires, goals, hopes, preferences, and the like"--suggests that the capacity to reason is the natural feature that entails these kinds of interests. He says, for example, that primates are a paradigm of those animals who have these interests, but that it is less clear in the case of others. This notion of having interests seems to differ from the notion of having interests that he uses in the pain arguments. There, the interests are in decreasing pain and increasing pleasure, and sentience is the natural feature that entails having those interests.

It is certainly plausible to suppose that the same individual might have both features and both kinds of interests. But it seems to me that Regan's distinction has undermined or at least severely restricted his own argument for vegetarianism. The success of that argument depends on showing that if the pain arguments and the right-to-life arguments hold for humans, they also hold for animals. But shifting the notion of interests results in either excluding or provisionally excluding most animals from the right to life. Regan prefaced his article with the statement that his intentions are fundamentally practical, not theoretical. But, as a matter of practice, most people are not eating humans or other primates.

What strategies are available to Regan to save his position? Leaving aside the many internal deficiencies in his arguments, the

basic structure of his argument could be maintained if it could be demonstrated that other animals (cows, pigs, etc.) do have the sorts of interests required by the right-to-life argument. This might be demonstrated either by showing that they have the necessary capacity to reason or by showing that such interests are entailed by another feature that they do have. Furthermore, Regan is wrong to suppose that this is purely an empirical matter, since such determinations depend on using criteria whose appropriateness is a theoretical concern.

Prospectus

The review of historical and contemporary views about the moral status of animals shows: (1) that the usual assumption is that animals are not rational, and (2) that much use is made of assumptions about the rationality of animals in arguments about the moral status of animals, but the notion of animal rationality is not as clear as it ought to be.

Clarifying the notion of animal rationality would surely sharpen arguments about the following kinds of issues that are germane to a consideration of the moral status of animals: (1) What are the necessary and sufficient bases for having the sorts of interests that qualify one for membership in the moral community? (2) Who has those features? (3) Within the moral community, which features might be generally relevant to decisions about differential treatment? (4) What bases are appropriate for making interspecific comparisons?

It is beyond the scope of this work to explore thoroughly all those issues. My purpose is the more fundamental one of clarifying

the notion of the rationality of animals, which seems to be a necessary prelude for consideration of those issues. My concern is epistemological in that I want to consider how one might go about trying to determine whether animals are rational.

On the basis of human experience, we can identify structural features of behavior that is considered rational. Such behavior is based on a body of beliefs that are based on sound inductive processes. When behavior is characterized by this feature, it is properly considered rational. This feature can be used as a criterion for ascribing (or inferring) rationality. I want to emphasize that I am not proposing a behavioral definition of rationality, but, rather, a behavioral criterion for the proper ascription of the concept.

How can we know if behavior is based on such beliefs? What can count as evidence for this feature? What entitles us to infer from some behavior (specifically, animal behavior) that that behavior is based on beliefs based on sound inductive procedures? What guidelines or constraining principles are appropriate to direct our inferences?

Our problem is to find ways to determine whether or not the behavior of any given species is based on a body of beliefs based on sound inductive processes. An immediate restriction on what we need to find is suggested by what we know about the complex relationships among beliefs, desires, and human behavior. (1) Some human behavior is rational in that it is based on beliefs inferred from sound inductive processes. (2) Some is irrational in that it is based on beliefs not inferred from sound inductive processes.

(3) Some behavior is nonrational in that it is independent of beliefs. This type of behavior is usually thought of as genetically programmed or instinctive, and although it is nonrational, it may be purposive in that it has survival value or it contributes to individual pleasure. (4) Some beliefs inferred from sound inductive processes are not acted upon. Beliefs and desires seem to be related such that they form conditional pairs, e.g., given desire X, then A acts on belief Y; or given belief X, then A acts on desire Y. Some beliefs inferred from sound inductive processes may not be manifest in behavior because the conditional desire is not present or because it is superseded by a stronger desire. For example, I may believe that eating will satisfy my hunger, but I am not hungry, or perhaps I am hungry, but I want to wait for my dinner companion, so I do not eat. The point is that there is conditional behavioral manifestation of beliefs.

What this brief analysis suggests for us is that we do not need to assume or to discover that all behavior of a species is based on beliefs based on sound inductive processes, but only that some of it is. This restriction is based on the assumption of similarity between human behavior and animal behavior. Whether or not that is defensible will be considered in what follows, but its provisional use at the beginning seems unobjectionable.

I want to suggest two criteria for determining whether some behavior of a biological species is based on beliefs based on sound inductive processes: (1) neurophysiological complexity (NPC) and (2) language use (LU). The first is prospective in the sense that

if an animal has a certain level of NPC, we might expect it to be capable of rational behavior. The second is retrospective in the sense that if an animal uses language, we might take such LU as evidence for rational behavior. The NPC criterion is not itself behavioral. The LU criterion is behavioral. Jointly, they may be used to determine whether some of the behavior of any given biological species is based on a body of beliefs based on sound inductive processes, i.e., whether the behavior under consideration is characterized by this formal feature of behavior that is considered to be rational behavior in the human case.

I want to emphasize that I am not claiming that the only rational beings are those whose behavior meets these criteria. My suggestion is the more conservative one that, in the case of biological organisms, all those whose behavior meets these criteria may be considered rational.

The formal feature of rational behavior that is our guide (i.e., that it is based on a body of beliefs that are based on sound inductive processes) is taken from human experience. Given the assumption of evolutionary continuity, it seems reasonable to use NPC and LU as criteria for determining whether that feature of human rational behavior characterizes the behavior of other species.

We will have to consider the notion of analogy. The very idea of moral status for animals is based on thinking about the analogies between humans and other animals. The comparison of interspecific behavior involves the use of analogy. Consider, for example, the usual characterization of biological concepts as polytypic. Properties or activities (behavior) which are considered to

be appropriately characterized by a specific polytypic concept share a family resemblance (in a Wittgensteinian sense) and that resemblance is one of analogous function. In considering criteria for inferences from animal behavior, we will have to consider grounds for analogical arguments. What we want to know is the conditions under which we can appropriately say that two molar or general behaviors are analogous.

I will consider each of the proposed criteria (NPC and LU) in detail in order to determine its appropriateness and usefulness, and secondarily, I will consider whether there is evidence that some animal species meet the criteria.

CHAPTER II

NEUROPHYSIOLOGY

Use of the Neurophysiological Similarity Notion in Philosophy and Zoology

Philosophers and zoologists make use of the rough notion that similarity of neurophysiological structure allows assumptions about similar experience. I want to review the way this notion has been used in both disciplines in order to point out its usefulness and its limits. Then I want to consider current empirical evidence for the correlation between NPC and the capacity for inductive reasoning.

Philosophy

Perhaps the best example for our purpose is the work that has been done about the problem of radical interpretation or radical translation which is, in Quine's apt phrase, the other minds problem socialized. Lewis' formulation of the problem indicates more explicitly than most that the inferences are grounded in the physical facts about the Subject: "Given P, the facts about Karl as a physical system, solve for the rest" [42]. What the rest includes is Karl's beliefs and desires as he could express them in his own language and as we could express them in ours. The basic presupposition is that P determines the rest to the extent that

anything does. Then, given that P determines beliefs and desires, and given the assumption that the physical systems of all persons are roughly the same, we can suppose that Karl's beliefs and desires will be roughly the same as our own. This supposition, which serves as a constraining principle in our interpretations, is generally known as the Charity principle (which seems to be a misnomer since to follow the reasonable conclusion may be considered sensible, but hardly charitable).

There are variant formulations of the Charity principle whose variance is due to differences in the sort of mental or psychological similarity that is claimed. Davidson's formulation seems to emphasize the ascription of identical beliefs and desires. "We will try for a theory that finds him consistent, a believer of truths, and a lover of the good (all by our own lights, it goes without saying)" [43]. Lewis, on the other hand, rejects a Charity principle that requires ascribing to the Subject the same beliefs and desires as the translator's in favor of one that makes more allowance for developmental differences. In Lewis' formulation, what is shared is some common inductive method and some common underlying system of basic intrinsic values [44]. What is common to the formulations is the attribution of rationality to others (and implicitly to oneself). If P determines the rest, and the rest includes rationality, then it is the physical system of humans that determines that they are capable of rational thinking.

It is the similarity of human physical systems that grounds analogical arguments. The use of such arguments is justified because

of the neurophysiological similarity of the observer and the subject. Quine provides an example when he discusses the problem (in a hypothetical field situation) of determining which particular physical stimulation prompts a specified linguistic response. Quine points out that besides formal procedures, there are "intuitive judgments based on details of the native's behavior: his scanning movements, his sudden look of recognition, and the like" [45]. These sorts of judgments are both "intuitive" and acceptable because of the assumed similarities of the translator and the subject. The particular unit of non-linguistic behavior by the subject is taken by the translator to be highly analogous to his own behavior in similar circumstances precisely because of their other kinds of basic similarities, i.e., neurophysiological structure and consequent general psychology.

We are interested, of course, in the applicability of the tenets of radical interpretation to other species. If P determines the rest, then we suppose that there is psychological similarity among the individuals in any given species. Are we to suppose that the mental states of another species are like our own? If P determines the rest, then we might suppose that when the neurophysiological structure of another species is similar to ours, the mental states are, also. And in that case, the soundness of analogical arguments about other species might be correlated with the degree of similarity between their neurophysiology and our own.

Zoology

Most zoological studies, whether molecular-cellular or molar, assume the principle of evolutionary continuity and make use of a similarity assumption. It is the assumption of neurophysiological similarity between humans and animals that underlies much interpretation of experimental observations. As in philosophy, neurophysiological similarity grounds a certain class of analogical argument. This takes two forms: (1) interpreting animal behavior by analogy to human behavior, and (2) making inferences about human behavior on the basis of animal behavior.

In the first case, the interpretation of animal behavior by analogy to human behavior, the typical assumptions that are part of the rationale for the study are: (1) that neurophysiology influences behavior, and (2) that there is relevant similarity between the neurophysiology of humans and that of the non-human subject species. The behavior of selected individuals in the subject species is observed. Then, given the similarity assumption, inferences are made about experiences or mental states of the subject animals. Given the similarity between the subject animals and humans, the behavior is understood as, say, pain behavior because it is similar to how humans do behave or would behave in similar circumstances. Then, given the further assumptions of manifestation and truthfulness on the animal's part, the human researcher infers that the animal is experiencing pain. In these studies, the neurophysiological similarity grounds the analogical arguments that justify the inferences about animal behavior.

Behaviorists know that their methodological constraints are too parsimonious, and a common strategy is to use the notion of functional relationships between observable stimuli and response events. To explain learning, the researcher assumes: (1) that the process underlying learned reactions entails the formation of an association, and (2) that the elements that are associated are functionally equivalent or isomorphic to those designated in the observed S-R relationship [46]. What is of interest to us here is that the very notion of functional equivalence obviously depends on some sort of similarity assumption. Whether or not functional equivalence can be construed as a weak or strong analogy depends on circumstantial details, but the point is that such a notion is introduced as a necessary assumption for the research of the behaviorist.

Furthermore, if pushed on the notion of mental states, most behaviorists fall back on a reductionist version of the identity theory such that mental states are nothing but brain states. If that were true, then it would seem plausible that those with similar brain states have similar experiences of such mental states as pain. It also seems plausible that the complexity (degree of organization) of neuroanatomy would determine what sort of brain states (mental states) could be experienced. But if this were so, then it would seem remarkably unparsimonious to suppose a significant dichotomy between Homo sapiens and other species.

In the second kind of study listed above, not only does the zoologist interpret animal behavior by analogy to human behavior,

but the neurophysiological similarity is used to justify additional inferences about human response and behavior based on animal response and behavior. This includes most health and medical research. Because of the neurophysiological similarity, it is assumed that human physiological and behavioral responses to various external stimuli will be similar to that of the tested animals.

An example of this type of study is a recent well-publicized project by the American Museum of Natural History in which cats and kittens were denervated (nerve ends in the genitalia, central nervous system, or eyes, noses, and ears were severed) in order to observe the effects of such nerve damage on their psychosexual behavior. The experimenters noted such things as whether being blinded affected sexual behavior and whether penis denervation interfered with normal sexual behavior. The National Institute of Health financed this study and the Museum's staff conducted it on the assumption that the neurophysiological similarity between cats and humans allowed valid inferences about human sexual problems.

Given the assumption of evolutionary continuity, the necessity of a similarity assumption as part of the rationale for zoological studies does not seem problematic to most zoologists. Although it is true that theoretical biologists are interested in the logical features of polytypic concepts, they do not question their validity or utility. What is often at issue is the validity of the similarity assumption as specified in a given instance. A common strategy for attacking study results is to attack the validity or plausibility of the specified similarity on which the results depend.

At the molecular level, an example is the well-known Canadian government study of saccharin as a carcinogen. The subject animals were rodents whose neurophysiology is similar to that of humans. The study depended on the assumptions: (1) that the rodents and humans are sensitive to the same carcinogens, to the same degree, and (2) that any change in the dose of a carcinogen will cause an exactly proportional change in the incidence of tumors. The first assumption, which is the specified similarity assumption, is widely disputed. According to a 1975 report from the National Academy of Sciences: "There is the possibility that such tests may also identify chemicals carcinogenic to rodents that do not pose such a threat to man" [47]. Uncertainty about the assumption is clearly stated by Dr. Marvin Schneiderman of the National Cancer Institute: "The correlation between man and animals may be wrong. Man may be less sensitive than animals to a carcinogen. But he may just as easily be more sensitive" [48].

At a behavioral level, the Museum's study of felines provides an example. It can be argued that, although there is neurophysiological similarity between cats and humans, the greater complexity of the neurophysiological structure of humans allows for adaptive behavior, e.g., in the case of blindness, such that the inferences from feline behavior are questionable.

Whenever specified similarity assumptions are attacked, what is questioned is: (1) the empirical evidence for the claim of similarity of relevant features, and (2) the relevance of the selected features of the compared species in that case. The issue is the strength of the analogy in the given instance.

Empirical Evidence for Correlation Between Neurophysiological Complexity and the Capacity for Inductive Reasoning

In the two preceding sections, we have seen some of the ways in which philosophers and zoologists make use of the notion that similarity of neurophysiological structure allows assumptions about similar experience. This notion grounds a certain class of analogical argument in both disciplines. In general, similarity of neurophysiological organization is correlated with similarity of physiological response and behavior.

For our present purpose, we are interested in a more specific correlation, i.e., the relationship between the complexity of neurophysiological structure and the capacity for inductive reasoning. It is generally thought that humans are capable of inductive reasoning because of the neurophysiological complexity of the species. I want briefly to review the empirical evidence for that claim as well as the empirical evidence related to the neurophysiological complexity of some other species, and consider the implications for the claim that those species have the capacity for inductive reasoning.

Before proceeding with that, however, I want to point out why I think such a review of empirical data is a useful approach. The question of the relevance of empirical data to theories of mind-body (or more specifically, mental state-brain state) relation is certainly an interesting and difficult question, but it is not a question that need detain us here. It may well be the case that the empirical data are consistent with many theories. But for our present

purpose, all we need is an empirically supported correlation, not a theory to account for it. The theoretical claim that there is a correlation between brain states and mental states (the latter inferred from observable behavior) is not the same as a theoretical claim that accounts for the correlation. It is the former type of claim that is relevant to our present purpose.

In light of current neurophysiological knowledge, it is probably quaintly misleading to speak of the "localization" of brain state correlates of specific mental states, but for the moment, to speak in this way will help clarify the boundaries of our concern. Wherever a brain state correlate may be located, the brain state-mental state correlation remains puzzling. But for our purpose, such location is the relevant issue inasmuch as we are interested in the capacities of brains of different species that differ in complexity. For example, suppose (again putting the matter very crudely) that the mental states that constitute inductive reasoning are correlated with brain states that involve the neocortex. If the brains of a selected animal species lack neocortex, it would be plausible to be skeptical about that species' neurophysiological capacity for inductive reasoning.

Our task is not an easy one. During the recent past and at present, research in the neurosciences has been specialized and fragmented. One result of this organization of research is that there is serious disagreement about fundamental issues, e.g., the relation between electrical and chemical changes in and among nerve cells. There is agreement, however, about the rudimentary

nature of even the most advanced knowledge. Perhaps for these reasons, comparatively meager attention has been given to the development of theoretical neuropsychological models that would account for the piecemeal and often conflicting data. Furthermore, it is recognized that the available models are not entirely satisfactory [49].

Given this state of affairs, it seems to me that a reasonable way to proceed to find out what we want to know is to select the best available theoretical model and review the empirical data in light of that model. Formally, the data in which we are interested are empirical generalizations that: (1) describe observable properties and establish the frequency of occurrence of those properties in repeated observations, and (2) hypothesize a relation (between a theoretical independent continuous variable $\bar{x}$ and a dependent theoretical continuous variable $\bar{y}$) that is assumed to correspond approximately to relations that would be obtained between $\bar{x}_i$ and $\bar{y}_i$ if the experiments were repeated indefinitely, and if $\bar{x}_i$ were replaced by a continuous variable that within a certain range, could take any value. But since frequency of confirmation does not necessarily rule out non-spurious empirical generalization, it seems desirable to consider these empirical generalizations in the context of a theory that incorporates them, even though our primary interest at the moment is not the theory, but the empirical generalizations [50]. Philosophers do not ordinarily know neurophysiology, but they do know the features of good theories, and those features can serve as criteria in selecting a

theoretical model to guide our present review of empirical data and allow for consistent interpretation.

On the basis of such criteria, I propose to use Wassermann's integrated model (which he calls a neuropsychological molecular biological mapping theory) [51]. If Wassermann's model should turn out to be substantially wrong, what would be required, relevant to our present interest, would be to find the next best available model to help us consistently interpret research data.

One of the virtues of Wassermann's theory is its integration of structural and functional brain properties. Structural lateralization and functional hemispheric specialization have been key concerns in interspecific comparative studies. Typical questions are about: (1) the evolutionary development of bilateral brains, (2) morphological symmetry and asymmetry, (3) functional symmetry and asymmetry, and (4) the relationship between morphological and functional symmetry and asymmetry.

Evolutionary Development of the Bilateral Brain

The evolutionary history of the lateralized brain involved three major phases: (1) paired sense organs, paired motor structures, and paired and parallel brains; (2) commissural interconnection of the parallel brains, and (3) crossed lateralization. In symmetrical lateralization, each hemisphere acts as the mirror image of the other. The first known vertebrates had a brain in which the five fundamental regions were already established and it formed a lateral structure much like present typical vertebrate brains [52]. Later anatomic development included the growth of

the lateral structures (particularly the midbrain and telencephalon), a progressive tendency towards asymmetry, and the development of mammalian cerebral commissures, particularly the corpus callosum which progressively increases in size phylogenetically. There are differences in the speed of conduction across the callosum in different species [53].

All vertebrates have bilateral systems for perception and motor function. Given the symmetry of vertebrate body structure, such bilateral brain systems are clearly adaptive for survival. So, it is an intriguing question why there has been evolutionary progression towards asymmetry. Both anatomical and functional asymmetry is found in Homo sapiens and other species. One plausible hypothesis is that, for higher mammals, the capacity for complex cognitive activity is even more adaptive than the capacity for sensorimotor activity [54]. It is because of the supposed relationship between asymmetry and cognitive capacity that interspecific comparisons of anatomical and functional asymmetry are particularly relevant to our present purpose of determining whether or not some nonhuman species have specific kinds of cognitive capacities.

Anatomical Asymmetry

Anatomical asymmetry in the posterior regions of the temporal lobes has been observed in adult, neonate, and fetal humans and in nonhuman primates [55].

In humans, the superior (upper) horizontal surface of the Sylvian fissure--the part of the temporal lobe posterior to Heschl's

transverse gyrus which is the primary auditory cortex--is usually larger (longer) in the left than in the right hemisphere. This surface, the planum temporale, is part of the auditory association areas. There is extensive development of gyri around the Sylvian fissure. The posterior portion of the superior temporal gyrus is the core of Wernicke's language comprehension region, i.e., Wernicke's area is folded within the Sylvian fissure. (See Figure 1.)

There is also considerable evidence for anatomic asymmetry in temporal lobe regions in nonhuman primates. In studies of various species, it has been shown that the Sylvian fissure is longer more frequently in the left hemisphere. The most striking case is that of chimpanzees in which 80 per cent of those studied showed longer left-hemisphere Sylvian fissures (compared to 84 per cent of humans). This is particularly interesting since the observed neural asymmetry is in the auditory association cortex, but the modalities that have been used in developing language skills in chimpanzees have been visual and manual, rather than auditory [56].

What is the significance of the evidence for this marked anatomical asymmetry? The anatomical asymmetry correlates with traditionally accepted functional asymmetry, i.e., left hemisphere dominance for language. Although a larger anatomical area does not necessarily mean that it is more important for a particular function, "there are precedents in neural organization to indicate that size of cortical representation of function is positively correlated with degree of function" [57].

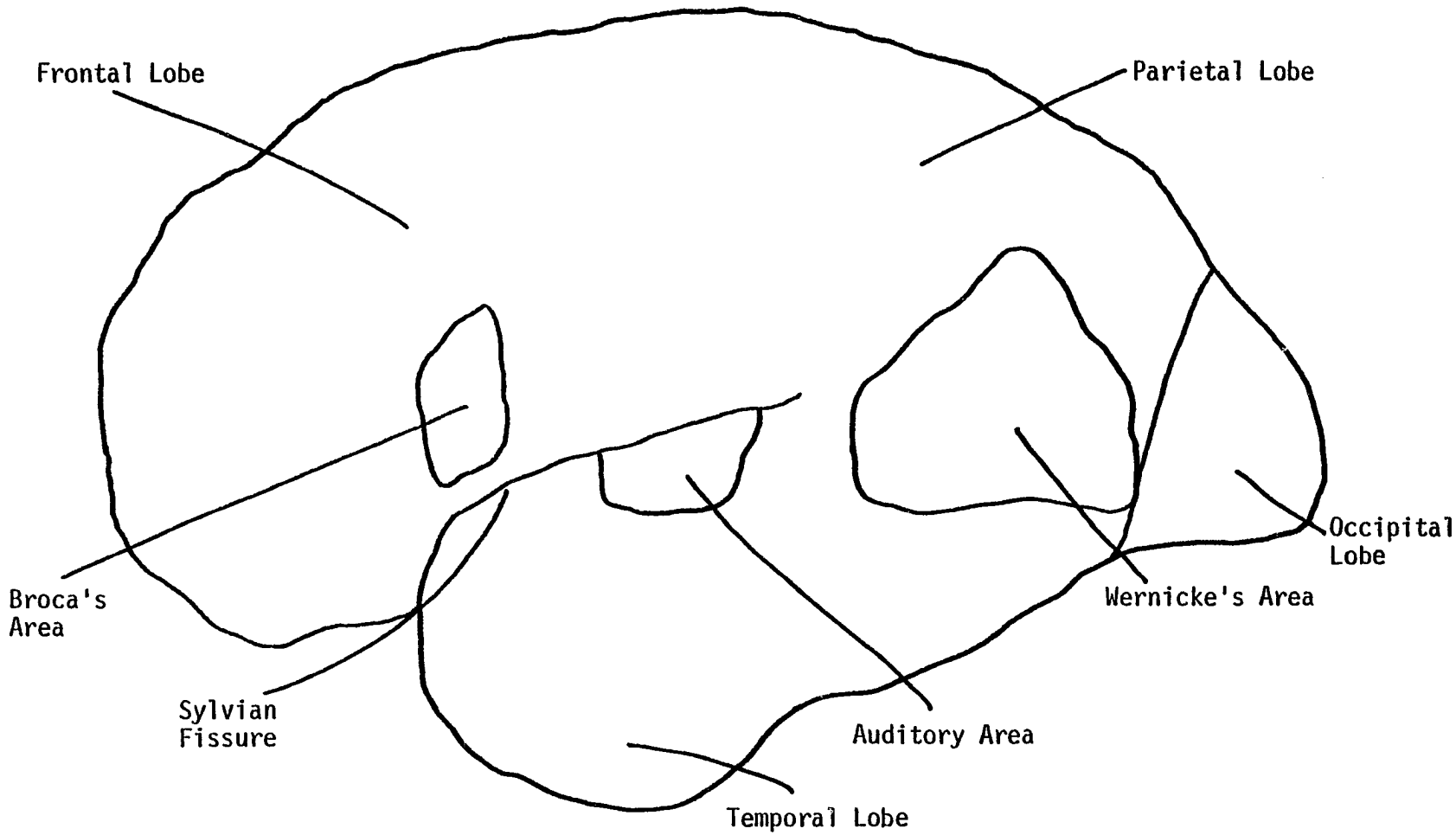

FIG. 1. LATERAL ASPECT OF LEFT HEMISPHERE.

Nevertheless, the relationship between neurostructure and function is unclear. There are normal asymmetries in various paired human anatomical structures, e.g., the left leg is longer but the right arm and ribs are longer. In the brain, there are asymmetries in the cerebral veins, cerebral blood flow and volume, EEG activity, and various subcortical nuclei and pathways. The volume of the left lateral ventricle is greater than the right, and the total weight of the right hemisphere is greater, which suggests that there is less tissue mass in the left hemisphere. The significance of the larger left Sylvian fissure is based on its correlation with independently established left hemisphere dominance for language. However, other areas correlated with language--Heschl's gyrus, Broca's area, and the major part of Wernicke's area--are larger in the right hemisphere [58].

For our purposes, it is serendipitous that data are available about the similarity of the Sylvian fissure asymmetry in human and nonhuman primates, since it relates to cognitive (linguistic) abilities. But the significance of the morphological asymmetry is unclear since the precise role of the planum temporale in linguistic behavior is not known [59].

Other Anatomical Comparisons

Some data related to interspecific neuroanatomical comparisons other than anatomical asymmetry are available. Quantitative differences between human and other primate brains are shown by several types of measurements.

First is the comparison of brain volume/body surface area ratio, a dimensional encephalization index. Among primates, there is a linear relationship between brain weight (E) and body weight (P) when plotted on a double-logarithmic scale by the following formula: $E = kP\,2/3$. Such plotting shows linear progression from baboons through pongids (including chimpanzees and gorillas) to humans [60]. This analysis of encephalization is consistent with other studies that indicate that higher apes have greater capacities than monkeys or gibbons [61]. In general, there is correlation between high encephalization of species and independent attributions of intelligence, e.g., humans, dolphins, elephants, great apes, and monkeys [62]. The cephalic index of bottlenose dolphins is approximately the same as humans [63]. Although intraspecific analysis of brain size is characterized by marked "error variance", as an interspecific statistic, it has stable correlation with other neural measurements including total cortical neurons, cortical volume, neuron density, glia/neuron ratio, length of dendrite tree, chloride, acetylcholinesterase, and cortical surface [64].

A second type of quantified comparison is a progression index that shows the extent of a particular component neural structure, e.g., how many times larger the neocortex is in a given species than it is in an average basal insectivore of the same weight. A simian scale on a progression index for neocortex (which is considered an anatomical correlate of intelligence) shows gorillas at 31, chimpanzees at 59, and humans at 154 (with base 1) [65]. Although neocortical extent is highly correlated with brain size

and encephalization indices, its usefulness as a correlate of intelligence is restricted inasmuch as it discounts the role of paleocortical structures in intelligence [66].

It is generally agreed that there are qualitative differences between different areas of the neocortex (frontal, parietal, temporal, and occipital lobes). The only reported comparative study of these areas measured the size of prefrontal areas in relation to total neocortex [67]. The results were 11.3 per cent in macaques, 16.9 per cent in chimpanzees, and 29 per cent in humans [68].

What these studies show are relative quantitative differences in neuroanatomic structure among humans and other primates. Again, what they do not show is the functional significance of such differences.

Functional Asymmetry

Brain researchers are interested in finding more precise correlations between structure and function. On the one hand, attention has been given to obtaining information about normal neurostructure including morphological asymmetries. Although knowledge in this area is limited, it does allow for some interspecific comparisons such as those discussed in the preceding sections.

On the other hand, attention has been given to obtaining information about normal brain functions by: (1) noting physiological responses or behavior, given specified neuroanatomical or neurophysiological conditions (e.g., unilateral lesions, commisurectomy,

hemispherectomy, carotid amytal injections, electrical stimulation, or normal), or (2) noting neuroanatomical or neurophysiological conditions, given specified responses or behavior (e.g., aphasia or handedness (long term) or specific task performance or response to stimulus (short term)). On the basis of these correlations, the functional properties of brain regions are inferred.

Functional asymmetry in human brains has been documented for more than a century. The traditional description of differences includes the following, with the first term in each pair referring to the left hemisphere and the second term to the right hemisphere: verbal-nonverbal; propositional-imaginative; analytic-synthetic; explicit-tacit; linguistic-spatial and manipulative; sequential-holistic; selective attention-sustained concentration; arithmetic-geometric [69].

Recent research has indicated, however, that most functional differences between hemispheres are a matter of relative domination, not exclusive specialization [70]. Furthermore, although hemispheric functional specialization is evident, there is great functional variety in neurological structures. In humans who have undergone commissurotomy, e.g., there is marked variability in the amount and kind of language capacity associated with the right hemisphere [71]. Experiments with hemidecorticate humans have shown that the right hemisphere is able to support a level of linguistic function grossly comparable to that of the left hemisphere, and experiments with global aphasics have shown that, under those conditions, the right hemisphere is unable to support any linguistic function [72]. Right

hemisphere control of linguistic function is markedly variable.

The evidence suggests that the hemispheres are not behavior-specific, but that there is processing specificity. Differential processing of Japanese languages provides an illustration of processing specificity. Katakana represents the sounds of speech while Kanji represents ideas and has little direct relationship to speech. A left hemisphere stroke impairs ability to read and write Katakana but has little effect on ability to read and write Kanji. Although the use of either is linguistic behavior, Katakana (primarily verbal and temporal) is primarily processed by the left hemisphere whereas Kanji (primarily visual and spatial) is primarily processed by the right hemisphere [73]. "Language is a complex of behaviors, each of which may lateralize (and localize) in varying ways and in varying degrees" [74].

Studies with neonates have shown changing asymmetrical functioning generated by stimuli with no verbal content in different modalities (auditory and visual). "These asymmetries are related to cerebral speech dominance, but appear to represent the more fundamental processes in which language appears to be only a part since they do not require stimuli with 'verbal' content" [75]. "It is becoming increasingly apparent that many tasks that might superficially be labelled linguistic or visuospatial are comprised of processing stages that individually engage one or the other hemisphere" [76].

I want to emphasize that part of what is being claimed is that there is complex cognitive activity in the absence of speech. Additional evidence for this comes from experiments with global aphasics

designed to test for cognitive capacity in the right hemisphere. These patients have learned the non-verbal language system developed by Premack for chimpanzees. In other experiments, they have demonstrated an efficient memory system, the ability to categorize, to conceptualize, and to make inferences [77].

The limited knowledge available about functional capacities (and anatomical correlates) in nonhuman animals makes interspecific comparisons difficult. It has been reported that total commissurotomy has no observable effects on the behavior of cats [78]. The studies that have been done with nonhuman primates suggest functional hemispheric specialization. Right hand preference by baboons for intricate motor tasks suggests left hemisphere specialization [79]. Experiments with monkeys have generally indicated no cerebral asymmetry in visual learning, but there is recent evidence that lesions of the parietal cortex that produce profound spatial disorientation in humans produce similar disorientation in rhesus monkeys [80]. There is evidence of a major functional hemispheric difference in monkey brains in the auditory mode, the mode that gives rise to verbal abilities. Lesions of the left superior temporal gyrus (the homologue of Wernicke's area in humans) impair performance on difficult auditory tasks whereas right-sided lesions in the same area do not [81]. Chimpanzees have demonstrated linguistic ability, possibly related to the longer Sylvian fissure in the left hemisphere. Recent studies with humans have indicated visual, auditory, and olfactory transfer through the anterior commissure, and behavioral studies have indicated visual transfer through the

anterior commissure in nonhuman primates [82].

Clearly, there is some evidence for hemisphere specialization in nonhuman primates similar to that of humans. As we have just seen, however, there is considerable evidence that what is hemisphere specific in human brain function is not behavior, but processing. If what is specialized in human linguistic behavior is not the behavior, but the underlying processing mechanisms, then it is plausible to suppose that the processes of nonhumans are similar even though the behavior may be non-linguistic [83].

Significance of the Empirical Evidence

Our purpose in reviewing empirical data about neurostructure and function in humans and other species was to determine whether those data constitute evidence for: (1) correlations between neurostructure and cognitive capacity in humans, and (2) structural and functional similarity between human brains and those of some nonhuman species.

Our review of the data has shown that there is some evidence for both claims, but caution is clearly in order for a number of reasons. First, the available data about humans as well as nonhumans are quite limited. It is easy to see why there is general agreement among neuroscientists that their knowledge is rudimentary. Although the usual sociological explanations for this state of affairs surely apply--scientists cannot do everything at once--there is, in this instance, another relevant factor. With regard to primates, for example, Witelson suggests that "the general lack of evidence for lateralization of cognitive functions in primates to

date [1977] may well be because it was not looked for since it was not expected in nonlinguistic animals" [84].

Furthermore, some of the data that are available have been obtained by methods which restrict generalizations. Data obtained from pathological cases or from human or nonhuman individuals with clinically or experimentally induced abnormalities may not provide reliable information about normal brains. The matter is further complicated by the fact, in the case of humans, that the induction of clinical abnormalities is undertaken because of already existent brain damage. For example, prior to surgery, most commissurotomy patients have severe epileptic seizures due to lesions in the cortex. Not only that, but the standard surgical procedure itself usually causes additional lesions [85]. But much of human brain research has been limited to abnormal brains because of ethical constraints. Wada, whose research interest is human infant brains, puts the matter quite succinctly: "Infant brains without neurological damage are hard to come by" [86]. Brains from humans who have died are, of course, available for research, but their very availability restricts their usefulness in assessing brain functions. Apart from these practical and methodological problems, there are conceptual questions about the rationales for many brain research studies.

The Sylvian fissure asymmetry studies illustrate some of the difficulties. The observation of anatomical asymmetry (in disembodied brains) is considered important because of its assumed relationship to linguistic functioning in living human brains, i.e.,

left hemisphere dominance for language. The Sylvian fissure studies show anatomical asymmetry in approximately 80 per cent of humans, but studies of aphasics with unilateral brain damage show 95 per cent with left hemisphere dominance for language while intracarotid sodium amytal studies with apparently normal humans show 90 per cent with left hemisphere dominance for language. How are the discrepancies to be explained? [87].

The first possibility is procedural. Witelson suggests, for example, that macroscopic measurement of the planum may be too imprecise to correlate well with functional variables and that such attempts might be more successful if histologic studies were done first in order better to define the area. Of course, this would still not account for the discrepancy between the aphasic and sodium amytal studies. Nor does it address the problem of the applicability of evidence from studies of damaged or abnormal brains to normal ones.

The suggestion for procedural precision also introduces a conceptual problem in formulating hypotheses for Sylvian fissure and other anatomical studies. "To attribute the capacity for language simply to quantitative parameters such as size or number of cells is a gross oversimplification" [88]. It is possible that various methods of assessment (anatomical measurement, testing functions of aphasics with lateral lesions, testing functions of normal individuals injected with sodium amytal) are "sensitive to different aspects of neural organization" [89].

The latter possibility is congruent with recent data that indicate that the traditional ways of thinking about brain structure and function (ways of thinking that provided study rationales and determined appropriate methodologies) have been misleading. One example, which we considered above, is the notion of language. Attempts to make sense of variant data have led to a conceptual shift in the notion of linguistic behavior. The notion of left hemisphere dominance for language is being superseded by a concept of linguistic behavior as a complex series of processes selectively involving both hemispheres.

One consequence of such a shift is a necessary reassessment of data and the inferred empirical generalizations obtained in previous studies. A relevant example is studies of cognitive functions in nonlinguistic animals. Studies designed to test cognitive abilities by testing functional left hemisphere dominance may be seen as poorly designed, and the conclusions would be suspect.

The situation is the same at a cellular level. Recent electrophysiological studies of neurons have indicated that brain functioning is much more complex than had been supposed. "Clearly, we cannot expect, even at the simplest levels, any one-to-one relation between structure and response" [90].

One of the virtues of Wassermann's neuropsychological theory is that it provides a coherent explanation of data that have seemed quite puzzling in the light of traditional theories.

Wassermann's theory takes account of the fact that a brain is a self-organizing system whose component types and numbers are not

initially fixed and whose component types can be self-generated during its development (formation of new cells and new cell types) or functioning (formation of engrams). The theory attempts to explain the psychobiology of brain in terms of both structural and functional properties of neurons and associated cells [91].

The central issue in neuropsychology is the type of code and encoding structures that nervous systems use. Wassermann rejects the traditional models that propose that nerve impulses serve as encoding means and proposes instead a molecular mapping paradigm. He argues that genetic systems control a developmental wiring-in of nervous systems that is very highly specific (due to qualitatively specified cell-labelling systems carried on the outside surface of cell membranes). Neurons are carriers of cable-like molecular channel systems, such that any particular channel can pass in, through, and out of various neurons, and traverse pre- and postsynaptic membranes and synaptic clefts. These molecular channels (linear polymeric cables whose monomers are proteins) are postulated to be the actual message encoders and carriers, and each channel is chemospecific. Nerve impulses function as non-selective energizers of the molecular machinery, and messages are encoded and transmitted along a channel in the form of an electronic excitation wave.

Within the synaptic clefts of many CNS neurons, certain molecular channel components that traverse the clefts form "unit molecular mapping systems" (UMMSs). These UMMSs code both (1) stimulus configurations (pictorial mappings of images) and (2) symbolic

(conceptual) representations and their respective engrams, though in different ways, and the two types of engrams are dissociable. Furthermore, the mapping machinery is essentially similar for different sensory modes. The type of stabilization of engram-forming UMMSs determines the formation of long-term memories, short-term memories, and sequences of UMMSs form engrams of serially ordered image sequences and concept sequences.

The model does not require that all message propagation start from receptor neurons (which would rule out creative cognitive activities), but allows for specific centrally ongoing message propagation as primary initiators of the mapping processes involved in creative cognitive activities. Furthermore, although some peripheral and central neurons are activated in response to the stimulation of certain sets of sensory receptor neurons, the response is not an analysis (feature detection), but recognition of configurations which involves engram formation [92].

We have seen that current research suggests that there are basic processing mechanisms that underlie various behaviors including linguistic behavior. On Wassermann's model, the same mechanisms map both pictorial and conceptual representations (and their respective engrams). Pictorial and conceptual representations may be connected by molecular channels, but they are dissociable. Lesions or commissurotomy might sever some of these connections. Channel connections allow for intermodal associations, e.g., auditory-visual associations which are important in linguistic behavior. They also allow for the intramodal associations (compounds

of concepts) necessary for complex cognition.

The model's allowance for multiple representations of engrams in both hemispheres explains the data indicating marked variability in hemisphere specialization and hemisphere capacities, and it also implies the enormous difficulty of attempting to correlate specific anatomical structures and functions.

Wassermann's theory is about the human brain, but it seems plausible that, if it holds at all, it holds for animals as well. According to the theory, brain size and weight are irrelevant in determining one's basic cognitive capacity. Rather, it is determined by genetically specified cell proteins. Wassermann himself notes that evidence from animal studies suggests that the essential mechanisms "might appear in simplified versions in all kinds of lower animals which are endowed with adequate nervous systems" [93]. For example, evidence that cortical lesions in monkeys produce deficits in object recognition and pattern discrimination but not in detection and localization of visual stimuli or in visually guided movements related to the stimuli can be explained by severed connections of molecular channels between image-representing and concept-representing UMMSs [94]. Studies of corpus callosum functioning in animals suggest multiple representation of engrams in both hemispheres which is the case for humans on Wassermann's theory [95].

The theory depends on genetically controlled wiring-in of nervous systems such that there is high specificity of cells. There is evidence that "nervous systems as diverse as that of the leech

and of mammals are at least in some parts ... so highly accurately wired-in that any two neurons in those parts may differ from each other with respect to specificities" [96]. As noted above, the UMMSs, which are the coding mechanisms, are located in the synaptic clefts of many CNS neurons. Studies of the vesicular grid (peak and hole pattern of the brain) of mammals and lower species show the presence of dense projections in synapses of many types of neurons [97]. Furthermore, even relatively small brains, such as those of mice, have a vast number of CNS synapses. In mice brains, on the average, there are 10^4 synapses per cortical neuron. The fact that the molecular weight of neurofilaments varies among species is also congruent with Wassermann's theory since, on the theory, such filaments serve as support structures for molecular channels [98].

So, there is genetic, functional, and anatomical evidence that the neuropsychology of animals is essentially the same as humans, on Wassermann's theory.

I pointed out above that I would use Wassermann's theory to provide for consistent interpretation of empirical data, and that I selected it on the basis of its formal features. It is clear that the theory's strength is its explanatory power. Although the theory is formally more adequate than available alternative ones, we do not know whether or not it is correct. At present, the biological evidence is indirect. The theory is in principle testable, but it has not, in fact, been adequately tested [99].

If the theory is correct, then: (1) genetically determined neurostructure determines cognitive capacities, (2) there is

genetically-determined structural similarity between humans and some nonhuman species, and (3) the one basic processing mechanism is essentially the same in human and nonhuman brains.

Our review of empirical research has shown that there is empirical evidence consistent with the theory. But the questionable reliability of some of the data and the uncertain status of the theory preclude firm conclusions.

The evidence does support the plausibility of using neurophysiological organization as one criterion in determining whether some behavior of a given species is based on inductive reasoning, but it does not allow for precise formulation of the criterion. For the same reasons that we do not know how precisely to formulate the criterion, we do not know how it might precisely apply to various species.

CHAPTER III

LANGUAGE

A second criterion that seems plausible for use in determining whether some behavior of a given species is based on sound inductive processes is the use of language.

We have just seen that neurophysiologists are beginning to conceptualize linguistic behavior in a way that is much broader than the traditional notion of language use. They have claimed that the processing mechanism is the same for behavior that is usually labelled linguistic and behavior that is usually labelled nonlinguistic. They have also claimed that both types of behavior may be composed of processing stages that defy common descriptive labels. Furthermore, they have claimed that there is clear evidence of the capacity for conceptual thought in the absence of language.

This clearly conflicts with a traditional philosophical view, which we discussed in Chapter I, that language use is evidence of conceptual capacity, that animals do not use language, and therefore animals do not have (strong version) or probably do not have (weak version) the capacity for conceptual thought.

In thinking about language use as a criterion for determining specific cognitive capacities, it is important to be clear about which are the relevant and disputed points. We might ask a question like this: Does language use indicate the capacity for conceptual thought? We are not likely to get much argument, since it is usually assumed that the nature of language is such that its use does constitute evidence of various cognitive capacities, including the capacity for conceptual thought. But what we want to examine, what is relevant to our present concern, is the assumption about the nature of language. The question of interest for us is this: What counts as linguistic behavior? This is not only a relevant matter; it is also a highly disputed one.

There are two basic approaches to answering this question. The first is to find an adequate theory of language--a language paradigm. The paradigm can then be used as a criterion in making decisions in given instances. The second approach is to consider what counts as evidence for linguistic behavior in the absence of a paradigm. It seems reasonable to begin by looking for a paradigm.

Theories of Language

We are confronted with an immediate theoretical problem: How do we know what to consider as theories of language if we do not know what language is? It is of no use to say that our inquiry is meta-linguistic, for, in this case, that is merely a second-order begging the question.

Let us begin by taking the case that is generally considered to be paradigmatic linguistic behavior--human propositional speech--and considering theories of language about that behavior. What we learn from that investigation may then help us consider nonparadigmatic and borderline cases.

But there is another theoretical problem: What will count as a theory of language? It is a matter of fact that study of language and linguistic behavior is conducted in many disciplines, including philosophy, psychology, linguistics, and anthropology. Within each discipline, there are theories that either purport to be or seem to be primarily descriptive and those that purport to be or seem to be primarily explanatory. In some instances, the status of the theory is a matter of considerable dispute, and, in some instances, the dispute derives from prior variant assumptions about language.

Our choice might be pragmatically guided by our own interests, i.e., the role of linguistic behavior as evidence for certain cognitive abilities. But I think it would be too restrictive to limit our considerations to those theories which are ordinarily labelled psycholinguistic, since it seems to me that even those theories that are primarily structural analyses of natural or non-natural languages include explicit or implicit notions about the relationship between language, linguistic behavior, and psychological or neurological phenomena. Indeed, questions about what language is and how it is possible for X to acquire language are clearly related.

In a sense, the questions about language may be seen as questions about a specific form of knowledge, i.e., (1) what is it that X knows when X knows language (or a language) and (2) how is it possible for X to know (or come to know) language? Generally, theories of human knowledge explain knowledge primarily in terms of experience (empiricist theories) or primarily in terms of mental structure or activity (rationalist theories). We would expect empiricist theories of language and rationalist theories of language and, of course, that is the case.

For our purposes, then, I propose that we examine an example of each kind that is available in order to see if we can find an adequate paradigm. I think that the most clearly illustrative theories of their kind are Skinner's empiricist theory and Chomsky's rationalist theory.

Skinner's Empiricist Theory

Skinner's work is within psychology and his theory is presented as a psychological theory [100]. The theory is empirical in that it explains language in terms of experience. Furthermore, in terms of methodology, it is presented as a radical behaviorist theory, i.e., the method consists in observing behavior without positing unobservable mental structures or activities.

Behaviorism developed in reaction to associational psychology, in which language is understood as an instrument for communicating thoughts. Internal ideas, accessible only to oneself through introspection, are externalized by means of language in order to communicate with others. The meaning of a word can be understood

in terms of its regular association with a certain idea.

Behaviorism rejected the method of introspection for the method of observation. It retained, but revised, the notion of association. In behaviorism, what is associated is overt behavior and environmental factors. Behaviorism also retained the notion of hierarchical associations such that complex units can be understood as composites of the simplest ones. Behaviorists hold that most behavior, including linguistic behavior, is learned, and they hold that the mechanism of learning is an association between stimulus and response [101].

What is remarkable about Skinner's theory is his claim that linguistic behavior can be adequately explained solely in terms of a functional analysis of the behavior. It is not only the case that Skinner's method consists in observing behavior without positing unobservable mental structures (methodological behaviorism), but also that he claims that there are no such mental structures (metaphysical behaviorism).

"The simplest and most satisfactory view is that thought is simply behavior. It is not some mysterious process responsible for behavior but the very behavior itself in all the complexity of its controlling relations" [102]. "The range of verbal behavior is roughly suggested, in descending order of energy, by shouting, loud talking, quiet talking, whispering, muttering 'under one's breath', subaudible speech with detectable muscular action, subaudible speech of unclear dimensions, and perhaps even the 'unconscious thinking' sometimes inferred in instances of problem

solving. There is no point at which it is profitable to draw a line distinguishing thinking from acting on this continuum" [103].

Skinner acknowledges that physiological processes "mediate all the relations disclosed in a functional analysis of behavior", but he thinks it is sensible to discuss behavior without identifying the muscular or neural substratum of verbal events [104]. Given Skinner's position, one is surprised to read his claim that "all behavior ... is subject to Kantian a priori's"; but apparently he is using the notion of Kantian a priori's in a very loose way to mean any natural constraints on behavior, for he adds that the claim is so "in the sense that man as a behaving system has inescapable characteristics and limitations" [105].

Skinner's view of man and his characteristics and limitations is certainly not Kant's view. Skinner, committed to an Evolution paradigm, sees man, like other species, as an organism in interaction with his environment. When such interactions alter behavior such that there is "a safer or more useful interchange with the environment", the benefits to the organism tend to stabilize and maintain the behavior [106]. Activities that operate on the environment are called "operant behavior" and a unit of such behavior is called an "operant". Operant behavior emerges from undifferentiated, undirected movements. For example, the babbling of human infants is undifferentiated, undirected movement from which operant verbal behavior develops in interaction with others [107].

Verbal behavior is defined as behavior that is reinforced through the mediation of other persons in those cases in which the other person is "responding in ways which have been conditioned precisely in order to reinforce the behavior of the speaker" [108]. What is called verbal behavior is not limited to speech, but may include other modes such as gestures, touch, manipulation of physical objects, etc. [109].

Children learn verbal behavior when undifferentiated "vocalizations, selectively reinforced, gradually assume forms which produce appropriate consequences in a given verbal community" [110]. Skinner suggests that the motivation for the reinforcing adults is that it is advantageous to have an additional literate member of the group [111]. As a child matures in a verbal community, he builds a repertoire of verbal responses to stimuli.

Psycholinguistic research does suggest that there is "babbling drift" such that a child's babbling moves in the direction of the sounds he hears, including the intonation patterns [112]. According to Skinner, children learn language (a repertoire of verbal responses) in the same way they learn everything else--by reinforcement of acceptable responses to stimuli. If a child says "bear" when his mother holds up a teddy bear, his mother may smile, nod, give verbal assent, hand him the bear, etc.--behavior that reinforces the child's behavior. It does seem to be the case that children learn some language in this way, i.e., they learn referents for many things. But, particularly as their speech becomes more complex, the reinforcement is less clear. For example, if a

child says "want apple", the mother may give him a piece of apple, a piece of banana (if no apples are there), or nothing at all, and she may do any of these either without talking to him or while talking about the rain. Skinner's assumption is that a child's utterances will be positively reinforced most of the time, but it is not clear what will count as reinforcement in the case of language. The difficulty is in trying to stretch the notion of reinforcement from reward for behavior in a laboratory situation to the situation of language acquisition.

Furthermore, psycholinguistic studies have shown that adults tend to reinforce what is true, not what is grammatically correct [113]. For example, given that the teddy bear has brown feet, if a child says "Teddy foots brown" or "Teddy has pink feet", the adult is likely to reinforce the first (true, but ungrammatical statement) and not the second (grammatical, but untrue).

Skinner has noted that there is a standard schedule for maturation of verbal behavior, but he does not seem to wonder why there would be such standardization. Children's babbling is followed by one-word utterances and two-word utterances that are nouns and verbs. At about the age of two, children begin using various grammatical forms, e.g., plural (-s), past tense (-d), copula (am, is, are). What is of special interest is that the sequence in which these forms appear in children's speech is almost identical for all English-speaking children [114]. The next stage includes the appearance of Wh- questions (what, where, why, who), and again there is a consistent sequence in the use of these

forms by all English-speaking children. At first, the Wh- word is placed in front of a sentence (When Mommy go?), later an auxiliary verb is added to the main verb (When Mommy will go?), and even later, the auxiliary verb is moved to the grammatically correct place in the sentence (When will Mommy go?). It is clear that some of these constructions are not imitations.

Furthermore, corrections do not seem to be effective in teaching correct grammar to a young child. For example, if the child says, "Teddy foots brown", and the mother says, "You mean Teddy has brown feet", the child is likely to reply, "Yes, Teddy foots brown" [115]. Nor are expansions effective. For example, if the child says, "Teddy fall", and the mother says, "Yes, Teddy is falling down the stairs", the child is likely to repeat, "Teddy fall" [116].

Children seem to be consistent at certain stages, but the consistency does not accord with the grammatical rules that adults follow. How do we explain the fact that there are these stages in language development and the fact that they are the same for all children? To say that language use develops in relation to general cognitive development is not very informative unless one specifies what is meant by general cognitive development and by the relation.

We have noted the vagueness of the notion of reinforcement in language acquisition. According to Skinner, reinforcement is also necessary for the maintenance of verbal responses in adult behavior. The notion of reinforcement is no less vague in this case, e.g.,

it includes anticipated reward (which may never occur) as well as actual rewards. An example is a poet who hopes that his poetry will be appreciated by someone, somewhere, at some time. According to Skinner's definition of verbal behavior, if someone does respond positively to the poetry, he will do so "precisely in order to reinforce the behavior of the speaker". But it is hard to see how someone who genuinely appreciates a Borges poem which she reads in a magazine in Lexington, Oklahoma, is responding "precisely in order to reinforce" Borges' behavior.

Skinner claims that one can predict and control verbal behavior by identifying the functional relation between the controlling stimulus and the response. But the notions of stimulus and response are also vague. In any given situation, we can identify numerous factors that might count as stimuli and numerous actions that might count as responses. Although Skinner claims that his explanation of verbal behavior "is not theoretical in the usual sense", he does want to establish lawful relations between a stimulus and a response, i.e., he wants to show that given stimuli control given responses. Skinner's view is that one can predict and control verbal behavior by identifying the functional relation between the controlling stimulus and the response. One problem is that it is difficult to identify a controlling stimulus independently of the controlled response. It is only after a response has occurred that one can identify the controlling stimulus. In some cases, the relation is very loose. For example, Skinner claims that the report of a statesman about a situation that he

had observed in a foreign country is under the "remote stimulus control" of those events. The difficulty with the notions of stimulus and response is the same as for the notion of reinforcement, i.e., in stretching the notions from laboratory situations to language use, they lose whatever precision and explanatory power they may have had.

Skinner's claim would be more reasonable if it were more moderate. What he could claim is that there seem to be lawful relations between some given stimuli and some given responses, and that further research might confirm these cases and discover others. Apart from acquisition, there is some evidence that specific kinds of responses increase when they are reinforced. For example, in controlled studies, subjects are likely to increase a specific type of response (e.g., plural nouns) if each instance is reinforced by the experimenter (e.g., by saying "good").

The strength of Skinner's theory is his emphasis on language use as a social behavior. For Skinner, verbal behavior necessarily involves a "speaker" and a "listener". But his attempt to explain this relation in terms of operant conditioning is inadequate for the sorts of reasons we have discussed above.

Chomsky's Rationalist Theory

Chomsky works within linguistics and his theory is presented as a linguistic theory, but he emphasizes that what is most interesting and important about a theory of language is what it explains about mental structure [117]. The fundamental problem

of linguistic theory, as Chomsky sees it, is to explain how it is possible for a child to acquire knowledge of a language. Chomsky holds that the empiricist explanation does not adequately account for important features of language: (1) creativity (generation and understanding of novel sentences), (2) structure-dependence of language, and (3) rapid acquisition of language by children which is unrelated (he claims) to their general intelligence.

Chomsky holds that it is useless to try to explain how children come to know language without first explaining what is known when they know it, i.e., what language is. The linguistic problem, for Chomsky, has "two variants": (1) psychological--accounting for language acquisition, and (2) methodological--justifying grammars [118].

The grammar of language is a theory of language (including elements and rules), which is an account of what is known by a "speaker-hearer who has mastered language" [119]. A grammar is a theory about the "defining properties of human language" [120]. But there are restrictions on the theory of language that derive from a rationalist approach. "Rationalist approaches ... assume that the form of the systems of acquired knowledge is determined by a priori principles of mind " [121]. These restrictions on a theory of language (a grammar) also link a theory of language (what is known when it is known) with a theory of acquisition (how one comes to know). "Plainly, he [the child] is endowed with some set of mechanisms (what we may call his 'language faculty') for ...

achieving a 'final state' in which he knows the language" [122]. The a priori principles of the human mind determine the form of language and they are the necessary condition for learning language.

Chomsky does not question that there are such principles. His task is to find out what they are. His method, which he claims is empirical, is to find "significant" features that are common to all human languages. "Let us define 'universal grammar' ... as the system of principles, conditions, and rules that are elements or properties of all human languages ... by necessity" [123].

For our purposes, we are less interested in the technical linguistic aspects of Chomsky's theory of grammar than in the logical and epistemological status of the basic tenets of his theory. What we want to know are the following kinds of things: (1) What, exactly, is meant by principles of the mind, mechanisms, and language faculty? (2) If the principles of the mind are the necessary condition for language learning, what are the sufficient conditions, and how are the other conditions related to principles of the mind? (3) What, exactly, is meant by the claim that a grammar is an account of what is known by one who knows language? Is knowing a language identical with knowing a grammar? In what sense does a speaker-hearer know a grammar? What is the relation between knowing a language (grammar) and language use?

Chomsky holds that there is a biological basis for what is innate in the mind. He notes that he departs from traditional views of innateness by "taking the 'a priori system' to be

biologically determined" [124]. However, he has either overlooked or discounted recent neurological work which provides evidence for functional integration, rather than functional localization, in the human brain (as well as in the brains of some other species). He rejects the notion of a general processing mechanism. "The proposal that language learning is simply an instance of 'generalized learning capacities' makes about as much sense, in the present state of our knowledge, as a claim that the specific neural structures that provide our organization of visual space must be a special class of the class of systems involved also in language use. This is true, so far as we know, only at a level so general as to give no insight into the character or functioning of the various systems" [125]. These remarks were published in 1975. Given Chomsky's acknowledgement that an integration theory of brain function is true at a general level, one might suppose that he would carefully consider the possibility that further neurological research would provide additional evidence for functional integration and provide more detailed explanations. This is, of course, precisely what has occurred in the last few years.

Instead, Chomsky has proposed and argued for a mentalistic special-faculty view, which he apparently supposes is somehow related to a localization theory of neurophysiology. "Some intellectual achievements, such as language learning, fall strictly within biologically determined cognitive capacity. For these tasks, we have 'special design', so that cognitive structures of great complexity and interest develop fairly rapidly and with little if

any conscious effort" [126]. Although Chomsky wants biological determination in order to support his claims about the universality and species-specificity (uniqueness to humans) of language, his accounts of the biological basis of what is innate are vague and uninformed by current research.

He proposes that mind is the innate capacity to form cognitive structures. Cognitive structures "express systems of (unconscious) knowledge, belief, expectation, evaluation, judgement, and the like" [127]. These cognitive structures are learned. One such structure is language. When the "language faculty", an innate faculty of mind, is appropriately stimulated, it will construct a grammar which in turn generates a language which is known by the person [128].

We noted above that Chomsky defines universal grammar as the system of principles, conditions, and rules that are elements of all human languages, by biological necessity. We have already considered some of the problems in his notion of biological necessity. There are many other problems here.

As best I can tell, what counts as "appropriate stimulation" for the "language faculty" is language. Confronted with these data, a child's mind constructs a language, the grammar of which will accord with the rules of universal grammar. The rules are already there. Chomsky denies that what is innate is disposition and claims that the principles and rules of universal grammar are innate. He argues that the rules that all children seem to use in acquiring language--rules that they have not been taught--are

evidence of the content of universal grammar. For example, one principle is that all rules must be structure-dependent. "The child's mind ... contains the instruction: Construct a structure-dependent rule, ignoring all structure-independent rules" [129].

It is Chomsky's contention that innate principles of universal grammar are necessary to account for children's language acquisition. He holds that their data are inferior, i.e., the speech they hear is substandard language (incomplete sentences, mistakes, etc.), and therefore could not provide a model adequate for language learning. Recent psycholinguistic studies suggest that he may be wrong about the quality of the speech children hear, since there is evidence that adults tend to speak in shorter sentences, simplify syntax, and make fewer mistakes when they talk with children [130]. Chomsky also claims that language acquisition is independent of intelligence, and therefore must be accounted for by some special means. Recent psycholinguistic studies also suggest that this claim is too strong. For example, children with very low intelligence do not develop language at all [131]. Furthermore, Chomsky holds that the process of language acquisition is very rapid. But recent studies have shown that there are marked exceptions, and that these are children who have been in linguistically impoverished environments [132]. Psycholinguistic studies have shown that children do not learn language by imitation, but follow grammatical rules that they devise. However, these rules produce divergences from adult language and they are not necessarily syntactic rules; but rather, syntax and semantics seem to be

intertwined in a complex way [133]. These studies suggest that Chomsky may be wrong about what is innate, that it is not universal grammar, independent of intelligence, but, rather, a general information-processing mechanism which, when applied to speech, provides for an analysis of language. This interpretation is also consistent with the recent developments in theoretical neurophysiology.

Chomsky's claim that the child's mind contains specific "instructions" does not entail that the child is hearing internal voices. In fact, according to Chomsky, the child does not know that he knows the rules of universal grammar since this is latent or tacit knowledge. The child knows how to acquire language, but he does not know how it is that he knows how to do so.

Chomsky claims that the mind constructs a grammar, which generates a language that is known by the speaker-hearer. What does it mean to say that an adult knows language?

Chomsky distinguishes between linguistic competence and linguistic performance. "Linguistic competence ... is understood as the speaker-hearer's knowledge of his language as represented by a generative grammar. It is ... a conceptual confusion to fail to distinguish competence, in this sense, from performance, in the sense of linguistic behavior, the actual use of language" [134]. Competence is knowledge about language (specifically, knowledge about universal grammar) which is latent and "may well not be immediately available to the use of the language" [135]. "In principle, one might have the cognitive structure that we call

'knowledge of English', fully developed, with no capacity to use this structure" [136].

The separation of competence and performance seems odd. If there is no relation between our latent knowledge about the structure of language and our use of language, the former seems gratuitous. Yet it is the former, the knowledge about language structure, that Chomsky claims is innate and genetically determined. To suppose that what is genetically determined is latent knowledge that may not affect language use (and thereby contribute to survival) is surely to present an anomalous case for genetic theory.

Psycholinguists have addressed the problem of the relation between competence and performance by studies designed to determine the psychological validity of transformational rules. The studies of the relation between the transformational complexity of a sentence and the psychological complexity in its processing have been plagued by methodological problems, but the prevailing view among psycholinguists is that there is no direct correspondence between transformational complexity and psychological complexity in processing the sentence. In other words, understanding a sentence does not involve the sort of complete syntactical analysis of a sentence that is presented in the transformational-generative-grammar-competence model. Transformational grammar is not a model of language production and comprehension. So these studies support Chomsky's claim that his theory does not explain language use.

There are two further problems here: (1) Exactly what is it that Chomsky claims adults have knowledge of? (2) What sort of

knowledge is tacit or latent knowledge? Does Chomsky mean that: (1) adults know the principles of universal grammar? (2) adults know the grammar of their particular language (and perhaps know that they know it? or (3) adults know propositions about the consequences of the grammar of their language, e.g., that a given sentence is or is not grammatical? Although it is not entirely clear, Chomsky seems to mean all of these. We have already seen that he attributes tacit knowledge of the principles of universal grammar to children; and since these principles are biologically determined, there is no reason to suppose, nor does he suggest, that children lose this knowledge. We have also seen that grammar is an account of what is known by an adult who has mastered language, i.e., the rules of his grammar. It seems reasonable to suppose that "mastering" rules requires knowing that they are rules. Chomsky also appeals to the "linguistic intuitions" of adults as evidence for the correctness of a theory of grammar, i.e., he thinks that adults know which sentences are acceptable, ambiguous, etc. With regard to the first two kinds of knowledge (of universal grammar and of the grammar of a given language), there are marked disanalogies between a speaker's knowledge of the grammar described by Chomsky and a knower's knowledge of what he knows in other cases of knowledge. In the latter case, generally, a person will assent to what he knows, if asked. But it is unlikely that a random speaker, asked whether he knows the grammar Chomsky has described, will readily assent. Further, if a person knows some proposition or some theory, he can understand a statement about what he knows. But many (perhaps most) speakers will not understand a statement about the

grammar which Chomsky claims they know. Furthermore, speakers who are not very intelligent may never understand such a statement. The sense in which speakers "know" the grammar Chomsky has claimed they know is not a straightforward sense of "know".

With regard to the last kind of knowledge (propositional knowledge about the consequences of a grammar), it does seem to be the case that adults can make judgments about sentences. But there is an alternate explanation for this that does not involve attributing tacit knowledge. The alternate explanation is that adults can acquire propositional knowledge in certain circumstances, e.g., when confronted with a new sentence. On this view, the adult does not draw on his store of propositions to make judgements, but, rather, uses his capacity for perceptual and cognitive discrimination to make judgements and acquire new knowledge. This view is, of course, a claim that some sort of internal mechanism underlies a speaker's abilities and that that mechanism produces the intuitions about language that a grammar describes. Unless one's sympathies are with Malebranche, the first part of this claim is rather trivial. This claim is contrasted to Chomsky's stronger claim that a speaker's abilities are due to internal rules that are isomorphic with the grammar.

Chomsky is well aware that there are alternative theories to account for the data and that they are underdetermined by the empirical data [137]. Chomsky claims that his theory is better because it has the formal feature of simplicity. But the notion of simplicity is not a simple matter. First, it is not always

the case that the simplest explanation is the best explanation. Occasionalism may be a simpler explanation of certain mental states than Chomsky's theory, but it is not, merely on those grounds, a better theory. Secondly, it is somewhat easier to make sense of simplicity with reference to hypotheses (as in curve fitting) than with reference to theories [138].

Furthermore, if alternative theories are descriptively adequate, data about intuitions will not suffice to enable us to choose among them. Nor will appeal to a model of language acquisition be successful. Unless there are constraints on the model, it cannot be used in choosing among alternative theories, but if it is constructed on the assumption of universal grammar, it cannot be used to test it.

If Chomsky's theory is a scientific, empirical theory, as he claims, it has not been adequately confirmed, and there are difficult theoretical problems in attempting to do so. Furthermore, it would be incautious to claim that it is the best of alternative theories on the grounds of simplicity and intuitions.

The major difficulty, as I see it, is Chomsky's unsuccessful attempt to fuse traditional rationalist theories of innateness onto a biological base. Biological necessity is not logical necessity and the epistemological status of Chomsky's innate principles is contingent. Current neurophysiological research, though inconclusive, at least casts doubt on Chomsky's notion of a special language faculty.

Chomsky is struck by the wonderfulness of human language, but its complexity does not seem to be a sufficient reason for attributing it to a special innate and unique faculty.

Music is also wonderful and also complex. We might well ask how it is that a child is able to acquire music, i.e., to come to know music. We could not suppose that it is only by imitation, since music is characterized by creativity (the ability to produce and to understand new phrases). We might begin by asking what it is that the child knows when he comes to know music. We assume that there are a priori principles of mind that determine the form of music, and these are also the necessary conditions for learning music. By examining all available harmonies, we discover certain universal features, i.e., the elements and rules that constitute music, a universal harmony. We claim that these principles are biologically determined which explains the universality of music (all humans can produce and understand music) and its uniqueness to humans. One might point out that other species are musical, but given our theory, their noise can only be described as music-like, not music. We might also claim that our knowledge of the structure of music is latent or tacit, and so it it is not necessarily available to us for music-making. Still, we seem to have some such knowledge. We can, for example, make judgements about dystonic chord structures. Although an average person may not know the rules about chord structures, he does know what sounds right.

We could continue the music analogy, but I think this sketch is sufficient to show that it is strongly analogous to the language case. Furthermore, it is not the only possible analogy. Arithmetic is another clear case. Dance may also be analogous. Are we to suppose that innate special faculties are the best explanations for each of these? Given various abilities, explanation in terms of special faculties is certainly not the simplest explanation, nor does it take account of the similarities among these cases. For example, the "instruction" to find rules that are structure-dependent could apply in any of these cases.

Chomsky's rationalist approach points out some interesting things about language, but it does not provide an adequate language paradigm.

Evidence for Linguistic Behavior

The purpose of examining empirical and rationalist theories of language was to see if we could find an adequate theory that would provide a language paradigm. If a paradigm were available, then we could decide whether any given behavior counts as linguistic behavior by comparing it with the paradigm. The paradigm would provide reliable criteria. Our survey has shown that such a paradigm does not seem to be available.

What we have to do now, then, is to consider what counts as evidence for linguistic behavior in the absence of a language paradigm. It is particularly important here not to beg the question. For example, it is not self-evident that language is necessarily a human artifact or enterprise. Nor is it self-evident

that there is a qualitative distinction between language and communication. Those are precisely the sorts of things we want to explore.

Chomsky's theory emphasized structure and Skinner's theory emphasized use. An account of linguistic behavior in terms of either structure alone or use alone is surely an incomplete account. Both aspects seem necessary and neither alone seems sufficient.

A common way of making a distinction between human language and "animal communication" is related to the emphasis on one or the other of these aspects. Explanations of human speech assume structure because the rationality of the speakers is assumed. The problem is seen as one of describing or explaining the structure. Use may enter in as a way to explain meaning, i.e., meaning may be explained in terms of the use of structured elements (social or linguistic context, tonal pitch in Chinese dialects, etc.). Explanations of animal communication do not assume structure because the rationality of the "callers" is not assumed. The problem is seen as one of explaining the use of the "calls" in given contexts. Structure may enter in in describing regularities of use, but structure is not generally considered to be constitutive.

In the human case, structure seems so important that factors related to use are often called para-linguistic (e.g., dialects, facial expressions, gestures). But these sorts of prior judgements about what is linguistic, para-linguistic, or non-linguistic are precisely what we want to avoid.

I want to propose two criteria for assessing behavior to determine whether or not it counts as linguistic behavior: (1) use of symbols, and (2) rule-following. I think that each of these is necessary, and that they are jointly sufficient. I want to discuss each of them in order to try to specify them as much as possible.

I want to emphasize that my task is not to develop an alternative theory of language, but rather, to consider what constitutes reasonable evidence of linguistic behavior in the absence of an adequate theory of language. I want also to emphasize that my task is not simply to list features of human language, a task that is not an uncommon enterprise among linguists and zoologists. For example, Hockett and Thorpe have provided similar well-known lists of what Hockett calls "design features" or "logical features" of human language. But Hockett's task is different from ours [139].

Hockett claims that human language is species-specific. But he also claims that finding the universal features of human language will provide criteria for distinguishing between language and animal communication, i.e., he assumes that the universe of language is coextensive with the universe of human language. Hockett not only takes human speech behavior as the paradigmatic case of language; he assumes that it is the only case. His purpose is to develop a list of features which, taken collectively, will distinguish language from animal "communication". Although he readily acknowledges that the "communication" of various species is characterized by one or more features on the language list, his claim is that the "communication" of any single given animal species will

not be characterized by all the features on the list. Hockett has published several lists that differ in the number of features that are taken to be jointly sufficient to distinguish language from animal "communication".

It seems that one way to refute Hockett's claims is to show that some non-human species' communication is characterized by each of the features on Hockett's list. This is precisely what Fouts has shown with Washoe. In light of this demonstration, one can either infer that the universe of human language is not co-extensive with the universe of language or that Hockett has not yet produced the correct list of features. The possibility of the second inference shows that Hockett's approach is question-begging if the question is what is to count as linguistic behavior. But, indeed, that is not Hockett's question, for he has already assumed that only human linguistic behavior will count as linguistic behavior. His question is what are the features of linguistic behavior, given the assumption that only human linguistic behavior will count. Consequently, the work of list-makers like Hockett and Thorpe are mostly irrelevant to our concern.

What we want to know is what will count as linguistic behavior without the prior assumption that only human behavior will count. With this purpose clearly in mind, we can consider the following criteria: (1) use of symbols, and (2) rule-following.

Use of Symbols

Linguistic behavior is behavior in which one thing is substituted for something else. Whatever the linguistic unit may be (spoken

word, written character, hand sign, etc.) the unit functions in place of another thing. It is used as a substitute for an act, object, event, proposition, etc. It is in this sense that the units of language are symbols [140].

The logical relations between symbols, signs, and signals have been given considerable attention and are a matter of continuing dispute. It is certainly the case that a symbol may also be used as a sign or as a signal. For example, I may hold up and apart the index finger and middle finger of my right hand to symbolize "peace". I may do so at an anti-war rally as a sign of my ideological commitment and camaraderie with the group. I may also do so to signal to my friend to warn him not to hit the onlooker who is taunting him.

It is also the case that a given symbol, sign, or signal may function in place of more than one thing. I might use the same gesture to symbolize "victory" if I win a marathon or to symbolize the letter "v" in a conversation with a deaf friend. I may use it as a sign to another friend, across a crowded room, that I have successfully extracted a secret in which we are interested from the person to whom I am talking. It may simultaneously be used as a signal that he is to interrupt our conversation immediately.

It is also the case that the same gesture might be made without symbolizing, signing, or signalling anything else. For example, while sitting on a parkbench, I might make the same gesture in order to see how a distant tree looks when framed by my two fingers, or I might want to compare the two knuckles to see whether or not one is still swollen.

The various functions of the gesture as symbol, sign, or signal depend upon its being publicly observable and upon its use being agreed upon in a given context. The flexibility of function of the particular gesture allows for both generalization (e.g., many people at many rallies about many wars) and ambiguity (e.g., peace or victory).

I might, of course, while sitting on the parkbench, fantasize about my participation in an upcoming peace rally, and while enacting the scenario in my fantasy, actually make the gesture. The passers-by are likely to ignore me, except that the ice-cream vendor may think I am trying to get his attention. In this case, the gesture is publicly observable, and it is being used in an agreed upon way (relative to my fantasy), but not in an agreed upon context.

Our examples thus far have dealt with one symbolic gesture. In this culture, there is also a symbolic gesture that consists in extending only the middle finger of one hand. This gesture symbolizes what is usually considered to be an obscene word for a sexual act, and it is used to express hostility. Let us suppose that during a peace rally, I notice that, among the onlookers, there is a sprinkling of what looks like the "peace" gesture. I ask one of the gesturing onlookers if he wants to join the rally and he seems astonished. I discover that he intended to be making the hostile gesture, but since it is more difficult to sustain (since it requires actually holding down the index finger), his index finger had moved up far enough that I took his sloppy hostile

gesture as a sloppy "peace" gesture. The problem which this exemplifies is that of identification and differentiation of symbols, i.e., a qualitative distinction.

As I glance away from this troublesome fellow, I catch a glimpse of a definite "v" sign from another onlooker, a woman standing several meters behind this man. She is talking animatedly to her companion. Embued with a sense of mission, I tell her I saw her gesture and invite her to join the rally. She is nonplussed and insists she never made such a gesture. Later, when viewing news clips of the rally, I see that she did make a momentary "v" sign as part of a longer period of movement of her arms and hands, gesturing while talking to her companion. The problem that this exemplifies is that of individuation of symbols, i.e., quantitative distinction.

The sorts of specific problems that are involved in differentiation and quantification of symbols may vary according to the kinds of symbols that are used. In the cases in which we are interested, i.e., cases in which we are trying to determine whether or not there is use of symbols, it is essential not to conflate difficulties in differentiating and quantifying symbols with the assumption that there is no use of symbols. From the fact that cases may not be clear cases, we cannot infer that they are not cases at all. Whether or not they are cases of symbol use is precisely what we are trying to determine.

Furthermore, it is necessary to distinguish between: (1) cases of symbol use and (2) cases of use of good symbols. Chao, for

example, has suggested criteria for good symbols [141]. But he points out that whether or not features of symbols are good depends on their use. Universality, for example, is not a good feature of symbols in cryptology. With regard to size, it is desirable to have the symbol or symbol-complex fill most of the field of attention, but it is also desirable to have small symbols in order to relate many things in a symbol-complex. With regard to discrimination, the desirable degree depends on the circumstances of use [142]. The criteria for good symbols depend on the circumstances of their use. But again, these problems are different from the problem of determining whether or not there is use of symbols at all.

To determine that, we need to know if the behavior: (1) consists in using some unit (word, gesture, etc.) as a substitute for something else (thing, proposition, etc.); (2) is publicly observable; and (3) consists in using the unit in a conventional or agreed upon way in a given context.

Does the third condition imply anything about choice? That question leads to the next criterion, rule-following.

Rule-following

We need to consider at least two questions: (1) What is meant by rules relevant to linguistic behavior? (2) How do we know if behavior is rule-following?

Rules are notoriously hard to define, but Garver's definition of a rule as a "prescribed guide for action" is adequate for our purposes [143]. Rules may be explicit or implicit. For many, or

perhaps most, human natural languages the rules are implicit. The correct patterns of linguistic behavior are learned developmentally by observing adults, being corrected, etc.

The rules may prescribe: (1) the relations between symbols and objects, (2) the relations between symbols, and (3) the relation between symbols and contexts. Rules of linguistic behavior are constitutive in that linguistic behavior consists in following rules about these relations. Rules may also be regulatory. For example, a rule may prescribe a norm for a given hand sign and thereby determine the range of allowable deviations.

Rules for linguistic behavior are necessarily public, and the very notion of a rule implies that the behavior is non-necessary in the sense that it could be otherwise than prescribed.

The question about whether or not the behavior could be otherwise is often discussed, for biological organisms, in terms of instinctive (or innate) behavior vs. learned (or acquired) behavior. This distinction is supposed by some to be a significant distinction between animals and humans, but it is quite difficult to make sense of the distinction. The radical claim that all animal behavior is instinctive and all human behavior is learned is disconfirmed by evidence about human physiological processes. The weaker claim that all animal behavior is instinctive (or that most of it is) and most human behavior is learned results in a quantitative, rather than qualitative distinction between animals and humans. Given the quantitative distinction view, there is marked disagreement about the degrees of instinctive behavior for both

animals and humans. Some sociobiologists, e.g., E. Wilson, claim that most human behavior is genetically determined. However, it is acknowledged that instinct or genetic programming does not determine specific behavior, but a range of possible behaviors. This leaves the possibility that a particular impulse to behave may be instinctive while the particular corresponding behavior is learned. That claim may be useful for some purposes, but it is not useful for distinguishing between animal and human behavior. It does allow that, for animals and humans, there could be a physiologically motivated or genetically determined impetus to linguistic behavior, but the linguistic behavior itself may be learned, i.e., it may consist in rule-following.

How then do we know if behavior is rule-following behavior? We have said that we are interested in observable behavior that, if it is linguistic, follows public rules. But if we do not already know that the behavior is rule-following, we are confronted with the radical interpretation problem. Observation may be useful, but it is limited. We cannot simply look. For example, an occurrence may not be rule-following linguistic behavior and a non-occurrence may be. Touching one's nose may be a sign of agreement that follows a rule relating the sign and the agreement, or it may be stifling a sneeze. Not touching one's nose in the presence of another individual may be following a rule that restricts nose-touching for agreement to use among peers and another rule that agreement with non-peers is assumed unless disagreement is expressed. If we know the language, we can look and listen for instances of

rule-breaking, e.g., lies or word games, but this is not possible if we do not already know whether or not the behavior is linguistic. Furthermore, we cannot ask the individual whose behavior we want to know about if we do not already know.

What we have to do is look for regularities and make an assumption about whether or not the behavior is rule-following. How do we know what assumption to make? If we cannot be certain, then we want to make the most plausible assumption. How do we decide what is most plausible?

It is at this point that one's basic paradigmatic commitments become relevant. When Descartes faced this question, he did so in light of his commitments to the Chain of Being paradigm (including the gradation principle), to metaphysical theses about the nature of reality (including material and immaterial substances), and to theological beliefs. If some animal behavior was linguistic behavior, then it was due to their having immaterial and immortal souls; and if some animals had these, there was no reason (given the gradation principle) to think that they did not all have them, and consequently, humans had no more to hope for in the after life than flies and ants. Descartes concluded that it is more plausible to think that animal behavior is not rule-following linguistic behavior.

If one is committed to the Evolution paradigm and to the empirical assumption that cognitive capacities are related to neurophysiological organization, then Descartes' conclusion may seem less plausible than the alternative.

As a matter of fact, the use of the Charity principle in the human case is now based on the assumption of similar neurophysiological organization. If others are like us in this respect, then it seems plausible to assume that some of their behavior is linguistic behavior and that their linguistic behavior is in many ways like our own. This is true not only in those cases in which the behavior is now observable, but also in those cases in which the behavior has not been and cannot be observed. An example of the latter case is the decipherment of writing on objects found in archaeological excavations. If there are observable regularities, then it is assumed that the marks are writing and that there is something to be deciphered, precisely because it is assumed that the writing was done by humans who are similar to us. It is also assumed that the language will be similar to other human languages [144].

We saw in Chapter II that our knowledge about the neurophysiological organization of humans and of some other species is limited, but it is sufficient to support the relevance of neurophysiological organization to the plausibility of the assumption that some behavior is linguistic behavior. If another species has similar neurophysiological organization, then it is at least plausible to assume that some behavior of individuals in that species is rule-following linguistic behavior. The evidence that is available supports the plausibility of extending the Charity principle to some other species.

In deciding whether it is plausible to assume that some behavior is rule-following linguistic behavior, neurophysiological organization is one relevant consideration. Another consideration is whether or not rule-following linguistic behavior would be useful for the individual or the species. Biological organisms are such that their behavior is adaptive to their environment. Successful adaptation results in survival. If rule-following linguistic behavior would contribute to successful adaptation, then that fact would support the plausibility of assuming that some behavior is rule-following linguistic behavior. I am suggesting that, if there is independent evidence that some behavior is linguistic, then a further consideration is whether rule-following linguistic behavior is a plausible explanation of some kinds of successful adaptation.

The rules that relate symbols and contexts would be particularly pertinent. But trying to determine the relation between symbols and contexts, and trying to determine whether or how some behavior contributes to survival is not an easy matter, particularly when the behavior is that of another species. It is not always easy to identify relevant behavior or to interpret the context. Since we are accustomed to vocal-auditory linguistic behavior, we are likely to be more skillful in identifying and analyzing it. But there is no intrinsic requirement (due to the nature of symbols and rules) that linguistic behavior be vocal-auditory. Possible modes of linguistic behavior are determined by physiological capacities. It is logically possible that vocal, gestural, tactile,

and olfactory modes can be modes of linguistic behavior.

Non-vocal behavior has often been considered para-linguistic in the human case either because: (1) the primary mode (vocal) was taken to be the only mode, or (2) the non-vocal behavior has been assumed to be non-rule-following.

Recently, more attention has been given to human non-verbal kinesic behavior. There is strong evidence that some of that behavior is indeed rule-following behavior. As with vocal linguistic behavior, there are variations in non-verbal behavior related to culture, ethnic group, age, gender, class, and role(s). One example is handshaking. Children in this culture learn the rules for handshaking in the same way they learn vocal language rules, and adult behavior generally follows the rules. One learns in which contexts handshaking is appropriate, which hand is used, how it is extended, the norm for pressure and duration of the grip, etc. One may choose to break the rules, e.g., handshaking to confirm a contract which one intends not to honor, or extending a hand which conceals a party-gag "buzzer". The first instance is also a case of breaking a rule which relates verbal behavior and kinesic behavior, i.e., the rule of congruity. There are also rules about the relation between handshaking and the objects (propositions, etc.) for which it stands. Handshaking is symbolic, rule-following behavior.

Our knowledge of human non-vocal behavior is rudimentary, and there are difficult methodological problems in understanding non-vocal behavior of other species. But our knowledge that in our

own case non-vocal linguistic behavior may contribute to survival, lends support to the assumption that that may be the case for other species. From the fact that it is difficult to identify such behavior, we cannot infer that such behavior does not occur.

One of the problems in identifying the behavior is understanding the context. Which behavior is functional for survival is to some extent determined by physiological structure and capacities. The implications for survival from the appearance of a cat are not the same for birds and humans, unless the cat is, say, a tiger or a lion. To make plausible assumptions about the functional value of rule-following linguistic behavior requires a non-anthropomorphic assessment of the context.

Again, it is necessary to distinguish between methodological problems in identifying rule-following behavior and the plausibility of the assumption that rule-following linguistic behavior explains some kinds of successful adaptation.

It might be argued that instinctive behavior is more conducive to survival since it is more rigid. We have already considered difficulties related to the notion of instinctive behavior, but let us use the notion here simply in contrast to rule-following behavior. Instinctive behavior is such that there is an immediate, fixed behavioral response (or limited range of responses) to a given stimulus. Rule-following behavior is such that there is a more flexible range of responses to a given stimulus, including responses that break the rule about standard responses. Our

question is whether instinctive behavior would be more functional for survival than rule-following behavior.

I want to suggest that the answer depends on the physiological structure and requirements of the organism. Physical and physiological flexibility (which usually depends on complexity) is the condition that determines the usefulness of rule-following behavior. Flexibility includes such things as mobility, capacity to adapt to various environments, etc. For example, if one's mobility is severely restricted, to be warned by another's linguistic behavior of impending danger may not be more useful than simply responding directly to the threatening stimulus, e.g., by emitting a foul or toxic substance [145]. There is no point in moving if one cannot adapt to a different environment. Furthermore, mobile organisms who can adapt to different environments are likely to be confronted with a greater variety of stimuli than organisms that are more fixed. The more flexible organisms could make use of more information. So the survival value of rule-following linguistic behavior depends on the physiological capacities of the organism.

Summary

Since an adequate language paradigm is not available, we have considered what might count as evidence for linguistic behavior in the absence of a paradigm. I have proposed two criteria: (1) use of symbols and (2) rule-following, and I have pointed out some of the difficulties involved in using these criteria. The nature of the difficulties is such that whether or

not some behavior counts as linguistic behavior must be determined by considering the behavior of each given species. Given these criteria, there is no way to make generalizations about species. Using the criteria requires assessing behavior species by species.

Use of the Criteria

I want to take the case of one species in order to illustrate the use of the criteria. I do not intend to provide a complete analysis, but rather, a sketch adequate to illustrate the use of the criteria.

I want to take the case of the chimpanzees, since it is both well-known and controversial [146]. Since there are significant variations in the chimpanzee language projects, I want to take the case of one chimp, Washoe. Washoe is the first chimp about whom it is claimed that she has learned a human language, i.e., American Sign Language (ASL), which is used by deaf humans in the United States.

The language-acquisition project was directed by psychologists Beatrice and Allen Gardner, and Roger Fouts was a graduate research assistant on the project. A gestural language was chosen for project Washoe because chimpanzees lack the anatomical structure necessary for human speech and also because there is evidence of gestural communication among chimpanzees in their natural habitats. Washoe's estimated age at the time the project began was between 8 and 14 months. For the next four years, she was raised in an environment that was physically confortable and full of natural objects and ordinary human domestic items. She slept

alone, but otherwise, constantly had human companions who interacted with her and used only ASL to communicate with her and each other.

The project was a longitudinal study of the development of sign language by Washoe. Washoe learned signs by shaping (reinforcement of acceptable spontaneous gestures), guidance (molding her arms and hands in the presence of a stimulus), and imitation. During the four years, she acquired 160 signs. When the four-year initial project was terminated, Washoe was moved to a Primate Institute, where she has been for the last eight years. Roger Fouts now directs the research, the primary purpose of which is to examine the cognitive capacities of chimpanzees as evidenced by linguistic ability.

One question of interest to us is whether the ASL signs (which are analogous to morphemes) function as signs or symbols. Does Washoe merely associate signs and their referents (e.g., the configuration for "sweet" is somehow linked with dessert) or does she understand that the sign "sweet" is a symbolic representation of dessert? The second question is whether or not Washoe's use of the signs is rule-following behavior.

Does Washoe use ASL signs as symbols? It is of considerable interest that only one of the first ten signs she acquired is a noun ("sweet" used for dessert). The others, in order of acquisition, were "come" or "gimme", "more", "up", "open", "tickle", "go", "out", "hurry", "listen". A criterion for ascribing the acquisition of a sign was contextually correct use. Acquisition of nouns

was tested by a double-blind procedure using exemplars. Washoe's errors suggested her grasp of class concepts. For example, on a test that included thirty examples of grooming articles, she correctly named eighteen, and seven of the twelve errors were signs for other items classified as grooming articles. In a test that included eight photographs of animals, Washoe correctly named seven. In a similar test that included ten three-dimensional miniatures of animals rather than photographs, Washoe correctly named six and each of the four errors was the sign for "baby".

In addition to the signs that she has been taught, Washoe acquired "smoke" by casual observation of her human companions, and she suggested a sign for "bib" that the Gardners later learned is the correct ASL sign.

Besides using signs to communicate with others, Washoe also used them in other ways. For example, when looking through a magazine, she signed "cat" when she saw a picture of a tiger and "drink" when she saw a vermouth ad.

Ten months after the project began, Washoe spontaneously began to combine signs ("gimme sweet", "come open"). At age two, she was taught name-signs for her human companions and the pronouns "you" and "me", which she began to use in contextually appropriate combinations ("Roger you tickle", "tickle me"). During the next twenty-six months, Washoe used 294 different two-sign combinations and 245 different combinations of three or more signs. These included the addition of appeal-signs ("please tickle more"), the addition of pronouns ("you me Greg go"), apologies ("hug me good"),

and the specification of subject and object of an action ("you tickle me Washoe").

Washoe clearly transfers signs to new situations. The referents include new events as well as objects. For example, after she urinated on Fouts while riding on his shoulders, she signed "funny". Since she has been in Oklahoma, she has also spontaneously combined signs she knows to describe new referents. For example, she referred to swans as "water birds". She has also made use of connotation in an interesting way. She learned "dirty" as a noun referring to feces. She has spontaneously used it as an adjective when she has been angry ("dirty monkey", "dirty Roger"). She has also learned to use language to attempt to alter others' perception of reality, e.g., she has lied.

One of the problems in assessing Washoe's performance is the lack of agreement about what constitutes language and the lack of an adequate model of human language acquisition that might be used for comparisons.

I have proposed that rule-following use of symbols is adequate evidence of linguistic behavior. In a well-known article published during the initial project, Bellugi and Bronowski argued that semantics and syntax are necessarily interrelated such that symbols have meaning only in the relationships described by sentences, and understanding the relations depends on constructing general rules by induction [147]. They did not believe that Washoe's performance showed a grasp of sentence structure because the diaries did not show negation and questions, and the word order

of utterances was loose (as compared to English grammar). Since they had argued that semantics and syntax are interrelated, they denied that Washoe's performance gave adequate evidence of linguistic behavior.

The Bronowski-Bellugi assessment is quite instructive in showing problems in using the criteria I have proposed. The data that they used (the diaries) were incomplete. Washoe asks and answers questions and uses negation. More importantly, Bronowski and Bellugi used English grammar as their paradigm, and as Bellugi has subsequently acknowledged, they lacked an adequate understanding of the grammar of Ameslan [148].

The same problem, as well as the problem presented by the absence of an adequate model for human language acquisition, is demonstrated by Roger Brown's assessment of Washoe's performance. Initially using a primarily descriptive model of children's language acquisition, Brown proposed developmental levels, but he then explained children's abilities in terms of innate capacities. Brown first argued that syntax appears in the two-word combinations of children such that word order reflects relations: agent-object, action-object, agent-action, locative, possessive, and attributive. After reviewing Washoe's language-acquisition diaries for the first three years, he claimed that her two-word utterances lacked a sense of word order, and therefore, that Washoe had not attained what is Level I for human children. More recently, Brown has revised his model. He now holds that word order is not necessary for communication at Level I, and that Washoe's performance is at Level I.

He now holds that syntax appears at Level II, the level of three-word combinations, and he denies that Washoe has attained Level II.

The Gardners held that Washoe had attained Brown's first Level I (syntactical two-word combinations) by showing that the order of 78 per cent of her utterances reflected the relations specified by Brown. When Brown's data on children were subjected to the same criteria used for Washoe, 75 per cent of their utterances reflected such relations. However, the Gardners rejected Brown's explanation of consistent word order in terms of syntax and suggested alternate (behaviorist) explanations, e.g., imitation of adults or semantic similarities.

A recurring problem in comparing utterances of children who speak English and Washoe or deaf children who use ASL is the structural difference in the languages. It is certainly the case that the structure of ASL has not been completely analyzed, but neither has the structure of English. Nevertheless, plausible comparisons depend on making use of what is known.

Variation in the formational structure of natural sign languages is analogous to variation in the sound structure of spoken natural languages. Semantically, ASL allows for abstractions, metaphors, and idioms. ASL signs are not gestural representations of English words. Although ASL signs may be "glossed" for English words, there are some lexical items that have no standard gloss, e.g., the notion of subjective time sign. Word order in some natural spoken languages, e.g., Finnish, is less important grammatically than in English. Word order in ASL is also less

important in expressing grammatical relations, and most fluent deaf signers use a fairly free order in their constructions, although deaf children who are exposed to English may show sign-order preferences similar to English word order [149]. Consequently, the use of word order as evidence for syntactical understanding is misleading.

Much of the recent work in linguistics has emphasized pragmatics, the analysis of language use. Emphasis is on categories of communicative intentions--requests, questions, agreement and disagreement, statements, descriptions, qualifications, etc. The intentions of young children and apes are inferred on the basis of the word or sign, other behavior that accompanies the word or sign (facial expressions, etc.), and the context. What is proposed is that the uses of language are at least as important as its structure. "The fact that apes initiate linguistic interactions, 'talk' to themselves, ask for what they want, and comment on their environment may prove to be more significant than the details of their encoded communications" [150]. Given this approach, it is of significance that Washoe's utterances include the various categories of communicative intentions, that she uses ASL to communicate with humans and other chimpanzees, and that their behavior indicates that her intentions have been understood.

The arguments about whether Washoe's behavior is linguistic behavior center around the two criteria of use of symbols and rule-following. With regard to the use of symbols, it is argued

either (a) that ASL is not symbolic, (b) that it is not adequately symbolic, or (c) that Washoe does not understand the signs as symbols.

I pointed out the necessity of distinguishing between (a) and (b), i.e., between the use of symbols and the use of good symbols. It could be argued that ASL symbols are good symbols (sufficiently arbitrary, etc.), but that question is not germane. The question of concern for us is whether ASL is symbolic at all, and it clearly is. ASL signs are used to stand for other things, propositions, etc., and their use is characterized by displacement. The question that remains is whether or not Washoe understands the signs as symbols. Her use of the signs as substitutes for things in the conventional way in appropriate contexts suggests that the ASL signs are used as symbols by her.

The second question is whether or not Washoe's use of the symbols is rule-following. I have just pointed out that her use of ASL symbols follows the rules relating symbols and objects and symbols and contexts. The main line of argument against counting Washoe's behavior as linguistic is that her behavior does not show that she is following rules for relations between symbols. Much of the difficulty here is disagreement about what those rules are. Some of Brown's arguments depended on the view that the rules are the syntactical rules of English grammar. If one argues that such rules are innate, then one does not consider other possible rules. We have seen that some rules for relations between ASL symbols (e.g., word order) are different from the rules in English.

The assessment of Washoe's behavior as rule-following is made easier by the fact that other humans also use ASL and some of those humans also speak English, so the problem is not one of radical interpretation. Some human adult ASL users not only assert that they are following rules, but they are able to explain the rules to non-ASL users. ASL users claim that they understand Washoe's utterances and that two-way communication occurs.

Furthermore, although the comparative studies of neurophysiological organization of humans and chimps are inconclusive, there is some evidence that chimps' neurophysiological organization is sufficiently complex for rule-following behavior. Wassermann's model provides a biochemical explanation of neurophysiological organization and functioning. Recent studies have shown marked similarities between chimpanzees and humans in blood protein, amino acids, and blood immunology. On these measurements, there is 0.27 per cent difference in biochemical blood composition of chimpanzees and humans [151].

The similarity of neurophysiology and the claims of human ASL users about Washoe's behavior provide strong evidence for the claim of symbolic, rule-following behavior by Washoe.

SUMMARY

The purpose of this study was to examine the notion of the rationality of animals. I suggested that the notion might be clarified by taking a formal feature of behavior that is generally considered to be rational--that it is based on sound inductive processes--and identifying criteria for determining if given behavior is based on such processes.

I proposed two criteria: neurophysiological organization and use of language. I have argued that neurophysiological organization is a plausible criterion, but that the present state of empirical knowledge does not allow for its precise formulation. I have also argued that use of language is a plausible criterion, and I proposed that rule-following use of symbols is sufficient evidence for the linguistic behavior of biological organisms.

I have not suggested that these are the only relevant criteria nor that only animals who meet these criteria are behaving rationally. My claim is the more conservative one that the attribution of rationality is appropriate for all animals who do meet these criteria.

I pointed out that using these criteria precludes generalizations about animals and requires, instead, an examination of each given

species. I suggested, for example, that there is strong evidence that chimpanzees meet these criteria.

Whether animals are rational has been an important question in reasoning about the moral status of animals. The traditional assumption has been that animals are not rational, and I have claimed that that general assumption may be false. If it is false in given cases, then that would surely have a significant effect on arguments about the moral status of animals that make use of such an assumption.

I want to emphasize that I have not critically assessed the systematic use of the notion of rationality in moral arguments. Whether rationality ought to be a relevant consideration or why it is relevant to moral status are not questions which have been addressed in this study. Rather, I have simply pointed out that rationality is generally considered to be relevant, but that the notion of the rationality of animals has been unclear. My concern has been to clarify that notion.

NOTES

[1]For a fuller discussion of the use of these principles in the historical philosophical tradition, see Arthur O. Lovejoy, The Great Chain of Being: A Study of the History of an Idea (New York: Harper and Row, 1936).

[2]As set forth in The Republic and Timaeus.

[3]As set forth in Physics and Metaphysics.

[4]See De Anima.

[5]See Politics.

[6]Thomas Aquinas, Summa Contra Gentiles, Book III: Providence, trans. V. J. Bourke (Notre Dame: University of Notre Dame Press, 1975), chap. CXII.

[7]Thomas Aquinas, Summa Theologica (2d ed. rev.; trans. English Dominican Fathers, London: Burns, Oates and Washbourne, 1922-1938), Pt. II.

[8]René Descartes, Philosophical Letters, trans. and ed. Anthony Kenny (Oxford: Oxford University Press, 1970).

[9]Jeremy Bentham, An Introduction to the Principles of Morals and Legislation (reprint of 2d ed; Oxford: Clarendon Press, 1879).

[10]John Stuart Mill, Collected Works, Vol. X: Essays on Ethics, Religion, and Society (Toronto: University of Toronto Press, 1963), pp. 185 - 87.

[11]Immanuel Kant, "Duties to Animals and Spirits," Lectures on Ethics, trans. Louis Infield (New York: Century, 1930).

[12]Robert Nozick, Anarchy, State, and Utopia (New York: Basic Books, Inc., 1974).

[13]H. J. McCloskey, "Rights," Philosophical Quarterly, XV, No. 59 (1965), pp. 115-27.

[14]Thomas Regan and Peter Singer, Animal Rights and Human Obligations (Englewood Cliffs, New Jersey: Prentice-Hall, 1976), pp. 148-62.

[15]Thomas Regan, "The Moral Basis of Vegetarianism," Canadian Journal of Philosophy, V, No. 2 (1975), pp. 181-214.

[16]Although McCloskey's entitlement theory of rights itself is problematic, our present concern is restricted to his consideration of criteria for membership in the moral community.

[17]McCloskey, op. cit., p. 123.

[18]Ibid.

[19]Ibid., p. 126.

[20]Ibid.

[21]Ibid.

[22]Ibid., p. 127.

[23]Ibid.

[24]Singer, op. cit., p. 152.

[25]Ibid., p. 153.

[26]Ibid.

[27]Ibid.

[28]Ibid., p. 150.

[29]Ibid.

[30]Ibid., p. 156.

[31]Ibid., p. 155.

[32]Ibid.

[33]In Whose Life Is It Anyway?, a play described as a major success on the current London stage, the action evolves from the physically disabled protagonist's reasoned decision to die. The New York Times, July 30, 1978.

[34]Singer, op. cit., p. 158.

[35]Ibid.

[36]Ibid.

[37]For a fuller discussion of this point, see Norman Malcolm, "Thoughtless Brutes," Proceedings and Addresses of The American Philosophical Association, XLVI (1972-1973), pp. 5-13.

[38]Descartes, op. cit.

[39]Regan, op. cit., p. 199.

[40]Ibid.

[41]Ibid., p. 212.

[42]David Lewis, "Radical Interpretation," Synthese, XXIII (1974), p. 331.

[43]Donald Davidson, "Mental Events," Experience and Theory, eds. Lawrence Foster and J. M. Swanson (Amherst: University of Massachusetts Press, 1970), p. 97. Emphasis mine.

[44]Lewis, op. cit., pp. 336-37.

[45]W.V.O. Quine, Word and Object (Cambridge: Massachusetts Institute of Technology Press, 1960), p. 30.

[46]Stewart H. Hulse, Harry Fowler, and Werner K. Honig, Cognitive Processes in Animal Behavior (Hillsdale, New Jersey: Lawrence Erlbaum Associates, 1978), p. 109.

[47]Anthony Wolff, "Of Rats and Men," New York Times Magazine, May 15, 1977.

[48]Ibid.

[49]These include Caianiello's model of dynamic circuit equations for neuronal activity and mnemonic equations for engram formation; the Boolean logical neural nets model; a probabilistic neural nets model; Hebb's model; and Zeeman's topological model. Discussion of their deficiencies is beyond the scope of this study.

[50]Gerhard D. Wassermann, Brains and Reasoning: Brain Science as a Basis of Applied and Pure Philosophy (London: The Macmillan Press, Ltd., 1974), pp. 69, 76.

[51]Gerhard D. Wassermann, Neurobiological Theory of Psychological Phenomena (Baltimore: University Park Press, 1978).

[52]Stuart J. Dimond, "Evolution and Lateralization of the Brain: Concluding Remarks," Evolution and Lateralization of the Brain, Vol. CCIC of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), p. 480.

[53]Ibid. The evolutionary development of lateralized brains is generally traced back to some species of worms (probably platyhelminthes). Simple as worm brains are, there are reports of conditioned learning by some worms (annelids). Edward S. Hodgson, "The Evolutionary Origin of the Brain," Evolution and Lateralization of the Brain, Vol. CCIC of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), pp. 23-24.

[54]Jerre Levy, "The Mammalian Brain and the Adaptive Advantage of Cerebral Asymmetry," Evolution and Lateralization of the Brain, Vol. CCIC of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), p. 267.

[55]N. Geschwind and W. Levitsky, "Human Brain: Left Right Asymmetries in Temporal Speech Region," Science, CLXI (1968), pp. 186-89; J. Wada, R. Clark, and A. Hamm, "Cerebral Hemisphere Asymmetry in Humans," Archives of Neurology, XXXII (1975), pp. 239-46; G. H. Yeni-Komshian and D. A. Benson, "Anatomical Study of Cerebral Asymmetry in the Temporal Lobe of Humans, Chimpanzees, and Rhesus Monkeys," Science, CXCII (1976), pp. 387-89; Sandra F. Witelson, "Anatomic Asymmetry in the Temporal Lobes: Its Documentation, Phylogenesis, and Relationship to Functional Asymmetry," Evolution and Lateralization of the Brain, Vol. CCIC of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), pp. 328-54.

[56]Witelson, op. cit., p. 347.

[57]Ibid., p. 340.

[58]Wada, Clark, Hamm, op. cit.; J. A. Akesson, W. J. Dahlgren, and J. B. Hyde, "Memory and Growth in the Superior Temporal Gyri," Canadian Journal of Neurological Science (1975), pp. 191-94. R. Campain and J. Minckler, "A Note on the Gross Configurations of the Human Auditory Cortex," Brain and Language, III (1976), pp. 318-23. Marjorie Le May, "Morphological Cerebral Asymmetry of Modern Man, Fossil Man, and Nonhuman Primate," Annals of New York Academy of

Sciences, CCLXXX (1976), pp. 349-66; Harry A. Whitaker and George J. Ojemann, "Lateralization of Higher Cortical Functions: A Critique," Evolution and Lateralization of the Brain, CCIC. Part of Annals of the New York Academy of Sciences (New York: The New York Academy of Sciences, 1977), p. 460.

[59]Whitaker and Ojemann, op. cit. Information about morphological asymmetries in non-primate mammals is limited, but two instances are of special interest to us since they are about the species who were subjects of the studies mentioned above in which similarity to humans was assumed by the experimenters, but questioned by others (sexual dysfunction related to nerve damage in cats and sensitivity to carcinogens in rats). It has been observed that there is a difference in the types of fissure patterns in each hemisphere in cats. It is usually assumed that fissures delimit functionally distinct cortical areas, but it is not known what the functional correlates of the asymmetry in cats might be. W. G. Webster and I. H. Webster, "Anatomical Asymmetry of the Cerebral Hemisphere of the Cat Brain," Physiological Behavior, XIV (1975), 867-69; F. Sanides, "Representation in the Cerebral Cortex and Its Areal Lamination Patterns," Structure and Function of Nervous Tissue, V (1972), ed. G.H. Bourne (New York: Academic Press, 1972), pp. 329-453. There is also evidence of a chemical asymmetry (in nigostriatal dopamine levels) in rats which is correlated with spatial-directional preferences. Although its functional permanence is unclear, if it were to provide a constant motor bias, that bias would facilitate left-right discrimination and memory. B. Zimmerberg, S. D. Glick,

and T. P. Jerussi, "Neurochemical Correlate of a Spatial Preference in Rats," Science, CLXXXV (1974), pp. 623 - 25; William G. Webster, "Territoriality and the Evolution of Brain Asymmetry," Evolution and Lateralization of the Brain, CCIC. Part of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), p. 219.

[60]John C. Eccles, "Development of the Self-Conscious Mind," Evolution and Lateralization of the Brain, CCIC. Part of Annals of the New York Academy of Sciences, eds. Stuart J. Dimond and David A. Blizard (New York: The New York Academy of Sciences, 1977), p. 163.

[61]See, for example, W. A. Mason, "Environmental Models and Mental Modes: Representational Processes in the Great Apes and Man," American Psychologist, XXXI (1976), pp. 284-295; D. A. Premack, "Language and Intelligence in Ape and Man," American Scientist, LXIV (1976), pp. 672 - 83.

[62]Harry J. Jerison, "The Theory of Encephalization," Evolution and Lateralization of the Brain, CCIC, op. cit., p. 156.

[63]Levy, op. cit., p. 269.

[64]Jerison, op. cit.

[65]Eccles, op. cit., p. 165.

[66]Jerison, op. cit.

[67]The measurements were of frontal lobes excluding areas 4 and 6.

[68]Eccles, op. cit., p. 164.

[69]M. S. Gazzaniga, "Consistency and Diversity in Brain Organization," Evolution and Lateralization of the Brain, CCIC, op. cit.,

p. 420; Witelson, op. cit., p. 349; Dimond, op. cit., p. 489; Eccles, op. cit., p. 173.

[70]Whitaker and Ojemann, op. cit., p. 466.

[71]Gazziniga, op. cit., p. 418.

[72]Whitaker and Ojemann, op. cit., pp. 460 - 61.

[73]John L. Debes, "Visuocultural Influences on Lateralization," Evolution and Lateralization of the Brain, CCIC, op. cit., pp. 474-75.

[74]Whitaker and Ojemann, op. cit., p. 465.

[75]J. A. Wada, "Pre-Language and Fundamental Asymmetry of the Infant Brain," Evolution and Lateralization of the Brain, CCIC, op. cit., p. 375.

[76]Whitaker and Ojemann, op. cit., p. 468. See Elkhonon Goldberg and Louis J. Gerstman, "Nonverbal Descriptive Systems and Hemispheric Asymmetry: Shape Versus Texture Discrimination," Brain and Language, V (1978), pp. 249 - 57.

[77]Gazzaniga, op. cit., pp. 419 - 20.

[78]Levy, op. cit., p. 268.

[79]C. R. Butler and A. C. Francis, "Specialization of the Left Hemisphere in the Baboon: Evidence from Directional Preference," Neuropsychologia, XI (1973), pp. 351 - 54.

[80]Michael Petrides and Susan D. Iversen, "Restricted Posterior Parietal Lesions in the Rhesus Monkey and Performance on Visuospatial Tasks," Brain Research, CLXI (1979), pp. 63-77.

[81]J. H. Dewson, "Preliminary Evidence of Hemispheric Asymmetry of Auditory Function in Monkeys," Lateralization of the Nervous

System, ed. S. Harnad (New York: Academic Press).

[82]M. S. Gazzaniga, "Interhemispheric Communication of Visual Learning," Neuropsychologia, IV (1966), pp. 183 - 89; G. L. Risse et al., "The Anterior Commissure in Man: Functional Variation in a Multisensory System," Neuropsychologia (1977); M. V. Sullivan and C. R. Hamilton, "Interocular Transfer of Reversed and Nonreversed Discriminations via the Anterior Commissure in Monkeys," Physiological Behavior, X, pp. 355 - 59.

[83]Webster, op. cit., p. 213.

[84]Witelson, op. cit., p. 348.

[85]Whitaker and Ojemann, op. cit., p. 465.

[86]Wada, op. cit., p. 372.

[87]Witelson, op. cit., p. 349.

[88]E. H. Lenneberg, The Neurosciences, Second Study Program, ed. F. O. Schmitt (New York: Rockefeller University Press, 1970), p. 362.

[89]Witelson, op. cit., p. 349.

[90]Hodgson, op. cit., pp. 24-25.

[91]Wassermann, op. cit., pp. 135, 139.

[92]This summary of Wassermann's theory is largely drawn from his own account. To review the arguments for the theory would take us far afield, but they are available in Wassermann's book, Neurobiological Theory of Psychological Phenomena (Baltimore: University Park Press, 1978).

[93]Ibid., p. 3.

[94]Ibid., p. 22.

[95]Ibid., p. 125.

[96]Ibid., pp. 5-6.

[97]Ibid., p. 66.

[98]Ibid., p. 9.

[99]"Its postulated molecular biological constituents should be capable of isolation, separation into subunits and reconstitution. The function of subunits should be partly testable in isolation (for example, by studying synaptosomes.)" Ibid., p. 10.

[100]B. F. Skinner, Verbal Behavior (New York: Appleton-Century-Crofts, 1957).

[101]Malcolm Crick, Explorations in Language and Meaning: Towards a Semantic Anthropology (New York: John Wiley and Sons (Halsted Press, 1976); David Palermo, Psychology of Language (Glenview, Illinois: Scott, Foresman and Co., 1978).

[102]Skinner, op. cit., p. 449.

[103]Ibid., p. 438.

[104]Ibid., p. 435.

[105]Ibid., p. 451.

[106]Ibid., p. 1.

[107]Ibid., p. 464.

[108]Ibid., p. 225.

[109]Ibid., p. 14.

[110]Ibid., p. 31.

[111]Ibid., p. 66.

[112]Jean Atchison, The Articulate Mammal: An Introduction to Psycholinguistics (New York: Universe Books, 1976), p. 82.

[113]R. Brown, C. Cazden, and U. Bellugi, "The Child's Grammar from I to III," Minnesota Symposium on Child Psychology, II, ed. J. P. Hill (Minneapolis: University of Minnesota Press, 1968), pp. 28-73.

[114]R. Brown, A First Language (London: Allen and Unwin, 1973).

[115]M.D.S. Braine, "The Acquisition of Language in Infant and Child," The Learning of Language, ed. C. E. Reed (New York: Appleton-Century-Crofts, 1971); C. Cazden, Child Language and Education (New York: Holt, Rinehart and Winston, 1972).

[116]R. Brown, Psycholinguistics: Selected Papers (New York: Free Press, 1970).

[117]"More intriguing is the possibility that by studying language we may discover abstract principles that govern its structure and use, principles that are universal by biological necessity...that derive from mental characteristics of the species." Noam Chomsky, Reflections on Language (New York: Random House [Pantheon Books], 1975), p. 4.

[118]Noam Chomsky, The Logical Structure of Linguistic Theory (New York: Plenum Press, 1975), p. 36.

[119]Ibid., p. 9.

[120]Ibid., p. 9.

[121]Ibid., p. 13.

[122]Ibid., p. 9.

[123]Chomsky, op. cit., p. 29. Chomsky argues that the grammar of language is two-dimensional such that every sentence has a surface structure and an underlying deep structure, the latter explained

by basic syntactical principles that are common to all actual (and possible) natural languages. The rules for expressing the relation of deep to surface structure are called grammatical transformations. Chomsky does not claim that all languages have the same deep structure. What he claims is that structure is a feature of sentences within language, and that deep structure of sentences is universal.

[124]Ibid., p. 39.

[125]Ibid., p. 21.

[126]Ibid., p. 27.

[127]Ibid., p. 24.

[128]Ibid., p. 13.

[129]Ibid., p. 33.

[130]Atchison, op. cit., pp. 76-77.

[131]Ibid., p. 63.

[132]Ibid., p. 70.

[133]Ibid., pp. 78, 80, 116 - 24.

[134]Chomsky, op. cit., p. 7.

[135]Noam Chomsky, Aspects of the Theory of Syntax (Cambridge: Massachusetts Institute of Technology Press, 1965), p. 21.

[136]Noam Chomsky, Reflections on Language (New York: Random House [Pantheon Books], 1975).

[137]Chomsky has, in fact, rejected decision procedures in linguistics, i.e., criteria for choosing the best possible theory for data, in favor of evaluation procedures, i.e., criteria for choosing between alternate theories (or grammars).

For a fuller discussion of these points, see Stephen P. Stich, "What Every Speaker Knows," Philosophical Review, LXXX, No. 4 (October, 1971), 476-96.

[138]Chomsky himself seems to recognize this. "Although one wants the 'simplest' linguistic theory, in some sense that cannot be specified in a useful way...." Noam Chomsky, "Some Empirical Issues in the Theory of Transformational Grammar," Goals of Linguistic Theory, ed. Stanley Peters (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972), p. 69.

[139]Charles F. Hockett, "Logical Considerations in the Study of Animal Communication," Symposium on Animal Sounds and Communication, eds. W. E. Lanyon and W. N. Tavolga (Intelligencer Printing Co., 1960), pp. 392-427.

[140]This view allows for symbols of symbols, e.g., a written word may be understood as a symbol of a spoken word which is, in turn, a symbol of an object such as a tree.

[141]These include simplicity; elegance; ease of production, reproduction, repetition, and transmission; suitability of size; balance between number of symbols and size of symbol complexes; clearness of relation between symbol and object; relevance of the structure of symbol complexes to the structure of objects; discrimination between symbols; suitability of operational synonyms; and universality. Yuen Ren Chao, Language and Symbolic Systems (Cambridge: Cambridge University Press, 1968), p. 212.

[142]Chao also suggests that the use of Euler's circles in Venn diagrams may be a less clear relation between symbol and object than the use of arbitrary outlines. Ibid., p. 219.

[143]Newton Garver, "Rules," The Encyclopedia of Philosophy, ed. Paul Edwards, VII (1972), pp. 231-33.

[144]See, for example, John Chadwick, The Decipherment of Linear B (2d ed., Cambridge: Cambridge University Press, 1967).

[145]In Lewis Carroll's "Garden of Live Flowers," the flowers are rational and linguistic, but their being able to warn each other of danger is useless since they cannot move, and their aggressive threats to each other are idle threats. Lewis Carroll [Charles L. Dodgson], Alice's Adventures in Wonderland and Through the Looking Glass (Philadelphia: The John C. Winston Co., 1923).

[146]The standard primate classification of chimpanzees is as follows: Suborder--Simiae; Superfamily--Hominoidea (apes and man); Family--Pongidae; Genus--Pan. Other primates in this family include Pongo (orangutan and gorilla).

[147]J. Bronowski and U. Bellugi, "Language, Name and Concept," Science, CLXVIII (1970), pp. 669 - 73.

[148]In correspondence with Fouts, Bellugi wrote, "All of us who have written about word order and its implications for structure should be forced to eat all those words." Eugene Linden, Apes, Men, and Language (New York: E. P. Dutton and Co., Inc. [Saturday Review Press], 1974), p. 74.

[149]Nancy Frishberg, "Code and Culture," Sign Language and Language Acquisition in Man and Ape: New Dimensions in Comparative Pedolinguistics, ed. Fred C. C. Peng (American Association for the Advancement of Science Selected Symposia Series, Boulder, Colorado: Westview Press, Inc., 1978), pp. 45-85.

[150]Lyn W. Miles, "Language Acquisition in Apes and Children," Sign Language and Language Acquisition in Man and Ape: New Dimensions in Comparative Pedolinguistics, ed. Fred. C.C. Peng (American Association for the Advancement of Science Selected Symposia Series, Boulder, Colorado: Westview Press, Inc., 1978), pp. 103-20.

[151]M. C. King and A. C. Wilson, "Evolution at Two Levels in Humans and Chimpanzees," Science, CLXXXVIII (1975), pp. 107-16.

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