

Large Feline Survival, Gene Pool Diversity and the Human Touch:
The Role of Private Captive Stewardship in Species Survival
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The Earth's many offspring from invertebrates to vertebrates, from insects to mammals, from ocean-life to land-life are increasingly under the threat of extinction from man's assault. In particular, deforestation and pollution by chemical products are destroying the natural habitats and forests essential for the survival of thousands of different species. The future of many primates, e.g. the great apes--gorilla, orangutan and chimpanzee are threatened where man's encroachment upon their natural habitat has placed them on the endangered species list. The same is true for many species of the large Felines, e.g. tigers, leopards, jaguars, lynx, etc. This essay is addressed to the survival of the large Felines, although many other animal species could be identified that merit similar attention.

Zoos have attempted to meet the challenge of the dwindling number of such large Felines by providing alternate habitats that, hopefully, would encourage breeding and expansion of species number, but with limited success. The zoos lack of a natural habitat which supports the evolutionary biological context for successful reproduction and parenting is a major factor in failed reproduction and parenting by the mothers of its newborn. Typically, the newborn has to be removed from the mother to preserve and nurture its life. A brief overview of some of the historical research on the effects of maternal-social deprivation and social isolation upon brain-behavioral development in various mammalian species will provide a helpful background and foundation for understanding the specific recommendations that will be made for human private captive-rearing of the large Felines that should optimize their sociability and reproductive capacity which would contribute to their species survival.

It has been well established in primate laboratories where newborns are separated from their mothers at birth and hand-reared to be self-sufficient at self-nursing from a bottle where there is minimal physical body contact with human attendants or other peer animals that such rearing conditions result in many emotional-socially disturbed behaviors which include depression, stereotypical chronic stimulus-seeking behaviors involving toe and penis sucking as infants and self-mutilation during adolescence and adulthood, pathological violence toward other animals as juveniles and adults and impaired social-sexual and parenting behaviors. Such mother-deprived infants are incapable of providing normal maternal care of their infants when artificial means are used to impregnate such social-sexually disturbed animals. Physical abuse and neglect of offspring which are life-threatening are commonly observed among motherless reared mother monkeys and human intervention is necessary to preserve the life of these infants.

Dr. Harry Harlow pioneered in the mother-infant separation and deprivation studies in monkeys at the University of Wisconsin Regional Primate Center. Unfortunately, he did not recognize the sensory deprivation processes nor the brain mechanisms involved in what has been called the maternal-infant deprivation syndrome (Harlow, 1958). In one of his published studies Dr. Harlow stated: The most extreme

deprivation condition we have studied is total social isolation (not sensory isolation, only social isolation) (Harlow, 1964).

Dr. Casler, a developmental psychologist, also maintained this distinction between social and sensory deprivation where, upon the conclusion of his review of the effects of maternal deprivation, he stated: "One may agree that it is social rather than perceptual or sensory deprivation that is involved in these cases (Casler, 1961). R.A. Spitz (1965), an internationally renowned child psychiatrist, also maintained this distinction when he stated: "In recent years a great deal of illuminating and interesting work has been done with animals and humans on the effects of sensory deprivation...it should be realized that sensory deprivation and emotional deprivation are not interchangeable concepts. Granted, in the present state of the art, it is practically impossible to inflict the one without involving the other...accordingly, I believe that further experimentation and study will be required before we can delineate the nature of the two forms of deprivation and isolate their effects from each other." (pp. 281-284).

This developmental neuropsychologist could not have disagreed more with these eminent authorities that social and emotional deprivation does not involve specific forms of sensory deprivation and upon a review of the mammalian maternal and social deprivation literature it was concluded that the emotional-social-sexual behavioral pathologies resulting from such deprivations are due specifically to sensory deprivation of the Somatosensory system, specifically, body touch (somesthetic sensory system) and body movement (vestibular-cerebellar sensory system). This led to my renaming of the maternal-social deprivation syndrome as the Somato-Sensory Affectional Deprivation (S-SAD) Syndrome. Sensory deprivation in the other senses do not lead to emotional-social-sexual behavioral pathologies provided somatosensory stimulation is present (Prescott, 1968, 1971, 1975, 1976, 1980).

The most critical study in the history of primate social isolation rearing was conducted by Drs. William Mason and Gershon Berkson when they reared infant monkeys in single cages in a colony room where they could socialize with other animals through all the sensory systems except body touch and movement and where one group was reared on a swinging mother surrogate and another group was reared on a stationary mother surrogate. (The mother surrogate consisted of a Clorox bottle with a fur rug wrapped around it, a pie pan bolted on the bottom of the bottle which the infant monkey could sit on; and a cam operated rod through the middle of the Clorox bottle which permitted swinging randomly in the horizontal plane and six inches in the vertical plane; or bolted to the floor).

An extraordinary result was obtained. The infant monkeys reared on the swinging mother surrogate did not develop the SAD Syndrome whereas the infant monkeys reared on the stationary mother surrogate developed all the classic symptoms of the mother deprived animals. The monkeys reared on the swinging mother surrogate developed some minor behavioral disorders, such as thumb sucking but no autistic-like behaviors, stereotypical rocking, tactile avoidance, self-mutilation or violence later in life (Mason, 1968; Mason and Berkson, 1975). Mason and Berkson concluded that dynamic social interaction between mother and infant

were important factors in the development of the maternal-social deprivation syndrome.

The Mason-Berkson study and other studies of isolation rearing are portrayed in the Time-Life documentary Rock-A-Bye Baby where this writer served as its Scientific Director and who was privileged to premier this documentary at the 1970 White House Conference on Children (Dokecki, 1973).

This writer recognized the significance of their study in implicating the vestibular sensory system and the brain structures which are the primary recipients of vestibular afferent activity, namely, the cerebellum and brain stem. There is very little vestibular afferent projections to the cerebral neocortex. Further review and studies led this writer to conclude that the vestibular-cerebellar system had to be intimately connected to the limbic system and to the frontal and pre-frontal cortex to account for the dramatic changes in social-sexual behaviors induced by artificial vestibular sensory stimulation. The existing neurophysiological data were quite sparse on these proposals and led to a series of brain studies which confirmed the cerebellar-limbic-frontal/prefrontal cortical complex and their abnormalities in isolation reared primates.

As Health Scientist Administrator, Developmental Behavioral Biology Program, National Institute of Child Health and Human Development (NICHD), National Institutes of Health, I initiated a number of brain studies in isolation-reared pathologically adult violent monkeys with several brain scientists throughout the country. The first of these involved brain implant studies conducted under an NICHD contract with Professor Bernard Saltzberg and Robert G. Heath, M.D., Sc.D, then Chairman of the Department of Neurology and Psychiatry, Tulane University School of Medicine.

These investigators discovered abnormal deep brain spiking activity in the limbic and cerebellar brain structures, thus confirming my S-SAD prediction of brain abnormalities associated with pathological violence in mother-deprived monkeys. Based upon these findings, Heath embarked on a number of studies establishing extensive connections between the cerebellum and limbic system structures which had only been alluded to in a few prior studies involving different animal preparations (Saltzberg, Lustick and Heath, 1969, 1971; Heath, 1972ab, 1975).

Subsequently, additional brain studies on mother-deprived monkeys were initiated that documented deficits of brain serotonin (Coleman, 1971); structural abnormalities of brain cells in the cerebellum and somatosensory cortex (Riesen, Dickerson and Struble, 1977; Struble and Riesen, 1978; Bryan and Riesen, 1989; Floeter and Greenough, 1979); and a brain neurosurgical study involving paleocerebellar decortication which eliminated the pathological violence in an adult mother deprived monkey where a neocerebellar decortication had no such effect (Berman, Berman and Prescott, 1974).

It is now firmly established in many psychiatric studies of violent individuals (homicidal and suicidal) that deficits in brain serotonin mediate depression, impulse dyscontrol and violent behaviors. However,

these psychiatrists have yet to link these effects with failed mother love (S-SAD) and have incorrectly inferred genetic factors in their results (Asberg, Thoren, Traskman, 1976; Brown, Goodwin and Ballenger, 1979; Brown, Ebert, Goyer, 1982; Linnoila, Virkkunen, Scheinin, 1983).

An additional factor that affects brain serotonin development is breastfeeding where tryptophan, an essential precursor amino acid for the development of brain serotonin, is richly present in colostrum and breastmilk but absent in formula milk. The failure to human breastfeed or to breastfeed for two years of age and beyond, as recommended by the World Health Organization (WHO) and UNICEF, results in a high risk for aberrant brain development. (Prescott, 1996ab, 1997, 1998). These and other biochemical/neurochemical brain transmitter issues associated with breastfeeding/bonding and non-violence will be returned to later, particularly, as it relates to optimal nutrition for normal brain development in being raised by humans.

The above conceptual reanalyzes and experimental studies have yielded insights into the sensory processes and brain mechanisms which are responsible for these social isolation induced pathological adult behaviors and have provided solutions for the prevention of these pathological adult social-sexual behaviors in wrongfully-reared newborns/infants. These insights led to a series of Cross-Cultural studies on primitive or pre-industrial cultures by this writer who was able to confirm the high predictive validity of mother-infant affectional bonding in predicting the peaceful or violent nature of these cultures. The primary child-rearing practice that could predict the peaceful or violent nature of these cultures with 80% accuracy was whether the infant was carried on the body of the mother throughout the day. These human culture studies confirmed what was learned in the primate laboratory and will be described later.

It is emphasized that the above described pathological adult behaviors consequent to social isolation rearing are not confined to monkeys but can be demonstrated in virtually every mammalian species whose newborns/infants are subjected to the effects of maternal-social deprivation.

In the 1950s and 1960s, voluminous research on the effects of social isolation upon brain-behavioral development were conducted on rodents which documented neurostructural and neurochemical alterations of the brain consequent to both impoverished and enriched environments (Krech, Rosenzweig and Bennett, 1960; Rosenzweig, et. al, 1968). In addition to this research group at Berkeley, many other investigators were studying the effects of sensory deprivation upon brain development and behavior, e.g. Valzelli, 1967; Welch and Welch, 1969; Essman, 1971; De Feudis and Marks, 1973; Eichleman and Thoa, 1973; and many others. More recent studies will be cited later.

Drs. David H. Hubel and Tosten N. Wiesel at Harvard University won a Nobel Prize in 1981 for their studies on the effects of visual sensory deprivation upon brain development and visual perception in kittens and cats. Dr. Austin Riesen at various universities studied the effects of sensory deprivation upon brain-behavioral development in primates and kittens. One of Riesen's (1964) studies provided additional data in kittens that emotional disturbances result from somatosensory

deprivation and not from visual deprivation in his studies on the effects of isolation rearing in cats. His observations merit repeating:

"Multisensory deprivation has a much more pronounced effect on the motivational systems of our animals than has the restriction of vision alone. It was not difficult to keep our animals healthy and emotionally capable of learning new behavior if we made sure that they were not deprived in more than the visual sensory area. They were socially dependent upon litter mates and later upon cage mates and human contacts, as mediated tactually and through hearing. A number of animals with which our precautions were insufficient, including both cats and monkeys, were permitted a greater degree of isolation and monotony. These animals proved to be untestable. They were typically either withdrawn or hyperactive to the point of uncontrollability when brought into a complex environment. These observations are not surprising when viewed in relation to the work of the Harlows." (p.297).

Melzack and his associates at McGill University reared puppies in social isolation and reported many of the similar symptoms found in isolation reared primates: hyperactivity, hyperreactivity, whirling behavior, self-mutilation, impaired pain perception and neurohyperexcitability of brain electrophysiological activity (Melzack and Thompson, 1956; Melzack and Scott, 1957; Melzack and Burns, 1965). Many other studies could be cited and much of this ancient literature has been the subject of a rediscovery, as the recent White House Conferences on children and brain development have brought new attention to how the environment affects brain development, intelligence and emotional-social behaviors, although, these latter behaviors have been given little attention in the White House Conferences of 1997, as a case was being made to promote day care (group infant/child care) whose advocates claim provides a richer environment for brain development than the intimate mother-infant interaction associated with breastfeeding and nurturance that takes place in the home environment but cannot take place in day care environments. Dr. Peter S. Cook, an Australian child psychiatrist, has summarized the damaging effects of institutionalized day care in his 1996 book: *Early Child Care: Infants and Nations At Risk*.

Dr. Cook's review reminds us of the 1951 World Health Organization's Report: *Maternal Care and Mental Health*, authored by John Bowlby and in the popular published version of that report: *Child Care and The Growth Of Love*" (1953), Bowlby states:

"Among the most significant developments of psychiatry during the past quarter of a century (written in 1951) has been the steady growth of evidence that the quality of the parental care which a child receives in his earliest years is of vital importance for his future mental health." (p.11)....

"Deprived children, whether in their homes or out of them, are the source of social infection as real and serious as are carriers of diphtheria and typhoid. And, just as preventive measures have reduced these diseases to negligible proportions, so can determined actions greatly reduce the number of deprived

children in our midst and the growth of adults liable to produce more of them."

"Yet, so far, no country has tackled this problem seriously." (p. 181)....

"The second factor still at work is a lack of conviction on the part of governments, social agencies, and the public that mother-love in infancy and childhood is as important for mental health as are vitamins and proteins for physical health" (p. 182).....

"One must be beware of a vested interest in the institutional care of children!" (p. 182, emphasis added).

"Let it be hoped, then, that all over the world men and women in public life will recognize the relation of mental health to maternal care, and will seize their opportunities for promoting courageous and far-reaching reforms." (p.182). The basic principles surrounding the controversies on institutionalized day care of children are the same for the many animal studies on the effects of mother-infant separations and deprivations and for any proposal as to how to most effectively rear animals for the most healthiest outcomes given the absence of mother and the natural habitat which typically supports intimate mother-infant bonding and nurturance."

These issues have been addressed in recent popular science articles that have addressed the role of the environment in shaping brain-behavioral development. In *'Babies, Bonds, and Brains'* (Discover, October 1997) by Karen Wright, she describes the current research on the adverse consequences of mother-infant separations in monkeys by Dr. Stephen Suomi at the National Institute of Child Health and Human Development:

"Stephen Suomi's simian charges are another example of how behavior can be warped by bonding with a maladroit mom. The timid peer-reared monkeys at the NIH center are the victims of insecure attachment; their peers didn't provide the stability and sensitivity that make for a secure bond. (Imagine what a wreck you'd be if you were raised by a twin sister). These monkeys are anxious and inhibited, and their temperaments are reflected in their reluctance to explore strange objects, their shyness with unfamiliar peers, their low status in monkey communities, and their distress on being separated from their companions. Some peer-reared monkeys, mostly males, also have self-destructive tendencies toward impulsive behavior and aggression. They're the playground bullies, and they're often shunned by, or even kicked out of, their play groups."

The above data clearly indicate that 'peer-rearing' alone of animals results in dysfunctional emotional-social-sexual behaviors that would not facilitate a breeding program for species survival. These issues will be returned to later.

Additional adverse consequences in mother-deprived or peer-reared animals is increased vulnerability to alcohol consumption and decreased brain serotonin which has been reported by Dr. J.D. Higley of the National Institute of Alcohol Abuse and Alcoholism and other research associates (Higley, Suomi, and Linnoila, 1990; Higley, Hasert, Suomi and Linnoila, 1991).

These findings replicate the reduced brain serotonin and other brain disorders found in mother deprived reared monkeys in NICHD supported research initiated in the late 1960s and 1970s by this writer when he was Health Scientist Administrator, Developmental Behavioral Biology Program, NICHD(1966-1980), as causative factors in the development of depression, impulse dyscontrol, alcohol/drug abuse and addiction; sexual dysfunctioning and pathological violence.

In the January 1998 edition of Scientific American, Kristin Leutwyler summarized in her article: *"Don't Stress"* some of the research reported at the Society of Neurosciences's annual meeting in October 1997 on the effects of early environments on brain-behavioral development. Her essay is reproduced below:

"Most people do not share Chicken Little's fear of falling skies. Stress is, after all, largely subjective. Nevertheless, it does prompt a series of marked physiological changes: The adrenal gland cranks out steroids that mobilize sugars and fat reserves. Additional hormones curb growth, reproduction and other nonessential activities to conserve energy. And the brain produces more epinephrine to ready the heart and other muscles for action."

"In the face of danger, this short-lived reaction helps you survive. If the stress response is regularly tripped for the wrong reasons, however, it has the opposite effect. Indeed, researchers have known for some time that chronic stress often leads directly to certain illnesses, including heart disease, hypertension, depression, immune suppression and diabetes. Recently they have discovered that stress also causes developmental abnormalities, unhealthy weight gain and neurodegeneration. Fortunately, some of these new insights suggest better means for combating excess stress. "

"An individual's susceptibility to undue stress seems to reflect, in part, early life experiences. Michael Meaney and his colleagues at the Douglas Hospital Research Center in Montreal examined levels of corticotropin-releasing hormone (CRH)--the master hormone choreographing the stress response--in baby rats. They found that when mother rats lick their offspring often, the pups produce less CRH. "The amount of maternal licking during the first 10 days of life is highly correlated with the production of CRH in the hypothalamus of the brain of the adult offspring," Meaney says."

"In addition, Meaney discovered that, compared with isolated infants, licked rats develop more glucocorticoid receptors in the hippocampus. These receptors, when activated, inhibit the

production of CRH in the hypothalamus and thus dampen the stress response. Licked rats also produce more receptors for the CRH-inhibiting neurotransmitter GABA in both the amygdala and locus coeruleus, brain regions associated with fear. "When the rat is raised in calm environments, regions of the brain that inhibit CRH are enhanced," Meaney summarizes. "But bad environments enhance areas that activate CRH production. So over the long term, these systems are biased to produce more or less base amounts of CRH." In effect, early experiences set the sensitivity of an individual's stress response."

"Not only do orphaned rats generate fewer glucocorticoid and GABA receptors, they actually have fewer neurons in certain brain regions as well. Mark Smith of the Du Pont Merck Research Labs and researchers at the National Institute of Mental Health looked at patterns of programmed cell death--a normal pruning process--during development. They found that in orphaned pups, twice as many cells died in several brain areas, particularly in the hippocampus, a central structure in learning and memory. Smith suggests that a lack of tactile stimulation might bring about this cell death much the way that insufficient visual stimulation causes abnormal organization of the visual cortex in infants."

"Mary Carlson of Harvard Medical School observed behavioral problems in socially isolated chimpanzees and suspected that the autistic-like symptoms stemmed from a lack of tactile stimulation. So she and her co-workers chose to study the adrenal stress steroid, a glucocorticoid (GC) called cortisol, in Romanian orphans, who often display similar behaviors. Half of the children Carlson studied had participated in a social and educational enrichment program, and half had not. Compared with family-reared children, all showed retarded physical and mental growth. But the enriched children had more normal levels of cortisol during the day and under stress than the most deprived children did. Those with the most irregular cortisol fluctuations suffered the most extreme behavioral and learning problems."

"Over time, elevated levels of GCs cause other serious disorders. Studies done by Mary F. Dallman of the University of California at San Francisco indicate that persistently high levels of GCs interact with insulin to increase food intake and redistribute energy stores in the body. "The results may be very clinically relevant because sustained responsiveness of the stress program to new stimuli may be a root cause for abnormal cardiovascular events in highly stressed individuals," Dallman says. "In addition, the redistribution of energy stores from muscle to fat, particularly abdominal fat, may have a role in the development of abdominal obesity, which is strongly associated with increased incidence of adult-onset diabetes, coronary artery disease and stroke."

"Robert M. Sapolsky of Stanford University has found that total lifetime exposure to GCs best determines the rate of neuron loss in the hippocampus and cognitive impairment during aging. Sapolsky reports that not only do chronically high GC levels kill off hippocampal neurons, they leave many others vulnerable to

damage from epilepsy, hypoglycemia, cardiac arrest and proteins implicated in Alzheimer's disease and AIDS-related dementia. "Metaphorically, GCs make a neuron a bit light-headed," Sapolsky explains, "and if that happens to correspond with the worst day of that neuron's life, the cell is much more likely to succumb to the stroke or seizure."

"Sapolsky and his co-workers are developing gene therapies to protect stress-weary neurons. But a simpler solution may come from work outside the laboratory. For 18 years Sapolsky has studied a population of wild baboons in the Serengeti. In stable hierarchies, subordinate animals have higher levels of GCs--as well as less "good" cholesterol and less robust immune and reproductive systems. The lowest levels of GCs occur in males with the strongest social networks. "These more socially savvy or socially affiliating personality styles appear to be lifelong and to predict more successful lifelong rank histories, life span and old age," Sapolsky adds. "The worst thing for an animal is to remain isolated." (emphasis added).

Suomi (1997) has reviewed a number of studies from the NICHD Laboratory of Comparative Ethology which has also established that mother deprivation or peer-reared infants consistently exhibit more severe behavioral and greater adrenocortical and noradrenergic reactions to social separation than do their mother-reared cohorts. Such differences in separation reactions persist from infancy to adolescence, if not beyond. Interestingly, the general nature of the separation reactions of peer-reared monkeys seems to mirror that of naturally high-reactive mother-reared subjects, both behaviorally and physiologically. Thus early peer rearing appears to have the effect of making monkeys more high-reactive than they might have been if reared by their biological mother.... and also consistently show lower CSF concentration of 5-HIAA (metabolite of brain serotonin) than their mother-reared agemates which were also associated with being at the lower end of the social dominance hierarchy (pp.176-177).

Of particular relevance to the proposed non-biological mothering of newborn large Felines (or any other mammal) is Suomi's reports on the effects of peer-rearing and cross-fostering rearing on the future maternal behaviors of such offspring:

"An additional risk that peer-reared females carry into adulthood concerns their maternal behavior. Like all other maternally deprived rhesus monkey females, peer-reared primiparous mothers are more likely to exhibit neglectful and/or abusive treatment of their first-born offspring than are their mother-reared counterparts, although their risk for inadequate maternal care is significantly less than that of maternally deprived females who also lack early peer experience and their maternal behavior toward subsequent offspring tends to improve dramatically...."

"In summary, early peer-rearing seems to make rhesus monkey youngsters not only more highly reactive but also more impulsive, and the resulting developmental trajectories not only resemble those of naturally occurring subgroups of rhesus monkeys in the wild but also continue in that vein long after the differential

peer-rearing procedures have been completed. Indeed, some effects of early peer-rearing seem likely to be passed on to the next generation via aberrant patterns of maternal care, as may also be the case for both high-reactive and impulsive females rearing offspring in natural settings." (pp.176-177)....and

"Finally, some of the cross-fostered females in the prospective longitudinal studies have since become mothers themselves, and their maternal behaviour toward their first-born offspring has been assessed. It appears that these young mothers have adapted the maternal style of their foster mothers, independent of both their own original reactivity profile and the type of maternal style displayed by their biological mother. Thus, the apparent benefits accrued by these high-reactive (by pedigree) females reared by unusually nurturant foster mothers seemingly can be transmitted to the next generation of offspring, even though the mode of cross-generational transmission is nongenetic in nature. Clearly, high-reactivity need not always be associated with adverse short- and long-term outcomes. On the contrary, following certain early attachment experiences, high-reactive monkeys appear likely to have relatively normal, if not optimal, developmental trajectories, which in turn, are apparently amenable to cross-generational transmission." (pp. 180-181).

The above findings can only give optimism for the success of foster-parenting by humans of the large Felines, provided attention is given to the specific aspects of the maternal-nurturing environment which will be crucial to the success of such foster-parenting programs. Unknown, of course, are the species differences between large Felines and primates, however, the consistent findings that environmental factors can override genetic predisposing factors lends additional optimism to the success of the proposed human foster-parenting of the large Felines. A significant problem that will need to be addressed is the composition of infant formula milk that must contain certain biochemical factors essential for the development of brain neurotransmitter substances, e.g. serotonin, dopamine, oxytocin, etc that are intimately involved in attachment, sexual and parenting behaviors.

We will now turn to some of those crucial mother-infant nurturing behaviors that are crucial to any foster-parenting program of newborn mammals, particularly, those mammals that have a more evolved vestibular-cerebellar-limbic-frontal lobe interconnective brain complex. Relevant to this inquiry are my Cross-Cultural studies on primitive or pre-industrial cultures which were undertaken to cross-validate the findings of the Mason-Berkson study on swinging-mother surrogates upon developmental outcomes of infant monkeys in human primates.

In order to evaluate the above hypothesis, the Human Relations Area Files database, as represented in R. B. Textor's (1967) *A Cross-Cultural Summary*, was consulted to identify all cultures of that 400 culture sample represented in Textor which had information on cultures which carried their infants on the body of the mother throughout the day vs. those that did not have this child rearing practice and where information was available on the peaceful or violent nature of the

culture. This double criteria of selection yielded 49 primitive cultures for evaluation where it was found that this single child-rearing practice predicted the peaceful or violent nature of these cultures with a 73% accuracy. Subsequent revisions of this data that was based upon corrections provided by cultural anthropologists resulted in a predictive accuracy of 80% of cultures, as being peaceful or violent. There were 29 peaceful cultures and 20 violent cultures in this culture sample.

The social-behavioral characteristics of those cultures with high infant physical affection are summarized in the Table below:

TABLE 1. Social and Behavioral Characteristics of Cultures That Provide High Infant Physical Affection (% Communalities of Cultures)			
% CORRECT CLASSIFICATION - SAMPLE SIZE - SOCIAL-BEHAVIORAL CHARACTERISTICS			
1.	81	27	Religious activity is low
2.	80	66	Overall infant indulgence is high
3.	78	18	Dissociation of sexes at adolescence is high
4.	76	17	Witchcraft is low or absent
5.	76	17	Belief in reincarnation absent
6.	74	65	Degree of reducing infant needs is high
7.	73	49	Torture, mutilation, and killing of enemy captured in warfare is absent/negligible
8.	72	36	Incidence of theft is low
9.	71	38	Fear of human beings is high
10.	68	65	Child anxiety over performance of responsible behavior is low
11.	68	59	Immediacy of reducing infant needs is high
12.	68*	22	Superordinate Justice is absent
13.	66*	41	Asceticism in mourning is low
14.	66*	50	Invidious display of wealth is low
15.	65	63	Child anxiety over performance of obedient behavior is low
16.	65	63	Infant physical pain is low
17.	63	63	Weaning age is 2.5 years or longer
1. All of the above relationships are statistically significant with $p < .05$ except for starred items where: $*.10 < p < .05$			
2. Derived from R.B. Textor (1967) <i>A Cross Cultural Summary</i> HRAF Press New Haven			
3. Measures of Infant Physical Affection were provided by Barry, Bacon and Child (1967)			
4. Previously published with more complete statistical data (Prescott, 1975, 1979, 1990)			

The above data provide strong support for the role of high infant physical affection, as measured by carrying the infant on the body of the mother throughout the day, as being highly and significantly linked to a profile of non-violence which is essential for normal development of infants and children and, ultimately, for species survival.

Since what is being proposed is a major social engineering experiment in rearing newborn large felines away from their mothers and to substitute human mothers for their natural mothers, it would seem helpful to be reminded of a similar social engineering experiment

involving elephants which had a disastrous consequence while at the same time achieving part of its objective--preservation of the species. This experiment was reported in TIME Magazine and is reproduced below as a reminder as to the mistakes that can be made in providing non-biological mother substitutes and adult social-structures in the rearing of newborns/infants:

TIME MAGAZINE--BEHAVIOR-- OCTOBER 13, 1997 VOL. 150 NO. 15

YOUNG, SINGLE AND OUT OF CONTROL RHINOS ARE BEING MURDERED, AND THE KILLERS ARE JUVENILE DELINQUENTS OF THE ELEPHANTINE KIND
BY MICHAEL D. LEMONICK

The trouble first surfaced about three years ago. Rangers in Pilanesberg National Park, in northwestern South Africa, began to notice that white rhinos were being killed at the rate of about one a month. Then the same phenomenon started happening at Hluhluwe-Umfolozi Park, in the southeastern section of the country. Poachers looking for precious horns are the usual suspects when rhinos turn up dead. But not this time.

These animals were left intact, horns and all. Their wounds, moreover, had been caused not by gunshots but by long, sharp objects with some mass to them. The mystery was soon solved: the rhinos had been murdered, all right, but the perpetrators were not poachers but pachyderms--young, aggressive bull elephants that did in the rhinos by knocking them over, kneeling on them and goring them.

What drives the elephants to do it is not clear. Game wardens and animal-behavior experts have a theory, however, and while they stress that it is speculative, the idea is compelling. The elephants may be depraved, the experts say, because as children they were deprived. The troublemakers are apparently all orphans, taken as calves from their slaughtered parents during culling operations in the huge Kruger National Park and relocated to establish elephant populations in parks and private reserves throughout the country.

One positive result of the operation was that it helped preserve a threatened species. But because elephants in the wild live in tight-knit groups, the relocation was also a major experiment in social engineering--and like so many such experiments, it has had unexpected consequences. Since 1978, almost 1,500 orphan calves, 600 of them males, have been moved to unfamiliar locations and raised with no exposure to adult elephants or the hierarchical social structure that defines elephant life.

The long-term effect of this isolation appears to be a generation of juvenile delinquents. "The whole thing has much to do with the setup of elephant society," says zoologist Marian Garai, a Swiss-born South African who has been studying the relocation. Under normal circumstances, she says, a dominant older male elephant is around to keep young bulls in line. For the newly arrived youngsters, however, no such role models were provided, and Garai

believes this may have had a profound effect on the elephants' psychology.

The result may be even more pronounced during the period known as "musth," a time when male elephants' testosterone levels shoot up. Elephants often become aggressive during musth, but in the wild, older bulls usually keep the young ones in line. Not only are the orphan bulls going into musth without chaperones, but their musths seem to start earlier and last longer. The condition usually begins at age 30, but at Pilanesberg some 20-year-old elephants are going into a musth that lasts not the usual few days but as long as three months.

Why do these elephants pick on the rhinos? Evidently, because they're there. At least one human was killed by a rogue bull last year, but for an elephant looking to make trouble, a small, relatively helpless rhino is an easier target. Garai has often seen a young elephant grab a stick in its trunk and throw it at a rhino--seemingly playful behavior that in an unbalanced animal could easily turn violent. "Elephants are complex and intelligent creatures," she observes. "They aren't immune to stress." She suspects that other game parks with populations of orphan elephants may soon develop similar problems.

Park rangers are prescribing a little adult supervision for the bad-boy elephants. Indeed, when two adult female circus elephants were returned to Pilanesberg in 1979, shortly after the first orphans arrived, the nervous youngsters quickly settled down. Now officials hope something like that will work on rhino-bashing bulls. Early next year, a few 40-year-old bull elephants will be moved to Pilanesberg to help calm things down. Meanwhile, authorities are trying to get to the root of the problem. Two years ago, Kruger Park stopped its elephant-culling program and began moving entire families of elephants to their new homes.

It will be some time before the effects of these efforts are known. Until then, the white rhinos of South Africa had better watch their backs. -- Reported by Peter Hawthorne/Cape Town.

The above reporting highlights a number of dangers in departing from rearing newborns/infants in artificial environments where the natural biological mother with its adult social supportive structures are absent. These lessons apply to all mammals where the species-specific mothering and social-structures of support must be taken into account in providing for the optimal rearing of newborns/infants in artificial environments, i.e. environments that depart from those provided by millions of years of evolutionary biology.

RECOMMENDATIONS:

With these precautions in mind, the following recommendations are suggested for the human rearing of large Felines where they are separated from their mothers at birth and hand-reared.

NOTES:

1. One mammalian universal is the extended body contact between the mother and her newborn which, dependent upon the species, will continue for months until the infant is able to locomote on its own when it begins to explore its environment within a safe distance from its mother. The more highly evolved the species the longer is the mother-infant continuous body contact and the greater duration of mother-infant body contact, in general. For these reasons, newborn/infant large felines should be carried in a sling, pouch or knapsack continuously on the body of the human surrogate mother including co-sleeping with it at night. Every effort should be made to have as much skin to skin contact so that the smell and taste of the surrogate mothers body (through licking behaviors of the newborn cat) are also encoded in the developing brain of the newborn cat.

2. Given the litter nature of the large feline, it is important to provide-- as much as possible-- an approximation to the normal social group experience of litter mates where it is essential that the basic sensory experience of its own species become encoded in the developing brain of the surrogate reared feline cubs. These sensory-brain templates that are species-specific may be necessary for later adult socialization with members of its own species and to optimize mating behaviors. For these reasons, human hand-rearing of newborn large felines should include at least two large feline cubs who are carried together in the same pouch with the human surrogate mother.

3. The lack of the biological mother's breastmilk is a major limiting factor for assuring normal physiological health, brain development and behavior. Every effort must be made to obtain natural biological milk from an appropriate domesticated animal that could serve as a best-substitute for large feline breastmilk. Goat milk is one possibility, which can be fortified with micro-nutrients that are specific to large feline breastmilk. This is an area that is in need of research.

4. During early development, socialization experiences with peer large felines should be a part of the human-rearing program to optimize social behaviors that are necessary for successful mating behaviors. If adult successful mating behaviors are not achieved with primary human hand-rearing, then the objectives of the program to achieve successful mating and carrying of the pregnancy to term to achieve species survival will have failed.

5. Several on-going pilot demonstration projects with different species of large felines seems well-justified given the threat of species-extinction of many of the large felines. Special attention must be given to identifying the selection criteria for the identification and selection of human mother surrogates who will be successful mother surrogates of large Felines.

6. Special consideration should be given to optimizing the development of the brain serotonin system in large feline newborn/cubs by supplementing their biological formula milk with tryptophan, a precursor amino acid essential for the development of brain serotonin. Similar considerations should be given to optimizing their brain

dopamine and oxytocin systems which are uniquely involved in pleasure bonding and social-sexually affiliative behaviors.

(Insel,1992; Carter, et. al, 1992; Murphy, et. al. 1990; Carmichael, et. al, 1994; Fazzolari-Nesci, et. al, 1992; Winslow, et. al, 1993).

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Appendix A: Cub Rearing Protocols Toward Less Dangerous Captive Felines

A call for private captive stewardship of large Felines as
supplemental support toward species survival.

John Williamson - Tiger Touch, Inc.

In the U.S. there are approximately 150 zoos accredited by the American Zoo and Aquarium Association that are the front line of defense against the further erosion and loss of many endangered or threatened species of large felines. Their survival plan is almost brutally simple; keep the genetic carriers in isolated captivity until a species management program decides the need for additional specimens. While this is better than rapid species extinction, it offers little to the welfare of the animals, very limited genetic variability, and inadequate gene pool size.

Government, having few clear guidelines, limited effectiveness, and often serious conflicts of interest with respect to conservation and species preservation in particular, has abdicated its power to literally hundreds of Non Government Organizations (NGO's) whose survival plans range from fencing off natural habitat, hiring small armies to protect the remaining wildlife, endless studies, to negotiations with governments to become signatories to various agreements purported to solve the pernicious problem of plain old poaching. The NGO's themselves range from highly rational to patently off-focus. One thing they have in common, however, is incessant pleading for money to support activities that are all but impossible to achieve or evaluate within our lifetime.

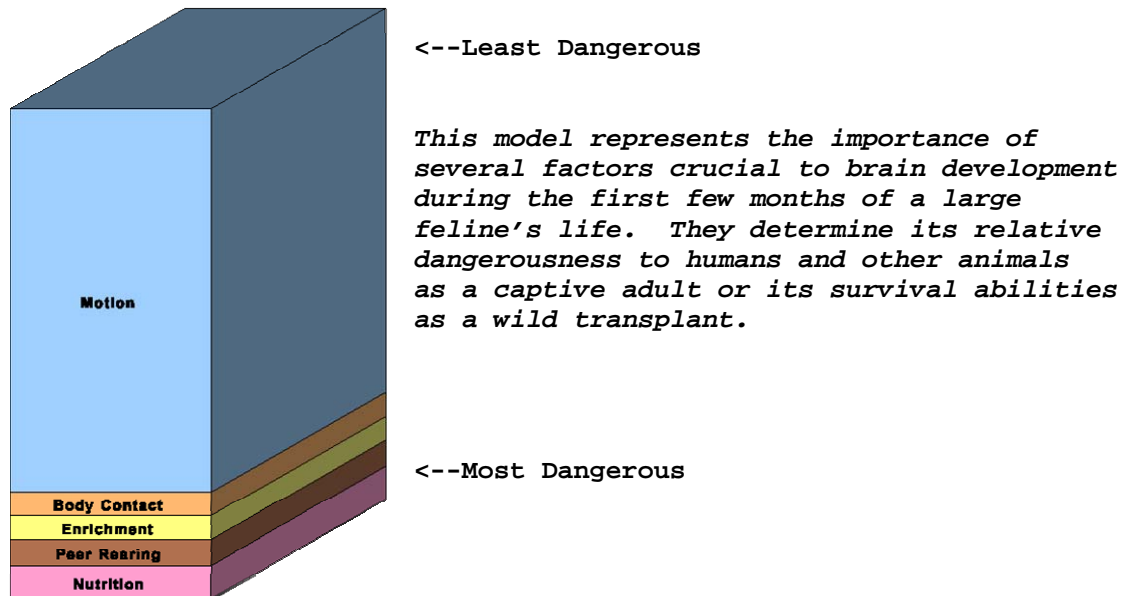
Moreover, while many species continue to decline in numbers and genetic variability, a struggle to preserve genetic purity in preservation is raging. It reflects many arguments the Nazis once raised in their regrettable drive to preserve the Aryan sub-species. The proponents of purity, aside from weak arguments, can't win for the same reasons the Nazis couldn't in their day: By the time the notion of purity occurred to them, they were many centuries too late. The forces behind "purity" run counter, not only to preserving a diminishing gene pool, but to the long range survival strategies of nature itself.

In any event, this outline does not call for changes to the politics of conservation / preservation. It does not seek to alter the distribution of hard-to-come-by moneys. It does not need to address the issue of species purity, nor any other aspect of present day strategies -- they all have their place. It's main thrust is only to provide insurance acceptable to all; a much larger backup pool of endangered large Felines with greater genetic variability than seems likely with present strategies alone. And last but not least, better lifestyles for many big cats than zoo or display captivity can offer.

Dr. James W. Prescott's data and wide ranging research outlined in his paper, *Large Feline Survival, Gene Pool Diversity And The Human Touch: The Role Of Private Captive Stewardship In Species Survival*, leads to a universal working model of animal behavior which clearly illuminates the genesis, variability, and the great amount of confusion with respect to violent aggression. The following illustration depicts the variables which largely determine the dangerousness of a mammal. These same variables are also crucial to the reproductive and parenting

behaviors of captive animals as well as animals to be returned to the wild. Only the ratios are different.

The purpose here is to convert the many aspects of Dr. Prescott's research to a practical model; one that provides an efficient cub rearing method to significantly reduce the danger of violent aggression by large adult felines. This method relies on enhancing overall brain development and optimizing those neural pathways which, in effect, dampen reactive aggressive behavior at the brainstem level. It is completely natural and does not rely on drugs of any kind. It does not replace conventional "no, no" training for interactions with humans, but greatly raises the threshold beyond which dangerous aggression can be triggered.



NUTRITION

In the broadest sense, nutrition underpins developing life and a developing brain in particular. As the term is used here, nutrition means quite a bit more than the short list of vitamins, minerals, proteins, fats and carbohydrates commonly held necessary for a healthy offspring. It also includes fatty acids, trace minerals, and certain pre-cursor peptides necessary to the thousands of different enzyme reactions crucial to the body's correct synthesis of neurochemicals, hormones, and specialized cells such as those of the immune system.

Though the precise role of many of the trace minerals has yet to be defined, research is slowly resolving their metabolic functions. There is an emerging belief among many scientists of their importance, and that their absence results in cellular dysfunction of many kinds.

Nutrition as a variable in this model also includes the nutrition available to the mother. Since brain development begins in the unborn fetus, the brain's initial development is dependent on the mother's systemic health and store of trace minerals and enzymes related to

neuronal growth and the complex neurochemicals involved in brain structure and activity. A point is made, that without a brain, there is no behavior, and that a dysfunctional brain results in dysfunctional behavior. Nor would it stretch the point to suggest that a well functioning brain is likely to support more functional behavior.

Good nutrition also includes the many phytochemicals found to combat free radical cell damage, tumor formation, and viral replication. These phytochemicals also act to neutralize a vast number of man made toxins impacting the environment and, by default, the food chain which serves us all.

PEER REARING

Peer rearing as reflected in the model simply means that feline offspring should be reared in an interactive peer environment. Important feedback is provided to shape the brain's early perceptions of "self" and "other" in play, reproductive behavior, and self control under stress.

BODY CONTACT

Body contact plays an important role in brain development because it not only promotes feelings of security and pleasure in intimate contact but serves to desensitize areas of the old brain, reducing impulse reactions as an adult. If a newborn is deprived of body contact, mere proximity to a person or other animal, when an adult, can trigger a violent attack. Body contact serves to imprint the developing brain with the smell and taste of humans and other animals in a positive context.

ENRICHMENT

The enrichment variable in this model means substantial, repetitive exposure to the sights, sounds, touch, and odors of the dominant human environment within a pleasurable context. Enrichment means positive interaction with others, human and animal alike, thus shaping the young animal's developing brain to recognize and seek out rather than fear the countless stimuli it may encounter as an adult. Enrichment of this nature stimulates increased dendritic growth within the brain, resulting in improved control of impulsive behavior by higher brain centers.

MOTION

As indicated by the research data, substantial rhythmic motion of the young animal is clearly the singular most important variable contributing to functional, well integrated brain development. Its action upon the vestibular system stimulates neural pathway development between higher and lower brain areas, greatly diminishing reactive aggressive behavior, and improving higher order control of the limbic responses to environmental stimuli of all kinds.

THE MODEL AND A REAL WORLD

The following "rules" are realistic and for the most part, intuitive. The motion requirements may seem a bit strange but they are the singular key to optimum brain development for a captive cat intended as a "safe" companion. These "rules" should NOT be used for cats which will not have consistent human interaction and affection in their lives, such as those intended for display or release to the wild .

1. To provide the best foundation for optimum brain development in captive felines, the mother should be placed on a course of supplements providing enhanced nutrition before breeding.

2. The cub should be taken from the mother between seven and ten days after birth and placed in the care of a surrogate human mother for approximately three months. The surrogate mother should, ideally, be the permanent owner or care giver.

3. During that period, the transition to solid food should be made. However, in the interest of maximum bonding to the permanent owner or care giver, It is highly appropriate to hand feed the cat throughout its life thereafter. It is also appropriate to continue bottle feeding, as a treat only, for one to two years or even longer if the cat desires it. In all cases, "super food" supplements should be introduced in the bottle formulae and continued throughout the cat's life for its best health.

4. Starting from the time the cub is taken from its mother, it should sleep in contact with the surrogate mother as much as it desires. It should be fed upon demand during this time.

5. Essentially, the cub should be with the surrogate mother virtually all the time. During routine activities, the cub, or cubs, should ride in, preferably, a tummy pack. As the cub grows, however, it will be easier to carry it in a backpack, papoose style. This is the crucial factor to the cub's development. All in all, the cub should receive several hours a day of the random motions made by its surrogate mother in the course of working, walking, etc. An old fashioned rocking chair is an excellent investment that will be appreciated by all parties.

6. From about the third week, the cub, in its body pack, should be exposed to all the sights, sounds, odors, and complexity of the human environment. Later, in its adult life, there should be no surprises. It should also be exposed to a variety of people and animals, either from its body pack or a secure carry case. It should NEVER be teased or otherwise dominated, especially by children. One should also remember that many human respiratory diseases can be transmitted to cats, so exposure should be avoided. They can be extremely stressful. Some can even be lethal to a young cub.

7. If it's not possible to rear the cub with a litter mate or another cub of similar age and weight, it should be raised with another animal such as a dog which can buffer its immense energy in play.

8. The generic rules for young cat affection training in the areas of jumping, biting and appropriate "trick" performance should be followed. There are some excellent books available which, along with professional nutrition guidance and health care, should be part of any cat owner's library.