Appendices for Chimpanzee Spirituality: A Concise Synthesis of the Literature

Table 1: Chimpanzee Basic Spiritual Practices
Birth, Mortuary, Consortship, Reverence for Life/Nature

Site/Incident	Observer Interpretation	Comment
Yerkes Regional Primate Research Center. Unexpectedly, the entire 200 chimp colony gathered in silence around Mai, the mother-to-be. Several chimps carefully poked a finger at Mai's behind and then sniffed their finger. Mai stood half upright, with her legs slightly apart, holding one hand between her legs. "Remarkably, an attentive older female mimicked Mai by cupping her hand between her own legs in exactly the same fashion." After about ten minutes Mai delivered her baby catching it in both her hands. "The crowd stirred and Mai's best friend," an elder female named Atlanta, in reaction to the birth "emerged with a scream, looking around and embracing a couple of chimpanzees next to her, one of whom uttered a shrill bark." Mai then cleaned the baby and consumed the afterbirth. Atlanta spent the next several weeks closely attending the mother and her offspring. Our chimpanzees "seemed as much taken with the process as with the outcome. It is entirely possible that the emotional reaction of Atlanta…reflected empathy, that is, identification with and understanding of what was happening to her friend. Needless to say, empathy and sympathy are pillars of human morality" (de Waal 1996: 19-20). *Georgia State Univ. Language Research Center.* When Panbanisha gave birth Sue Savage-Rumbaugh exclaimed "'it's your baby' whereupon she smiled broadly, pushed downward" and delivered the baby. After suctioning, she gave the baby back to mother exclaiming 'Panbanisha, this is YOUR baby'. She gasped, took it, pressed it to her ventrum and rushed to her nest with it.	Empathy de Waal 1996 Birth behavior Savage-Rumbaugh 1998	Birth practice: gathering in silence, screaming and embracing, elation, welcoming and cleansing response of midwives and relatives of the newborn

Gombe. At death of adult male Rix from fall from a tree, group members showed intense excitement, called, paused to stare at his corpse, then performed charging displays away from the corpse, and threw rocks in all directions, while other chimps embraced, touched and mounted one another. Later, some "spent considerable time staring at the body. One male leaned down from a limb, watched the corpse, then whimpered. Others touched or sniffed Rix's remains. An adolescent female uninterruptedly gazed at the body *for more than an hour*, during which she sat motionless and in complete silence. After three hours of activity around the corpse, one of the older males finally left the clearing, walking downstream along the valley bottom. Others followed one by one, glancing over their shoulder toward Rix as they departed. One male approached the remains, leaned over for a final inspection, then hurried after the others" (de Waal 1996:56; Goodall 1986:330).	Death behavior Telecki 1973 cited in Goodall 1986 and de Waal 1996	<u>Dearth practice</u>: announcement, social excitement; group silence; visitation; lamentation; vigil; male charging display; back-glance departure
Arnhem Zoo. a) Female chimpanzees commonly wail, whimper and sometimes burst out screaming after loss of an offspring, e.g., Gorilla, who rubbed her eyes though tears could not be determined. b) When a young adult female, Oortje suddenly died, Gorilla uttered a non-threatening scream; a female in the other hall, made a similar sounding scream and "then every chimpanzee in the building went completely silent." c) An adult male, Luit, died in a fight. While his body remained in the cage that evening the rest of the colony maintained "absolute silence", even at feeding time the following morning. Vocal activity resumed when the corpse was carried out of the building (de Waal 1996:55-56; 1989:66).	Death behavior de Waal 1989 de Waal 1996	<u>Death practice</u>: announcement, group silence, lamentation
Taï Forest, Ivory Coast. Tina, a 10-year-old female bonobo died after being ambushed by a leopard. Several bonobos gathered quickly around the corpse, making loud calls. After a brief period 12 adults sat in silence around the body, with some males occasionally showing aggression, making ostentatious 'displays' nearby and dragging the corpse around for short distances. High-ranking females inspected the body, seemingly allowed to do so by high-ranking males who were guarding the corpse, and who chased off individuals of lesser rank. Some 30 minutes after Tina died, two high-ranking males began to groom the corpse – an action that lasted for well over an hour, while lower-ranking adults and infants were at the same time intensively inspecting the spot at which she was killed. Occasionally, the individuals guarding the body would make 'play' faces and laugh,	Death behavior Boesch and Boesch cited Pettitt 2002	<u>Death practice</u>: announcement (loud calls), group silence; (male aggression display); high rank female viewing of corpse with high rank males guarding corpse; male grooming of corpse

probably to ease tension or confusion. "It is very easy to conclude from this fascinating episode that reverent care for the dead body may have taken place amongst the very earliest hominids, alongside a range of tension-relieving activities and rituals in which social rank governed access to the corpse. An event that prompts mourning and worry. Primates must also recognize that the dead individual, formerly part of the social group, has changed in a sudden and irreversible fashion – and has gone. This must inevitably cause confusion and perhaps sorrow" (Pettitt 2002).		
Mahale. "At 11:00 the mid-morning calm was suddenly broken by a loud outburst of alarm calls. 'Wrra, wrra!!' This unmistakable call is rarely heard except on occasions of great fear or alarm, for instance, after hearing the deep raspy growl of a leopard prowling nearby in the forest. Half afraid ourselves of what lay head, we ran towards the commotion. The entire group was up in the trees peering down into the dense bush at something on the ground. . . . Several chimpanzees cautiously, almost reluctantly, approached for a look. A few individuals such as the adult male Fanana and the adult females Tootsie, Calliope and Nkombo spent several minutes each looking down at the body from the safety of the trees. The two young adults, Fanana and Linda, made day nests in the trees within three meters above the body. These two and later Cadmus, the five year old son of Calliope, softly vocalized, 'hoo, hoo', at the body. They were concerned and seemed almost mournful. Fanana would not stare directly at the body for long periods of time, but preferred to turn his back and lay there quietly, glancing back on occasion. Others were more fearful and tried to steal a glance from a distance (Engel 2002a: 200).	Death behavior Huffman (personal communication) cited in Engel (2002a)	<u>Death practice</u>: announcement, group silence; viewing; lamentation; sympathy

Gombe. Mating patterns include (a) estrous promiscuity involving direct male courtship displays with erect penis, relative female choice, and rump presentation; (b) monopolization of sexual rights by higher ranking male; (c) and exclusive consortship away from main group for up to three months, during estrous and anoestrous phases of roughly 36 day cycle (Goodall 1986: 450-451). A male initiates consortship using signals of courtship: penile erection, gaze toward, hair erection, branch shaking, rocking, and arm stretching, and if the female responds with approach, "he gets up and moves away, looking back over his shoulder to make sure she follows. If she does not, he stops and repeats his summons." If she still is reluctant the male may become violently punitive or wait with more patience. She may refuse the solicitation by calling out to other males or, if attacked, by screams. If in a multi-male sexual party, the male may stay close to the female and groom her frequently before courtship signaling. Once initiated the relationship is typically relaxed and tolerant. The female terminated the exclusive relationship by calls for arrival of other males or "stole away" unseen (457-465).	Consortship Goodall 1986	Incipient 'romantic love' practice
With respect to bonobo society, an important characteristic is strong female bonding, facilitated by genito-genital rubbing, and the non-reproductive functions of sex, including solicitation of food sharing and soothing of male-male and other interpersonal tensions.	Non-Reproductive Sexuality de Waal 2001; de Waal & Lanting 1997	Incipient 'romantic love' practice

Gombe. At the onset of thunderstorms or sudden wind gusts chimpanzee males' hair bristles; they perform spectacular aggression displays, charging, swaying back and forth, breaking off and brandishing branches. Such displays are performed more often toward the beginning of the rainy season. Incidents range from single individual solitary events to a single individual participant within a social group, to multiple participant events. Dominance plays a secondary role (if any) in most of these displays. Sometimes even females participate (Wallauer 2002). "Often I am asked whether I think the chimpanzees have any kind of religion…Are they defying the elements? Awed and excited by the pounding of the rain on the canopy, the jagged flashes of lightning, the crashing of thunder? We do not know what emotion underlies this behavior." "If they had spoken language, the chimpanzees could discuss the feeling that prompted these displays. Is it something like awe? If the	Rain dance, like waterfall display may be a kind of reverence for nature and its mysteries Goodall 1986 Goodall 2001 Wallauer 2002 Whiten *et al* 1999	Reverence for life/nature

chimpanzee could share his feelings and questions with the others, might these wild elemental displays become ritualized into some form of animistic religion? Would they worship the falls, the deluge from the sky, the thunder and lightning -- the gods of the elements? So all-powerful; so incomprehensible" (Goodall 2001). *Multiple sites*. Rain dance is habitual at Tai Forest and Budongo and customary at Gombe, Mahale-M, Mahale-K and Kibale (Whiten et al 1999).		
Gombe. Males and sometimes females, such as the aggressive Gigi, display at, play in and gaze for extended periods of time at waterfalls and streambeds (Wallauer 2002, Goodall 2001, Goodall 1986:67). At a magnificent waterfall where a small, fast-flowing streams plunges some 80 feet down a sheer rock face, creating its own wind as the water is forced through a narrow fissure, sometimes the chimpanzees, hair bristling, perform their displays in the streambed below the falls, swaying rhythmically upright, hurling rocks, climbing the slender hanging vines, and pushing out into the spray. "Afterwards a male may sit on a rock at the edge of the streams, looking up at the sheet of living water as it falls, watching as it flows past him on its way to the lake. What is he thinking? What is this thing that is always coming from above, always going away, yet always there? Is it alive?" (Goodall 2001). Wallauer "recorded on video a waterfall display performed by the alpha at the time, Freud. Freud began his display with typical rhythmic and deliberate swaying and swinging on vines. For minutes he swung over and across the eight to 12-foot falls. At one point, Freud stood at the top of the falls dipping has hand into the stream and rolling rocks one at a time down the face of the waterfall. Finally, he displayed (slowly, on vines) down the falls and settled on a rock about 30 feet downstream. He relaxed, then turned to the falls and stared at it for many minutes…Dr. Goodall and I have seen several events in which the participants seemed to ponder or consider the natural event to which they were reacting" (Wallauer 2002).	Waterfall display and water fall and stream gazing, may be a kind of reverence for nature and its mysteries Goodall 1986 Goodall 2001 Wallauer 2002	<u>Reverence for life/nature</u>
Gombe. Chimpanzees have been observed enjoying the peaceful contentment of evening and beauty of a sunset over a lake, playing gently with young ones, laughing and at last sharing spontaneous pant-hoots before turning in to sleep. These calls have a "melodious, 'almost singing' quality…[in which] the callers do not appear to be motivated by the same need for information [as in the inquiring pant-hoot]" (Goodall 1986:594, 135). Goodall interprets it as an "intimate moment" implying awareness and even self-awareness of the serenity and beauty of	An intimate moment, awareness and self-awareness of natural beauty Goodall 1986	<u>Reverence for life/nature</u>

the evening.		
Eastern Congo. In the wild chimpanzees "were unceasingly alert and curious. They seized every opportunity to bring variety into their lives…Once I saw a chimpanzee gaze at a particularly beautiful sunset for a full 15 minutes, watching the changing colors until it became so dark that he had t o retire to the forest without stopping to pick a pawpaw for his evening meal" (Kortlandt 1962:132).	Fascination and curiosity for new and unusual; natural beauty Kortlandt 1962	Reverence for life/nature
Gombe. Chimpanzees show respect and intense curiosity to snakes, particularly pythons, which are not dangerous to adults. They utter a 'snake wraa' call to gather the group around. They stare at the snake. Typical facial expressions are those of fear and curiosity. Physical reassurance contact is often made (especially mutual embracing), and eye contact among individuals is frequent. After tens of minutes, members finally begin to disperse. Some individuals however, (Skosha and Apollo, for instance) show exaggerated and prolonged interest. Both call time and again even after the other individuals have moved well away. I have seen both stay and stare and call for as long as 30 minutes. "I honestly do believe that chimps have the capacity to contemplate and consider (even revere) both the animate and inanimate."	Respect and curiosity toward nature's wildlife, perhaps reverence Wallauer 2002	Reverence for life/nature
Georgia State Univ. Language Research Center. Bonobos in Pan/Homo community are concerned about the happiness and well-being of their favorite animals in the forest, Deer, Turtle and Snake. They like to visit and feed Turtle (William Field 2000, personal communication).	Empathy toward other wild creatures William Field 2000	Reverence for life/nature
Bossou, Guinea. Wild chimpanzees were observed capturing and playing with hyraxes. An adolescent female carried one for 15 hrs, slept with it and groomed it.* *Georgia State Univ. Language Research Center.* Dogs establish bonds with different bonobos and behave protectively toward bonobos by moving ahead in the forest and keeping watch for snakes, foxes, bears and panthers and wild dogs that occasionally are seen there (Savage-Rumbaugh et al 2005).	Empathy toward other wild creatures Hirata et al 2001	Reverence for life/nature
*At The Gorilla Foundation the sign-trained gorilla Koko has had three pet cats; the third she named Smokey (Patterson and Cohn 1999).		

Table 2. Chimpanzee Life-Instinct Practices Exocannibalism and Endocannibalism; Mass Murder; Care for the Marginalized; Reproductive Choice and Healthy Pregnancy; Medical/ Healing; Psychoactive Substance Use		
Site/Incident	**Observer Interpretation**	**Comment**
Gombe. 6 infant chimpanzees killed and/or eaten, 3 consequent adult male attacks on stranger females with infants, and 3 infants of local females by female Passion.*	Cannibalism Goodall 1986	Two categories of infanticidal cannibalism, 'exocannibalism' and 'endocannibalism'
Mahale. 2 male newborn chimps killed and eaten, probably by adult male; 1 1.5-year-old male eaten by local adult males; 1 3-year-old male eaten by adult males of neighboring community. "Cases reported from Mahale, Tanzania, are of special interest because adult males kill and eat those infants that not only belong to the same community but are likely to be their own offspring" (Turner 1992:151). On October 3, 1989, a case of within-group infanticide among Mahale chimpanzees was observed" (Nishida, 1992:152).	Cannibalism Nishida *et al* 1979 Kawanaka and Seifu 1979 Kawanaka 1981 Norikoshi 1982 Takahata 1985 cited in Goodall 1986	Infanticidal 'exocannibalism' and 'endocannibalism' (?)
Budongo Forest, Uganda. 1 newborn chimp eaten by adult males, killer not seen	Cannibalism Suzuki 1971 cited in Goodall 1986	Infanticidal cannibalism, subtype unknown
Gombe. While chimpanzees are aggressively territorial even raiding the core areas of neighboring groups, the worst violence observed occurred in the case of the Kahama community, which split off from the larger Kasakela community, survived for five years under repeated violent aggressive episodes until it was completely exterminated and its territory annexed (Goodall 1986:503-522)	Territorial aggression, verging on warfare Goodall 1986	Mass murder
Gombe. Chimpanzees show empathy and take special care of relations (own family) who are injured, sick, or fatally ill; grooming, feeding, and protecting them and waiting for them to catch up on walks or assisting them to walk. *Mahale.* Chimpanzees show empathy and respect for the elderly. Wanaguma, a female in her fifties led a privileged and protected life under the watchful eye of her son. Older males receive fewer male aggression threats, and younger, stronger males tolerate their threats without retaliation. Elderly chimpanzees are honored with more grooming than they give and are allowed access to meat while others are rebuffed.	Love and compassion Goodall 1986 Huffman and others cited Engel 2002a	Compassion for the suffering of the marginalized (the disabled)

Gombe. Chimpanzee females and also males adopt orphans whose mothers have died. Goodall observed 13 orphans; 7 adopted by female sibs or unrelated females, 2 by male sibs, 2 not adopted died within weeks, and 2 aged 7-8 years adopted infant sibs.	Love and compassion Goodall 1986	Compassion for the suffering of the marginalized (the orphan)
Multiple sites. Females of several primate species are known to regulate the timing of pregnancy through ingestion of phytoestrogens and other hormones affecting plant chemicals.** Female chimpanzees sometimes consume plants that local people use to abort fetuses (*Combretum* and *Ziziphus* leaves), although it is not known whether they were pregnant before or after consumption of these plants.	Family planning Garey 1997 Engel 2002a	Reproductive choice, conscious and healthy pregnancy
Female chimpanzees in the wild go off their food during early pregnancy and they eat small amounts of acacias, hibiscus, smilax, *Alcornea cordifolia* and *Celtis africana*, all used by local people to treat morning sickness and other stomach upsets.	Healthy pregnancy Garey cited Engel 2002a	Reproductive choice, conscious and healthy pregnancy
Multiple sites. Among related chimpanzees care of the sick is common. Köhler's chimpanzees zealously squeezed pus from wounds and removed splinters, and Yerkes and Fouts have described similar behavior. Miles observed an adult male remove a speck of grit from his companion's eye in response to her whimpering and solicitation. Little Bee took food to her ailing mother (Goodall 1986:385-86). Chimpanzee mothers groom and express sympathy to alleviate stress of injured or sick offspring, whether children or adult (Goodall 1986:401-02). Lucy tended to Jane Temerlin when she was sick, putting her arm around her to comfort her, grooming her, kissing her, bringing and sharing food with her or sitting on the edge of her bed attempting to comfort by stroking and grooming her (Temerlin 1975 cited de Waal 1996:57).	Care of the sick. Köhler 1925, Yerkes 1943, Fouts 1983, Miles 1963 cited Goodall 1986 Goodall 1986 Temerlin 1975 cited de Waal 1996	Medical/healing practice
Multiple sites. Chimpanzees lick their own wounds and those of other group members after a fight or accident, as do other primates; and because of the antiviral and antibacterial properties of saliva wounds may heal quickly and leave virtually no scar. Boesch takes wound cleaning to be a sign that his apes "are aware of the needs of the wounded" and demonstrate "empathy for the pain resulting from such wounds" (Boesch cited de Waal 1996:58).	Healing wounds Boesch 1992 cited de Waal 1996	Medical/healing practice

Gombe. Chimpanzees often dab at bleeding wounds with leaves, which they then lick; they may repeat the process many times (Goodall 1986:547).***	Healing wounds Goodall 1986	Medical/healing practice
Gombe. A female chimp practiced rudimentary dentistry, cleaning teeth of a young male and pulling out a rotten, loose deciduous molar with a simple wooden lever she made herself; chimps also use toothpicks and pull out their own rotten teeth.	Dentistry McGrew and Tutin 1973; Goodall 1986	Medical/healing practice
Multiple sites. Chimpanzees swallow leaves of *Aspilia* and 18 other species of plants, sometimes carefully folded, as mechanical scours to expel intestinal worms (Huffman 1997; Huffman et al 1996; Wrangham 1995; Messer and Wrangham 1995; Newton and Nishida 1990; Wrangham and Goodall 1989; Rodriguez *et al* 1985). Leaf swallowing has now been seen in at least eleven different populations of chimpanzees, as well as in eastern lowland gorillas, in at least ten different sites across Africa. The great apes swallow a variety of leaves from 34 species of herbs, trees, vines, shrubs; some of the leaves contain bioactive antibiotic, anti-fungal and anti-parasitic chemicals; others do not, but all are rough in surface texture with hook-like microstructures called trichomes (Huffman 2001). In addition to hooking loose worms, the rough leaves stimulate diarrhea and increases gut motility, which also help shed worms and possibly their toxins from the body. Furthermore, when adult worms are removed from the gut, larvae emerge from the tissues thereby rapidly relieving more general feelings of malaise. It is this rapid relief that most likely motivates leaf swallowing 'self-medication' behavior (Huffman and Caton 2001).****	'Zoopharmacognosy', the process by which wild animals select and use specific plants with medicinal properties for the treatment and prevention of disease Rodriguez and Wrangham 1993	Medical/healing practice
Mahale. In 1987, scientists observed another kind of self-medication. An ill female stripped the outer bark of *Vernonia amygdalina*, commonly known as bitter-leaf, and chewed and sucked for at least 20 minutes on the inner pith, and spit out the unwanted fibrous husks. She continued to suck on the bitter-leaf pith while other healthy chimpanzees ate far more nutritious and palatable plants. They next day she regained her appetite and she was observed feeding on elephant grass. African herbalists often prescribe this plant to treat malarial fever, schistosomiasis, amoebic dysentery and other intestinal parasites and stomach disorders. On another occasion, four other chimpanzees, with diarrhea, malaise and nematode infection, chewed *Vernonia* pith, two recovering within 24 hours. Chemical analysis revealed that *Vernonia* pith contained seven previously unknown steroid glycosides and four lactones, the latter no only antihelmintics but antiamoebic, antitumor and	Self-medication Huffman and Seifu 1989 Koshimizu *et al* 1994 Huffman 1997 Huffman 2003 Engel 2002a	Medical/healing practice

antimicrobial. Outer bark and leaves of Vernonia are extremely toxic, the inner pith bears just the right dosage to be effective but not harmful, and chimpanzees seem to be well aware of this.****		
Multiple sites. Chimpanzees eat mouthfuls of termite mound clay, apparently for mineral supplementation, toxin adsorption, anti-diarrhoeal action, and gut pH adjustment. Clay can bind mycotoxins (fungal toxins), endotoxins (internal toxins secreted by pathogens), man-made toxic chemicals, bacteria and viruses. They also protect the lining of the gut, act as an antacid and absorb excess fluids – thereby curbing diarrhea. Clay also regulates iron uptake. Thus, clays are naturally occurring multi-purpose medicines.*****	Self-medication Goodall 1986 Mahaney *et al* 1996 Krishnamani 2000 Aufreiter *et al* 2001 Gilardi *et al* 1999	Medical/healing practice
Temerlin's. The chimpanzee Lucy when first taken to an orchard picked apples, but subsequently took a liking to the rotten fruit on the ground. After such sessions she "seemed happy, often laughing . . she was getting a 'high' on the natural fermentation." Chimpanzees are frugivores, which is correlated evolutionarily with the human genetic predisposition to alcohol intoxication; which in limited amounts has psychoactive and medicinal values (Dudley 2002, Dudley 2000). It is possible that the same plant may have both psychoactive hallucinogenic properties and be therapeutic for parasitic worms (Rodriguez *et al* 1982).******	Spontaneous taste for alcohol Temerlin 1975 cited Goodall 1986.	Psychoactive substance practice
* Infanticide and cannibalism are not yet reported for bonobos; perhaps due to female dominance and solidarity against male aggression (de Waal and Lanting 1997). Cannibalism is well documented for lion, hyena. Cases among primates: male redtail twice killed and ate infant of troop he took over; adult male chacma baboon seized and ate an infant. At Gombe a female baboon ate part of her own infant that had died of severe injuries and another female ate the body of premature infant. Fossey reported feces of a female gorilla and her son had gorilla infant remains in it. However, in most cases of infanticide among langurs, gorillas and baboons victim is not eaten (Goodall 1986:285). Among langurs it is a male reproductive strategy (S. Hrdy; V. Sommer). Estimates for infant mortality due to infanticide are 37% in mountain gorillas; 43% in red howler monkeys; and 29% in blue monkeys (Sterk et al cited in de Waal 1997).		
** Howler monkeys appear to eat plants that affect gender selection of their offspring; muriquis eat plants that control timing of fertility (Glander 1994). Female rhesus monkeys commence rainy season breeding cued by ingestion of phytochemicals; vervets in Kenya have been observed to feed on *Acacia elatior* flowers, the amount predicting the onset of breeding activity; and gelada baboons consume *Trifolium* during the dry season so that few conceptions occur during this time (Garey 1984). Vervets eat plants that are estrogenic and aphrodisiac (Garey *et al* 1992). Termination of pregnancies is routine among many species under conditions of stress due to arrival of a stranger male on the scene, high population density, conflict, inadequate food resources, or mistiming of the optimum season for giving birth. Goats, rabbits, cats, marmots, rodents, and horses simply resorb very young fetuses into their bodies wasting no resources in the process (Engel 2002a).		

*** A captive capuchin monkey called Alice was wounded by other monkeys so badly that she required stitches. She groomed the area intensively for days, then took a stick, and chewed one end of it to make a brush for applying sugary syrup to the wound area. Sugar is antibacterial (strong sugar solutions explode bacterial cells) and an excellent ointment for soothing wounds, and is so used by western medics as a first-aid treatment for wounds. A few years later Alice's infant received a severe wound to the head from other monkeys. Alice not only licked and groomed the wound. She also made a tool for applying syrup to the wound – just as she had done for herself years before (Ritchie and Fragaszy 1988; Westergaard and Fragaszy 1987). Toque macaques lick each other's wounds caused by fights, a behavior especially useful for wounds out of the victim's own reach (Dittus 1989 cited de Waal 1996).
****Self-medicinal behavior is widespread among primates. Howler monkeys in Costa Rica with low intestinal parasites have access to fig trees (*Ficus* sp.); fig sap decomposes worm proteins, and is used by traditional herbalists to cure worms. Muriquis monkeys in Brazil were free of parasites; they had access to plants used as anthelmintics by local Amazonian peoples; baboons eat plants to counteract schistosomiasis (Glander 1994; Engel 2002a, 2002b). Colubus and howler monkeys sometimes consume tannin-rich lower protein plants or parts of plants, the reverse of their normal eating pattern, possibly because tannin reduces bloat and helps detoxify alkaloids (Glander 1994). Gorillas eat wild ginger, a potent, water-soluble antibiotic (Gibbs 1996).
*****Many primates and other mammals have been observed to ingest clay for medicinal purposes, including rhesus macaques in Puerto Rico; black and white colubus (Glander 1994; Engel 2002a).
****** Many primates go out of their way to ingest psychoactive plants. South African wild baboons intoxicate themselves on the red fruit of the rare and poisonous cycad tree; South American spider monkeys eat fermented fruits, become boisterous, chuckle and scream before slumping into a stupor; Borneo monkeys intoxicate themselves fermented durian fruits; St. Kitt vervets have a liking for beer obtained from locals (Engel 2002a). The adaptive benefit may be energy; alcohol provides twice the calories of carbohydrates (Dudley 2002, 2000). Durian fruit is packed with minerals, vitamins and carbohydrates, and alcohol in moderation has a variety of known health benefits (Engel 2002a). Gorillas eat alpine *Lobelia* and reports suggest that South American monkeys eat hallucinogens (Gibbs 1996). *Lobelia tupa* in the New World is used as an emetic and purgative and the leaves contain hallucinogenic alkaloids. Baboons eat small amounts of *Datura innoxia* and *Datura stramonium*, Solanacae plants that are highly poisonous at high doses; they also ingest *Euphorbia avasmontana*, another hallucinogen. *Datura stramonium* is used in herbal medicine as an antispasmodic to relieve symptoms of asthma and other bronchial complaints, and is sedating and mildly analgesic; natural cannabinoids and hallucinogens may be necessary for the healthy functioning of the central nervous system (Engel 2002a).

Table 3 Chimpanzee Social Cooperation Prestige Practices Sexual Mating; Dominance Coalitions; Affiliative Bonding; Subgroup Task and Territorial Bonding; Grandmothering; Forgiveness		
Site/Incident	**Observer Interpretation**	**Comment**
Gombe. Mating patterns include (a) estrous promiscuity involving direct male courtship displays with erect penis, relative female choice, and rump presentation; (b) monopolization of sexual rights by higher ranking male; (c) and exclusive consortship away from main group for up to three months, during estrous and anoestrous phases of roughly 36 day cycle (Goodall 1986: 450-451).	Mating patterns Goodall 1986	Sexual bonding
Multiple Sites. Male coalitions are instruments to achieve and maintain power and status in a social hierarchy. Coalition partners are replaceable with little room for sympathy or antipathy. Female coalitions are more stable over time and overlap kinship bonds and personal preferences. By direct threat or attack, dominants express disapproval of subordinate's behavior, which may be viewed as punishment for disobedience (Goodall 1986:322). Inferiors attacked or otherwise frustrated by superiors may redirect aggression on innocent bystanders, scapegoats (323).	Coalitions, formal rank hierarchies, using punishment discipline de Waal 1989 Goodall 1986	Dominance hierarchy practice
Multiple Sites. Chimpanzee relationships are of two distinct types, coalitions and social bonds (de Waal 1989:50). Group affiliative, social bonds are maintained through networks that exchange favors, especially grooming, but also food, reassurance, protection, mentoring ('follower'), play, etc. Failure to reciprocate may be punished (Goodall 1986:381).*	Friendly relationships, primarily caretaker, two-way friendships, and follower Goodall 1986	Affiliative bonding practice, caretaker and horizontal friendships
Multiple Sites. Chimpanzees have a fusion-fission society; portions of the main group may on a regular basis separate from and then rejoin the rest. They typically forage, travel and sleep in parties of five or less. Parties may be of one gender or mixed, or just one individual. The membership of parties is constantly changing.	Fusion-fission society Goodall 1986	Subgroup task party, temporary bonding practice
Multiple Sites. Chimpanzees are territorial and, unlike ritualized territoriality of many nonhuman animals, aggressively so. Males not only patrol boundaries and defend them; they also raid neighboring territories, killing adult males and capturing territory and females. A male feeling aggressive tension on a border patrol may, on return to their safe, core area, displace aggression on a scapegoat (Goodall 1986:523). Males are particularly violent against mixed groups that spin	Territoriality Goodall 1986	Subgroup territorial patrol party, temporary bonding practice

off on their own, as if in betrayal of the main group.		
Gombe. Gigi had a strong interest in infants became 'auntie' to a succession of them (Goodall 1986). Patti, who may herself have been an orphan, severely neglected her newborn and within a week he was dead. Later after her next birth, Gigi became her companion and helped care for the infant. By her third infant, Patti was an excellent mother (Goodall 1989).	Grandmothering Goodall 1986 Goodall 1989	Grandmothering
Arnhem Zoo, Netherlands. After a slap, common chimpanzees perform reconciliation sequence involving offering of hand for kiss and consolation embraces for witnesses. Fights are reconciled with a hug and kiss. Bonobos reduce competitive aggression and reconcile after conflicts using sexual activity.	Social reparation, peacemaking and reconciliation behaviors de Waal 1989 de Waal 1997	Reparation, reconciliation forgiveness practice
* Compare Nash equilibrium theory, in which cooperation optimizes self-interest.		

Table 4. Chimpanzee Techno-Economic Prestige Practices Festal Sharing; Begging-Sharing; Hunting – Techniques, Choice of Game; Hunting – Distribution of Game; Culinary Practices; Tool Making and Tool Use		
Site/Incident	**Observer Interpretation**	**Comment**
Gombe. Individual males or mixed parties emit loud food calls that announce arrival and presence at food (whether vegetal or meat), attracting others to access a food resource.* *Wamba*. Bonobo emit excited food calls like common chimpanzees.	Food calls, announcement, benefits community, not altruistic, enough food to go around Goodall 1986:136 Kano & Mulavwa 1984	Festal sharing of food surplus practice, festal feeling of joy and excitement leading to sharing access to food surpluses
Gombe. With respect to meat eating, high-ranking males tend to retain head, allow other parts to be shared, but sometimes only many hours later. In groups there is often intense aggressive competition for a piece of the prey, with attacks on the possessor, counterattacks, threats at low-ranking individuals to keep them away, and constant begging. Possessors usually maintain control of the carcass, but allow or share pieces with beggars, mostly after they have taken the head. Chimps are less sharing of plant foods; males are more tolerant of begging, while females more intolerant. The biggest danger of competitive violence for common chimpanzees is not high ranking males but females who more frequently fight over food. *Wamba*. Among bonobo aggressive conflicts of any type occurred in only 10% of feeding incidents, a figure comparable to common chimpanzees. Of a total of 983 feeding bouts only 7 involved theft, all by young adults or adolescent males who were attacked by the possessor. 90% involved active begging (487) or various forms of staring or cautious taking, i.e., passive begging. Bonobo females engaged in genital rubbing, which may play an important role in preventing female feeding disputes.	Food-sharing behavior, basis of altruism in humans Goodall 1986 Most common begging gesture is open hand held out; generosity seems obligatory to avoid beggars tantrums de Waal 1989 Sometimes begging occurs when not necessary, apparently to enhance affiliative bonds Kano & Mulavwa 1984 Kuroda 1984	Food sharing, begging practice
Multiplessites. "Wild chimpanzees hunt for a part of their living. All across equatorial Africa, meat-eating is a regular feature of chimpanzee life, but its style and technique vary from one forest to another. In Taï National Park in western Africa, hunters are highly cooperative; Christophe Boesch has reported specific roles such as ambushers and drivers as part of the apes' effort to corral colobus monkeys in the forest canopy. At Gombe in East Africa, meanwhile, hunting is like	Hunting as cultural and social behavior, even for its own sake Stanford 2002	Hunting practice, hunting technique, choice of game

a baseball game; a group sport performed on an individual basis. This difference may be environmentally influenced; perhaps the high canopy rain forest at Taï requires cooperation more than the broken, low canopy forest at Gombe. There is a culture of hunting in each forest as well, in which young and eager male wannabes copy the predatory skills of their elders. At Gombe, for instance, chimpanzees relish wild pigs and piglets in addition to monkeys and small antelope. At Taï, wild pigs are ignored even when they stroll in front of a hunting party" (Stanford 2002). "I have argued that since the energy and time that chimpanzees spend hunting is rarely paid back by the calories, protein and fat gotten from a kill, we should consider hunting a social behavior done at least partly for its own sake" (Stanford 2002).		
Multiple sites. "There is also a culture of sharing the kill. Sharing of meat is highly nepotistic at Gombe; sons who make the kill share with their mothers and brothers but snub rival males. They also share preferentially with females who have sexual swellings, and with high-ranking females. At Taï, the captor shares with the other members of the hunting party whether or not they are allies or relatives; a system of reciprocity seems to be in place in which the golden rule works…When chimpanzees barter a limited commodity such as meat for other services – alliances, sex, grooming – they are engaging in a very simple and primitive form of a currency exchange. Such an exchange relies on the ability of the participants to remember the web of credits and debts owed one another and to act accordingly. It may be that the two chimpanzee cultures 2,000 kilometers apart have developed their distinct uses of meat as a social currency. In one place meat is used as a reward for cooperation, in the other as a manipulative tool of nepotism. Such systems are commonplace in all human societies, and their roots may be seen in chimpanzees' market economy, too" (Stanford 2002).	Hunting as cultural and social behavior Stanford 2002	<u>Hunting practice</u>, distribution of game
Multiple sites. At *Gombe* chimps tear off chunks of meat with their teeth and hands; large bones cracked open and marrow extracted; small bones chewed and swallowed. In case of small prey, first the face is bitten into and the skull is bitten open, blood sucked and the brain consumed. Large prey skulls are bitten open or opened by enlarging the *foramen magnum*; then viscera are eaten. Almost always a morsel of meat is chewed together with a wadge of leaves, and usually discarded along with unwanted pieces of bone or skin. Sometimes the brain is scraped out of the skull with a leaf wadge. Also reported for *Tai Forest*.	Eating behavior pattern Goodall 1986 Leaf wadge one of 39 chimpanzee behaviors showing 'cultural' variation Whiten *et al* 1999	<u>Culinary practice</u>

Multiple sites. Gombe chimps engage in extensive tool-using behavior including using leaves for sponging, mopping, brushing, fishing probe, napkin, and container; stems for honey fishing and investigation; leafy twigs as fly whisk; small sticks for ant fishing, stirring and expelling, perforating termite mounds, as toy, prod for termites, prod for resin, and investigation; large sticks for investigation, dipping driver ants, enlarging nest entrances, hooking branches, as missile and as club; short, thick sticks as hammer or weapon; stones or rocks as hammer, missile and toy. Such techniques are known at multiple other sites (Goodall 1986:537, 542). At multiple sites tools are made and used for 25 foraging, communication and body-oriented behaviors, including nut-cracking with wood or stone hammers (Boesch and Tomasello 1998) and some 65 behavior patterns more or less cultural (Whiten *et al* 1999). At least 14 similar tool use behaviors are noted for bonobo sites (Hohmann and Fruth 2003).	Tool use Goodall 1986 Boesch and Tomasello 1998 Whiten *et al* 1999 Hohmann and Fruth 2003	Toolmaking and use
* Individual rhesus monkeys who emit distinctive calls that announce a food discovery suffer far fewer aggressive attacks, such as chasing, hitting and biting, than monkeys who remain silent but get caught with food by other group members. Silent males detected by higher-ranking males were most likely to encounter aggression. Vocal females ate more food than silent females, since the latter often dropped food while being chased (Hauser MD cited by Bower 1992). Contra Wrangham *et al* 1999, the problem in this society does not appear to be theft but silence; the virtue is a festal feeling of joy and excitement; the same virtue seems expressed in chimpanzee society.		

Table 5. Proto-Symbolic Communicative Behaviors 'Pan-morphism', Pretend Play, Sense of Self, 'Pre-symbolism', Iconic Gesture, Symbolism		
Site/Incident	**Observer Interpretation**	**Comment**
Gombe. A young female chimpanzee, Gaia, carried, cradled and groomed rocks and sticks as she held them in her lap in mimicry of nurturing behavior, much as human children care for dolls, which is a possible case of projected 'animation' on an inanimate object (Wallauer 2002)*	Empathy toward 'inanimate nature' or 'projected animation' Wallauer 2002	Pan-morphism, chimpanzee equivalent of anthropomorphism and/or Pretend play
Georgia State Univ. Language Research Center. Vickie, the first chimpanzee to participate in a language project, was reported to have a great time pulling an imaginary to with an imaginary string, sometimes even letting it appear that the toy got stuck in its movements. Austin often pretended to eat imaginary food, sometimes using an imaginary dish and an imaginary spoon, place the it in his mouth and roll it around on his lips, as though it were real food. Sherman loved to pretend that dolls, particularly King Kong dolls, were biting his fingers and toys as well as having fights with each other. Once Austin and Sherman saw King Kong in a cage on TV, which was like one in their room, at which point they made threat barks at the cage and threw things at it as if King Kong was in it. Sherman even got out the hose and began to spray the cage. Kanzi would pretend to hide imaginary food under his blanket or under his toys, and pretend to give Panbanisha or others bites of the imaginary food. Panbanisha's favorite pretend game was to was to act as though she heard a monster in the next room. Going toward the door with her hair out, she'd comment 'monster' and invite others to search with her. Sometimes she would then put on a monster mask and pretend to chase her sister Tamuli. "But whether it is self-awareness, awareness of the minds of others, pretense, or deception—all of these cognitive activities are manifest in language, for it is with language that Kanzi and Panbanisha and Sherman and Austin can tell us things that we would otherwise not know" (Savage-Rumbaugh and Lewin 1994: 276-278). Kanzi enjoyed watching movies such as Quest for Fire and Tarzan, and tapes of Sherman and Austin and commented on incidents in them, and most loved tapes of Bunny and Gorilla, two costumed figures that would enter the lab and do interesting things, such as play with one of his balls or hide in the forest. Kanzi loves social games	Pretend play or deception or theory of mind or self-awareness Savage-Rumbaugh and Lewin 1994 Savage-Rumbaugh, Shanker, Taylor 1998	Pretend play, toddler pretend (symbolic) play and early childhood pretend fantasy play, deceptive hiding, and Sense of self, i.e., toddler 'verbal, categorical self', distinct self/other knowledges of world (Stern) [=theory of mind] and early childhood self-identity, self-possession, self-direction, and self-reliance

such as hide-and-seek, chase and tag, and keep away (Savage-Rumbaugh, Shanker, Taylor 1998:45, 47). Kanzi evidences 'theory of mind' (55-65).		
Georgia State Univ. Language Research Center. Panbanisha, a female bonobo in a Pan/Homo community, was "very quiet and pensive" and when I [Sue Savage-Rumbaugh] asked her what she was thinking, "she seemed to reflect upon the question a few seconds and then answered 'Kanzi'. I was very surprised, as she almost never uses Kanzi's name. I replied, 'Oh, you are thinking about Kanzi, are you?' and she vocalized in agreement, 'Whuh, whuh, whuh'." Similarly, she asked Heather, a two year old, a similar question, to which she replied 'Mommy'. "I cannot be certain that either Panbanish or Heather was really thinking. "Currently there is no way to establish scientific consensus regarding the inner thoughts of another person" (Savage-Rumbaugh and Lewin 1994: 258-259).	Self-reflection, thinking Savage-Rumbaugh and Lewin 1994	Sense of self, early childhood object constancy (Mahler)
Kibale, Uganda. Wild chimpanzees habitually use a pointing gesture, 'directed scratches', to request grooming of specific body areas. Observations suggest recipient of the gesture 'has an understanding of the intended meaning of the gesture' and the gesture is used 'to specify an area of the body to be groomed and to depict a desired future action. They therefore qualify as referential and iconic' and imply mental-state attribution and inferences about knowledge of others, i.e., theory of mind (Pika & Mitani 2006). This contra earlier view that neither ape nor monkey gestures seem to be used referentially as case with monkey calls (Tomasello and Zuberbühler 2002).	Iconic and referential gesture Pika and Mitani 2006	Iconic and referential gesture
Multiple captivity sites. During copulatory bouts of bonobo couples, one or the other had a clear notion of the preferred position and used a series of gestures to indicate what was required. These gestures were of three types: (1) hand on the partner's body moved in some deliberate way; (2) combination of one hand touching part of partner's body that is to move and other hand making iconic motion to indicate desired movement; (3) completely iconic hand and arm gesture motions. These hand gestures require "a clear concept of self and others; temporary equivalence between the motion of the hand and the movement of the recipient's body, and that the hand not be acting as a hand in the instance of gesturing, but as a symbol for the recipient's body" (Savage-Rumbaugh and Lewin 1994:112-113).	Iconic gesture, a "truly abstract communication system" Savage-Rumbaugh and Lewin 1994	Iconic gesture
Georgia State Univ. Language Research Center. Kanzi used iconic gestures in requests to take a certain direction, open lid of a jar, crack nuts, and have an object given to him as human infants do (Savage-Rumbaugh and Lewin 1994:134).	Iconic (visually representational) gestures Savage-Rumbaugh and Lewin 1994	Iconic gesture

Multiple sites. Chimpanzees intensely 'groom' leaves; this is customary at Gombe, Mahale-M, Mahale-K and Kibale, present at Budongo but not observed at Tai Forest or Bossou, and thus 'cultural'. Categorized as 'communicative behavior' (Boesch and Tomasello 1998). In Uganda, chimps run their fingers over leaves and touch them to their lips—a "signal that a male without much social status may use it to let more dominant males know that he would like to groom. The signal avoids social blunders that might draw the wrath of others in their group" (Wrangham quoted Cromie 1999). At Gombe sometimes a lone "individual leaf grooms—and (subjectively) it looks like a form of doodling. The behavior, presumably (at least in origin) a displacement activity, is not yet properly understood" (Goodall 1986:391).	Communication meaning desire to groom Whiten *et al* 1999 Boesch and Tomasello 1998 Cromie 1999 Undetermined: doodling? displacement? Goodall 1986	Symbolic gesture
Wamba, Zaire. Adult male bonobos will grab a branch, often spending up to half an hour searching for the 'right' branch, and drag it around boisterously to get attention of others, sometimes as display, but sometimes as a prelude to group movement, the group "following the direction described by the branch dragging" and if a change in direction from the original one is desired, "the males leading the group will indulge in a burst of branch dragging, describing the new direction to be followed" (Kano 1992 cited in Savage-Rumbaugh and Lewin 1994:119). A male also used branch dragging as a wake up call to another to follow him to a good fruit tree for a breakfast (Ingmanson 1989 cited in Savage-Rumbaugh and Lewin 1994:119).	Branch-dragging Kano 1992 Ingmanson 1989 'Elements of symbolism' similar to honey-bee dance Savage-Rumbaugh and Lewin 1994	Symbolic gesture
Congo. Bonobos use complex trail markers to silently communicate direction taken in the dense tropical forests where they live along the Congo River. In a presentation to the American Association for the Advancement of Science, Savage-Rumbaugh said that in following the animals through the forest, she noticed that whenever a trail crossed another trail, the lead group would stamp down vegetation or rip off large leaves and place them carefully. "What they are doing is leaving little notes in the vegetation," she said. "Those notes are signals about where they are going to go." Plants were disturbed only at the junctions of trails and it was clear that the lead group was leaving markers for those who followed. Frequently a path intersection would have a single smashed plant and two smashed plants would mark the selected trail. Sometimes, she said, intersections would be marked by large leaves pointing in the direction of travel. In muddy areas where footprints were obvious, no plants were disturbed. When a tree trunk crossed the path, there were smashed plants in front and behind. If plants were disturbed only in front of the trunk, the animals then walked on top of the trunk, following it to another trail, she said. "These cues are not left at arbitrary points, but	Symbolic communication Associated Press 1998	Symbolic tokens

rather at locations where the trails split or cross and where an individual following might be confused as to the correct direction to take," she said. When all the members of the band travel together, the trail markings are absent. To prove her discovery, Savage-Rumbaugh said she twice followed the trail signs far behind groups of the apes. At the end of each day, she found her way to the reassembled band's new nesting trees. The discovery is contrary to the belief of many scientists that apes lack the brain structure for the use of symbolic language in complex communications, said Savage-Rumbaugh (cited in Associated Press 1998).		
Edinburgh Zoo. Chimpanzees in feeding situations acoustically modified their rough grunts to produce functionally referential signals when encountering different quality of food and some evidence that different types of high preference foods were individually labeled, such as 'bread' and 'apple' (Slocombe & Zuberbühler 2005, 2006). [This parallels evidence of mental representations of categories of things in Diana monkeys**] *Budongo Forest, Uganda*. On the other hand, acoustic modification of pant hoots appears to signal individuality of caller and status of caller (level of arousal, locomotion/resting, arrival at food source) (Notman & Rendell 2005).	Functionally referential calls Slocombe & Zuberbühler 2005 Notman & Rendell 2005	
Georgia State Univ. Language Research Center. Using a lexigram keyboard Sherman and Austin, two captive common chimpanzees, acquired the ability to name objects and comprehend symbols as referents of objects (Savage-Rumbaugh and Lewin 1994:67). Later they could attend to one another; coordinate their communication; exchange roles of tool-requester and tool-provider; comprehend the function and intentionality of their communication; and share their access to tools and food obtained through tool use (81). Kanzi, a male bonobo in a Pan/Homo community, spontaneously learned use of lexigram keyboard to articulate requests to receive objects or actions; name objects, persons and locations; and request that A act on B; including embedded clause actions, evidencing independent symbol status of element; reference, rules specifying relations between categories of symbols across combinations; syntactic rules, such as word order; implicit understanding of categorical distinctions such as agent and object; and productive rules, rule applied to new situations from the first use (146: 158-159; Savage-Rumbaugh, Shanker, Taylor 1998:49). Kanzi's communicative behavior was 'symbolic communication' meeting 4 operational criteria: (1) an arbitrary symbol that stands for, and takes the place of, a real object, event, person, action or relationship; (2) stored knowledge regarding the actions,	Symbolic communication Savage-Rumbaugh and Lewin 1994 Savage-Rumbaugh, Shanker, Taylor 1998	Syntactic, linguistic communication

objects, and relationships relating to the symbol; (3) intentional use of symbols to convey this stored knowledge about an object, event, person, action, or relationship to another individual who has similar real world experiences and has related them to the same symbol system; (4) the appropriate decoding of, and response to, symbols by the recipient (187-188). This behavior emerged sequentially in a similar manner to that in child language acquisition from communicative intent, to reference, to multi-word utterances (190). (Savage-Rumbaugh and Lewin 1994:146; 158-159; Savage-Rumbaugh, Shanker, Taylor 1998). [Compare syntactic combination and semantic meaning in vocal communications of monkeys and gibbons****]		

* Pretend play. A young female baboon at Gombe was observed mothering a rock (Wallauer 2002).

** Mental representations. Diana monkey alarm call vocalizations, which are referential signals, have semantic features distinct from acoustical features, and hence 'mental representations' of categories of things, such as predators leopard and eagle (Zuberbühler, Cheney & Seyfarth 1999)

*** Gestural Communication. Among captive subadult gorillas, we recorded a repertoire of 33 different communicative gestures (visual, auditory, tactile) learned by 'ontogenetic ritualization' and 'social learning', and the number of gestures used increases with age of user. The same gesture might be used in multiple contexts. Contrary to Tanner & Byrne (1999, 1996) we did not observe any iconic use of gesture, where 'iconic' = gesture that depicts motion in space or the form of an action (Pika, Liebal & Tomasello 2003).

**** Syntax and Semantics. Diana monkeys may comprehend semantic changes caused by a combinatory rule present in the natural communication of another primate species. They follow syntactic rules that combine signals with existing meaning to create new meanings, in this case using semantic modifiers (Zuberbühler 2002, 2004). Putty-nosed monkeys combine two vocalizations into different calling sequences that are linked to specific external events, such as the presence of a predator and the imminent movement of the group. 'Our findings indicate that non-human primates can combine calls into higher-order sequences that have a particular meaning' (Arnold & Zuberbühler 2006). In the first evidence for combinatoric rules in apes, wild gibbons 'use referential signaling based on a communication system that utilizes combinatorial rules'. They can rearrange a finite repertoire of call units into structurally more complex sequences in rule-governed ways to convey different contextual situations. They can select and combine a set of 5-7 call units into songs that differentially repel conspecific intruders, advertise pair bonds, or attract mates, and these arrangements were meaningful to out-of-sight receivers (Clarke, Reichard & Zuberbühler 2006).