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What Is Psychological Well-Being? Can We Know if Primates Have It?

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> Animals lack what we have gained, but we lack what they still have...With them we are still in the Garden of Eden; and with ourselves, the Fall is everyday (Fowles 1970, pp. 61-62)

Fowles wrote the above in his discourse on "relativity of recompense," his view that a sentient creature's happiness is relative to its awareness of its existence. In Fowles's opinion, animals are blissfully ignorant.

We will consider whether nonhuman primates are blissfully ignorant or whether they are aware of their existence. We assume that awareness of one's existence is a prerequisite to knowing or having "psychological wellbeing" and that two prerequisites for the "awareness of one's existence" are having adequate "consciousness" and "self-awareness." Before we can consider whether nonhuman primates have these capacities, we must consider the general status of such concepts. Hereafter, we will not use the "shudder quotes" (Putnam's [1981] useful phrase, p. 216) but the discomfort they indicate will remain.

Since previous regulations were limited to considerations of physical wellbeing, the introduction of regulations concerning the psychological wellbeing of nonhuman primates implies that a distinction between physical and psychological wellbeing is reasonable. Whether it is reasonable depends on the context. In the present regulatory context, making rules to provide for psychological wellbeing implies that something exists to be regulated. This needs to be examined, as does the scientific meaningfulness of a distinction between physical and psychological wellbeing.

ONTOLOGICAL AND EPISTEMOLOGICAL CONSIDERATIONS

Questions about the existence of psychological wellbeing as distinct from physical wellbeing call for a more general consideration of "existence" and "reality." These are ontological questions about what *is*. Inseparable from such questions are epistemological questions about what can we know about what there is. Ernst von Glasersfeld (1987) examined some of these issues in connection with Piaget's "radical constructivist epistemology." An important conclusion of radical constructivist epistemology is that we can never know what there is.

Ontological and epistemological beliefs have implications for theory and for choice of methodology. For example, does legitimate methodology include introspection, intuition, empathic introspective discourse, observational, correlational, and experimental studies of nonverbal behavior, neurophysiology, etc? All scientists have ontological and epistemological beliefs, although some may not realize important implications of their beliefs. We want to be clear about our views, because they guide what we write later about consciousness, self-awareness, and psychological wellbeing. For rhetorical purposes, if no other, we submit that our views are the ones that behavioral scientists ought to hold.

Ontologically, we believe there is a real world of physical entities that exists independently of perceivers. Epistemologically, we believe (1) that what one can know about the real world will be incomplete for logical, practical (e.g., economic and temporal) and theoretical reasons (e.g., implications of the uncertainty principle; Heisenberg 1958) but (2) that reasonable agreement can be reached by perceptive and knowledgeable persons about the parameters of the physical entities and their spatial-temporal relationships. "Perceptive and knowledgeable" recognizes that special knowledge may be necessary (e.g., learning electron microscopy to "see" a bacterium or knowing the theory of relativity in order to estimate the composition and dimensions of the universe). We also assume that one's knowledge of the physical world is constructed, in part, from one's prior knowledge and theoretical commitments (Kuhn 1970). Therefore, we combine a realist ontology with a constructivist epistemology (see Manicas & Secord 1983; Leary 1984). According to Manicas and Secord, "...it is precisely the task of science to invent theories that *aim to represent* the world" (p. 401; italics added), and this aim is best accomplished by the "...application of imaginative theory that simultaneously guides observations, analysis, and experiment" (p. 405). We agree with Leary (1984) that "...concepts and theories are best construed as constructive approximations or tentative mappings of the real world as opposed to 'real knowledge' in some simple objectivist sense" (p. 918).

With our beliefs stated, we now address the status of the concept of psychological wellbeing and its proper place within a scientific framework, for these are scientific questions and not matters of personal values or anthropomorphic projections.

PSYCHOLOGICAL-PHYSICAL WELLBEING AND MIND-BODY DUALISM

The distinction between psychological and physical wellbeing is an aspect of mind-body dualism, a topic with a considerable literature to call upon. The three contrasting beliefs about mind-body are: (1) only the mind exists: idealistic monism; (2) only the body exists: materialistic monism; or (3) both mind and body exist: dualism. We emphasize *belief*, because there is no way to establish the "truth" or logical priority of any of these views.

The range of human beliefs can be exemplified by those who believe in faith healing versus those who believe in administering rabies antitoxin in case of a bite by a rabid animal. Beliefs are influenced by one's knowledge as well as other factors, perhaps chief among them what one is most "confident" or "comfortable" with, whatever that means! Confidence and comfort as criteria of belief are not stated lightly, but we must leave this issue and move on.

Idealistic monism and dualism posit mind as a nonphysical substance. While there are many versions of these two views (see Churchland 1984), all agree that consciousness is nonphysical and does not reduce to the concepts or explanations of physical science; consciousness requires a new science and a new methodology. Positive evidence of a nonphysical mental substance is lacking, however, and there is no clearly articulated theory of mind-stuff, no statement regarding its elements, no laws of its operations or of its structural connections (Churchland, 1984).

We prefer the materialist view that mind reduces to body and the psychological reduces to the physical, in part, because:

> . . . there are many clear cases of physical causation but not one clear case of nonphysical causation... Most philosophers now agree that no argument has successfully demonstrated why mind-body causation should not be regarded as a species of physical causation (Fodor 1981, p. 132).

Further, we believe that a materialist view is more compatible with the scientific approach to evidence and reasoning and is the appropriate one for considering the psychological wellbeing of nonhuman primates.

There are several versions of materialism with different implications for concepts like consciousness, self-awareness, and psychological wellbeing. We will consider briefly four theories, drawing heavily on Churchland's (1984) and Fodor's (1981) accounts.

Radical behaviorists hold that all reference to mental causes can be eliminated from the language of psychology in favor of reference to an organism's responses to environmental stimuli. The radical behaviorist, according to Fodor, "...is prepared to dismiss references to mental causes, however plausible they may seem, as the residue of outworn creeds" (p. 250).

Logical or philosophical behaviorists acknowledge the existence of mental states but translate them into behavioral hypotheticals expressed in the language of observable stimuli and responses. Note that there might be an infinite number of behavioral hypotheticals pertaining to a particular mental state. For example, "The monkey has psychological wellbeing" (mental state) might be translated as: (1) If the monkey eats (sleeps, copulates, etc.), then it will do so in a way that is normal (statistically) for its species; (2) If cage space is sufficient, then the monkey's movements will be normal (e.g., not showing stereotypies); (3) Etc.

Central state identity theorists hold that mental states are identical with states of the brain. An identity theorist might ascribe psychological wellbeing to those nonhuman primates whose brain neurophysiology is sufficiently similar to a human's...on the assumption (questionable; see Concluding Remarks) that psychological wellbeing can be defined adequately for humans. A difficulty for central state identity theory is its specificity, that is, it casts its lot with the carbon-based nervous systems of Earth's fauna and fails to allow for other systems that might be capable of mental states, such as computers or a hypothetical alien's silicon-based nervous system (Churchland 1984).

Functional theorists avoid the problems of identity theory's specificity by emphasizing the "causal role" of mental states as opposed to structural commonalities among them. The analogy of computer software versus hardware is applicable here. Functional theorists define mental states in terms of "...their unique causal roles in a complex economy of internal states mediating sensory inputs and behavioral outputs" (Churchland, 1984, p. 36). Further, in a complete departure from logical behaviorism, "Functionalism construes the concept of a causal role in such a way that a mental state can be defined by its causal relations to other mental states" (Fodor 1981, p. 136). Also unlike logical behaviorism, functionalism is not reductionistic; it does not require the elimination of mentalistic concepts from theoretical explanations. While functionalism avoids the problems of identity theory's specificity, "The functionalists would not be disturbed if brain events turned out to be the only things with the functional properties to define mental states" (Fodor, p. 137).

We endorse the functionalist view of mental concepts. However, it is not clear how psychological wellbeing qualifies as a functional mental state.

Churchland chose "pain" (and Fodor chose "headache") to illustrate functional mental states. Consider Churchland's example of how pain causes both behavioral outputs and other mental states. "Pain...causes distress, annoyance, and practical reasoning aimed at relief; and it causes wincing, blanching, and nursing of the traumatized area" (p. 36).

We observe that there is an unbalanced relationship between pain and the three examples of mental states said to be caused by pain. Consider the following: (1) we can think of pain directly causing annoyance or distress or practical reasoning to gain relief but not vice versa; (2) pain is caused only by localized physical trauma, but annoyance, distress, or practical reasoning may be caused by a number of conditions not related to pain nor physically localizable; (3) although we won't make the case here, we suggest that mental states like annoyance are reducible to mental states, like pain, that are reducible to their physical substrates. Therefore, mental states like annoyance appear to be superordinate to mental states like pain.

Psychological wellbeing also appears to be a superordinate concept. Consideration of psychological wellbeing as a functional mental state awaits an adequate account of the sensory inputs, behavioral outcomes, or other mental states that define it. We believe that psychological wellbeing is too ill defined to serve as a scientific concept. However, in view of its spreading use, it would be silly to ignore the concept, no matter how ill defined it may be. A scientifically-acceptable definition might be developed by identifying a suitable subset of behavioral hypotheticals (see Logical Behaviorism above) but that would require a separate chapter. In order to move on, we will simply assume that the psychological wellbeing that is to be addressed via regulations would first be defined in a scientifically-acceptable way.

CONSCIOUSNESS, LANGUAGE, AND SELF-AWARENESS

We are assuming that consciousness and self-awareness are prerequisites for awareness of one's existence and wellbeing. These are mental states which, as scientific concepts, may be no better defined than psychological wellbeing, but there is a vast literature on consciousness on which we can draw. Natsoulas (1978) began his analysis of consciousness by distinguishing between consciousness$_3$ and consciousness$_4$. The subscripts refer to the third and fourth definitions in the 1933 Edition of the Oxford English Dictionary. Quoting Natsoulas:

> The main definiens of the fourth entry reads in full, "The state or faculty of being conscious as a condition or concomitant of all thought, feeling, and volition; 'the recognition by the thinking subject of its own actions or affections' (Hamilton)." This concept of consciousness amounts to a restriction of the "wide, colorless use" (Dewey, 1906) to which the third entry is addressed. Consciousness3 means simply being aware of something, anything, whereas I exemplify consciousness4 by being aware of, or by being in a position to be aware of, my own thought, feeling, volition, or other mental episode (i.e., event, process, or occurrent state).

Natsoulas (1983 1985) states that consciousness$_3$ is simply being aware of something, such as an internal state or environmental event. This subsumes activities such as perceiving red, hearing a noise, holding an event in short-term memory, and perhaps Segal's (1976) category of consciousness as synonymous with stimulus control of behavior. Consciousness$_4$ is being aware of being aware and includes such categories as intentions, abstractions, self-concepts, and thoughts.

Many have expressed views on the relationship between language and consciousness. In Carlson's (1987) recent account, "Consciousness...can be viewed as being synonymous with verbal processes" (p. 407) and "... the *sole* criterion for consciousness is verbal acknowledgement" (p. 403). "Private nonverbal processes are conscious if we can describe them...we are conscious of *external* events only if we can think (and verbalize) about them" (p. 407). Because even the most linguistically accomplished of the apes could barely provide such descriptions, it might appear that this view precludes nonhuman animals from having consciousness. Carlson also said,

> Although consciousness may be synonymous with activity of verbal mechanisms of the brain, we need not conclude that only humans are conscious. The evolutionary process is incremental: new traits and abilities build upon ones that already exist...Certainly your dog can learn to communicate with you. The fact that it can learn to tell you when it wants to eat, go for a walk, or play probably means that it is conscious, also, (p. 406).

However, Carlson did not equate consciousness with *communication per se,* noting that "Species-typical communications...probably do not fall in the domain of consciousness" (p. 404).

We maintain that consciousness$_4$ is a prerequisite for an organism's appreciation of its psychological wellbeing as distinct from its physical wellbeing. We will now consider some of the evidence for consciousness$_4$ in nonhuman animals.

Self-Awareness in Nonhuman Primates

The first reference should be Donald Griffin's book, *The question of animal awareness* (1976; 1981), because it has made him the best recognized authority on the subject. However, Mason's (1976) incisive review of the first edition found Griffin's examination of the title question to be unsatisfactory. Because Griffin's book has influenced, perhaps, too

many uncritical readers, it is worth quoting quote extensively from Mason's review:

> What bothers me most about this book is not the cautious tone of these rather inoffensive conclusions, but the fact that so much time is spent building up to them - defending propositions that do not require defense...By now we should need only the briefest reminders that animals have knowledge of their environments, that such information is processed, stored, and retrieved, that animals are sensitive to the consequences of their actions, that they are capable of intentions and expectancies...one might hope that some useful distinctions could be drawn between "having a mental experience" (that is, being aware of one's internal state or of the external environment) and "being aware of having such an experience"...he has not explored such questions systematically in relation to the problem of animal awareness at either the substantive or the theoretical level (p. 930)."

Natsoulas (1978) also questioned whether Griffin had addressed awareness in animals at the level of consciousness$_3$ or consciousness$_4$. Natsoulas suggested that the closest Griffin came to considering the distinction was when he discussed "intention" and "It is not clear whether Griffin was suggesting that the function of an animal's intentional behavior involves consciousness$_4$ or merely consciousness$_3$" (p. 141).

In the second edition of his book (1981, p. 27) Griffin acknowledged Mason's review but only to make a minor point, not to answer the principal objections Mason had raised. Griffin also cited Natsoulas but, again, in a secondary way. Based on Griffin's "Summary and Conclusions," we think he would agree that the animal literature still did not permit one to assert clearly whether any animal performances reflect consciousness$_4$.

Self-recognition: The most direct tests of self-awareness that have been reported involve recognizing oneself in a mirror. The procedure was introduced by Gallup (1970) who subsequently asserted that it was a test of self-awareness and consciousness (Gallup 1977 1982). Animals given access to mirrors typically respond initially as they do toward *other* members of their species, but after a few days of exposure to the mirrors, chimpanzees (*Pan troglodytes*) and orangutans may respond (some don't) with self-directed behavior (Gallup, 1982). Gallup also introduced a test in which dye was placed on an eyebrow ridge or ear while the animal was anesthetized. The dye marks could be seen by their bearers only in the mirror, and self-directed responses to the dye marks, aided by the mirror, were taken as evidence of self-recognition. In less formal testing, the Rumbaughs have obtained videotaped evidence of a chimpanzee examining

the inside of his mouth with the aid of a flashlight and a real-time video image. The chimpanzee gave every sign of being aware that it was his own mouth he was viewing in the video monitor. (See photograph taken from the videotape in Rumbaugh Washburn & Savage-Rumbaugh: this volume. Ed.)

Gallup (1982) also reported *failures* of self-recognition by 11 species of monkeys, two species of gibbons, and gorillas. The report of failure by gorillas was supported by three experimental studies. William McGrew, during formal discussion of a conference presentation by Gallup (1986; attended by RKT), objected that the gorillas tested were in zoos and were, as a result, abnormal. Gallup responded that he had no bias in the matter, that he hoped a successful experiment with gorillas could be conducted, and that he was merely reporting the available data. In any event, the evidence for self-recognition is limited to chimpanzees and orangutans. (But see Bramblett: this volume, for descriptions of sophisticated mirror use in vervet monkeys. Ed.)

Robert (1986) investigated the development of mirror responses in an infant chimpanzee and an infant orangutan. She concluded that the chimpanzee's responses were similar to those of children of the same age, while the orangutans's were similar to those of younger children. It should be noted that the orangutan was 2 years old at the time of the study, whereas the chimpanzee was 7 months. While there was some indication of self-directed behavior, the results were negative for the dye-mark tests of self-recognition. Nevertheless, given that the ape infants behaved toward the mirror as did human children of roughly comparable age, and that adult chimpanzees and orangutans show self-recognition, it is reasonable to suggest that the development of self-awareness in the apes might have progressed beyond that revealed by the mirror tests. Nonetheless, there is as yet no compelling evidence that a chimpanzee or an orangutan might contemplate its psychological wellbeing.

"BEING IN A POSITION TO BE AWARE..."

Natsoulas (1978) suggested two criteria for consciousness$_4$, (1) "...being aware of, or...(2)...being in a position to be aware of, my own thought, feeling, volition, or other mental episode (i.e., event process, or occurrent state)" (p. 140). The second criterion provides a reason to ask whether nonhuman primates show the kinds of cognitive processes that would be essential to consciousness$_4$ and self-awareness. Owing to time and space constraints, we will address only a few of the many topics on cognitive processes in animals that might be addressed. We will begin with Carlson's (1987) view that consciousness is synonymous with verbal processes, because it is related to the Premacks' (1983; Premack & Premack, 1983) findings that language training is essential to successful

performance on some tests of abstraction. The Premacks cited several examples of tasks used with language-trained and nonlanguage-trained chimpanzees. We will take issue with their principal example, abstract "same/different" judgments.

"Same" and "Different" Judgments

The importance of such judgments was indicated by Henry Nissen (1958) who wrote:

> ...all reasoning reduces to three processes: responsiveness to identity and to difference, and thirdly the balance or relative weight given to each of these...The term reasoning is usually reserved for higher level integrations - that is, for response to similarities and differences among units...All class concepts require simultaneous responsiveness to identities among the members of the class, and to differences between them and members of other classes. The balance between the two we may call sagacity; "judgment" might be an even better term (p. 194).

Premack (1983) distinguished between *same* and *different* judgments based on appearance and those based on abstraction. Using a matching-to-sample paradigm and letters to symbolize objects, one may illustrate the distinction as follows. An appearance-based task might involve presenting AA and BC and reinforcing responses to AA when "same" is correct or reinforcing responses to BC when "different" is correct (changing objects frequently to preclude memorizing the objects; e.g., CC vs. DE, FF vs. GH, etc.). An abstraction-based judgment, following Premack's example, might involve "XX as sample with YY and CD as alternatives or XY as sample with CD and BB as alternatives" (p. 128).

The Premacks (1983) argued forcefully that the successful performance of abstract same and different judgments demands a form of analogical reasoning that requires language. However, they either overlooked or discounted the report by Smith King Witt and Rickel (1975) of the performance of the chimpanzee, Casey, on a similar abstract problem. Smith et al. concluded that Casey "...learned a generalized form of the sameness-difference matching from sample concept" (p. 471) despite never having been "...previously trained on any type of learning task" (p. 469).

Burdyn and Thomas (1984) gave squirrel monkeys programmed training that led to conceptual judgments of same and different. The cues to choose exemplars of same were exemplars of the concept "triangularity" and the cues to choose exemplars of different were exemplars of "heptagonality." Because the triangle and heptagon cues in no way resembled same and different, the Premacks presumably would agree that the judgments involved abstraction. The squirrel monkeys also performed successfully when an interval as long as 16 seconds (for the best monkey) was introduced between the withdrawal of the triangle or heptagon and the presentation of exemplars of same and different. Successful performances under such circumstances meant that the monkeys were able to use conceptual symbols as mediational cues; that is, despite their physical removal, the cues served a time-bridging function. Whether the programmed training with these symbols in the same-and-different tasks may be construed as language training is unresolved, but Burdyn and Thomas's (1984) and Smith et al.'s (1975) studies raise questions about the Premacks' (1983; Premack & Premack, 1983) contention that language training is necessary for abstract representation.

Nevertheless, it is impressive that the Premacks' most experienced chimpanzee, Sarah, often performed new problems posed to her immediately and without special training. Burdyn and Thomas's squirrel monkeys had hundreds of trials of programmed training before reaching criterion on the final task, and Smith et al.'s chimpanzee also had extensive programmed training. Undoubtedly, Sarah's extensive experience with many kinds of verbal and conceptual problems facilitated her performances on new tasks. Her "education" may be compared to that of humans. Opposed to the Premacks' view that language training is essential, we suggest that what's essential is adequate "instruction" on the contingencies involved in new tasks. One may ask whether the Premacks' chimpanzees that failed on the same-different tasks had sufficient training on the relevant reinforcement contingencies.

Piaget's Theory Applied to Nonhuman Primates

Piaget's theory addresses cognitive development, the extent of which is relevant to the capacity to be aware of one's psychological wellbeing. Although Piaget's research was done with children, the theory was meant to apply to nonhuman animals as well (e.g., Piaget 1971). Piaget's theory posits four major periods in cognitive development. First is the *Sensorimotor Period*, which extends from birth to about 24 months in humans and involves the initial development of the child's concepts of space, time, causality, object permanence and so on (cf Phillips 1975, Piaget & Inhelder 1969). Second is the *Preoperational Period*, from about 2 to 7 years. According to Phillips (1975):

> The essential difference between a child in the Sensorimotor Period and one in the Preoperational Period is that the former is relatively restricted to direct interactions with the environment, whereas the latter is capable of manipulating symbols that represent the environment (p. 62).

Except for transitivity, which will be considered below, relatively little research explicitly on the Preoperational Period has been done using

nonhuman animals. However, there is a large and growing body of evidence that animals use concepts that represent environmental entities or events (e.g., Thomas 1980).

The Preoperational Period is followed by the *Concrete Operational Period.* Again, according to Phillips:

> Since birth, the dominant mental activities of the child have changed from overt actions (in the Sensorimotor Period) to perceptions (in the Preoperational Period)...the Concrete Operational child conserves quantity and number, constructs the time and space that he will live with as an adult, and establishes foundations for the kind of thinking that is the identifying feature of the next and final period of his intellectual development, Formal Operations (p. 117).

Conservation of quantity and number is representative of the Concrete Operational Period. Several studies have investigated conservation by nonhuman primates. We will consider these below.

The Period of Formal Operations was summarized by Piaget and Inhelder (1969) as follows:

> The great novelty of this stage is that by means of differentiation of form and content the subject becomes capable of reasoning correctly about propositions he does not believe, or at least not yet; that is, propositions that he considers pure hypotheses. He becomes capable of drawing the necessary conclusions from truths which are merely possible, which constitutes the beginning of hypothetico-deductive or formal thought (p. 132).

To the best of our knowledge, there has been no research to substantiate the occurrence of formal operations in nonhuman primates.

Now we will examine briefly some studies with nonhuman primates concerning object permanence, transitivity, and conservation concepts representative of the Sensorimotor, Preoperational, and Concrete Operation Periods, respectively.

Object permanence: The most studied Piagetian concept in animal research (see Thomas & Walden's review, 1985) is "object permanence." According to Piaget (e.g., 1954), the child does not realize initially that objects have independent existence. The development of that knowledge occurs in six stages extending to about 24 months. Because all the animal studies report success in the first three stages, we will begin our description with stage 4. A typical stage 4 task would have the subject observe an object being hidden in location A and then moved to location B. The subject that has not yet developed the concept of object permanence will search for the object in location A. In stage 5, the subject performs

stage-4 tests successfully but fails to search appropriately when the object is hidden from view (e.g., covered with a cloth) while being moved, especially if more than one move is involved (e.g., from A to B to C). In stage 6, the subject performs successfully even when the object is hidden from view and moved more than once.

At the time of Thomas and Walden's review (1985) investigators had reported the partial development of object permanence for birds, hamsters, woolly monkeys, and a stumptail macaque. Complete development of object permanence had been reported for cats, dogs, squirrel monkeys, cebus monkeys, rhesus monkeys, a gibbon, chimpanzees, and gorillas.

Redshaw (1978) compared the development of gorillas and humans on 14 developmental tasks including tests of object permanence. She concluded that the gorillas were consistently ahead of the humans, completing the tasks at a mean age of 43.5 weeks versus the humans' mean age of 54 weeks. Wood Moriarity Gardner and Gardner (1980) compared two chimpanzees, ages 18 and 30 months, with humans, ages 8, 18, and 24 months, on tests of object permanence. The 18-month human and chimpanzee performed comparably, but the 24-month human performed slightly better than the 30-month chimpanzee.

Cornell (1978) raised methodological and theoretical questions about the test procedures typically used with humans (procedures that have been adapted relatively directly for use with nonhumans) and Thomas and Walden raised further methodological objections to the animal studies. A rigorous interpretation is that none of the studies with animals or humans is entirely free from methodological objections.

Most recently, Natale Antinucci Spinozzi and Poti (1986) , who also questioned much of the earlier work, devised new methods to avoid the flaws as they saw them and tested a Japanese macaque and a gorilla, both 22 months old. They concluded that the gorilla showed the fully-developed concept of object permanence but that the Japanese macaque showed development only through stage 5. The gorilla's development of the concept was said to be comparable to that reported for humans.

Transitivity: Transitivity, an example of cognitive functioning in the Preoperational Period, involves giving the subject the information that a certain relation holds between A and B and between B and C and testing whether the subject can infer that the relation holds between A and C (e.g., A > B and B > C implies that A > C). Menzel (1969) trained and tested seven adult chimpanzees in ways that permitted him to distinguish between a "logical" and a "statistical" solution. Briefly (but see Menzel for his thorough examination of the issues), Menzel tested the chimpanzees on tasks with logically complete information (permitting transitive inference) and logically incomplete information (where the apes could only learn the reinforcement contingencies associated with particular pairings, AB, BC, etc.). The statistical solution was applicable in both tasks and the data

indicated that the chimpanzees' performance in both cases was consistent with a statistical solution. Menzel concluded, "The evidence for an inferential rather than learned basis of ordering must be judged inconclusive...(and)...it would appear unnecessary to invoke logical transitivity to account for their performance" (p. 488).

McGonigle and Chalmers (1977) tested squirrel monkeys using a nonverbal test of transitivity based on one used with children by Bryant and Trabasso (1971) and obtained results similar to those reported by Bryant and Trabasso. However, McGonigle and Chalmers described a "binary (statistical) decision model" (somewhat comparable to Menzel's "statistical" solution) that might account for the results as opposed to Bryant and Trabasso's "coordination model" (somewhat comparable to Menzel's "logical" solution). Gillan (1981) studied transitive inference in chimpanzees using procedures comparable to McGonigle and Chalmer's (1977) and concluded that his findings supported an "integration" interpretation (somewhat comparable to Menzel's "logical" solution or Bryant and Trabasso's "coordination model") as opposed to a "nonintegration" one (somewhat comparable to Menzel's and McGonigle and Chalmers's "statistical" interpretations). Although Gillan included a number of control measures and concluded that McGonigle and Chalmers's binary decision model could not account for the results (Gillan did not cite Menzel), he misrepresented McGonigle and Chalmers and did not use some of the tests they did which help distinguish between the logical and statistical solutions.

Conservation: Important in the Concrete Operations Period are conservation tests which assess whether the subject knows that quantity has not changed despite changes in appearance. A typical example is to show the subject two identical vessels containing equal amounts of liquid: the pretransformational display. While the subject observes, the liquid is then poured into two new vessels, one tall and narrow and the other short and wide: the posttransformational display. A nonconserving subject usually indicates that the tall, narrow container has more liquid. Alternatively, two identical rows of objects (e.g., M & M candies) are shown as the pretransformational display. Then, without removing any candies, one row is shortened: the posttransformational display. A nonconserving subject judges the shorter row to have less candy.

Czerny and Thomas (1975) using squirrel monkeys investigated the ability of animals to make conservation-related judgments, and Thomas and Peay (1976) studied conservation of length by squirrel monkeys. Pasnak (1978) studied prerequisites to conservation using macaques (*Macaca mulatta*). Woodruff Premack and Kennel (1978) investigated the chimpanzee Sarah's ability to conserve liquid and solid quantity. Muncer (1983) studied two chimpanzees' abilities to conserve liquid quantity and number of M & Ms. While at least some of the subjects in each experiment appeared to perform successfully, Thomas and Peay (1976) noted the

principal problem that makes all the studies inconclusive. Briefly, the problem is whether animals that correctly judge the stimuli in the postransformational condition to be "equal" or the "same" in quantity do so because they are good "perceptual estimators" (see Gelman 1972) of equivalence or because they use the concept of conservation. Despite the careful controls used by Muncer (1983), Thomas and Peay (1976), and Woodruff et al. (1978), these two possible bases of correct responding cannot be distinguished absolutely. Thomas and Walden (1985) concluded that it may not be possible to determine whether a perceptual or conservational solution was used in the absence of the subject's verbal explanation. They noted that none of the language projects with nonhuman animals has developed the linguistic skills an animal would need to explain its responses so that we could decide whether they were governed by perception or conservation.

Summary

The evidence whether nonhuman primates are "...in a position to be aware..." that is, show evidence of self-awareness and higher cognitive functions such as abstraction is, at best, inconclusive. Self-recognition (which is not equivalent to being aware of one's psychological wellbeing) has only been demonstrated for a few chimpanzees and orangutans, not all of those tested. Abstract representation (measured by sameness-difference judgments) has been demonstrated for chimpanzees and monkeys but such evidence does not demonstrate a capacity to be aware of one's psychological wellbeing. The assessment of cognitive development within a Piagetian framework is fraught with methodological questions which when rigorously applied preclude any conclusion about the state of a nonhuman primate's cognitive development.

CONCLUDING REMARKS

Psychological wellbeing is too ill defined to be used as a basis for regulatory action. We believe that there is no compelling reason to distinguish between psychological and physical wellbeing. If psychological wellbeing were defined adequately, regulations pertaining to it would likely be regulations pertaining to physical conditions. Whether a list of meaningful physical conditions, other than those already specified in existing regulations, can be constructed remains to be determined. We do not deny the possible relevance of social conditions, simulations of natural habitat, and so forth, but there should be scientifically valid evidence that such things matter to the animal before they are included in the regulations.

Psychological wellbeing can be compared to concepts like "freedom." Legislation can be drawn to protect freedom, but what does it address? It

addresses physical activities such as speaking, writing ("freedom of expression") and attending the church of one's choice ("freedom of religion"), etc. In each case, there are behavioral (physical) correspondents.

Relatively well-educated and suitably motivated humans have the only chance of understanding what psychological wellbeing might mean to a human, much less a nonhuman animal. Other than certain physical assurances (e.g., adequate food and water and habitats that provide safety, sanitation, and thermoregulation), how could legislation be drafted to insure the psychological wellbeing of humans? Even within the relatively narrow culture of, say, Caucasian Americans, what regulations could assure the psychological wellbeing of one who prefers life in the country versus one who prefers life in a big city? Humans have hardly determined what psychological wellbeing means to us. The pitfalls of anthropomorphic projection by a human of what psychological wellbeing might mean to a nonhuman primate should make such projection prohibitive.

Despite the cognitive achievements of nonhuman primates, there is no compelling reason to believe that they have the capacity to be aware of their psychological wellbeing. Yet, we do not overlook the possibility of such capacity, especially in the great apes. In view of the uncertainty that remains, we close with the sixth stanza from Judson Mitcham's (1985) "Notes for a prayer in June"...

Before our eyes, that heavy old coin disappears,
while it stays where it is. We're aware
sundown is a lie now, though we see it
the same way. Chimpanzees, I have read,
might pause from their foraging or play,
sit quietly and gaze into the west
till moved by darkness.
Perhaps, in their eyes,
nothing seems magical, or it all does. From us
comes a forced final nod toward the sleight
of relentless method, how it turns
pure mystery to laughter in the end.
Still,
we know there's a magic we begin with, tricked
by love's act into this ruled world.

REFERENCES from the mss are attached.

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Resolving Issues of Psychological Well-Being and Management of Laboratory Nonhuman Primates

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PROBLEMS IN DEFINING PSYCHOLOGICAL WELL-BEING

A recent Congressional amendment to the Animal Welfare Act (1985) mandates a physical environment to enhance the nonhuman primate's "psychological well-being." Psychological well-being, however, is an ambiguous expression. *Webster's Ninth New Collegiate Dictionary* (1987) defines "well-being" as "the state of being happy, healthy or prosperous." To prosper, Webster's says, is to flourish or thrive, which, in the case of animals, must refer to good health. Since any assessment on our part of the happiness of a nonhuman primate could only be subjective, I will therefore focus in this paper on the part of the definition concerning health, specifically mental health.

Many ways to assess well-being in animals have been proposed, including reproductive success, body weight, physical condition, physiological indices of stress like cortisol and ACTH, and behavioral assessments. Whether such measures in fact show how to optimize the environments of nonhuman primates is unclear, however. For example, stereotypic behavior is considered undesirable in any primate management program, but that does not mean that the absence of stereotypies is *prima facie* evidence of mental or psychological health. No single measure of well-being is likely to apply to all nonhuman primate species in all circumstances. Therein lies the difficulty in implementing the amended Animal Welfare Act.

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